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COST AND MANAGEMENT ACCOUNTING

The Institute of Chartered Accountants of Pakistan

CA PAKISTAN

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Clifton
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Email: studypacks@icap.org.pk
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INVENTORY VALUATION

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Inventory is one of the major components of manufacturing and trading organizations and, in most cases, the higher proportion of cost. Therefore, it is important to put proper controls over inventory's cost and its usage cycle.

Inventory which is consumed during the production is treated as expense whereas the unused inventory at the end of reporting period is treated as an asset in the financial statements.

Cost of inventories includes purchase cost and any cost incurred to bring the inventory into saleable condition. In manufacturing entities, inventory includes raw material, work in progress and finished goods.

Net realizable value(NRV) is the estimated selling price in the ordinary course of business less the estimated cost of completion and estimated cost necessary to make the sale.

Inventory should be valued at lower of cost or NRV in the financial statements.

The inventories that are purchased in bulk quantities with different prices during a period are allocated cost on the basis of First-In-First-Out (FIFO) or Weighted Average Cost (AVCO).

1. MATERIALS: PROCEDURES AND DOCUMENTATIONS

1.1 Material handling procedure and related documentations:

Materials are the basic components of manufacturing and production process in a goods manufacturing entity. Materials are also called raw materials which are used in the production of a finished products (such as Crude Oil is a raw material for Petrol, Milk is a raw material for Yogurt, Yarn is a raw material for Garment whereas Petrol, Yogurt and Garment are the finished products).

In some manufacturing processes, raw material cost is major part of its total production cost and any loss of control over material may cause significant increase in production cost. It is, therefore, important for any entity to control the material activities from purchase till its use.

An entity that purchases materials to be used in its production or further sale, must ensure that proper procedures are in place to enable the controls over their costs, purchase quantity, quality as well as usage quantity.

In order to make the controls effective, their documentation is necessary so that verifiable records can be maintained.

The following example shall illustrate the procedure of purchasing, storing and issuing the raw materials to the production department.

▶ *Example 01:*

A Limited is engaged in the manufacturing of Cotton Garment. It uses yarn as its raw material. It requires 10 tons of yarn for the next production.

The Production Department raises the Material Requisition (M.R) to the Store / Warehouse of the company depicting the quantity and time at which the stock is needed. The Store / Warehouse of the company raises a Purchase Requisition (P.R) to the Purchase / Procurement Department. The Purchase / Procurement Department raises a request for quotation to the yarn suppliers and on the basis of accepted quotation, raises a Purchase Order (P.O) which is delivered to the supplier. The supplier on the basis of P.O (which includes quantity, rate and time of delivery) delivers the yarn at the store / warehouse of A Limited and issues a Goods Dispatch / Delivery Note (GDN) to the Store and Purchase/ Procurement Departments of "A Limited". The storekeeper / warehouse in-charge of "A Limited" issues a Goods Received Note (GRN) the copy of which is given to the supplier and Purchase / Procurement Department after inspecting the goods along with the invoice.

The Storekeeper / Warehouse in-charge arranges the goods on the First in First Out (FIFO) basis or Weighted Average (AVCO) basis depending upon the company's policy (usually perishable products are carried at FIFO basis).

The Store then issues the raw materials to the Production Department and prepares a Goods Issue Note (GIN).

The following table summarizes the above procedures and documents.

Process	Documents
Production Department raise material requisition to Store / Warehouse	Material Requisition
Store / Warehouse issues purchase requisition to Procurement / Purchase Department	Purchase Requisition
Procurement Department raises Purchase Order to the approved supplier	Purchase Order

Process	Documents
Supplier delivers goods at company's warehouse	Goods Dispatch / Delivery Note and Invoice / Bill
The warehouse in-charge receives the goods and inspect	Goods Received Note
The warehouse issues raw materials to the production department	Goods Issue Note

Documentation of purchase process is therefore needed:

- to ensure that the procedures for ordering, receiving and paying for materials has been conducted properly, and there is no error or fraud
- to provide a record of materials purchases for the financial accounts
- to provide a record of materials costs for the cost and management accounts.
- to ensure physical controls over the materials and to ensure its proper usage
- to ensure that each document is authorized by line manager

The detailed procedures for purchasing materials and the documents used might differ according to the size, complexity and nature of the business. However, the basic requirements are same for all types of business where material purchases are made.

1.2 Functions of storekeeper:

Storekeeper has to perform four basic functions including receiving of goods, storing of goods, issuing of goods and recording the inventory movements.

Whenever purchase department issues purchase order, the supplier/s deliver goods to store department of entity. It is the basic responsibility of storekeeper to check that goods are intact, means that these goods are not damaged and are in accordance with the specification provided in the purchase order.

Storing looks more simple, but it's one of the most important functions as negligence in proper storing may cause damage or expiry of goods/ raw material. These goods must be stored in proper storage in such a way that existing stock of goods/ raw material should be issued first. Similarly, few raw materials in industries require specific storage like some chemicals should be stored in cold storage, otherwise, these could be damaged.

Another important function of storekeeper is to issue the goods/ raw materials to relevant department against purchase requisition. Storekeeper must ensure that the document is properly authorized by line manager (authorized person) of that department.

All the transactions of receiving and issuing must be recorded by storekeeper; normally bin card is maintained for each raw material item. Bin card includes quantities received and issued; running balance is maintained in it. It helps the storekeeper to ensure that items of raw materials are not falling to re-order level, otherwise, new purchase is required.

2. INVENTORIES AND ITS VALUATION

2.1 Types of inventories:

In manufacturing entities, inventory comprises raw materials, work-in-process, stores, spares and tools and finished goods.

Raw materials are purchased by manufacturing entities for consumption in the production during a period. They are treated as expense when these are issued to production whereas those raw materials that still exist, at the end of the reporting period are treated as current assets and are termed as inventories.

Work-in-process is the inventory on which partial costs have been incurred till period end but it is not yet finished or completed and further cost is required to complete it. For instance, for manufacturing a liter of mango juice, 100% of mango pulp (raw material) has been put into process whereas the labour has worked only 50% up to the end of the reporting period. Due to this, the product is neither considered completed nor it is raw material any more. This kind of inventory is called work-in-process and is treated as current asset.

Finished goods are the final products which have been completed and stored in a warehouse known as "Finished Goods Store". The goods that have been sold to the customers are treated as cost of sales in the financial statements whereas, the goods that have not been sold till the end of the reporting period are considered as inventories.

Stores, spares and loose tools are used in the equipment and machinery and are kept in inventory so that in case of any damage to the machinery or equipment, the production should not stop and necessary tools are available in stock to resume the production at earliest. The unused stores, spares and loose tools at period end is treated as inventory while used stores, spares and loose tools is charged as expense in financial statements.

2.2 Cost of inventories:

The following table explains the cost of each type of inventory:

Inventory	Cost
Raw Material	Purchase price including import duties & taxes (other than those subsequently recoverable by the entity), transport, handling and other cost directly attributable to the purchase of goods. Trade discounts, rebates and other similar items are deducted in determining the cost. (IAS 2)
Work-in-process	Cost of raw material as determined above, plus direct labour cost and production overhead costs to the extent of work done.
Stores, spares and tools	Same as Raw Material
Finished Goods	Cost of raw material as determined above, plus direct labour cost and production overheads.

Sometimes, the inventories are damaged or become wholly or partly obsolete. In such a case, the company

- Either have to incur more cost to bring them into saleable condition due to which the cost may exceed the selling price
- Or sell them in the damaged / obsoleted form for which the selling price would probably be lower than actual cost as demand of such obsoleted product may have come down

In such cases, the company needs to bring the inventories at their net realizable value.

2.3 Net Realizable Value:

Net realizable value is the estimated selling price in the ordinary course of business less the estimated cost of completion and estimated cost necessary to make the sale (IAS 2).

It refers to the net amount that an entity expects to realize from the sale of the inventory in the ordinary course of business (IAS 2).

▶ *Example 02:*

Jawa Enterprises received consignment on January 15, 2019, consisting of 4 different types of material items, A, B, C and D. The relevant data is given as under:

Description	A	B	C	D
Invoice price Rs.	500,000	400,000	300,000	200,000
Relative weight Kg	1,500	2,500	2,000	1,000

Total freight paid on consignment Rs. 350,000; of which 20% shall be refundable.

a) Calculation of cost per kg of each material, if the freight is apportioned on the basis of invoice price.

Freight cost of Rs. 280,000 shall be added in cost of inventories of each material while Rs. 70,000 (20% of freight) shall not be included as it is refundable.

Freight is apportioned in the ratio of invoice price as 5:4:3:2.

Description	A	B	C	D
Invoice price Rs.	500,000	400,000	300,000	200,000
Freight Rs.	100,000	80,000	60,000	40,000
Cost of inventory Rs.	600,000	480,000	360,000	240,000
Cost per kg	400.00	192.00	180.00	240.00

b) Calculation of cost per kg of each material, if the freight is apportioned on the basis of relative weight.

Freight is apportioned in the ratio of relative weight as 3:5:4:2.

Description	A	B	C	D
Invoice price Rs.	500,000	400,000	300,000	200,000
Freight Rs.	60,000	100,000	80,000	40,000
Cost of inventory Rs.	560,000	500,000	380,000	240,000
Cost per kg	373.33	200.00	190.00	240.00

2.4 Valuation of Inventory:

An entity is required to evaluate, at the end of each reporting period, the net realizable value of its inventories and value the inventories at lower of:

- Cost or
- Net realizable value

The cost of the inventories is ordinarily lower than the net realizable value. Therefore, the inventories are carried at their costs. However, the cost may exceed the net realizable value in the following cases:

- The inventories are damaged,
- The inventories have become wholly or partially obsolete,
- The selling price of the inventories have declined, or
- The estimated cost of completion or estimated cost to be incurred to make the sale have increased (IAS 2).

AT A GLANCE

SPOTLIGHT

STICKY NOTES

- *Example 03:*

A business has three items of inventory currently carried at their cost. The market prices of the inventories have fallen down due to sudden decrease in demand. Their estimated selling prices, cost of completion and selling costs are as under:

	Cost	Sales price	Cost of completion	Selling costs
	Rs.	Rs.	Rs.	Rs.
Finished Product A1	8,000	7,800	-	500
Finished Product A2	14,000	12,000	-	200
Work-in-process B1	16,000	14,000	1,500	200

Calculation of the NRV of each inventory item is given below:

	Est. Selling price – Est. Cost of completion - Est. Selling Cost:	Rs.
Finished Product A1	7,800 – 500	7,300
Finished Product A2	12,000 – 200	11,800
Work-in-process B1	14,000 – 1,500- 200	12,300

It is to be noted that for finished goods no further processing cost is needed and therefore, the formula for NRV does not include cost to complete.

- *Example 04:*

A business has following items of inventories with their costs and NRV. You are required to calculate the value at which the inventories should be carried.

Inventories	Cost	Cost of Completion	Cost to Sell	Selling Price
	---------------Rs.----------------			
Raw Materials	150,000	500,000	50,000	850,000
Work-in-process	450,000	250,000	50,000	850,000
Finished Goods – in good condition	700,000	-	50,000	850,000
Finished Goods – damaged during transport	700,000	300,000	50,000	850,000

Calculating the value of inventories:

Inventories	Cost	NRV (Est. Selling Price-Est. Cost to complete-Est. Cost to Sell)	Value at lower of cost or NRV
	---------------Rs.----------------		
Raw Materials	150,000	300,000	150,000
Work-in-process	450,000	550,000	450,000
Finished Goods – in good condition	700,000	800,000	700,000
Finished Goods – damaged during transport	700,000	500,000	500,000

It is to be noted here that the finished goods that were damaged during transport need to be worked on further before sale, therefore, the formula of NRV shall now include cost to complete the goods.

2.5 Cost Formula

For all inventory items, particularly large and expensive items, it might be possible to recognize the actual cost of each item.

In practice, however, this is unusual because the task of identifying the actual cost for all inventory items is impossible because of the large numbers of such items and when the prices of those items differ in different periods. The following example explains the situation well.

▶ *Example 05:*

On 1 January a company had an opening inventory of 100 units which cost Rs.50 each.

During the year it made the following purchases:

- 5 April: 300 units at Rs. 60 each
- 14 July: 500 units at Rs. 70 each
- 22 October: 200 units at Rs. 80 each.

During the period it sold 800 units as follows:

- 9 May: 200 units
- 25 July: 200 units
- 23 November: 200 units
- 12 December: 200 units

This means that it has 300 units left at the end of the year (100 + 300 + 500 + 200 – (200 + 200 + 200 + 200 + 200))

But since the units were purchased at different prices so what price should the remaining units be allocated?

Should the units be allocated cost of units that were purchased last (that is Rs. 80)? But in that case the inventory shall be overstated as only 200 out of 300 units were purchased at Rs. 80.

Should the cost of oldest purchased units be used? But in this case inventory will be understated.

Should the units be given the weighted average cost?

A system is therefore needed for measuring the cost of inventory.

The historical cost of inventory is usually measured by one of the following methods:

- First in, first out (FIFO)
- Weighted average cost (AVCO)

The FIFO and weighted average cost (AVCO) methods of inventory valuation are used within perpetual inventory systems. They can also be used to establish a cost for closing inventory with the period-end inventory system.

First-in, first-out method of valuation (FIFO)

With the first-in, first-out method of inventory valuation, cost of inventory consumed is strictly based in the order of purchase means first purchase is issued first and so on. In simple words, the first items that are received into inventory are the first items that go out.

To establish the cost of inventory using FIFO, it is necessary to keep a record of:

- the date that units of inventory are received into inventory, the number of units received and their purchase price (or manufacturing cost)
- the date that units are issued from inventory and the number of units issued.

With this information, it is possible to put a cost to the inventory that is issued (sold or used) and to identify the cost of the items still remaining in inventory.

Since it is assumed that the first items received into inventory are the first units that are used, it follows that the value of inventory at any time should be the cost of the most recently-acquired units of inventory.

- *Example 06:*

Taking the data from example 04 above, we are preparing the cost ledger as per FIFO method:

	Receipts			Issues			Balance		
Date	**Qty**	**@**	**Rs.**	**Qty**	**@**	**Rs.**	**Qty**	**@**	**Rs.**
1 Jan b/f	100	50	5,000				100	50	5,000
5 Apr	300	60	18,000				300	60	18,000
							400	50/60	23,000
9 May				100	50	5,000	100	50	5,000
				100	60	6,000	100	60	6,000
				200	50/60	11,000	(200)	50/60	(11,000)
							200	60	12,000
14 Jul	500	70	35,000				500	70	35,000
							700	60/70	47,000
25 Jul				200	60	12,000	(200)	60	12,000
							500	70	35,000
22 Oct	200	80	16,000				200	80	16,000
							700	70/80	51,000
23 Nov				200	70	14,000	(200)	70	(14,000)
							500	70/80	37,000
12 Dec				200	70	14,000	(200)	70	(14,000)
	1,100		74,000	800		51,000	300	70/80	23,000
Note:	1,100		minus	800		equals	300		
			74,000	minus	51,000		equals	23,000	

Weighted average cost (AVCO) method

With the weighted average cost (AVCO) method of inventory valuation it is assumed that all units are issued at the current weighted average cost per unit.

The normal method of measuring average cost is the perpetual basis method. With the perpetual basis AVCO method, a new average cost is calculated whenever more items are purchased and received into store. It is also termed as running weighted average method, as at new purchase with different price will change the average cost of inventory. The weighted average cost is calculated by using the following formula:

- *Formula:*

$$\text{Average cost: } \frac{\text{Cost of inventory currently in store + Cost of new items received}}{\text{Number of units currently in store + Number of new units received}}$$

- *Example 07:*

Taking the data from example 04 above, we are preparing the cost ledger as per AVCO method:

	Receipts			Issues			Balance		
Date	**Qty.**	**@**	**Rs.**	**Qty.**	**@**	**Rs.**	**Qty.**	**@**	**Rs.**
1 Jan b/f	100	50	5,000				100	50	5,000
5 Apr	300	60	18,000				300	60	18,000
							400	57.5000	23,000
9 May				200	57.5000	11,500	(200)	57.5000	(11,500)
							200	57.5000	11,500
14 Jul	500	70	35,000				500	70	35,000
							700	66.4286	46,500
25 Jul				200	66.4286	13,286	(200)	66.4286	(13,286)
							500	66.4286	33,214
22 Oct	200	80	16,000				200	80	16,000
							700	70.3057	49,214
23 Nov				200	70.3057	14,061	(200)	70.3057	(14,061)
							500	70.3057	35,153
12 Dec				200	70.3057	14,061	(200)	70.3057	(14,061)
	1,100		74,000	800		52,912	300	70.3057	21,092

Note: 1,100 minus 800 Equals 300

74,000 Minus 52,912 equals 21,092

- *Example 08:*

XYZ Limited manufactures four products. The related data for the year ended December 31, 20X3 is given below:

	A	B	C	D
Opening inventory				
- Units	10,000	15,000	20,000	25,000
- Cost (Rs.)	70,000	120,000	180,000	310,000
- NRV (Rs.)	75,000	110,000	180,000	300,000
Production in units	50,000	60,000	75,000	100,000
Costs of goods produced (Rs.)	400,000	600,000	825,000	1,200,000
Variable selling costs (Rs.)	60,000	80,000	90,000	100,000
Closing inventory (units)	5,000	10,000	15,000	24,000
Damaged units included in closing inventory	300	600	800	1,500

Inventory valuation method in use	Weighted Average	Weighted Average	FIFO	FIFO
Unit cost of purchase from market (Rs.)	10.50	11.00	11.50	13.00
Selling price per unit (Rs.)	10.00	12.00	12.00	12.50
Unit cost to repair damaged units (Rs.)	3.00	2.00	2.50	3.50

AT A GLANCE SPOTLIGHT STICKY NOTES

The company estimates that selling expenses will increase by 10% in January 20X4.

In computing the amount of closing inventory that should be reported in the statement of financial position as on December 31, 20X3, following are the considerations.

To calculate the cost of closing stock, we have to first calculate the cost of goods available for sale to determine the weighted average cost per unit for the purpose of AVCO method.

Formula		A	B	C	D
Step 1: Calculating Units Sold during the period		**Units**			
Opening stock	Given	10,000	15,000	20,000	25,000
Production during the period	Given	50,000	60,000	75,000	100,000
Goods available for sale	Op. stock + production during the period	60,000	75,000	95,000	125,000
Closing Stock	Given	(5,000)	(10,000)	(15,000)	(24,000)
Units Sold	Goods available for sale – Closing Stock	55,000	65,000	80,000	101,000
*Units sold are calculated only to determine the mix of units for the purpose of costing of closing stock as per FIFO.					
Step 2: Calculating Cost of goods available for sale					
		-----------------Rs.--------------			
Opening stock valuation (at lower of cost and NRV)	From the given data	70,000	110,000	180,000	300,000
Cost of production for the period	Given	400,000	600,000	825,000	1,200,000
Cost of goods available for sale	Op. stock + production during the period	470,000	710,000	1,005,000	1,500,000
Step 3: Calculating cost of closing stock					
A & B (W/Avg.):	(Cost of goods available for sale /Goods available for sale) x Closing Stock	39,167	94,667		
C & D (FIFO):	(Cost of goods produced during the period/Goods produced during the period) x Closing Stock			165,000	288,000

	Formula	A	B	C	D
Step 4: Calculating NRV					
Sales price - per unit	Given	10.0	12.0	12.0	12.5
Total sales price of closing stock	(Closing Stock x Sales Price per unit)	50,000	120,000	180,000	300,000
Selling costs	(Selling Cost/Production Units) x Closing Stock	(6,000)	(13,538)	(18,563)	(26,139)
Repair cost of damaged units	Damaged units x repair cost per unit	(900)	(1,200)	(2,000)	(5,250)
NRV of Closing stock	Selling price – cost to sell – cost to complete	43,100	105,262	159,438	268,611
Value of closing stock to be reported in the SFP	Lower of cost and NRV	39,167	94,667	159,438	268,611

2.5 Comparison of Methods

The different methods of inventory valuation will give significantly different valuations for the cost of sales and the value of closing inventory during a period of high inflation (when prices are increasing)

- With FIFO during a period of high inflation, the cost of sales will be lower than the current replacement cost of materials used. The closing inventory value should be close to current value since they will be the units bought most recently.
- With AVCO during a period of high inflation, the cost of sales will be higher and the value of closing inventory lower than with FIFO valuation.

In the example used above to illustrate FIFO and AVCO, prices were rising and the valuations of the cost of goods issued and closing inventory were as follows

Valuation method	Cost of goods issued	Closing inventory
	Rs.	Rs.
FIFO	51,000	23,000
AVCO	52,912	21,092

The valuation of closing inventory is higher and the cost of goods issued is lower using FIFO. This is typical during a period when prices are rising steadily.

The opposite is true when prices are falling. The valuation of closing inventory is lower and the cost of goods issued is higher using FIFO.

Advantages & Disadvantages of FIFO

Advantages

- This method is realistic and in line with the physical movement of goods normally.
- Easy to understand and explain to managers
- Gives a value near to replacement cost

Disadvantages

- Can be cumbersome to operate especially when frequent purchase is made and prices are fluctuating on regular basis
- Managers may find it difficult to compare costs and make decisions when they are charged with varying prices for the same materials
- In a period of high inflation, inventory issue prices will lag behind current market value

Advantages & Disadvantages of AVCO

Advantages

- Smoothens out price fluctuations as different prices are converted into average prices.
- Easier to administer than FIFO

Disadvantages

- Issue price is rarely what has been paid
- Prices tend to lag a little behind current market values when there is gradual inflation

2.6 Journal Entries

Following journal entries are related to movement of raw material inventory under perpetual inventory system.

Description	Journal Entry
When raw material is purchased	Material Inventory Dr. Accounts Payable Cr.
When raw material is issued to production	Work in process Dr. (Direct material) Factory overhead control Dr. (Indirect material) Material Inventory Cr.
When raw material is returned to vendor	Accounts Payable Dr. Material Inventory Cr.
When raw material is returned from production to store	Material Inventory Dr. Work in process Cr. (Direct material) Factory overhead control Cr. (Indirect material)
Recording of loss of raw material inventory (Shortage)	Factory overhead control Dr. Material Inventory Cr.
Recording of inventory at NRV if cost exceeds NRV at period end	Factory overhead control Dr. Material Inventory Cr. (With difference of cost and NRV)

- *Example 09:*

Taking the data from example 04 above, Journal Entries on basis of AVCO method of costing are given below:

Journal entries:		**Debit**	**Credit**
		Rupees	
5 April	Raw material	18,000	
	Account payable		18,000
	(Cost of material purchased)		
9 May	Work in process	11,500	
	Raw material		11,500
	(Issue of raw material to production)		
14 July	Raw material	35,000	
	Account payable		35,000
	(Cost of material purchased)		
25 July	Work in process	13,286	
	Raw material		13,286
	(Issue of raw material to production)		
22 October	Raw material	16,000	
	Account payable		16,000
	(Cost of material purchased)		
23 November	Work in process	14,061	
	Raw material		14,061
	(Issue of raw material to production)		
22 December	Work in process	14,061	
	Raw material		14,061
	(Issue of raw material to production)		

2 COMPREHENSIVE EXAMPLES

- *Example 01:*

Mehanti Limited(ML) produces and markets a single product Wee. Two chemicals Bee and Gee are used in the ratio of 60:40 for producing 1 liter of Wee. ML follows perpetual inventory system and uses weighted average method for inventory valuation. The purchase and issue of Bee and Gee for May 20X3, are as follows:

Date	Bee			Gee		
	Receipt		Issue	Receipt		Issue
	Liter	Rate	Liter	Liter	Rate	Liter
02-05-20X3	-	-		450	110	-
05-05-20X3	-	-	560	-	-	650
09-05-20X3	-	-	300	-	-	300
12-05-20X3	420	52	-	700	115	-
18-05-20X3	-	-	250	-	-	150
24-05-20X3	500	55	-	250	124	-
31-05-20X3	-	-	500	-	-	450

Following further information is also available:

i. Opening inventory of Bee and Gee was 1,000 liters at the rate of Rs.50 per liter and 500 liters at the rate of Rs. 115 per liter respectively.

ii. The physical inventories of Bee and Gee were 535 liters and 140 liters respectively. The stock check was conducted on 01 June and 31 May 20X3 for Bee and Gee respectively.

iii. Due to contamination, 95 liters of Bee and 105 liters of Gee were excluded from the stock check. Their net realizable values were Rs20 and Rs.50 per liter respectively.

iv. 250 liters of Bee which was received on 01 June 20X3 and 95 liters of Gee which was issued on 31 May 20X3 after the physical count were included in the physical inventory.

v. 150 liters of chemical Bee was held by ML on behalf of a customer, whereas 100 liters of chemical Gee was held by one of the suppliers on ML's behalf.

vi. 100 liters of Bee and 200 liters of Gee were returned from the production process on 31May and 01 June 20X3 respectively.

vii. 240 liters of chemical Bee purchased on 12th May and 150 liters of chemical Gee purchased on 24th May 20X3 were in advertently recorded as 420 liters and 250 liters respectively.

a) Reconcile the physical inventory balances with the balances as per book.

Reconciliation (Bee)	Liters
Bal. as per physical count (1st June)	535
Add: Contaminated Stock	95
Less: Receipt of June, 1	(250)
Third party stock	(150)
Balance as per books (W-1)	230

Reconciliation (Gee)	Liters
Balance as per physical count (31st May)	140
Less: Issued after Count	(95)
Actual Physical as on 31.5.20X3	45
Add: Contaminated stock	105
Stock with 3rd party	100
Stock as per books (W-2)	250

(W-1) (Bee)

Date	Receipts			Issues			Balance		
	Units	PUC	TC	Units	PUC	TC	Units	PUC	TC
1-5-X3							1,000	50	50,000
5-5- X3				560	50	28,000	440	50	22,000
9-5- X3				300	50	15,000	140	50	7,000
12-5- X3	420	52	21,840				560	51.5	28,840
18-5- X3				250	51.5	12,875	310	51.5	15,965
24-5- X3	500	55	27,500				810	53.66	43,465
31-5- X3				500	53.66	26,830	310	53.66	16,635
31-5- X3				(100)	(53.66)	5366	410	53.66	22,001
31-5- X3 (Adj)	(180)*	(52)	(9,360)				230	54.96	12,641

*Purchases of 240 liters erroneously recorded as 420 liters now corrected. It is assumed that the error was highlighted on 31st May or later.

(W-2) (Gee)

Date	Receipts			Issues			Balance		
	Units	PUC	TC	Units	PUC	TC	Units	PUC	TC
1-5- X3							500	115	57,500
2-5- X3	450	110	49,500				950	112.63	107,000
5-5- X3				650	112.63	73,210	300	112.63	33,790
9-5- X3				300	112.63	33,789	-	-	-
12-5-X3	700	115	80,500				700	115	80,500
18-5- X3				150	115	17,250	550	115	63,250
24-5- X3	250	124	31,000				800	117.81	94,250
31-5- X3				450	117.81	53,015	350	117.81	41,235
31-5- X3	*(100)	124	12,400				250	115.34	28,835

*Purchases of 150 liters were erroneously recorded as 250 liters. It is assumed that error is highlighted on 31st May 20X3.

b) Determine the cost of closing inventory of chemical Bee and Gee. Also compute the cost of contaminated materials as on 31 May 20X3.

Valuation of Bee

As on 31 May 20X3

	Units	PUC	TC
Balance as per books	230	54.96	12,641
Less: contaminated stock (BV)	(95)	(54.96)	(5,221)
Add: contaminated stock (NRV)	95	20	1,900
Balance as per books as on 31 May 20X3	230	40.52	9,320

Above calculated stock include 95 liters of contaminated stock @ 20/ liter i.e. its NRV

Thus the cost of closing inventory of Bee is Rs. 9,320 and cost of contaminated material would be Rs. 1,900 included above.

Valuation of Gee

As on 31 May 20X3

	Units	PUC	TC
Stock as per books	250	115.34	28,835
Less: Contaminated stock (BV)	(105)	(115.34)	(12,110.70)
Add: Contaminated stock (NRV)	105	50	5,250
Value of stock as on 31 May 20X3	250	87.90	21,974.30

Thus the cost of closing inventory of Gee is Rs. 21,974.30 including the cost of contaminated material Rs. 5,250.

Above calculated stock include 105 liters of contaminated material at its NRV i.e. Rs. 50/ liter.

- *Example 02:*

Quality Limited (QL) is a manufacturer of washing machines. The company uses perpetual method for recording and weighted average method for valuation of inventory.

The following information pertains to a raw material (SRM), for the month of June 20X3.

i. Opening inventory of SRM was 100,000 units having a value of Rs. 80 per unit.

ii. 150,000 units were purchased on June 5, at Rs. 85 per unit

iii. 150,000 units were issued from stores on June 6.

iv. 5,000 defective units were returned from the production to the store on June 12.

v. 150,000 units were purchased on June 15 at Rs. 88.10 per unit.

vi. On June 17, 50% of the defective units were disposed of as scrap, for Rs. 20 per unit, because these had been damaged on account of improper handling at QL.

vii. On June 18, the remaining defective units were returned to the supplier for replacement under warranty.

viii. On June 19, 5,000 units were issued to production in replacement of the defective units which were returned to store.

ix. On June 20, the supplier delivered 2,500 units in replacement of the defective units which had been returned by QL.

x. 150,000 units were issued from stores on June 21.

xi. During physical stock count carried out on June 30, 2010 it was noted that closing inventory of SRM included 500 obsolete units having net realizable value of Rs. 30 per unit. 4,000 units were found short.

Necessary journal entries to record the above transactions would be prepared as follows

Journal entries:		**Debit**	**Credit**
		Rupees	
5-Jun-20X3	Raw material	12,750,000	
	Account payable (150,000 x 85)		12,750,000
	(Cost of material purchased)		
6-Jun-20X3	Work in process	12,450,000	
	Raw material		12,450,000
	(Issue of raw material to production)		
12-Jun-20X3	Raw material	415,000	
	Work in process		415,000
	(Defective material returned from the production)		
15-Jun-20X3	Raw material	13,215,000	
	Account payable (150,000 x 88.1)		13,215,000
	(Cost of material purchased)		
17-Jun-20X3	Cash (2,500 x 20)	50,000	
	Factory overheads	165,000	
	Raw material		215,000
	(Defective units sold as scrapped)		
18-Jun-20X3	Account payable	212,500	
	Raw material		212,500
	(Defective material returned to the supplier)		

		Debit	Credit
		Rupees	
19-Jun-20X3	Work in process	430,050	
	Raw material		430,050
	(Replacement of defective material to production by the store)		
20-Jun-20X3	Raw material	212,500	
	Account payable (2,500 x 85)		212,500
	(Goods returned were replaced by the supplier)		
21-Jun-20X3	Work in process	12,900,000	
	Raw material		12,900,000
	(Issue of raw material to production)		
30-Jun-20X3	Factory overheads - {500 x (86-30)} (obsolete items)	28,000	
	Factory overheads - (4,000 x 86) (shortages)	344,000	
	Raw material		372,000
	(Cost of obsolete and shortages charged to factory overheads)		

Date	Particulars	Receipts /(Issues)		
		Quantity	Rate	Rupees
01-Jun-20X3	Balance	100,000	80.00	8,000,000
05-Jun-20X3	Purchases	150,000	85.00	12,750,000
	Balance	**250,000**	**83.00**	**20,750,000**
06-Jun-20X3	Issues	(150,000)	83.00	(12,450,000)
12-Jun-20X3	Returned from production	5,000	83.00	415,000
15-Jun-20X3	Purchases	150,000	88.10	13,215,000
	Balance	**255,000**	**86.00**	**21,930,000**
17-Jun-20X3	Defective goods sold	(2,500)	86.00	(215,000)
18-Jun-20X3	Returned to supplier	(2,500)	85.00	(212,500)
	Balance	**250,000**	**86.01**	**21,502,500**
19-Jun-20X3	Replacement to production	(5,000)	86.01	(430,050)
20-Jun-20X3	Replacement by supplier	2,500	85.00	212,500
	Balance	**247,500**	**86.00**	**21,284,950**
21-Jun-20X3	Issues	(150,000)	86.00	(12,900,000)
	Balance	**97,500**	**86.00**	**8,384,950**
30-Jun-20X3	Shortage	(4,000)	86.00	(344,000)
	Balance	**93,500**	**86.00**	**8,040,950**

- *Example 03:*

Standard Limited (SL) is in the business of buying and selling electric ovens. It follows perpetual inventory system and uses weighted average method for valuation of inventory. Following information is extracted from SL's records for the month of February 2021:

i. Opening inventory consisted of 220,000 units having average cost of Rs. 7,000 per unit.

ii. 280,000 units were purchased on 5 February 2021, at Rs. 7,200 per unit.

iii. 180,000 units were sold to Khurram Limited (KL) on 10 February 2021.

iv. 5,000 defective units were returned by KL on 12 February 2021.

v. 30% of the defective units returned to SL, had a manufacturing fault and were returned to the supplier on 15 February 2021. Remaining defective units were damaged due to mishandling at the warehouse. These units were disposed of as scrap on 20 February 2021 for Rs. 2,000 per unit.

vi. 5,000 units were sent to KL on 22 February 2021 in replacement of the defective units returned.

vii. 150,000 units were sold on 25 February 2021. On 28 February 2021, a physical stock count was carried out and the following was discovered:

- 4,500 units were identified as obsolete having net realizable value of Rs. 6,000 per unit.
- 500 units were found missing.

Necessary journal entries to record the above transactions relating to inventory are as follows:

Journal entries:		**Debit**	**Credit**
		Rupees in '000	
1-Feb-21	Inventory	2,016,000	
	Account payable		2,016,000
	(Inventory purchased)		
10-Feb-21	Cost of goods sold	1,280,160	
	Inventory		1,280,160
	(Sales made to KL)		
12-Feb-21	Inventory	35,560	
	Cost of goods sold		35,560
	(Defective units returned by KL)		
15-Feb-21	Accounts Payable	10,800	
	Inventory		10,800
	(Defective units returned by KL)		
20-Feb-21	Cash (3,500 x 2,000)	7,000	
	Profit & Loss account (Bal)	17,891	
	Inventory		24,891
	(Defective units sold as scrap)		
22-Feb-21	Cost of goods sold	35,558	
	Inventory		35,558
	(Replacement of defective units to KL)		

		Debit	Credit
		Rupees in '000	
25-Feb-21	Cost of goods sold	1,066,739	
	Inventory		1,066,739
	(Sales made)		
28-Feb-21	Profit & Loss account-NRV Adjustment [4,500 x (7,111.59-6,000.00)]	5,002	
	Profit & Loss account- Shortage	3,556	
	Inventory		8,558
	(Cost of obsolete and shortages charged to factory overheads)		

In order to prepare journal entries of above transactions, it is important to prepare stock ledger card of electric ovens. It will help to identify cost assigned to each transaction.

Date	Particulars	Receipts /(Issues)		
		Quantity	Rate	Rs. In '000
01-Feb-21	Balance	220,000	7,000.00	1,540,000
05-Feb-21	Purchases	280,000	7,200.00	2,016,000
	Balance	**500,000**	**7,112.00**	**3,556,000**
10-Feb-21	Sales to KL	(180,000)	7,112.00	(1,280,160)
12-Feb-21	Returned by KL	5,000	7,112.00	35,560
15-Feb-21	Returned to supplier-defective	(1,500)	7,200.00	(10,800)
	Balance	**323,500**	**7,111.59**	**2,300,600**
20-Feb-21	Defective goods scrapped	(3,500)	7,111.59	(24,891)
22-Feb-21	Replacement of defective to KL	(5,000)	7,111.59	(35,558)
25-Feb-21	Sales	(150,000)	7,111.59	(1,066,739)
28-Feb-21	Short inventory found in physical count	(500)	7,111.59	(3,556)
	Balance	**164,500**	**7,111.59**	**1,169,856**

STICKY NOTES

Inventory is valued at lower of cost or NRV

Net Realizable value is the estimated selling price in the ordinary course of business

The costs of large volume inventories are calculated using FIFO or AVCO method

FIFO & AVCO methods provide different results of cost of sales and closing value of inventories if the prices are moving frequently

CHAPTER 2

INVENTORY MANAGEMENT

IN THIS CHAPTER

AT A GLANCE

Inventory management refers to the process of ordering, storing and using a company's inventories. Managers of inventory-intensive industries have to be very vigilant to manage the inventories in such a way so as to make adequate stock available to meet expected demands at minimum costs, while keeping it safe from obsolescence and damage.

They have to determine:

- order quantity at which the relevant cost is lowest and level of stock at which the order must be placed.
- quantity in addition to the normal usage to meet unexpected demand in order to avoid loss of profit whereas keeping the holding cost lowest.

Costs associated with inventories include: cost of purchasing, ordering and holding the inventory. Relevant costs are the costs that occur on the occurrence of an activity.

EOQ model is used to determine the order quantity at which the cost is minimum. EOQ can be determined using: Tabular Method, Graphical Method and EOQ Formula.

A business entity shall always maintain certain levels of inventories. These levels are: Re-order Level, Safety Stock / Buffer Stock, Maximum and Minimum Inventory Levels.

Probabilities are used to make the comparison of holding cost with stock-out cost to achieve cost efficiencies.

1. WHAT IS INVENTORY MANAGEMENT?

Inventory management refers to the process of ordering, storing and using a company's inventories. This includes management of raw materials, components and finished products as well as warehousing and processing such items.

Since the inventory is the most important component of any inventory-intensive sectors, special efforts are put to ensure that:

- There is sufficient inventory of raw materials available to produce the quantity of finished goods to meet the sale forecast,
- There is sufficient inventory of finished goods available to meet the immediate sales requirement (both expected and unexpected) to avoid stock out situations,
- The quantity so available is not in excess of the market needs to avoid any obsolescence, damage or blockage of finance and
- The costs associated with inventory are minimized.

1.1. Why do companies hold stocks?

There are three general reasons:

1. Transaction motive
2. Precautionary motive and
3. Speculative motive.

The **transaction motive** occurs when there is a need to hold stocks to meet production and sales requirements instantaneously. The stock is maintained in order to operate the production smoothly without stoppage of work due to mishandling of material.

The firm might also decide to hold additional amounts of stocks to cover the possibility that it may have underestimated its future production and sales requirements or the supply of raw materials may be unreliable because of uncertain events affecting the supply of materials. This represents **precautionary motive** which applies only when future demand is uncertain and fluctuating.

When it is expected that future input prices may change, a firm might maintain higher or lower stock levels to speculate on the expected increase or decrease in future prices. This is called **speculative motive**.

1.2. Costs Associated with Inventories:

Inventory management is quite critical for the companies as it includes substantial costs, especially in material-intensive manufacturing concerns. Following are the costs that are associated with inventories:

1. **Cost of purchasing the inventory** – the price that is settled with the supplier, after deducting the trade discounts and rebates.
2. **Cost of ordering the inventory** – such as clerical costs of preparing the material requisition, purchase order, receiving and handling shipments and preparing receiving report, communicating in case of quantity/ quality errors or delay in receipt of shipment, and accounting for the shipment and the payment.
3. **Cost of holding the inventory** – such as interest cost on borrowings for purchase of inventory, insurance cost, warehouse and storage cost, handling cost and cost of obsolescence, deterioration of inventory and opportunity cost of holding the stocks.

All these costs are financed either through company's own funding or borrowings from banks.

a) If inventories are financed using company's own funds, the company would have to bear the opportunity cost in a way had these funds were not invested in the inventories could be used in investing in any other avenues to earn a fixed return. The gain so forgone shall be treated as the opportunity cost.

b) Similarly, if the inventories are funded by obtaining bank loan, the interest on such loan shall make the part of cost of inventories.

Now if the investment on which a fixed return could be attained or the loan was obtained, for three months, the company would have to complete its cycle of purchasing, manufacturing, selling and realizing cash in three months to:

- adjust the opportunity cost with gain from sale of inventories or
- pay off the borrowings and interest

which if not materialize in the given time would make the company to bear more cost (more interest, more storage and insurance costs etc.). Therefore, to avoid such a situation the companies put substantial efforts to determine the expected market demand on the basis of which purchasing and manufacturing plans are made in order to achieve a point of inventory at which the cost is minimized.

The mathematicians have therefore derived quantitative models to determine the level of stock to be maintained at which the price is minimal (known as optimum stock level).

Such quantitative models undertake only relevant costs in calculation.

1.3. Relevant and Irrelevant Cost:

Relevant costs are the costs that occur on the occurrence of given relevant activity.

Irrelevant costs are those that occur whether or not any activity is carried, means not related to specific activity.

▶ *Example 01:*

A company is planning to shut down its operations for two months. The operations run on a factory for which company pay rent of Rs. 50,000 per month. The company uses raw material of Rs. 75,000 for monthly production and incurs Rs. 60,000 towards labour cost. Due to it shut down, the company would not purchase raw material for the two months and pay half to the labours as per labour unions agreement. However, it would be required to pay full amount of rent for the factory.

In this case the cost of raw materials and half cost of labour is relevant cost as the same occur when the factory runs. Whereas, the rent of the factory and half cost of labours shall occur irrespective the operations run or not and is irrelevant cost.

This concept shall be discussed in detail in chapter 'Decision Making' and here we will look at areas that are relevant for decisions relating to inventories.

The relevant cost that should be considered when determining optimum stock levels are holding cost and ordering cost.

Relevant Holding Cost to be used in quantitative models should include only those items that will vary with the levels of stock. For example, in the case of storage and warehouse only those costs should be included that will vary with changes in number of units ordered. Such costs are called variable costs. However, fixed cost is not included in holding cost because it will not change as a result of holding higher or lower inventory levels.

▶ *Example 02:*

Fixed and variable holding costs

Salaries of storekeepers, depreciation of equipment and fixed rental of equipment and buildings are often irrelevant because they are unaffected by changes in stock levels.

On the other hand, if storage space is owned and can be used for other productive purposes, such as to obtain rental income, then the opportunity cost must be included in the analysis.

Similarly, the insurance cost of stock must be undertaken when the premium is paid at the fluctuating value of stocks and not the fixed insurance cost per annum.

To the extent that funds are invested in stocks, the analysis must include opportunity cost (as explain in cost associated with inventories). The opportunity cost is reflected by the required return that is lost from investing in stocks.

The relevant holding costs for other items such as material handling, obsolescence and deterioration are difficult to estimate and these costs are not very critical to the investment decision.

Normally, the holding costs are expressed as a percentage rate per rupee of average investment.

Same as holding costs, the **ordering costs** that are common to all inventory decisions are irrelevant and only the incremental costs of placing an order are useful for this purpose.

Note: the cost of purchasing or manufacturing the inventories are irrelevant for the purpose of determining optimum stock level since it remains unchanged irrespective of the order size or stock levels unless quantity discounts are available.

▶ *Example 03:*

Ore Limited (OL) is a manufacturer of sports bicycles. The company buys tyres from a local vendor.

Following data, relating to a pair of tyres, has been extracted from OL's records:

Cost (per unit)	Rs.
Storage cost based on average inventory	80
Insurance cost based on average inventory	60
Store keeper's salary (included in absorbed overheads)	8
Cost incurred on final quality check at the time of delivery	10

Other relevant details are as follows:

i. The purchase price is Rs. 900 per pair.
ii. The annual demand for tyres is 200,000 pairs.
iii. The ordering cost per order is Rs. 8,000.
iv. The delivery cost per order is Rs. 3,000.
v. OL's rate of return on investment in inventory is 15%.
vi. Recently the vendor has offered a quantity discount of 3% on orders of a minimum of 5,000 pairs.

a) Annual Ordering Cost, can be calculated as follows:

Annual Ordering Cost = Number of orders per annum x cost per order

Number of orders = Annual demand / order size = 200,000/5000 = 40 orders per annum

Cost per Order = Ordering Cost + Delivery Cost = Rs. 8,000 + Rs. 3,000 = 11,000

Therefore, the annual ordering cost = 40 x 11,000 = Rs. 440,000

b) To calculate Average inventory, following calculations would be required:

Average Inventory = (Opening quantity of stock + Closing quantity of stock) / 2 (0+5000)/2 = 2,500 pairs

c) Annual Holding cost, to be calculated as follows:

Annual Holding Cost = Holding Cost per unit x Average Inventory

Holding cost per unit:

Storage cost based on average inventory =	80
Insurance cost based on average inventory =	60
Opportunity Cost = Rs. 900 x 97% x 15% =	130.95
Total (relevant) holding cost per unit =	270.95
Annual Holding Cost = 270.95 x 2,500 =	677,375

d) Lastly, Total Cost of Inventory would be

Total Cost of Inventory:

Purchase cost (net of discount) = 900 x 200,000 x 97% =	174,600,000
Annual Ordering Cost = (a) =	440,000
Annual Holding Cost = (c) =	677,375
Total Cost of Inventory per annum =	175,717,375

Note: for the purpose of average stock it is assumed that there is no inventory available when the order is received and the inventory is consumed at a constant rate throughout the period, therefore, opening stock is zero and closing stock is the order size.

Alternatively, it can be assumed that the stock level is at the quantity of order received (5,000 in this case) which is consumed at a constant rate and becomes zero before the new order is received. This way opening shall become 5,000 and closing will be zero. However, in both cases the answer will be same.

Therefore, the average inventory is quantity reordered divided by 2.

AT A GLANCE

SPOTLIGHT

STICKY NOTES

2. ECONOMIC ORDER QUANTITY

There are models which incorporate transaction motive for holding optimum level of stocks. This is possible where a company is able to predict the demand for its inputs and outputs with perfect certainty and where it knows with certainty that prices of inputs, will remain constant for some reasonable length of time.

In such a situation, the optimum order will be determined by those costs that are affected by either:

- the quantity of stocks held or
- the number of orders placed.

If more units are ordered at one time, fewer orders will be required per year. This will result in reduction in ordering costs.

As seen in above example, if order size is 10,000 units, the number of orders will be 200,000 / 10,000 = 20 orders which will reduce the ordering cost to Rs. 220,000

However, when fewer orders are placed, larger average stocks must be maintained which leads to increase in holding costs that is (10,000 / 2) x 270.95 = 1,354,750. Hence the total relevant cost (ordering cost + holding cost) shall become Rs. 1,574,750 that is Rs. 457,375 higher than the one calculated at 5,000 units (i.e. 440,000+677,375=1,117,375).

Therefore, an optimum level must be determined at which the total relevant cost is minimized. This optimum level is called **Economic Order Quantity (EOQ).**

The EOQ can be determined by using the following methods:

1. Tabular Method
2. Graphical Method
3. Formula Method

We shall look into these methods using the following example.

▶ *Example 04:*

Stock items 6786:

A company uses 40,000 units of stock item 6786 each year. The item has a purchase cost of Rs.10 per unit. The cost of placing an order for re-supply is Rs.2. The annual holding cost of one unit of the item is 10% of its purchase cost.

if it would be required to calculate the economic order quantity for item 6786, to the nearest unit using:

a) Tabular method
b) Graphical method
c) Formula Method

a) Tabular Method:

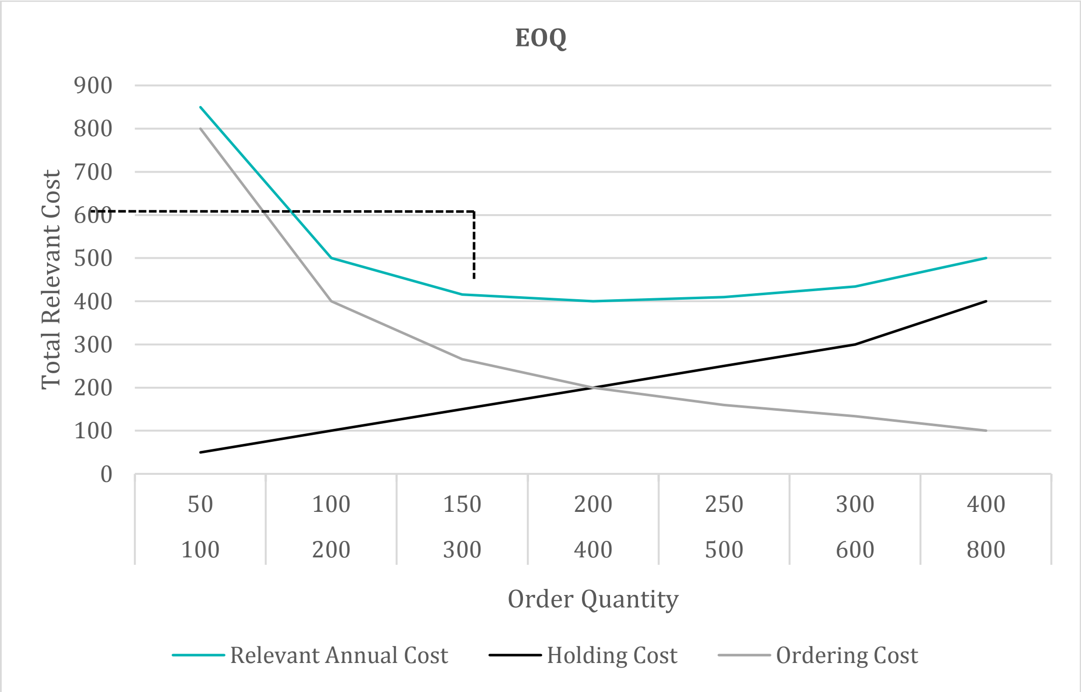
Order Quantity (Q)	100	200	300	400	500	600	800	10,000
Average Inventory (Q/2)	50	100	150	200	250	300	400	5000
Number of Purchase Orders (Annual Demand (A) / Q)	400	200	133	100	80	67	50	4
Annual Holding Cost (10% x 10 x Average Inventory)	50	100	150	200	250	300	400	5000
Annual Ordering Cost (2 x No. of Orders)	800	400	266	200	160	134	100	8
Total Relevant Cost	850	500	416	**400**	410	434	500	5,008
So the relevant cost is minimum at 400 units per order where annual OC and HC are equal. This is the optimum point or EOQ.								

b) Graphical Presentation Method:

We have taken total relevant cost (ordering cost + holding cost) on the vertical axis and order quantity and average inventory on the horizontal axis.

We can see that as the average inventory and order size increases, the holding cost also increases whereas the order cost decreases.

It also to be noted here that the total relevant cost line is lowest at a point where ordering cost line and holding cost line are intersecting. This intersecting point determines our EOQ.



c) Formula method:

The economic order quantity formula is based on mathematical model that incorporates the basic relationships between ordering and holding costs.

These relationships can be stated as follows:

Annual Demand = A

Quantity per Order / Order size = Q

Cost per Order = Oc

Holding cost per unit = Hc

Average Inventory = Q / 2

Annual Ordering Cost (AOc) shall be calculated as (A / Q) x Oc

Annual Holding (AHc) shall be calculated as (Q / 2) x Hc

TRC = $\frac{A}{Q} \times Oc + \frac{Q}{2} \times Hc$

Total Relevant Cost (TRC) = Annual Holding Cost (AHc) + Annual Ordering Cost (AOc)

AT A GLANCE SPOTLIGHT STICKY NOTES

When differentiating the above equation with respect to Q and setting the derivative equal to zero, we get the economic order quantity 'Q':

$$Q = \sqrt{\frac{2AOc}{Hc}}$$

Applying this formula to the example 2 above:

$$Q = \sqrt{\frac{(2 \text{ x } 40{,}000 \text{ x } 2)}{1}}$$

$$= 400 \text{ } units$$

Assumptions of EOQ:

EOQ model is valid only as per the following assumptions:

1. The holding cost per unit will be constant.
2. The average inventory is equal to one half of the order quantity as the stock is consumed at a constant rate throughout the period. (discussed in above sections)
3. The cost per order is constant.
4. There are no quantity discounts available.
5. The demand for its inputs and outputs can be predicted with perfect certainty.

▶ *Example 05:*

Taking the data from example 04, determine the effect of an increase in annual holding cost per unit on:

a) EOQ

b) Total annual ordering cost

In order to fulfil the requirement, assume that HC has increased to 15%, the revised HC will be = 15% x 10 = 1.5

The revised EOQ would be $\sqrt{\frac{(2\times40{,}000\times2)}{1.5}} = 326.6 \approx 327$

Effect: the order size shall decrease due to increase in holding cost.

The Annual Ordering Cost shall increase due to reduction in order size.

$$AOc = \frac{40{,}000}{326.6} \times 2 = Rs. 244.6$$

The AOC has increased by Rs. 44.6

▶ *Example 06:*

Rana Manufacturers require 1,500 units of an item per month. The cost of each unit is Rs. 27. The cost per order is Rs. 150 and material carrying charge works out to 20% of the average material.

(a) Calculation of EOQ by using formula, is given below:

Here, A = 18,000 (1,500 x 12)

Oc= Rs. 150

Hc= Rs.5.40 (27 x 20%)

We use the economic order quantity formula 'Q' as:

$$Q = \sqrt{\frac{2\ AOc}{Hc}}$$

By putting values in formula

EOQ would be $\sqrt{\frac{(2\times18{,}000\times150)}{5.40}}$ = 1,000 units

(b) Calculation of Annual ordering and holding cost, is given below:

Annual cost	Rupees
Ordering cost (18,000/ 1,000 x 150)	2,700
Holding cost (1,000 / 2 x 5.40)	2,700
	5,400

2.1 Quantity Discounts affecting the decision of order size:

As per above assumptions, it is assumed that no quantity discounts exist. However, sometimes the suppliers offer discounts on bulk purchases. In such a case, the EOQ model can only be used when the total cost including purchase price after taking into account the discounts is more than the cost at EOQ. This means, the entity shall evaluate both the options and determine which option gives the lesser cost.

Following steps should be followed in order to calculate EOQ in case of bulk discounts.

i. Calculate EOQ (Ignoring discounts)

ii. Calculate Annual Inventory Cost including purchase cost at above EOQ level.

iii. Calculate Annual Inventory Cost at each discount level including purchase cost.

iv. Compare annual inventory costs calculated in above II and III, and determine EOQ level at a point where total inventory cost is minimum.

► *Example 07:*

Entity G uses 105 units of an item of inventory every week. These cost Rs.150 per unit. They are stored in special storage units and the variable costs of holding the item is Rs.4 per unit each year plus 2% of the inventory's cost.

a) If placing an order for this item of material costs Rs.390 for each order, the optimum order quantity to minimize annual costs would be calculated as follows. It is assumed that there are 52 weeks in each year.

The annual holding cost per unit of inventory = Rs.4 + (2% × Rs.150) = Rs.7.

Annual demand = 52 weeks × 105 units = 5,460 units.

$$\text{EOQ} = \sqrt{\frac{2\times390\times5{,}460}{7}} = 780 \text{ Units}$$

b) Now suppose that the supplier offers a discount of 1% on the purchase price for order sizes of 2,000 units or more. The order size to minimize total annual costs would require following calculations

A discount on the price is available for order sizes of 2,000 units or more, which is above the EOQ.

The order size that minimizes cost is therefore either the EOQ or the minimum order size to obtain the discount, which is 2,000 units.

Annual costs	Order size 780 units	Order size 2,000 units
	Rs.	Rs.
Purchases		
(5,460 × Rs.150): ((5,460 × Rs.150 × 99%)	819,000	810,810
Holding costs	2,730	6,970
(Rs.7 × 780/2): (Rs.6.97 × 2,000/2)		
Ordering costs	2,730	1,065
(Rs.390 × 5,460/780): (Rs.390 × 5,460/2,000)		
Total costs	824,460	818,875

Conclusion: The order size that will minimize total annual costs is 2,000 units

- *Example 08:*

W Co. is retailer of barrels. The company has an annual demand of 30,000 barrels. The barrel cost Rs. 12 each. Fresh supplies can be obtained immediately, with ordering and transport costs amounting to Rs. 200 per order. The annual cost of holding one barrel in stock is estimated to be Rs. 1.20 per year.

A 2% discount is available on orders of at least 5,000 barrels and 2.5% discount is available if the order quantity is 7,500 barrel or above.

Step-I Calculation of EOQs (Ignoring discounts)

Holding cost per barrel per year = Rs. 1.20

Cost per order = Rs. 200

Annual demand = 30,000 barrels

$$\text{EOQ} = \sqrt{\frac{2 \times 200 \times 30{,}000}{1.20}} = 3{,}162 \text{ barrels}$$

Step II Calculation of annual inventory cost at Q= 3,162

Annual costs	Order size 3,162 barrels
	Rs.
Purchases (30,000 x 12)	360,000
Ordering cost (30,000/3,162 x 200)	1,898
Holding cost (3,162/2 x 1.20)	1,897
Total Inventory Cost	**363,795**

Step III Calculation of annual inventory cost at each discount level

Annual costs	Order size 5,000 barrels	Order size 7,500 barrels
	Rs.	Rs.
Purchases (30,000 x 12 x 98%) / (30,000 x 12 x 97.5%)	352,800	351,000
Ordering cost (30,000/5,000 x 200) / (30,000/7,500 x 200)	1,200	800
Holding costs (5,000/2 x 1.20) / (7,500/2 x 1.20)	3,000	4,500
Total Inventory cost	**357,000**	**356,300**

Step IV Determine EOQ

The optimal order size should be 7,500 barrels as at this level, annual inventory cost is minimum.

Sometimes, the holding cost is based on percentage of purchase price (opportunity cost or interest cost) which will be changed in case of discounts in purchase cost. The annual holding cost shall also change as result of discounts. It can be explained with the help of following example.

- *Example 09:*

Raveen Shah Enterprises produces Product Y and its monthly demand is 2,000 units. 2.5 kg of material K is required to produce one unit of Product Y. Cost of placing an order is Rs. 150 and purchase price of Material K is Rs. 80 per Kg. Average holding cost is 8% of purchase price. Recently, vendor offers discount of 2% at minimum purchase quantity of 5,000 kg and 3% at minimum purchase quantity of 10,000 kg.

In order to calculate EOQ following steps are used:

Step-I Calculation of EOQs (Ignoring discounts)

Holding cost per unit per year = Rs. 6.40 (80 x 8%)

Cost per order = Rs. 150

Annual demand = 60,000 kg (2,000 x 12 x 2.5)

$$\text{EOQ} = \sqrt{\frac{2 \times 150 \times 60{,}000}{6.40}} = 1{,}677 \text{ kg}$$

Step II Calculation of annual inventory cost at Q= 1,677

Annual costs	Order size 1,677 Kg
	Rs.
Purchases (60,000 x 80)	4,800,000
Ordering cost (60,000/1,677 x 150)	5,367
Holding cost (1,677/2 x 6.40)	5,366
Total Inventory Cost	**4,810,733**

Step III Calculation of annual inventory cost at each discount level

Annual costs	Order size 5,000 Kg	Order size 10,000 Kg
	Rs.	**Rs.**
Purchases (60,000 x 80 x 98%) / (60,000 x 80 x 97%)	4,704,000	4,656,000
Ordering cost (60,000/5,000 x 150) / (60,000/10,000 x 150)	1,800	900
Holding costs (5,000/2 x 80 x 8% x 98%) / (10,000/2 x 80 x 8% x 97%)	15,680	31,040
Total Inventory cost	**4,721,480**	**4,687,940**

Step IV Determine EOQ

The optimal order size should be 10,000 kg as at this level, annual inventory cost is minimum.

2.2 Limitations of Economic Order Quantity Model:

a) It is assumed that annual demand of material is known and constant, which in fact not. The demand will be based on sales which may vary.

b) It is also assumed that per order cost and holding cost per unit shall not change. In practice, it is not possible as some of these costs are not controllable. For example, increase in prices of petrol by Government will enhance transportation cost.

c) Another limitation of EOQ model is its assumption in connection to non-availability of discounts which is not possible in practice.

d) In seasonal variation situation, the demand will be higher during season while it will be declined in off season. Therefore, it will not justify the assumption that demand can be predicted with perfect certainty.

3. INVENTORY LEVELS AND BUFFER STOCK

A business entity shall always maintain certain levels of inventories. These levels are:

a) Re-order Level
b) Safety Stock / Buffer Stock
c) Maximum Inventory Level
d) Minimum Inventory Level

So far, it has been assumed that when an item of materials is purchased from a supplier, the delivery from the supplier will happen immediately. In practice, however, there is likely to be some uncertainty about when to make a new order for inventory in order to avoid the risk of running out of inventory before the new order arrives from the supplier. The period of time between placing a new order with a supplier and receiving the delivery of the same is called "**Lead Time**". This lead time could be in days, weeks or months.

On the basis of this lead time, the companies determine the level of stock at which new order should be placed to avoid stock-out situation. The level at which a new order is placed is called "**Re-order Level**". It depends upon two factors, one is lead time and other is usage. If any of these factors is higher, then re-order level should be higher to avoid any stock out.

Such re-order level is determined using the average consumption during lead time. However, sometimes the demand during lead time exceeds the expectations, in such case, if the demand is not fulfilled, the customers may move to competitors and result in loss of profit and good will. Also, the delivery may delay the expected time due to which the company may fail to produce the expected demand which again result in loss of profits. To avoid such risk, the company also maintains a level of stock which is called "**Safety Stock** or **Buffer Stock**"

The re-order level is determined by two ways:

- **Under certain circumstances** = Average consumption during lead time =Average Lead Time (days / week / month) x Average Consumption per day / week / month. This is also called **Minimum Inventory Level**
- **Under uncertain circumstances** = maximum lead time (days / weeks / month) x maximum demand per day / week / month

The **Safety Stock** is determined as:

Re-order level at uncertain circumstances – Re-order level at certain circumstances

(Maximum Demand x Maximum Lead Time) – (Average consumption x Average Lead Time)

Due to safety stock, the **average inventory** shall become:

$$\frac{Q}{2} + Safety\ Stock$$

This way, the entity carries safety stock on the basis of maximum demand as well as maximum delivery time. However, the probability of both the events occurring at the same time is very low. Thereby, the management is incurring excessive holding cost on safety stocks.

If the cost of holding safety stocks is greater than the cost of stock-out, the business would be incurring more loss. Therefore, a level should be set where the cost of stock-out plus the cost of holding the safety stock is minimized.

Stock-out Cost are the opportunity cost of running out of stock. As the stock-out occurs when there is demand but no stock available, therefore, the loss of profit, which could be earned had the stock available. It also leads to loss of customers' goodwill as the customers may move to the products of competitors. If the customer is permanently lost, the stock-out cost is determined using the loss of future profits as well.

Once the stock-out cost has been estimated, the cost of holding safety stocks should be compared for various demand levels. This can be done using probability theory by attaching probabilities to different potential demand levels.

- *Example 10:*

XY Enterprises produces product that requires two components X and Y and relevant data for each type of components are given as below:

Description	
Normal usage in kg for each component per week	500
Minimum usage in kg for each component per week	250
Maximum usage in kg for each component per week	750
Re order quantity	X: 4,000 kg Y: 6,000 kg
Re order period	X: 4-6 weeks Y: 2-3 weeks

Required. Compute re order level, safety stock level and average stock level for each component of material.

- *Solution*

For each component of material, re order level, safety stock level and average stock level is calculated as under:

Re-order level = Average usage per week x Average lead time per week

Component	Kg
Component X (500 x 5)	2,500
Component Y (500 x 2.5)	1,250

Safety stock level = (Maximum usage x Maximum lead time) - (Average usage x Average lead time)

Component	Kg
Component X [(750 x 6) - (500 x 5)]	2,000
Component Y [(750 x 3) - (500 x 2.5)]	1,000

Average stock level = EOQ/2 + Safety stock level

Component	Kg
Component X (4,000/2) + 2,000	4,000
Component Y (6,000/2) + 1,000	4,000

3.1 Probability Theory to determine the Safety Stocks:

A probability table can be prepared. For each possible reorder level under consideration, we can calculate:

- the probable demand in the lead time between order and delivery;
- the risk of having excess inventory (buffer stock) and its cost;
- the risk of stock-outs, and their cost.

The reorder level selected might be the reorder level at which the expected value (EV) of cost is minimized.

► *Example 11:*

Entity X uses item Z in its production process. It purchases item Z from an external supplier, in batches.

For item Z, the following information is relevant:

Holding cost	Rs.15 per unit per year
Stock out cost	Rs.5 for each stock-out
Lead-time	1 week
EOQ	270 units

Entity X operates for 48 weeks each year. Weekly demand for unit Z for production is variable, as follows:

Units demanded during the lead time	Probability
70	10%
80	20%
90	30%
100	40%

Required

Suggest whether a reorder level of 90 units or 100 units would be more appropriate.

► *Solution*

The probabilities in the above example allow us to identify the possible stock-outs associated with different reorder levels.

Demand is always greater than 60 units in the lead time. Therefore, if the company allowed inventory to fall to 60 units before placing an order, it would face a stock shortage in every lead time. There is a 10% chance that demand would be 70 leading to a shortage of 10 units, a 20% chance that demand would be 80 leading to a shortage of 20 units, a 30% chance that demand would be 90 leading to a shortage of 30 units and a 10% chance that demand would be 100 leading to a shortage of 40 units. This can be used to work out the expected value of the stock out and its associated cost.

Setting a higher reorder level reduces the chance of a stock out but the company would then have more inventory on hand on average and this would increase holding cost. For example, if the company set the reorder level to 80 units it would only face stock-out if demand were greater than 80 in the lead time. The above information shows that there is a 30% chance that demand would be 90 leading to a shortage of 10 units and a 10% chance that demand would be 100 leading to a shortage of 20 units. Thus, the stock-out cost would be reduced. However, the company would hold an extra 20 units on average compared to a reorder level of 60 units.

AT A GLANCE SPOTLIGHT STICKY NOTES

Following steps are suggested:

Step 1: Calculate the average demand in the lead time

The average demand in the lead-time is:

(70 × 10%) + (80 × 20%) + (90 × 30%) + (100 × 40%) = 90 units

Average annual demand is 48 weeks × 90 units = 4,320 units.

Since the EOQ is 270 units, entity X will expect to place $\frac{4,320}{270}$ orders = 16 orders each year.

Therefore, there will be 16 lead times each year.

Step 2: Set up a probability table

(Starting with a reorder level set to the average demand in the lead time and then looking at higher reorder levels).

Reorder level of 90 (the company will be out of stock if demand is greater than 90)	
Demand = 100	
Stock outs if demand is 100	10 units
Probability of demand of 100	× 0.4
Cost per stock out	× Rs. 5
Number of orders per year	× 16
Annual stock out cost	320
Buffer stock (reorder level – average demand in lead time)	nil
	320
Reorder level of 100 (the company will never be out of stock)	
Stock out cost	nil
Buffer stock (reorder level – average demand in lead time)	10 units
Holding cost per unit per annum	× Rs. 15
	Rs. 150
The reorder level should be set at 100 units. The extra cost of the buffer stock (Rs. 150) achieves savings by reducing the stock out cost (Rs. 320).	

3.2 Maximum inventory level:

A company will set a maximum level for inventory. Inventory held above this would incur extra holding cost without adding any benefit to the company.

The inventory level should never exceed a maximum level. If it does, something unusual has happened to either the supply lead time or demand during the supply lead time. The company would investigate this and take action perhaps adjusting purchasing behavior.

When demand during the supply lead time is uncertain and the supply lead time is also uncertain, the maximum inventory level is found as follows.

Maximum inventory level:	
Re-order level	X
Add: Re-order quantity / EOQ	X
	XX
Less: Minimum Demand x Minimum Lead Time	(X)
	X

3.3 Minimum inventory level:

The inventory level could be dangerously low if it falls below a minimum warning level. When inventory falls below this amount, management should check that a new supply will be delivered before all the inventory is used up, so that there will be no stock-out.

When demand during the supply lead time is uncertain and the supply lead time is also uncertain, the minimum (warning) level for inventory is set as follows.

Minimum inventory level:	
Re-order level	X
Less: Average Demand x Average Lead Time	(X)
	X

► *Example 12:*

Stock Item 6787:

Data relating to stores item 6787 are as follows.

Daily use:	300 units
Lead time for re-supply:	5 – 20 days
Reorder quantity:	10,000 units

Required

Identify the reorder level for this stock item, to avoid the possibility of inventory-outs.

► *Solution*

In order to identify the reorder level for this stock item, to avoid the possibility of inventory-outs, following calculations would be required:

Reorder level to avoid inventory-outs

= Daily demand × Maximum lead time

= 300 units × 20 days

= 6,000 units.

► *Example 13:*

Robin Limited (RL) imports a high value component for its manufacturing process. Following data, relating to the component, has been extracted from RL's records for the last twelve months:

Maximum usage in a month	300 units
Minimum usage in a month	200 units
Average usage in a month	225 units
Maximum lead time	6 months
Minimum lead time	2 months
Re-order quantity	750 units

Required

Calculate the average stock level for the component.

AT A GLANCE SPOTLIGHT STICKY NOTES

- *Solution*

The average stock level for the component would be calculated as follows:

Average stock level:

Average stock level = minimum level + ½ (reorder quantity)
As minimum level is not given it will be computed as follows:
Re-order level = maximum usage × maximum lead time
Re-order level = 300 × 6 = 1,800 units.
Minimum level = Re-order level – (average usage × average lead time)
Minimum level = 1,800 –[(225 × (6+2/2) = 900 units.
Therefore, Average stock level = 900 + (½ 750) = 1,275 units.

4. COMPREHENSIVE EXAMPLES

- *Example 01:*

Orchid Limited (OL) is a trading concern. It is planning to implement Economic Order Quantity model (EOQ) from 1 April 2019. OL deals in four products each of which is purchased from a different supplier. To compute EOQ for one of its products Beta, the following data has been gathered:

i. Actual data for the last year relating to Beta:

Annual Sales	Units	72,000
Safety Stocks	Units	2,000
Transit Losses as % of purchases		10%
Average Holding Cost per Month	Rs.	500,000
Average Holding Cost per Month per Unit	Rs.	80
Number of Purchase Order issued for Beta		40

ii. Total cost of purchase department for the last year amounted to Rs. 4,500,000 which included fixed cost of Rs. 1,350,000. A total of 100 purchase orders were issued during the last year.

iii. Projections for the next year:

Increase in Sales Volume		25%
Safety Stock	Units	2,500
Transit Losses as % of Purchase		6%
Impact of inflation on all costs		10%

iv. Closing inventory (excluding safety stock) varies in line with the sale volume.

Required

Calculate EOQ for Beta.

- *Solution*

EOQ for Beta can be calculated as follows:

Annual demand (Purchases):		**Units**
Projected sales	72,000×1.25	90,000
Opening stock - including safety stock	(500,000÷80)	(6,250)
Closing stock - including safety stock	[(6,250–2,000)×1.25]+2,500	7,813
Purchases - net of transit losses		91,563
Purchases including transit losses of 6%	91,563÷0.94	**97,407**

Ordering cost per order:		**Rupees**
Variable cost	(4,500,000–1,350,000)×(1.1÷100)	34,650
Holding cost per unit per annum	80×1.1×12	1,056

Economic Order Quantity (EOQ):	**Units**
SQRT[(2×Annual demand × Ordering cost per order)÷Carrying cost per unit]	
SQRT[(2×97,407×34,650)÷1,056]	**2,528**

▶ *Example 02:*

ABC has recently established a new unit in Multan. Its planning for the first year of operation depicts the following:

i.	Cash sales	600,000 units
ii.	Credit sales	1,200,000 units
iii.	Ending inventory	Equivalent to 15 days sales
iv.	Number of working days in the year	300
v.	Expected purchase price	Rs. 450 per unit

Manufacturer offers 2% discount on purchase of 500 units or more as bulk quantity discount. The company intends to avail this discount.

vi. Carrying costs include:
- Financial cost of investment in inventory @ 16% per annum.
- Godown rent of Rs. 10,000 per month.

vii. Ordering costs are Rs. 300 per order.

Required

Compute Economic Order Quantity (EOQ), the estimated carrying costs and ordering costs for the first year of operation.

▶ *Solution*

Computation of the Economic Order Quantity (EOQ) and the estimated carrying costs and ordering costs for the first year of operation would be as follows:

Computation of annual requirement	
Units sold on cash basis	600,000
Units sold on credit basis	1,200,000
Ending Inventory (1.8 million x 15/300)	90,000
Annual purchases	1,890,000
Computation of Carrying Cost per unit	
Carrying cost per unit (Rs. 450 × 98% × 16%) (Bulk quantity discount availed)	Rs. 70.56

Computation of EOQ

$$EOQ = \sqrt{\frac{2 \times 1{,}890{,}000 \times 300}{70.56}}$$

= 4,009 units

Estimated carrying cost	= (EOQ/2) × carrying cost per unit
	= 4,009/2 × 70.56
	= Rs. 141,438
Add: Godown rent p.a.	= Rs. 120,000
Total carrying cost	= Rs. 261,438
Estimated ordering cost	= (annual requirement / EOQ) × cost per order
	= (1,890,000 / 4,009) × 300
	= Rs.141,432

- *Example 03:*

Karachi Limited is a large retailer of sports goods. The company buys footballs from a supplier in Sialkot. Karachi Limited uses its own truck to pick the footballs from Sialkot. The truck capacity is 2,000 footballs per trip and the company has been getting a full load of footballs at each trip, making 12 trips each year.

Recently the supplier revised its prices and offered quantity discount as under:

Quantity	Unit price (Rs.)
2,000	400
3,000	390
4,000	380
6,000	370
8,000	360

Other related data is given below:

- All the purchases are required to be made in lots of 1,000 footballs.
- The cost of making one trip is Rs. 15,000.
- The company has the option to hire a third party for transportation which would charge Rs. 9 per football. The cost of placing an order is Rs. 2,000.
- The carrying cost of one football for one year is Rs. 80.

Required

a) Work out the most economical option.

b) Compute the annual savings in case the company revises its policy in accordance with the computation in (i) above

- *Solution*

a) When required to work out the most economical option, below are the computations involved:

Karachi Limited

Price per football	A	400	390	380	370	360
Annual purchases (nos.)	B	24,000	24,000	24,000	24,000	24,000
Purchase cost	A × B	9,600,000	9,360,000	9,120,000	8,880,000	8,640,000
Minimum order size	C	2,000	3,000	4,000	6,000	8,000
No. of orders (B÷C)	D	12.00	8.00	6.00	4.00	3.00
Ordering cost	D × 2,000	24,000	16,000	12,000	8,000	6,000
Trips per order (C÷2,000)	E	1.00	1.00 (hired transport)	2.00	3.00	4.00
Total no. of trips (D×E)	F	12.00	8.00	12.00	12.00	12.00
Transportation cost	F× 15,000	180,000	120,000	180,000	180,000	180,000
Hired transport cost	8,000 units×9		72,000			
Average inventory (C÷2)	G	1,000	1,500	2,000	3,000	4,000
Inventory carrying cost	G × 80	80,000	120,000	160,000	240,000	320,000
Total cost (Rs.)		9,884,000	9,688,000	9,472,000	9,308,000	9,146,000

AT A GLANCE SPOTLIGHT STICKY NOTES

b) Computation of the annual savings in case the company revises its policy in accordance with the computation in (i) above, will be as follows:

The most economical option is to purchase 3 lots of 8,000 footballs each against the existing purchases of 12 lots of 2,000 footballs. The saving will be as under:

Cost for 12 lots of 2,000 footballs each.		9,884,000
Cost for 03 lots of 8,000 footballs each.		9,146,000
Cost saving	Rs.	738,000

▸ *Example 04:*

Modern Distributors Limited (MDL) is a distributor of CALTIN which is used in various industries and its demand is evenly distributed throughout the year.

The related information is as follows:

- Annual demand in the country is 240,000 tons whereas MDL's share is 32.5% thereof.
- The average sale price is Rs. 22,125 per ton whereas the profit margin is 25% of cost.
- The annual variable costs associated with purchasing department are expected to be Rs. 4,224,000 during the current year. It has been estimated that 10% of the variable costs relate to purchasing of CALTIN.
- Presently, MDL follows the policy of purchasing 6,500 tons at a time.
- Carrying cost is estimated at 1% of cost of material.
- MDL maintains a buffer stock of 2,000 tons.

Required

Compute the amount of savings that can be achieved if MDL adopts the policy of placing orders based on Economic Order Quantity.

▸ *Solution*

Computation of the amount of savings that can be achieved if MDL adopts the policy of placing orders based on Economic Order Quantity would be as follows:

Purchase department's variable cost:	Rs.	4,224,000
Costs applicable to product CALTIN - 10% of above	Rs.	422,400
Ordering costs per purchase order		
Annual purchases of CALTIN (tons) [240,000 x 32.5%)	Tons	78,000
Existing size of purchase order (tons)	Tons	6,500
No. of orders (78,000 / 6,500)	Orders	12
Ordering cost per order (422,400/12)	Rs.	35,200
Carrying costs per ton (22,125 / 1.25 x 1%)	Rs. Per Ton	177

Computation of EOQ $\sqrt{\frac{2 \times 78{,}000 \text{ tons x } 35{,}200}{177}} = 5{,}570$ tons

		EOQ	Existing
Demand of CALTIN	Tons	78,000	78,000
Order quantity	Tons	5,570	6,500
No. of orders		14	12
Average inventory excluding buffer stock (Q / 2)	Tons	2,785	3,250
Cost of placing orders (Rs 35,200 per order)	Rupees	492,800	422,400
Carrying cost ([Avg. Inventory x Rs. 177)	Rupees	492,945	575,250
Total costs	Rupees	985,745	997,650
Savings on adoption of EOQ	Rupees	11,905	

- *Example 05:*

Aroma Herbs (AH) deals in a herbal tea. The tea is imported on a six monthly basis. The management is considering to adopt a stock management system based on Economic Order Quantity (EOQ) model. In this respect, the following information has been gathered:

i. Annual sale of the tea is estimated at 60,000 kg at Rs. 1,260 per kg. Sales are evenly distributed throughout the year.

ii. C&F value of the tea after 10% discount is Rs. 900 per kg. Custom duty and sales tax are paid at the rates of 20% and 15% respectively. Sales tax paid at import stage is refundable in the same month.

iii. Use of EOQ model would reduce the quantity per order. As a result, bulk purchase discount would be reduced from 10% to 8%.

iv. Cost of financing the stock is 1% per month.

v. Annual storage cost is estimated at Rs. 320 per kg.

vi. Administrative cost of processing an order is Rs. 90,000. Increase in number of purchase orders would reduce this cost by 10%.

vii. AH maintains a buffer stock equal to fifteen days' sales.

Required

a) Compute EOQ.

b) Determine the amount of savings (if any) which can be achieved by AH by adopting the stock management system based on EOQ model.

- *Solution*

a) Economic order quantity can be computed as follows (EOQ):

Annual demand of herbal tea	**(A) kg**		60,000.00

			Rupees
Purchase cost per kg (C&F + Import duty)	[(900÷0.9)*0.92 ×1.2]	B	1,104.00
Ordering cost per purchase order	90,000×90%	C	81,000.00
Annual holding cost per kg			
- Finance cost	B×1%×12		132.48
- Storage cost			320.00
		(D)	452.48
EOQ =			
SQRT [(2×annual demand × ordering cost) ÷ Holding cost per kg)]			
SQRT [(2×60,000×81,000)÷452.48)]	(E) kg		4,635.00

b) Determination of the amount of savings (if any) which can be achieved by AH by adopting the stock management system based on EOQ model would be as follows

Savings on adopting EOQ:

No. of purchase orders (A÷E) (F)		13	2
Holding of inventory:			
- Average inventory	(E÷2); (A÷F ÷2)	2,318	15,000
- Buffer stock		2,500	2,500
	(G)	4,818	17,500

		-------- Rupees --------	
Ordering costs	(C×F); (90,000×F)	1,053,000	180,000
Holding costs of inventory	(G×D); (G×*449.6)	2,180,049	7,868,000
Purchasing cost of tea	(A×B); (60,000×900×1.2)	66,240,00 0	64,800,000
Cost of 60,000 kg of tea		69,473,04 9	72,848,000
Savings on using EOQ model (72,848,000 – 69,473,049)		3,374,951	
**Existing holding cost per unit (900×1.2×0.12)+320=449.6*			

- *Example 06:*

Chocó-king Limited (CL) produces and markets various brands of chocolates having annual demand of 80,000 kg. The following information is available in respect of coco powder which is the main component of the chocolate and represents 90% of the total ingredients.

i. Cost per kg is Rs. 600.

ii. Process losses are 4% of the input.

iii. Purchase and storage costs are as follows:

- Annual variable cost of the procurement office is Rs. 6 million. The total number of orders (of all products) is estimated at 120.
- Storage and handling cost is Rs. 20 per kg per month.
- Other carrying cost is estimated at Rs. 5 per kg per month.

iv. CL maintains a buffer stock of 2,000 kg.

Required:

a) Calculate economic order quantity.

b) A vendor has offered to CL a quantity discount of 2% on all orders of minimum of 7,500 kg. Advise CL, whether the offer of the vendor may be accepted.

- *Solution*

a) Economic order quantity (EOQ) can be calculated as follows:

Annual requirement of the coco powder	80,000÷0.96×90% kg	75,000
Ordering cost per order	(6,000,000÷120) Rs.	50,000
Storage and handling	20×12	240
Other carrying cost	5×12	60
Carrying cost per kg	Rs.	300
Economic order quantity (EOQ)		
SQRT[(2 × Annual demand × Ordering cost per order) ÷ Carrying cost per kg]		
SQRT[(2×75,000×50,000)÷300] = $\sqrt{25,000,000}$ = 5,000		

A vendor has offered to CL a quantity discount of 2% on all orders of minimum of 7,500 kg. Advise CL, whether the offer of the vendor may be accepted. This would require computation as below:

b) Analysis of purchases using EOQ / minimum quantity as offered by the vendor:

			EOQ	Vendor's offer
No. of orders	(75,000÷5,000), (75,000÷7,500)	A	15.00	10.00
Average inventory including buffer stock (Order quantity÷2)+2,000		B	4,500	5,750

		Rs.	Rs.
Annual cost of placing orders	(A×50,000)	750,000	500,000
Carrying cost	(B×300)	1,350,000	1,725,000
Discount on placing order of 7,500 kg each	(75,000×600×2%)	-	(900,000)
Net cost		2,100,000	1,325,000
Annual saving on acceptance of vendor's offer			775,000

▶ *Example 07:*

Hockey Pakistan Limited (HPL) is engaged in the manufacturing of a single product 'H-2' which requires a chemical 'AT'. Presently, HPL follows a policy of placing bulk order of 60,000 kg of AT. However, HPL's management is presently considering to adopt economic order quantity model (EOQ) for determining the size of purchase order of AT.

Following information is available in this regard:

i. Average annual production of H-2 is 45,600 units. Production is evenly distributed throughout the year.
ii. Each unit of H-2 requires 10 kg of AT. Cost of AT is Rs. 200 per kg. 5% of the quantity purchased is lost during storage.
iii. Annual cost of procurement department is Rs. 2,688,000. 65% of the cost is variable.
iv. AT is stored in a third party warehouse at a cost of Rs. 6.25 per kg per month.
v. HPL's cost of financing is 8% per annum.

Required:

a) Calculate economic order quantity.

b) Supplier of AT has offered a discount of 5% quantity per order is increased to 120,000 kg. Advise whether HPL should accept the offer.

c) Discuss any three practical limitations of using the EOQ model.

▶ *Solution*

a) Computation of Economic Order Quantity (Units to order) would be as follows

SQRT [(2×annual demand × ordering cost) ÷ Holding cost per kg)]	
SQRT [(2×480,000 (W-4) × 218,400 (W-1) ÷ 91(W.5)]	48,000
W-1: Ordering cost per order (Rs.) (1,747,200(W-2)÷8 (W-3)	218,400
W-2: Purchase department cost -Variable cost (Rs.) 2,688,000×65%	1,747,200
W-3: Number of orders 480,000 (W-4)÷60,000	8
W-4: Annual Requirement of AT (kg) 45,600×10/95%	480,000
W-5: Holding cost (Rs. per unit)	Rs. per unit
Storage cost (6.25 per kg per month×12)	75
Finance cost 200×8%	16
Total holding cost (Rs. per unit)	91

b) Supplier of AT has offered a discount of 5% quantity per order is increased to 120,000 kg. Whether HPL should accept the offer or not, the evaluation would involve following:

Evaluation of discount offer from supplier of AT

Comparison of cost		EOQ	As per offer
Annual Requirement of AT (kg)	A (W-4)	480,000	480,000
Order quantity (kg)	B (EOQ, Given)	48,000	120,000
Number of orders	C=A/B	10	4
Average inventory (kg)	D=B/2	24,000	60,000
		--------- Rupees ---------	
Ordering cost	C×218,400 (W-1)	2,184,000	873,600
Holding cost D×91(W-5);[D×{75(W-5)+(16(W-5)×95%)}]		2,184,000	5,412,000
Purchase cost (200×480,000); (200×480,000×95%)		96,000,000	91,200,000
Total cost		100,368,000	97,485,600

Opinion: Offer from AT's supplier should be accepted as it would reduce the purchase cost.

c) The practical limitations/assumptions of EOQ are as follows

i. The formula assumes that demand/usage is constant throughout the period. In practice, actual demand/usage may be uncertain and subject to seasonal variations.

ii. Holding cost per unit are assumed to be constant. Further, many holding costs are fixed throughout the period and not relevant to the model whereas some costs (e.g. store keepers' salaries) are fixed but change in steps.

iii. Purchasing cost per unit is assumed to be constant for all purchase quantities and is ignored while calculating order size in EOQ. In practice, quantity discounts can be available in case of bulk purchasing.

iv. The ordering costs are assumed to be constant per order placed. In practice, most of the ordering costs are fixed or subject to stepwise variation. It is therefore, difficult to estimate the incremental cost per order.

▶ *Example 08:*

Alpha Motors (Pvt.) Ltd. uses a special gasket for its automobiles which is purchased from a local manufacturer. The following information has been made available by the procurement department:

Annual requirement (no. of gaskets)	162,000
Cost per gasket (Rs.)	1,000
Ordering cost per order (Rs.)	27,000
Carrying cost per gasket (Rs.)	300

The gaskets are used evenly throughout the year. The lead time for an order is normally 11 days but it can take as much as 15 days. The delivery time and the probability of their occurrence are given below:

Delivery time (in days)	Probability of occurrence
11	68%
12	12%
13	10%
14	6%
15	4%

Required

a) Compute the Economic Order Quantity (EOQ) and the total Ordering Costs based on EOQ.

b) What would be the safety stock and re-order level if the company is willing to take:

i. a 20% risk of being out of stock?

ii. a 10% risk of being out of stock?

Note: Assume a 360 day year.

▶ *Solution*

a) Computation of EOQ and Ordering Costs:

$$EOQ = \sqrt{\frac{2 \times 162{,}000 \times 27{,}000}{300}}$$

EOQ = 5,400 gaskets

Number of orders = 162,000 / 5,400 = 30 Orders

Ordering costs = 30 x Rs. 27,000 = Rs. 810,000

b) Computation of the safety stock and re-order level if the company is willing to take (Assuming a 360 day year):

- 20% risk of being out of stock?
- 10% risk of being out of stock?

Safety stock required to be maintained at 20% and 10% risk level

	Risk level	
	20%	10%
Number of days required to be maintained	1	2
Safety Stock		
1 x 450 (W-1)	450	
2 x 450 (W-2)		900

W-1

Average Stock requirements per day = Annual Demand ÷ 360 days

= 162,000 ÷ 360 = 450

Re-Order Level at 20% and 10% risk level

Re-order level = (Average Consumption x Average Lead Time) + Safety Stock

Re-order level at 20% = (450 x 11) + 450 = 5,400 gaskets

Re-order level at 10% = (450 x 11) + 900 = 5,850 gaskets

Notice the trade off, in the above example, between the cost of stock out and the holding costs at different reorder levels. A higher reorder level reduces the chance of a stock out but incurs higher holding costs.

Practically the risks associated with a stock out are so great that the company always tries to avoid it even if it leads to extra holding cost.

▶ *Example 09:*

a) List any four situations in which EOQ model for determining optimum level of stocks becomes invalid.

The EOQ model becomes invalid in the following situations:

- The holding cost per unit is not constant.

- The stock is not consumed at a constant rate throughout the period due to which average inventory is not equal to one half of the order quantity.
- The cost per order is not constant.
- There are quantity discounts available.

b) Jamal Limited (JL) purchases raw material T3 for its product DBO on a quarterly basis as per the requirement of the production department. The management is considering to revise the existing policy of placing orders for T3. Following information is available in this regard:

i. Annual production of DBO is 19,000 units.

ii. Each unit of DBO requires 1 kg of T3 which is the resultant quantity after normal loss of 5%.

iii. Minimum order quantity set by the supplier for purchase of T3 is 3,500 kg. However, the supplier offers following prices at different order quantities:

Order Quantity Kg	Price per kg (Rs.)
3,500	305
4,000	299
5,000	296

iv. JL maintains T3's safety stock of 320 kg.

v. The cost of placing each order is Rs. 4,200 out of which Rs. 1,780 pertains to salaries of staff of purchase department.

vi. Holding cost per kg of average stock is Rs. 260 which includes rent of Rs. 180 for the floor space occupied by each kg. Variation in the stock held has no effect on the remaining holding cost.

Required:

Determine the purchase order quantity of T3 offered by the supplier at which JL's cost would be minimized.

Order Quantity	Cost per kg	Purchase of cost of 20,000 kg	Number of orders	Order cost	Holding cost at Rs. 180 per unit Note 1	Total cost
A	B	C=20,000xB	D=20,000+A	E=2,420 [4,200-1,780]xD		
3,500	305	6,100,000	6.00	14,520	372,600	6,487,120
4,000	299	5,980,000	5.00	12,100	417,600	6,409,700
4,500	296	5,920,000	4.00	9,680	507,600	6,437,280

Annual usage = [(19,000 x 1)/95%] = 20,000

Note 1:

Holding cost = (*average stock + safety stock) × holding cost per unit

*Average stock = Order quantity ÷ 2

▶ *Example 10:*

QZ Ltd., deals in domestic appliances and supplies special toasters to various outlets in south zone of the country. Special toaster is a popular product of QZ Ltd., which is distributed in large quantities throughout the year. The company's Chief Executive Officer, Mr. Kamal came to know the fact that company is holding excessive stocks which causes increase in monthly cost.

Mr. Kamal is of the opinion that application of Economic Order Quantity (EOQ) model will help in reducing cost. Being a Management Accountant, you are asked to guide Mr. Kamal regarding EOQ application.

Information regarding stocks for the month of January 2015 is given below:

Toasters demand from outlets (Units)	40,000
Carrying cost per lot (Rs. 0.20 per toaster) (Rs.)	200
Ordering cost (Rs.)	60

Special toasters are ordered from outlets in lot sizes of 1,000 units.

i. Calculation of optimal order quantity in lots and number of orders that should be placed by the company are given below:

Annual demand (40,000 x 12) = 480,000 units

Carrying cost per unit (0.20 x 12) = Rs. 2.40 per toaster

Order cost = Rs. 60 per order

Hence, EOQ shall be:

$$EOQ = \sqrt{\frac{2 x 480{,}000 x 60}{2.40}}$$

EOQ = 4,899 units or 5 lots

Number of orders = 40 lots / 5 lots = 8 Orders

ii. Impact on EOQ and number of orders if carrying cost per month is reduced to Rs. 0.10:

Carrying cost per unit (0.10 x 12) = Rs. 1.20

Hence, EOQ shall be:

$$EOQ = \sqrt{\frac{2 x 480{,}000 x 60}{1.20}}$$

EOQ = 6,928 units or 7 lots

Number of orders = 40 lots / 7 lots = 6 Orders

iii. Impact on EOQ and number of orders if order cost is reduced to Rs. 20:

Order cost = Rs. 20 per order

Hence, EOQ shall be:

$$EOQ = \sqrt{\frac{2 x 480{,}000 x 20}{2.40}}$$

EOQ = 2,828 units or 3 lots

Number of orders = 40 lots / 3 lots = 13 Orders

The EQO will decrease to 3 lots per order but orders will increase to 13 orders per year, in case per order cost will reduce to Rs. 20.

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iv. Impact on EOQ and number of orders if order cost is reduced to Rs. 20 and carrying cost is declined to Rs. 0.10 per month:

Carrying cost per unit (0.10 x 12) = Rs. 1.20

Order cost = Rs. 20 per order

Hence, EOQ shall be:

$$EOQ = \sqrt{\frac{2 x 480{,}000 x 20}{1.20}}$$

EOQ = 4,000 units or 4 lots

Number of orders = 40 lots / 4 lots = 10 Orders

The EQO will decrease to 4 lots per order but orders will increase to 10 orders per year, in case per order cost will reduce to Rs. 20 and carrying cost per month will decline to Rs. 0.10.

▶ *Example 11:*

Two-way Engineering Limited has been experiencing stock-outs on one of its important product RD-11. Using the EOQ formula, the company places orders of 1,250 units whenever the stock level reduces to 1,500 units. The records of the company show the following data relating to the usage of Product RD-11 during lead times:

Usage (Units)	1,800	1,600	1,400	1,200	1,000
Usage Probability (%)	4%	6%	10%	20%	60%

The company sells RD-11 at a price of Rs. 500 per unit. The annual carrying cost of one unit is Rs. 30. The company estimates that the cost of being out of stock is Rs. 125 for each unit.

The optimal safety stock level is calculated as under:

Safety Stock (Units)	Stock out (Units)	Probability	Stock out cost (Rs.)	Holding Cost (Rs.)	Total of Stock out and Holding cost (Rs.)
A	**B**	**C**	**D=B x 125 x C**	**E=A x 30**	**D+E**
0	300 100	4% 6%	1,500 750	0	 2,250
100	200	4%	1,000	3,000	4,000
200	100	4%	500	6,000	6,500
300	0	-	0	9,000	9,000

The optimal level of safety stock is zero units, as at this level, annual stock out and holding cost is minimum i.e. Rs. 2,250.

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Inventory management refers to the process of ordering, storing and using a company's inventories

Relevant costs are the cost that occur on the occurrence of an activity.

Economic order quantity is used to determine the order quantity at which cost is minimum.

The EOQ can be determined using tabular method, graphical method and EOQ formula

Inventory management includes determining re-order level, safety stock, minimum and maximum inventory levels.

CHAPTER 3

OVERHEADS

IN THIS CHAPTER

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Overheads are the indirect costs those that incur in the course of making a product, providing of service or running department but which cannot be traced directly and fully to the product, service or department.

Overheads are charged to departments, cost center, cost pools and products using a predetermined rate.

Predetermined rate is determined using estimated figures of the overhead cost and the activity level.

Shared costs of service departments are distributed among departments first and then total overheads are calculated for the production departments to be further allocated to products.

At the end of the period, the applied overhead is compared with actual overhead to determine over or under absorption of overheads.

1. MANUFACTURING EXPENSES

Manufacturing expenses are of two types:

1. **Direct expenses** – expenses that are fully traceable to the product, service or department that is being costed or in other words, the expenses which can be attributable directly to specific cost object.

- *Examples:*
  - Raw Materials that are specifically used for the product in consideration. For example, milk is raw material used in production of butter or cheese.
  - Labour which is directly involved in converting the raw material. For example, labour cost in connection with production of sugar.
  - Other expenses that are specifically incurred for the product. For example, hiring cost of machine in order to manufacture specific product.

2. **Indirect expenses (Production overheads)** –are those expenses that incur in the course of making a product, providing of service or running department but which cannot be traced directly and fully to the product, service or department.

- *Examples:*
  - Labour which is not directly involved in the conversion of raw material but indirectly involved in making of the product. Such as supervisor who is responsible to supervise the production process is not directly involved and therefore treated as indirect cost,
  - Tools, spares and materials that are used in the machinery or equipment used in the production,
  - Factory rent if the factory premises are hired,
  - Depreciation of machinery and equipment.
  - Electricity and other utility expenses incurred for the production facilities

The manufacturing expenses generally comprise:

a) Direct materials,

b) Direct labours and

c) Production / manufacturing / factory overheads.

Note:
Material cost + Labour cost are called 'Prime Costs'
Labour cost + Overhead cost are called 'Conversion Costs'

1.1 Cost Behaviors:

Cost behaviors refer to how a cost reacts to changes in the level of activity. As the activity level rises or falls, a particular cost may rise or fall as well or it may remain constant. To help make such distinctions, the costs are often categorized as 'variable cost' or 'fixed cost'.

Variable costs are those that tend to change with level of activity in direct ratio with equal proportion. For example, 100 units of raw materials are used to produce 100 units of the final product. It means for one unit of final product one unit of raw material will be required. Where the cost of one unit of material is Rs.10, the cost of 100 units will be (10x100) Rs. 1,000. Similarly, labour takes two hours to produce 1 unit of final product and so 400 hours will be used to produce 200 units. The labour charges Rs. 5 per hour and so their cost at 200 units, using 400 hours, will be Rs. 2,000. Since these costs vary with the variations in the output, therefore, these are called variable costs.

The variable expenses are fixed per unit of output while they vary in total.

Note: there are few expenses that are called **'Semi-variable'** because they carry some fixed part of cost and some variable. For example, electricity bill comprises of fixed charges as line rent / fixed connection charges as well as variable charges based on units of power consumed.

Fixed costs are those that remained constant, irrespective of the level of output. For example, the rent of the factory shall be charged on monthly basis whether or not the production is carried. The rent is charged for the occupation of the premises and therefore, do not vary with the production.

Fixed expenses vary per unit of output while they are fixed in total.

For example, factory rent is Rs. 10,000 per month. During month 1, the company produced 100 units and during month 2 it produced 150 units. The rent per unit for month 1 and 2 would be Rs. 100 (10,000/100) and Rs. 66.67 (10,000/150) however, the actual cost paid is Rs. 10,000 each month.

Note: Few fixed costs are called **'Step fixed costs'** which remains same at certain activity level and changes when the activity level changes. For example, a company uses one supervisor to supervise for up to 25 labour hours to produce 100,000 units a month. The cost of supervisor is Rs. 15,000. Next month, the company intends to produce 125,000 units using 6 more labour hours. Now a new supervisor would be required to supervise for additional 6 labour hours and 25,000 units. The cost is now increased to Rs. 30,000 when the activity level increased.

1.2 Production overheads and non-production overheads:

Production Overheads:

Overheads that incur in relation to the production processes are called production overheads (also called manufacturing overheads / factory overheads). For example, salary of factory supervisor, depreciation of production machine, electricity cost of factory, rent of factory premises etc. Production overheads can be fixed or variable. Any production overheads related to period are fixed production overheads like rent of factory premises or plant. However, some production overheads that tend to change with level of activity are known as variable production overheads like electricity consumption.

Non-Production Overheads:

Overheads that incur to support the overall objectives of the business are called non-production overheads. For example, salaries of sales team, salaries of finance, HR and IT teams, rent of the building occupied by finance, IT, sales and HR departments (other than production department), Depreciation of computers being used in these departments etc. These are classified as 'Administrative Expenses, Marketing, Selling and Distribution Expenses' in the Statement of Comprehensive Income.

Administrative Expenses:

The term administration generally relates to the functions necessary for the overall running of the business. Administrative costs include all costs associated with the general management of the organization rather than with manufacturing or selling. Examples of administrative activities include implementing and ensuring the effectiveness of fire extinguishing system for the safety of employees and overall business, ensuring the overall security of the business premises, the accounting and finance, human resource and information technology functions of the business are classified under administration and the cost incurred to run these functions are called administrative expenses.

These are mostly fixed expenses and charged to profit and loss account in the period in which they occur.

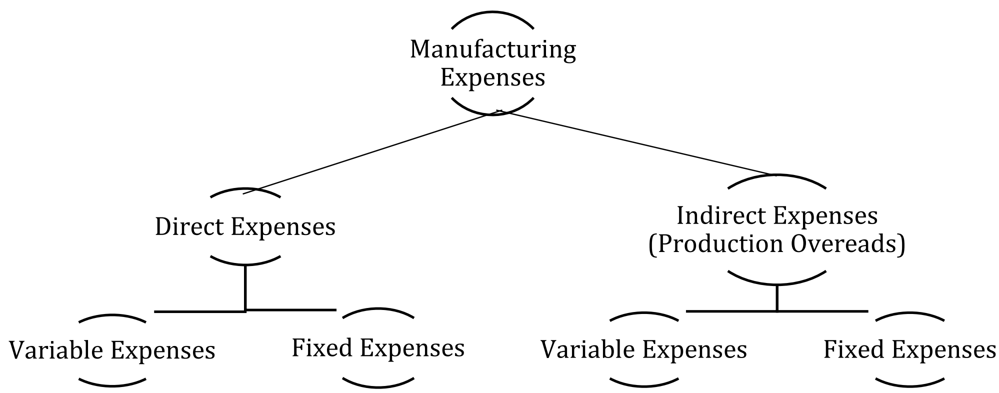
Marketing, Selling and Distribution Expenses:

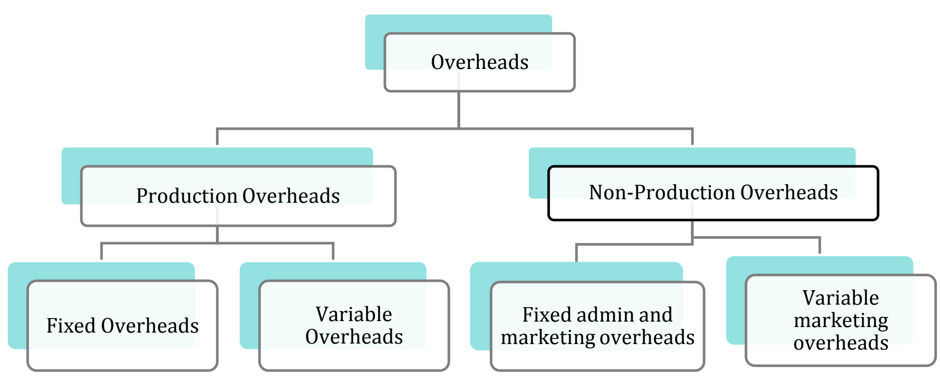
These expenses are related to the process of selling inventory to customers. These costs include all costs that are incurred to secure customer orders and get the finished product to the customer. Examples of marketing, selling and distribution activities are advertising the company's products / services on electronic and print media, devising and implementing marketing strategies to enter new markets, obtaining information about customers and competitors, distributing products to the markets for the customers, obtaining feedbacks from customers after sales and providing after sales services. The costs so incurred in performing such activities are classified as marketing, selling and distribution expenses.

These are both fixed and variable. Salaries of marketing staff, cost of advertisement, depreciation of equipment used in the marketing and distribution department etc. are fixed expenses. Commission of sales staff which depends on the number of units sold, delivery charges per weight of the unit or area of the carrier occupied by the unit are considered as variable expenses.

The administrative and marketing, selling and distribution expenses are never made part of the cost of the product. However, for internal reporting purposes (marginal costing) the variable marketing and selling costs are charged to cost of goods sold in determining the contribution margin. (This concept is discussed in Chapter 5)

These multiple bifurcations of expenses are elaborated as under:





In addition to classifying costs as manufacturing and non-manufacturing, they can also be classified as period cost and product cost. To understand the difference between product costs and period costs, we must first recall the matching principle from financial accounting.

The matching principle is based on the accrual concept that costs incurred to generate a particular revenue should be recognized as expenses in the same period that the revenue is recognized. This means that if a cost is incurred to acquire or make something that will eventually be sold, then the cost should be recognized as an expense only when the sale takes place—that is, when the benefit occurs. Such costs are called **product costs**.

Period costs are all costs that are not product costs. Period costs are not included as part of the cost of either purchased or manufactured goods instead, period costs are expensed in the period in which they are incurred.

Identifying manufacturing overheads:

Overhead	Classification
Depreciation of factory machinery	Manufacturing overhead
Factory insurance	Manufacturing overhead
Salary of the Finance Director	Administration overhead
Depreciation of the accounts clerk's computer	Administration overhead
Petrol used in delivery vehicles	Selling overhead
Cost of an advertising campaign	Selling overhead

2. COSTING OF PRODUCTION OVERHEADS

When more than one product is being produced using the same facilities, then they are allocated cost on individual basis. The costs that are directly attributable to the product can be easily allocated to that product. However, costs that are incurred in accumulation for all the products, need to be allocated on systematic basis. These are known as absorption of indirect cost and explained in detail in section 2.1.

2.1 How to absorb indirect production cost to product cost:

In order to absorb indirect production related cost to product cost, following steps should be followed:

1. **Allocation:** It is the process of allocating the individual cost element to specific cost center. For example, Mr. Jamal is supervisor in Finishing Department, therefore, his salary and related expenses are allocated to Finishing Department.
2. **Apportionment:** It is the process of allocating the common cost to more than one cost centers on fair basis. For example, rent of factory is to be apportioned between all production and service departments on the basis of area occupied by each department.
3. **Re-apportionment:** It is the process of apportioning the service department costs to production departments based on service provided by service cost centers to production cost centers. There are three different methods in dealing re-apportionment.
   (a) When service departments only provided services to production departments, then direct allocation method is used. In this method, no service department cost is transferred to other service department/s, rather it is apportioned to production departments only.
   (b) When one service department provides services to production departments along with other service department but with no reciprocity, then step down method is used. In this method, one service department cost is transferred to other service department/s along with production department, but with no reciprocity.
   (c) Sometimes, each service department provides services to each other including production departments, then we use the reciprocal method. For example, there are two service departments X and Y. Department X provides services to department Y which provides services to department X including production departments. It can be solved through further two methods, first is repeated distribution method and second is algebraic method. Both methods are discussed in detail with examples in following sections.
4. Absorption Rate: Next step is to calculate rate which is used to absorb production overheads to product or service cost. The rate can be single which is termed as composite rate or blanket rate and it can be separate rate for each department and is termed as departmental rates. The absorption rate/s can be calculated by using the following formula:

$$\frac{\textit{Estimated Factory Overhead}}{\textit{Estimated Base to be Used}}$$

Note: If the base is in cost, it is recommended to calculate the rate in percentage and in this situation, multiply the above formula with 100.

Estimated factory overhead:

The estimated factory overhead is the amount of overheads that management expects to incur in the coming periods. The amount of estimated factory overhead can be calculated by applying first three steps as mentioned above.

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Base to be used:

The following bases can be used for this purpose:

1. Physical output
2. Direct material cost
3. Direct labour cost
4. Prime cost
5. Direct labour hours
6. Machine hours

The selection of the base depends upon the nature or the function of the factory overhead. For example, if the factory overhead cost comprises indirect labour predominantly, the direct labour cost or hour can be used as base. If it relates to machine expenditures such as maintenance, depreciation and normal wear tear, then the base could be machine hours.

The base selection also depends on the nature of business and it may vary from company to company, department to department and one cost center to the other.

- *Example 01: (Allocation and apportionment)*

The AJFA & Co is preparing its production overhead budgets and therefore need to determine the apportionment of these overheads to products. Cost center expenses and related information have been budgeted as below:

		Production department			Service departments	
	Total	**Machine Shop A**	**Machine Shop B**	**Assembly**	**Canteen**	**Maintenance**
Direct wages (Rs.)	518,920	128,480	99,640	290,800		
Indirect wages (Rs.)	313,820	34,344	36,760	62,696	118,600	61,420
Consumable materials (incl. maintenance)	67,600	25,600	34,800	4,800	2,400	
Rent & rates (Rs.)	66,800					
Building insurance (Rs.)	9,600					
Heat & light (Rs.)	13,600					
Power (Rs.)	34,400					
Depreciation of machine (Rs.)	160,800					
Area (Sq ft)	90,000	20,000	24,000	30,000	12,000	4,000
Value of machines (Rs.)	1,608,000	760,000	716,000	88,000	12,000	32,000
Power usage (%)	100	54	40	3	1	2
Direct labour hours	72,020	16,020	21,410	43,590		
Machine usage hours	54,422	14,730	37,632	2,060		

Allocation and apportionment sheet of AJFA & Co is given below:

All amounts are given in Rupees.

	Base		Production department			Service departments	
		Total	Machine Shop A	Machine Shop B	Assembly	Canteen	Maintenance
Indirect wages	Allocated	313,820	34,344	36,760	62,696	118,600	61,420
Consumable materials (incl. maintenance)	Allocated	67,600	25,600	34,800	4,800	2,400	
Rent & Rates	Area sqft	66,800	14,844	17,813	22,267	8,907	2,969
Building insurance	Area sqft	9,600	2,133	2,560	3,200	1,280	427
Heat & Light	Area sqft	13,600	3,022	3,627	4,534	1,813	604
Power	Power usage %	34,400	18,576	13,760	1,032	344	688
Depreciation of machine	Value of machine	160,800	76,000	71,600	8,800	1,200	3,200
Allocated & Apportion cost		666,620	174,519	180,920	107,329	134,544	69,308

- *Example 02: (Re-apportionment – Direct allocation method)*

The RS company has provided you following data for its overheads. The allocated and apportioned cost of each department is given below:

	Production Departments			Service Departments	
	A	B	C	Canteen	Maintenance
Allocated and apportioned cost	150,000	100,000	60,000	30,000	40,000
Number of employees	80	60	10		
Machine hours	3,000	4,500	2,500		

Cost of service departments: canteen and maintenance is apportioned to production departments only.

The reapportionment sheet of overheads under direct allocation method is given below:

	Base	Production Departments			Service Departments	
		A	B	C	Canteen	Maintenance
Allocated and apportioned cost		150,000	100,000	60,000	30,000	40,000
Canteen cost	Employees	16,000	12,000	2,000	(30,000)	-
Maintenance cost	Machine H	12,000	18,000	10,000	-	(40,000)
		178,000	130,000	72,000	-	-

▶ *Example 03: (Re-apportionment – Step down method)*

The RS company has provided you following data for its overheads. The allocated and apportioned cost of each department is given below.

	Production Departments			Service Departments	
	A	**B**	**C**	**Canteen**	**Maintenance**
Allocated and apportioned cost	150,000	100,000	60,000	34,000	40,000
Number of employees	80	60	10		20
Machine hours	3,000	4,500	2,500		

Cost of service department canteen is transferred to maintenance department but maintenance department cost is only transferred to production departments.

The reapportionment sheet of overheads under step down method is given below.

	Base	Production Departments			Service Departments	
		A	**B**	**C**	**Canteen**	**Maintenance**
Allocated and apportioned cost		150,000	100,000	60,000	34,000	40,000
Canteen cost	Employees	16,000	12,000	2,000	(34,000)	4,000
Maintenance cost	Machine H	13,200	19,800	11,000	-	(44,000)
		179,200	131,800	73,000	-	-

▶ *Example 04: (Re-apportionment – Repeated Distribution method and Simultaneous method)*

In a factory with four production departments and two service departments, the operating costs for the month of October were as shown below.

	Rs.
Production Department 1	700,000
Production Department 2	300,000
Production Department 3	400,000
Service departments	
Canteen	78,000
Boiler house	100,000
	1,578,000

The costs of running the canteen are apportioned to each department on the basis of the estimated use of the canteen by employees in each department.

The costs of the boiler house are apportioned on the basis of the estimated consumption of power by each department.

The service departments' costs are therefore apportioned as follows:

	Canteen	Boiler house
	%	%
Production Department 1	40	30
Production Department 2	20	30
Production Department 3	30	20
Service departments		
Canteen	-	20
Boiler house	10	-

(a) Preparation of a statement showing the allocation of costs to the production departments using the repeated distribution method would be as follows:

C = Canteen

BH = Boiler house

	Dept 1	Dept 2	Dept 3	C	BH
	Rs.	Rs.	Rs.	Rs.	Rs.
Initial overheads	700,000	300,000	400,000	78,000	100,000
Apportion:					
BH (30:30:20:20)	30,000	30,000	20,000	20,000	(100,000)
				98,000	
C (40:20:30:10)	39,200	19,600	29,400	(98,000)	9,800
BH (30:30:20:20)	2,940	2,940	1,960	1,960	(9,800)
C (40:20:30:10)	784	392	588	(1,960)	196
BH (30:30:20:20)	59	59	39	39	(196)
C (40:20:30:10)	15	8	12	(39)	4
BH (30:30:20:20)	1	1	1	1	(4)
C (40:20:30:10)	1	0	0	(1)	0
Total overhead	**773,000**	**353,000**	**452,000**		

(b) the simultaneous equations method.

Let X = the total overheads apportioned from the Canteen

and Y = the total overheads apportioned from the Boiler House

This gives us the simultaneous equations:

$X = 78,000 + 0.2\,Y$ ... (1)

$Y = 100,000 + 0.1\,X$ ... (2)

Re-arrange:

$78,000 = X - 0.2\,Y$ ... (1)

$100,000 = -0.1\,X + Y$ ... (2)

Multiply (2) by 10

$1,000,000 = -X + 10Y$ ... (3)

Add (1) and (3)

$1,078,000 = 9.8Y$

$Y = 110,000$

Therefore, from (1) and substituting Y = 110,000:

$X = 78,000 + 0.2\,(110,000) = 100,000.$

	Dept 1	Dept 2	Dept 3
	Rs.	Rs.	Rs.
Initial overheads	700,000	300,000	400,000
Apportion:			
BH (30%, 30% and 20% of 110,000)	33,000	33,000	22,000
C (40%, 20% and 30% of 100,000)	40,000	20,000	30,000
Total overhead apportionment	773,000	353,000	452,000

► *Example 05: (Overhead absorption rate- Composite on different basis)*

Ahsan Enterprises (AE) produces three products Alpha, Beta and Gamma. The management has some reservations on the method of costing. Consequently, the cost accountant has reviewed the records and gathered the following information:

i. The costs incurred during the latest quarter were as follows:

	Rupees
Direct material	240,000
Direct labour	1,680,000
Indirect wages – machine maintenance	600,000
– stores	360,000
– quality control	468,000
– cleaning and related services	400,000
Fuel and power	2,800,000
Depreciation on plant, machinery and building	1,560,000
Insurance on plant and machinery	240,000
Insurance on building	60,000
Stores, spares and supplies consumed	1,800,000
Rent, rates and taxes	1,200,000

ii. The production report for the previous quarter depicted the following information:

	Production (units)	Direct labour hours per unit	Machine hours per unit	Inspection hours per unit
Alpha	12,000	20.00	6.00	2.00
Beta	20,000	5.00	8.00	3.00
Gamma	45,000	4.00	10.00	4.00

The rate of depreciation for plant and machinery is 10% per annum.

a) Calculations that would be required to determine the factory overhead rate on various basis are as follows:

a) Physical Output Bases:

$$\frac{Factory\ Overhead\ Cost}{Total\ Units\ Produced}$$

$$\frac{9{,}488{,}000}{77{,}000\ (w-1)}$$

Factory Overhead Rate = Rs. 123.221 per unit

b) Direct Labour Cost Bases:

$$\frac{Factory\ Overhead\ Cost}{Total\ Direct\ Labour\ Cost} \times 100$$

$$= \frac{9{,}488{,}000}{1{,}680{,}000\ (given)} \times 100$$

Factory Overhead Rate = 564.76%

c) Direct Labour Hour Bases:

$$\frac{Factory\ Overhead\ Cost}{Total\ Direct\ Labour\ Hours}$$

$$\frac{9{,}488{,}000}{520{,}000\ (w-1)}$$

Factory Overhead Rate = Rs. 18.246 per direct labour hour

d) Machine Hour Bases:

$$\frac{Factory\ Overhead\ Cost}{Total\ machine\ Hours}$$

$$\frac{9{,}488{,}000}{682{,}000\ (w-1)}$$

Factory Overhead Rate = Rs. 13.912 per machine hour

W-1	Alpha	Beta	Gamma	Total
Physical Output	12,000	20,000	45,000	77,000
Direct Labour Hours per unit	20.00	5.00	4.00	
Total Hours	(12,000 x 20) = 240,000	(20,000 x 5) = 100,000	(45,000 x 4) =180,000	520,000
Machine Hours per unit	6.00	8.00	10.00	
Total Hours	(12,000 x 6) 72,000	(20,000 x 8) 160,000	(45,000 x 10) 450,000	682,000

Absorption of overheads to cost objects

Once absorption rate is calculated, then this rate is used to absorb overheads to cost object. If cost object is product, then actual base is determined and overhead absorption rate is applied to absorb overheads to each product as "Actual base x OAR/base". For example, if OAR is Rs. 50 per labour hour and 500 actual labour hours are incurred in production of specific product, then overhead cost of Rs. 25,000 (500 x 50) is included in cost of this product.

The concept is further elaborated in above example, and given below in part b.

b) Factory overhead cost allocable to each product can be determined as follows:

	Alpha	Beta	Gamma	Total
Allocation based on physical units:				
Physical Units	12,000	20,000	45,000	77,000
Factory Overhead Rate based on physical output	123.221	123.221	123.221	
Cost allocated to the products	(12,000* 123.221) = 1,478,652	(20,000* 123.221) = 2,464,420	(45,000* 123.221) = 5,544,945	9,488,000
Allocation based on direct labour cost:				
Direct Labour cost per unit	(1,680,000 /77,000) = 21.818	(1,680,000 /77,000) = 21.818	(1,680,000 /77,000) = 21.818	
Labour Cost for total units	(12,000* 21.818) = 261,818.182	(20,000* 21.818) = 436,363.636	(45,000* 21.818) = 981,818.182	1,680,000

	Alpha	Beta	Gamma	Total
Factory Overhead rate	564.76%	564.76%	564.76%	
Cost allocated to the products	(564.76%* 261,818.182) = 1,478,649.340	(564.76% * 436,363.636) = 2,464,415.605	(564.76% * 981,818.182) = 5,544,935.168	9,488,000
Allocation based on direct labour hours:				
Direct Labour Hours (w-1)	240,000	100,000	180,000	520,000
Factory overhead rate	18.246	18.246	18.246	
Cost allocated to the products	(240,000x 18.246) = 4,379,076.923	(100,000x 18.246) = 1,824,615.385	(180,000x 18.246) = 3,284,307.692	9,488,000
Allocation based on machine hours:				
Machine Hours (w-1)	72,000	160,000	450,000	682,000
Factory overhead rate	13.912	13.912	13.912	
Cost allocated to the products	(72,000x 13.912) = 1,001,665.689	(160,000x 13.912) = 2,225,923.754	(450,000* 13.912) = 6,260,410.557	9,488,000

We must also note that factory overhead cost allocated to products in each case is different. This is why selection of base is very crucial and management must determine with vigilance the appropriate base to be used.

2.2 Factors affecting the predetermined overhead rate:

In addition to the selection of bases, the following more factors are also considered:

1. Activity level selection
2. Inclusion or exclusion of fixed overheads
3. Single rate or several rates

2.2.1. Activity Level Selection:

Activity level can be described as the level at which the business performs its production activities. For example, a company has the capacity to produce 100,000 units every month using 7,000 labour hours and 5,000 machine hours. However, in past months the company has only produced 80,000 units due to the market demand. This shows that company's activity level is 80% (80,000/100,000) of its maximum capacity.

If, the company expects that there is no change in the demand and therefore, the same number of units shall be produced. This is called **Normal Capacity** and overhead rate should be based on this capacity.

If the company expects that the demand will increase or decrease and estimates a level at 90% or 70%, this is called **Expected Actual Capacity** and overhead rate should be based on this capacity.

In normal capacity, the overhead rate is calculated using average utilization of plant and expenditures over a period long enough to level out the highs and lows that occur in every business venture. A rate based on normal capacity should not change periodically because of change in actual production. The rate will be changed when the prices of certain expense items change or when fixed costs increase or decrease.

In expected actual capacity, the overhead rate is determined using the expected cost and production at expected actual output for the next production period. This method usually results in different predetermined rates for each period. When the company is unable to judge its current performance on a long range (normal capacity) then this activity level is used.

2.2.2. Inclusion and Exclusion of Fixed Overheads:

In cost accounting there are two methods of assigning costs to the product:

a) Absorption costing / conventional costing or full costing
b) Marginal Costing or Direct Costing

In **Absorption costing**, both fixed and variable manufacturing expenses are included in product cost. However, in **Marginal costing**, fixed expenses are considered as period cost and not the product cost and therefore, are not included in the cost of the product.

Similarly, when predetermined overhead rate is determined, both fixed and variable overhead expenses are taken into account when using absorption costing, whereas, only variable overhead costs are taken into account in marginal cost system. This way, the fixed expenses shall be charged off in the profit and loss account in full unlike absorption costing where the portion of fixed cost is absorbed in the actual production.

2.2.3. Single Overhead Rate or Several Rates:

Overhead rates can be classified as:

a) Blanket rate or Plant-wide rate or composite rate,
b) Departmental rates or Cost centers or cost pool rates.

A **plant-wide or blanket overhead rate or composite rate** is used to describe a single overhead rate that is established for the organization as a whole.

If a business produces single product using one or more production departments, a single overhead rate can be used. However, if more than one products are produced using more than one departments, and each of them consuming different amount of overheads in each department, then using a blanket rate would not allocate the justified cost to products. Therefore, a separate rate is determined for each independent department and are called **departmental rates**. Departments are also called cost centers. However, cost centers may be a small segment within a department.

- *Example 06: (Blanket rate and departmental rates)*

A company makes two products, Product X and Product Y. Each product is processed through two cost centers, CC1 and CC2. The following budgeted data is available.

	CC1	CC2
Allocated and apportioned overheads	Rs. 126,000	Rs. 180,000
(All overheads are fixed costs.)		
Direct labour hours per unit		
Product X	1.5	2.0
Product Y	1.2	2.6

The budgeted production is 12,000 units of Product X and 10,000 units of Product Y. Fixed overheads are absorbed into costs on a direct labour hour basis.

The budgeted total fixed overhead cost per unit for Product X and for Product Y can be calculated using:

a) Blanket rate

In blanket rate, the overhead costs and labour hours of both departments / cost centers shall be summed and evenly distributed between both the products irrespective of their usage of the labour hours. Thereafter, using the blanket overhead rate, the overhead cost shall be allocated to each product using number of hours used by each product. Then the total allocated cost is divided by total units to arrive at the cost per unit.

Factory Overhead rate = $(Factory\ Overhead)/(Direct\ Labour\ Hours)$

FOH rate = $306{,}000/((1.5 + 2.0) \times 12{,}000 + (1.2 + 2.6) \times 10{,}000)$

FOH rate = 306,000 / 80,000

Blanket rate of overhead = Rs. 3.825 per direct labour hour

b) Cost center rates:

In cost center rates, the total hours of each center shall be calculated first. The overhead cost of each department shall be divided by the total hours of that department to arrive at the absorption rate for each department / cost center. Thereafter, the overhead cost shall be charged to products on the basis of hours used by each unit of products.

		CC1		CC2
		Total hours		Total hours
Product X	12,000 × 1.5	18,000	12,000 × 2.0	24,000
Product Y	10,000 × 1.2	12,000	10,000 × 2.6	26,000
		30,000		50,000
Total overheads		Rs.126,000		Rs.180,000
Absorption rate per hour		Rs.4.20		Rs.3.60

c) Absorption of fixed overheads under both methods.

If blanket rate of overheads is used.

Fixed overhead cost/unit		Product X	Product Y
		Rs.	Rs.
Product X (1.5+2.0) x 3.825		13.39	
Product Y (1.2+2.6) x 3.825			14.54

If separate rates are used for each department, then absorption of fixed overheads are:

Fixed overhead cost/unit		Product X		Product Y
		Rs.		Rs.
CC1	1.5 × Rs.4.20	6.30	1.2 × Rs.4.20	5.04
CC2	2.0 × Rs.3.60	7.20	2.6 × Rs.3.60	9.36
Total		13.50		14.40

In some situations, it is possible to go a stage further and establish separate overhead rates for small segments within a department (such as group of similar machines in a department). These small segments are called cost centers. A department can be reciprocated as cost center. However, a cost center describes a location to which overhead costs are initially assigned. The total cost accumulated in each cost center are then assigned to cost objects using a separate allocation base for each cost center. Therefore, it can be a department but it can also be a smaller segment.

When a departmental overhead rate is determined for the entire department, it may result in inaccurate allocation of overheads when a department consists of a number of different production centers with products passing through the departments consume overheads of each production center in different proportions. Therefore, determining overhead rates for each production centers / cost pools would help achieving the more accurate results.

- *Example 07:*

Using the data in Example 07, when required to calculate the factory overhead cost per unit, for each product, by allocating individual expenses on the basis of specific utilization of related facilities, please see below:

	Allocation basis	Alpha	Beta	Gamma	Total
Production (no. of units) A		12,000	20,000	45,000	77,000
Machine hours per unit		6	8	10	
Total machine hours	Units x Machine hours per unit	72,000	160,000	450,000	682,000
Units inspected		600	400	1,350	2,350
Per unit inspection hours		2	3	4	
Total no. of hours for units inspected	Units inspected x hours per unit	1,200	1,200	5,400	7,800
Overhead allocation:					
Indirect wages:					
Machine maintenance	Machine hours	63,343	140,763	395,894	600,000
Stores	Store consumption	144,000	54,000	162,000	360,000
Quality control	Inspected hours	72,000	72,000	324,000	468,000
Cleaning and related services	Factory space utilization	160,000	140,000	100,000	400,000
Fuel and power	Machine hours	295,601	656,892	1,847,507	2,800,000
Depreciation on plant and machinery	Machinery cost	600,000	400,000	300,000	1,300,000
Depreciation on building (1,560,000-1,300,000)	Factory space utilization	104,000	91,000	65,000	260,000
Insurance on plant and machinery	Cost of Machinery	110,769	73,846	55,385	240,000
Insurance on building	Factory space utilization	24,000	21,000	15,000	60,000
Stores, spares and supplies consumed	Actual	720,000	270,000	810,000	1,800,000
Rent, rates and taxes	Factory space utilization	480,000	420,000	300,000	1,200,000
Total overheads B	Rs.	2,773,714	2,339,500	4,374,786	9,488,000
Cost per unit (B/A)	Rs.	231.14	116.98	97.22	

In this example we could see that rate is calculated for each expense using its related activity and then allocation is based on the proportion utilized by the products of such activities.

- *Example 08:*

A production center has three production departments, A, B and C.

Budgeted production overhead costs for the next period are as follows:

	Rs.
Factory rent	60,000
Equipment depreciation	80,000
Insurance	20,000
Heating and lighting	18,000
Indirect materials:	
Department A	7,000
Department B	6,600
Department C	9,400
Indirect labour:	
Department A	40,000
Department B	27,000
Department C	20,000

Insurance costs relate mainly to health and safety insurance, and will be apportioned on the basis of the number of employees in each department. Heating and lighting costs will be apportioned on the basis of volume.

Other relevant information is as follows:

	Total	Department A	Department B	Department C
Direct labour hours	18,000	8,000	6,000	4,000
Number of employees	50	20	16	14
Floor area (square metres)	1,200	300	400	500
Cost of equipment (Rs.000s)	1,000	200	600	200
Volume (cubic metres)	18,000	8,000	6,000	4,000

a) Calculation for the overhead costs and overhead absorption rate for the period for each production department, assuming that a separate direct labour hour absorption rate is used for each department, would be as follows.

	Basis of apportionment	Total	A	B	C
		--------------------Rs.-----------------			
Indirect materials	Given	23,000	7,000	6,600	9,400
Indirect labour	Given	87,000	40,000	27,000	20,000
Factory Rent	Floor area	60,000	15,000	20,000	25,000
Depreciation	Equipment cost	80,000	16,000	48,000	16,000
Insurance	Employee numbers	20,000	8,000	6,400	5,600
Heating, lighting	Volume	18,000	8,000	6,000	4,000
Total		288,000	94,000	114,000	80,000
Direct labour hours			8,000	6,000	4,000
Absorption rate	(per direct labour hour)		Rs. 11.75	Rs.19.00	Rs.20.00

b) Then, overhead absorption rate for the period, assuming that a single factory-wide direct labour hour absorption rate is use, would be calculated as below:

If a single factory-wide absorption rate is used instead of separate absorption rates for each department, the absorption rate would be Rs.16 per direct labour hour (Rs.288,000/18,000 hours).

- *Example 09:*

On December 1, 20X3 Zia Textile Mills Limited purchased a new cutting machine for Rs. 1,300,000 to augment the capacity of five existing machines in the Cutting Department. The new machine has an estimated life of 10 years after which its scrap value is estimated at Rs. 100,000. It is the policy of the company to charge depreciation on straight line basis.

The new machine will be available to Cutting Department with effect from February 1, 20X4. It is budgeted that the machine will work for 2,600 hours in 20X4. The budgeted hours include:

- 80 hours for setting up the machine; and
- 120 hours for maintenance.

The related expenses, for the year 20X4 have been estimated as under:

i. Electricity used by the machine during the production will be 10 units per hour @ Rs. 8.50 per unit.

ii. Cost of maintenance will be Rs. 25,000 per month.

iii. The machine requires replacement of a part at the end of every month which will cost Rs. 10,000 on each replacement.

iv. A machine operator will be employed at Rs. 9,000 per month.

v. It is estimated that on installation of the machine, other departmental overheads will increase by Rs. 5,000 per month.

Cutting Department uses a single rate for the recovery of running costs of the machines. It has been budgeted that other five machines will work for 12,500 hours during the year 20X4, including 900 hours for maintenance. Presently, the Cutting Department is charging Rs. 390 per productive hour for recovery of running cost of the existing machines.

Required

Compute the revised machine hour rate which the Cutting Department should use during the year 20X4.

▶ *Solution*

Calculation of Annual Charges of New Machine

		Rupees
Total budgeted costs of existing five machines (Rs. 390 x (12,500 - 900))		4,524,000
Add: Costs of new machines		
i.	Depreciation (1,300,000 – 100,000)/10 x 11/12	110,000
ii.	Electricity (2,400 x 10 x Rs. 8.50)	204,000
iii.	Cost of maintenance (Rs. 25,000 x 11)	275,000
iv.	Part replacement (Rs. 10,000 x 11)	110,000
v.	Operator Wages (Rs. 9,000 x 11)	99,000
vi.	Departmental expenses (Rs. 5,000 x 11)	55,000
Total Cost		**5,377,000**
Productive Budgeted hours (12,500 + 2,600 - 900 - 120 - 80)		14,000
Adjusted machine hours rate		384.07

3. BASIS OF APPORTIONMENT OF SERVICE CENTRE COSTS TO PRODUCTION DEPARTMENTS

Case 1

The costs of service centers usually are apportioned among the production departments on the basis of their usage of services. For example, Service department X provides electricity to three production departments A, B and C in the ratio of 3:2:1 therefore, the cost of department X must be allocated to production departments in the same ratio.

- *Example 10:*

Ternary Engineering Limited produces front and rear fenders for a motorcycle manufacturer.

It has three production departments and two service departments. Overheads are allocated on the basis of direct labour hours. The management is considering changing the basis of overhead allocation from a single overhead absorption rate to departmental overhead rate. The estimated annual overheads for the five departments are as under:

	Production Departments			Service	
	Fabrication	Phosphate	Painting	Inspection	Maintenance
	Rs.000	Rs.000	Rs.000	Rs.000	Rs.000
Direct materials	6,750	300	750		
Direct labour	1,200	385	480		
Indirect material				30	75
Other variable overheads	200	70	100	30	15
Fixed overheads	480	65	115	150	210
Total departmental expenses	8,630	820	1,445	210	300
Maximum production capacity (Units)	20,000	25,000	30,000		
Direct labour hours	24,000	9,600	12,000		
Machine hours	9,000	1,000	1,200		
Use of service departments:					
Maintenance - Labour hours	630	273	147		
Inspection - Inspection hours	1,000	500	1,500		

a) Computation of the single overhead absorption rate for the next year, would be as follows

Production departments	Rs. (000)
Variable overhead	370
Fixed overhead	660
Service department	
Inspection	210
Maintenance	300
	1,540

Production departments	Rs. (000)
Estimated direct labour hours (DLH)	
Fabrication	24,000
Phosphate	9,600
Painting	12,000
Total estimated direct labour hours	45,600

$$\text{Single overhead absorption rate} = \frac{\text{Estimated Total Overheads}}{\text{Estimated Direct Labour Hours}}$$

$$= \frac{\text{Rs. } 1{,}540{,}000}{45{,}600 \text{ hours}} = \text{Rs. } 33.77 \text{ per direct labour hour}$$

b) Computation of the departmental overhead absorption rates in accordance with the below circumstances would be as follows:

- The Maintenance Department costs are allocated to the production department on the basis of labour hours.
- The Inspection Department costs are allocated on the basis of inspection hours.
- The Fabrication Department overhead absorption rate is based on machine hours whereas the overhead rates for Phosphate and Painting Departments is based on direct labour hours.

	Production			Service	
	Fabrication	Phosphate	Painting	Inspection	Maintenance
	Rupees in thousand				
Variable Overhead	200	70	100	60	90
Fixed Overhead	480	65	115	150	210
Allocation of Maintenance Department Costs on the basis of labour hours					
630 ÷ 1,050 x 300	180				(180)
273 ÷ 1,050 x 300		78			(78)
147 ÷ 1,050 x 300			42		(42)
Allocation of Inspection Department Costs on the basis of Inspection hours					
1,000 ÷ 3,000 x 210	70			(70)	
500 ÷ 3,000 x 210		35		(35)	
1,500 ÷ 3,000 x 210			105	(105)	
	930	248	362	-	-

Base	Machine hours	Direct labour hours	
number of hours	9,000	9,600	12,000
Departmental Overhead Rate (Rs.)	103.33	25.83	30.17

- *Example 11:*

Sparrow (Pvt) Limited (SPL) is engaged in the manufacture of two products A and B. These products are manufactured on two machines M1 and M2 and are passed through two service departments, Inspection and Packing, before being delivered to the warehouse for final distribution. SPL's overhead expenses for the month of August 2011 were as follows:

	Rupees
Electricity	2,238,000
Rent	1,492,000
Operational expenses of machine M1	5,500,000
Operational expenses of machine M2	3,200,000

Following information relates to production of the two products during the month:

	A	B
Units produced	5,600	7,500
Labour time per unit – Inspection department	15 minutes	12 minutes
Labour time per unit – Packing department	12 minutes	10 minutes

The area occupied by the two machines M1 and M2 and the two service departments is as follows:

	Square feet
Machine M1	5,500
Machine M2	4,800
Inspection department	12,000
Packing department	15,000

Machine M1 has produced 50% units of product A and 65% units of product B whereas machine M2 has produced 50% units of product A and 35% units of product B.

For Allocating overhead expenses to both the products A and B., the following calculation shall be made:

Allocation of costs to cost centers	Basis	Machine M1	Machine M2	Inspection	Packing	Total
Area Occupied		5,500	4,800	12,000	15,000	37,300
Allocation of Electricity	Area	330,000	288,000	720,000	900,000	2,238,000
Allocation of rent	Area	220,000	192,000	480,000	600,000	1,492,000
Operational cost		5,500,000	3,200,000	-	-	8,700,000
		6,050,000	3,680,000	1,200,000	1,500,000	12,430,000

ALLOCATION OF COST TO PRODUCTS			
Basis of Cost Allocation	**A**	**B**	**TOTAL**
Units produced	5,600	7,500	
Inspection time (hours) (5,600 x 15 min /60) & (7,500 x 12 min /60)	1,400	1,500	2,900
Packing time (hours) (5,600 x 12 min /60) & (7,500 x 10 min /60)	1,120	1,250	2,370
Units produced on Machine M1 (50% A and 65% B)	2,800	4,875	7,675
Units produced on Machine M2 (50% A and 35% B)	2,800	2,625	5,425
Cost Allocated			
Machine M1 cost (based on units produced on M1)	2,207,166	3,842,834	6,050,000
Machine M2 cost (based on units produced on M2)	1,899,355	1,780,645	3,680,000
Inspection department cost (based on inspection hours)	579,310	620,690	1,200,000
Packing department cost (based on packing hours)	708,861	791,139	1,500,000
	5,394,692	**7,035,308**	**12,430,000**

Case 2

However, in some cases, one or more service departments use other service department. In such a case, the cost of that service department shall be distributed first which provides services to other service departments too and the cost shall be distributed to all the departments (that is production and service departments which receive its services). Thereafter, the cost of remaining service departments is distributed to production departments. This case can be understood with the help of following examples.

- *Example 12:*

The Torrence manufacturing company has four production departments and three service departments: Maintenance, Toolroom and Storeroom. The estimated annual production overheads for these seven departments is given below:

	Departments						
	Producing				Service		
	01	02	03	04	Maintenance	Tool-room	Store-room
Estimated overheads	Amount in Rupees						
Fixed production overheads	360,000	480,000	450,000	300,000	150,000	105,000	120,000
Variable production overheads	240,000	220,000	200,000	200,000	108,000	105,000	30,000
Total	600,000	700,000	650,000	500,000	258,000	210,000	150,000

The management decided to distribute the service departments costs on a dual basis: (a) fixed production overheads on standby or ready to serve basis and (b) variable production overheads on a billing or charging rate basis. The fixed production overheads of the three service departments are to be distributed as shown in below table.

Allocation of fixed production overheads of service departments	Total	01	02	03	04
	Amount in Rupees				
Maintenance	150,000	50,000	40,000	30,000	30,000
Toolroom	105,000	35,000	25,000	25,000	20,000
Storeroom	120,000	60,000	30,000	20,000	10,000

The variable production overheads of the service departments are distributed on the basis of charging rate based on the following plant survey and other pertinent data:

Departments	Maintenance (Area in sqft)	Toolroom (Number of employees)	Storeroom (Number of Material requisitions)
01	12,000	40	30,000
02	10,000	30	30,000
03	9,000	20	28,000
04	5,000	10	12,000
Maintenance	5,000	5	
Tool-room	3,000	3	
Storeroom	1,000	2	

Maintenance department cost is apportioned to other service departments along with production departments but costs of tool-room and storeroom is transferred to production departments only.

Production overhead apportionment sheet on the basis of above data and analysis, is given below.

	Departments						
	Producing				Service		
	01	02	03	04	Maintenance	Tool-room	Store-room
Estimated overheads	Amount in Rupees						
Fixed production overheads	360,000	480,000	450,000	300,000	150,000	105,000	120,000
Maintenance	50,000	40,000	30,000	30,000	(150,000)		
Tool-room	35,000	25,000	25,000	20,000		(105,000)	
Storeroom	60,000	30,000	20,000	10,000			(120,000)
Apportioned fixed production overheads (A)	**505,000**	**575,000**	**525,000**	**360,000**			
Variable production overheads	240,000	220,000	200,000	200,000	108,000	105,000	30,000
Maintenance (sqft)	32,400	27,000	24,300	13,500	(108,000)	8,100	2,700
Tool-room	45,240	33,930	22,620	11,310		(113,100)	
Storeroom	9,810	9,810	9,156	3,924			(32,700)
Apportioned variable production overheads (B)	**327,450**	**290,740**	**256,076**	**228,734**			
Apportioned total production overheads (A+B)	**832,450**	**865,740**		**588,734**			

			781,076				

Case 3

In some cases, the structure becomes complex when service departments share services with each other. For example, Department X and Y provides services to each other as well as to production departments. In such a case, reciprocal apportionment of cost is carried. The following methods are used for such apportionment:

a) Repeated distribution method

b) Simultaneous equation method

Repeated Distribution Method:

In this method, cost of one service department is apportioned to all the departments according to the determined proportion. This way, the cost of that department becomes zero. Thereafter, the cost of other service department is distributed to all the departments in the given proportion. Now since the departments share services, the department whose cost is distributed first has receive the portion of cost from the departments whose costs are subsequently apportioned. This will happen with all the service departments. Therefore, the process of distribution should be repeated till all the costs including the ones after repeated distribution have become zero.

Simultaneous Equation Method:

In this method, simultaneous equations are made to solve the problem in shortest way.

These methods can be best understood through examples.

► *Example 13:*

The expenses of the production and service departments of a company for a year are as follows:

Department	Expenses before distribution of service department cost Rs. '000	Service provided (%age)	
		Dept. X	Dept. Y
Production department - A	500	50	40
- B	400	30	50
Service department – X	100	-	10
- Y	60	20	-

For allocating the service departments expenses to production departments by:

a) Repeated distribution method

	Production Department		Service Department	
	A	**B**	**X**	Y
Total expenses as given	500	400	100	60
Allocation of X department cost	50	30	(100)	20
Allocation of Y department cost	32	40	8	(80)
Allocation of X department cost	4	2	(8)	2
Allocation of Y department cost	1	1	-	(2)
	587	473	-	-

b) Simultaneous equation method

Let total expenses of department X inclusive of expenses allocated from department Y = x

Let total expenses of department Y inclusive of expenses allocated from department X = *y*

Then according to question

x = 100 + 0.1 y ------------ eq. (1)

y = 60 + 0.2 x -------------- eq. (2)

Putting the value of y from *eq. (1)* in *eq. (2)*

x = 100 + 0.1 (60 + 0.2x)

x = 100 + 6 + 0.02 x

x – 0.02 x = 106

x = 108

y = 60 + 0.2 (108)

y= 60 + 22 = 82

ALLOCATIONS		
Description	**Production Department**	
	A	**B**
Product department costs	500	400
Distribution of X department cost (108 × 50%) & (108 × 30%)	54	32
Distribution of Y department cost (82 × 40%) & (82 × 50%)	33	41
	587	473

AT A GLANCE

SPOTLIGHT

STICKY NOTES

4. OVER OR UNDER APPLIED / ABSORBED OVERHEAD

Once the factory overhead rate is determined using the estimated amount of factory overhead and estimated base, it is used to charge overhead cost to the jobs, products or work performed. The overhead absorbed is based on actual activity on which the rate is calculated. Multiply this rate with actual capacity resulted in absorbed overheads.

Since, some of the expenses are not related to product and cannot be identified when production is taken place because these are related to period. For example, electricity bill and rent is paid on monthly basis, while production is taken place on daily and continuous basis. In order to include the indirect cost, we have to calculate overhead absorption rate, as discussed in section 3.

Due to this, at each period end, the management calculates and compares the actual overhead cost with the applied overhead cost and determine the over or under applied overheads.

The over or under absorbed overhead is calculated as follows:

Actual Factory Overhead	xxx
Applied / Absorbed Factory Overhead (Budgeted overhead rate x actual activity level of the selected base)	(xxx)
Over or Under Applied / Absorbed Overhead	xxx

- Over applied / absorbed means the actual overhead cost is lesser than the cost applied to the production
- Under applied / absorbed means the actual overhead cost is greater than the cost applied to the production

Treatment of Over or Under Applied / Absorbed Overhead:

The over or under applied overhead so calculated is treated either as:

a) Period cost – charged to cost of goods sold, or

b) Product cost – charged to production (including closing inventory)

For financial reporting purposes, it is often closed to cost of goods sold as period cost.

► *Example 14:*

Amber Limited (AL) manufactures a single product. Following information pertaining to the year 20X4 has been extracted from the records of the company's three production departments.

	Department	Material	Labour	Machine
		Rs. in million	Hours	
Budgeted	A	80	200,000	400,000
	B	150	500,000	125,000
	C	120	250,000	350,000
Actual	A	80	220,000	340,000
	B	150	530,000	120,000
	C	120	240,000	320,000

AL produced 3.57 million units during the period. The budgeted labour rate per hour is Rs. 120. The overheads for Department-A is budgeted at Rs. 5.0 million, for Department-B at 15% of labour cost and for department-C at 5% of prime cost of the respective departments. Actual overheads for department A, B and C are Rs. 5.35 million, Rs. 8.90 million and Rs. 7.45 million respectively.

Overheads are allocated on the following basis:

Department-A	Machine hours
Department-B	Labour hours
Department-C	Percentage of Prime cost

There was no beginning or ending inventory in any of the production departments.

a) For calculating budgeted overhead application rate for each department, the following working shall be made

Budgeted overhead rate for department-A	Rs.
Budgeted Overhead rate per machine hour (OHD/MH Rs.5m/400,000)	Rs. 12.5
Budgeted overhead rate for department-B	
Budgeted labour cost (Rs. 120 × 500,000)	Rs. 60 million
Budgeted overhead (Rs. 60 m × 15%)	Rs. 9 million
Budgeted overhead rate per labour hour (Rs. 9 m/0.5 m)	Rs. 18
Budgeted overhead rate for department-C	
Budgeted overhead as a % of Prime Cost (Rs.7.5 m /150 m)	5%

b) For calculation of the total and departmental actual cost for each unit of product, the following working shall be made

	Departments		
	Rupees in million		
	A	B	C
Material cost	80.00	150.00	120.00
Labour cost			
(0.22 m × Rs. 120)	26.40		
(0.53 m × Rs. 120)		63.60	
(0.24 m × Rs. 120)			28.80
Actual overhead cost	5.35	8.90	7.45
Total Cost	111.75	222.50	156.25
Unit cost (Cost/3.57 m. units) **(Rs.)**	31.30	62.32	43.77
Total Actual Cost per unit (Rs.)		137.39	

c) For calculation of over or under applied overhead for each department, the following working shall be made.

(0.34 m × 12.5)	4.25		
(0.53 m × Rs. 18)		9.54	
(Rs. 148.8 m × 5%)			7.44
Actual Overhead Cost	5.35	8.90	7.45
Under applied / (over) applied	1.10	(0.64)	0.01

5. COMPREHENSIVE EXAMPLES

- *Example 01:*

Salman Limited (SL) has two production departments, PD-A and PD-B, and two service departments, SD-1 and SD-2. A summary of budgeted costs for the year ending June 2015 is as follows:

	PD-A	PD-B	SD-1	SD-2	Total
	---------------------- Rs. in '000 ----------------------				
Direct labour	5,400	3,648	-	-	9,048
Direct material	13,500	9,120	-	-	22,620
Indirect labour	1,900	600	50	20	2,570
Indirect materials	900	1,100	150	55	2,205
Factory rent	-	-	-	-	1,340
Power cost	-	-	-	-	1,515
Depreciation	-	-	-	-	3,500

Other related data is as follows:

	PD-A	PD-B	SD-1	SD-2
Production (units)	2,250	800	-	-
Direct labour hours (per unit)	20	38	-	-
Machine hours	19,250	12,250	2,800	700
Kilowatt hours (000)	800	600	50	150
Floor area (square feet)	5,000	4,000	500	500
Basis of overhead application	Machine hours	Direct labour hours	-	-

SL allocates the costs of service departments applying repeated distribution method. Details of services provided by SD-1 and SD-2 to the other departments are as follows:

Service Departments	PD-A	PD-B	SD-1	SD-2
SD-1	30%	65%	-	5%
SD-2	55%	35%	10%	-

Required

Compute the departmental overhead absorption rat.

- *Solution*

The departmental overhead absorption rate can be calculated as follows:

Allocation of overheads and overheads absorption rate

	Allocation basis	Total	PD-A	PD-B	SD-1	SD-2
		Rs. in 000				
Direct labour		-	-	-	-	-
Direct material		-	-	-	-	-
Indirect labour		-	1,900	600	50	20
Indirect materials		-	900	1,100	150	55
Factory rent	Floor area	1,340	670	536	67	67
Power	Kilowatt hrs.	1,515	758	568	47	142
Depreciation	Machine hrs.	3,500	1,925	1,225	280	70
			6,153	4,029	594	354
Allocation of service departments cost:						
SD-1	30:65:5		178	386	(594)	30
SD-2	55:35:10		211	134	39	(384)
SD-1	30:65:5		12	25	(39)	2
SD-2	55:35:10		1	1	0	(2)
			6,555	4,576	-	-
Allocation basis			**Machine hrs.**	**D. labour hrs.**		
Machine/D. labour hours			19,250	30,400	800×38	
Overhead absorption rate per hour		Rs.	340.52	150.53		

- *Example 02:*

Opal Industries Limited (OIL) produces various products which pass through Processing and Finishing departments. Logistics and Maintenance departments provide necessary support for the production. Following information is available from OIL's records for the month of June 20X1:

(i)	Overhead costs		Direct labour hours	
Departments	*Budgeted	Actual	Budgeted	Actual
	-------- Rupees --------		-------- Rupees --------	
Processing	560,000	536,000	14,000	14,350
Finishing	320,000	258,000	10,000	9,800
Logistics	-	56,700	-	-
Maintenance	-	45,000	-	-

*including apportionment of overhead costs of support departments

(ii) Costs of support departments are apportioned as under:

	Processing	Finishing	Logistics	Maintenance
Logistics	50%	40%	-	10%
Maintenance	35%	45%	20%	-

Required:

a) Allocate actual overhead costs of support departments to production departments using repeated distribution method.

b) Compute under/over applied overheads for the month of June 20X1

▶ *Solution*

a) Allocate actual overhead costs of support departments to production departments using repeated distribution method.

Allocation of support departments' actual overheads:				
	Production departments		**Support departments**	
	Processing	**Finishing**	**Logistics**	**Maintenance**
	Rupees			
Cost incurred	536,000	258,000	56,700	45,000
Allocation of support departments' costs:				
Logistics 50%:40%:0%:10%	28,350	22,680	(56,700)	5,670
Maintenance 35%:45%:20%:0%	17,734	22,802	10,134	(50,670)
Logistics	5,067	4,054	(10,134)	1,013
Maintenance	354	456	203	(1,013)
Logistics (Being immaterial amount, allocated to production dept. only) 50:40	113	90	(203)	-
Total - Actual overhead costs A	587,618	308,082	-	-

b) Compute under/over applied overheads for the month of June 20X1.

Under/over applied overheads:				
Predetermined overhead rate:				
Budgeted direct labour hours B	14,000	10,000		
Budgeted overhead costs C	560,000	320,000		
Budgeted overhead rate (C÷B) D	40.00	32.00		
Overheads applied:				
Actual direct labour hours E	14,350	9,800		
Overheads applied (D×E) F	574,000	313,600		
Overheads under/(over) applied (A-F)	13,618	(5,518)		

▶ *Example 03:*

Following information has been extracted from the records of RT Limited for August 20X3:

	Departments				
	Production			Service	
	P-1	P-2	P-3	S-1	S-2
Budgeted machine hours	60,000	100,000	120,000		
Actual machine hours	60,500	110,000	100,000		
Budgeted labour hours	50,000	200,000	75,000		
Actual labour hours	55,000	190,000	75,000		
Budgeted material cost (Rs. '000)	50,000	40,000	3,000		
Actual material cost (Rs. '000)	50,000	42,000	3,200		
Budgeted overheads (Rs. '000)	1,200	2,000	2,250	600	700
Actual overheads (Rs. '000)	1,250	2,000	1,800	500	750
Services provided by S-1	20%	30%	40%	-	10%
Services provided by S-2	30%	40%	20%	10%	-
Basis of overhead application	Machine hours	Labour hours	75% of Material cost		

Required

a) Allocate costs of service departments using repeated distribution method.

b) Compute department wise over / under applied overheads.

▶ *Solution*

a) Allocation of Service dept. cost to production dept. - Repeated distribution method:

	Production Dept.			Service Dept.	
	P1	P2	P3	S1	S2
	Rupees in thousand				
S1 overheads allocation %	20%	30%	40%		10%
S2 overheads allocation %	30%	40%	20%	10%	
Actual overheads as given	1,250	2,000	1,800	500	750
Allocation of S2 cost					
30:40:20:10	225	300	150	75	(750)
Allocation of S1 cost					
20:30:40:10	115	172	230	(575)	58
Allocation of S2 cost					
30:40:20:10	17	23	11	6	(58)
Allocation of S1 cost					
20:30:40:10	1	2	3	(6)	
Allocation from service dept.	358	497	394		
Total	1,608	2,497	2,194	–	–

b) Compute department wise over / under applied overheads.

Department wise over / under applied overheads:			
	P1	P2	P3
Budgeted OH's	1,200,000	2,000,000	2,250,000
Re-distributed OH's of service departments (W-2)	365,657	510,101	424,242
Total budgeted OH's (I)	1,565,657	2,510,101	2,674,242
Budgeted Base	Machine Hours	Labour Hours	Material Cost
	60,000	200,000	-
Budget OAR (II)	Rs. 26.0943	Rs. 12.5505	75% of DMC
	Per M.H	Per L.H	Given
Actual data of Base (III)	60,500	190,000	Rs. 3,200,000
Applied FOH (III x II) Rs.	1,578,705	2,384,595	2,400,000
Actual FOH (W-1)	1,608,586	2,497,475	2,193,939
(Under)/Over FOH Applied	(29,881)	(112,880)	206,061

(W-1)			
	P-1	P-2	P-3
Actual FOH			
Direct Incurred	1,250,000	2,000,000	1,800,000
Share of service dept's (part a)	358,586	497,475	393,939
	1,608,586	2,497,475	2,193,939

(W-2) Allocation of Service departments using Repeated Distribution Method.

R.T Limited FOH Distribution Sheet
For the month of August, 2009 (Based on Budgeted Cost for Computation of Budgeted OAR)

Date	Particulars	Head of A/c	Amount	Basis	Production Department			Service Department	
					P_1	P_2	P_3	S_1	S_2
	Budgeted Overheads Redistribution		1,300,000					600,000	700,000
	S – 1			20:30:40:10	120,000	180,000	240,000	(600,000)	60,000
									760,000
	S – 2			30:40:20:10	228,000	304,000	152,000	76,000	**(760,000)**
	S – 1			20:30:40:10	15,200	22,800	30,400	(76,000)	7,600
	S – 2			30:40:20:10	2,280	3,040	1,520	760	**(7,600)**
	S – 1			20:30:40:10	152	228	304	(760)	76
	S – 2			30:40:20:10	23	30	15	8	**(76)**
	S – 1			20:30:40:10	2	3	3	(8)	-
			1,300,000		**365,657**	**510,101**	**424,242**	**0**	**0**

▶ *Example 04:*

Hi-way Engineering Limited uses budgeted overhead rate for applying overhead to production orders on a direct labour cost basis for department A and on a machine hour basis in department B.

The company made the following forecasts for August 2006:

	Dept A	Dept B
Budgeted factory overhead (Rs.)	216,000	225,000
Budgeted direct labour cost (Rs.)	192,000	52,500
Budgeted machine hours	500	10,000

During the month, 50 units were produced in Job no. CNG-011. The job cost sheet for the month depicts the following information:

	Dept A	Dept B
Material issued (Rs.)	1,500	2,250
Direct labour cost (Rs.)	1,800	1,250
Machine hours	60	150

Actual data for the month were as follows:

	Dept A	Dept B
Factory overhead (Rs.)	240,000	207,000
Direct labour cost (Rs.)	222,000	50,000
Machine hours	400	9,000

Required

a) Compute predetermined overhead rates for each department.

b) Compute total costs and unit cost of Job no. CNG-011.

▶ *Solution*

a) Predetermined overhead rates for each department would be computed as follows:

	Dep A	Dep B
Budgeted factory overhead (Rs.)	216,000	225,000
Pre-determined Overhead rate	216,000/192,000*100= 125% of labour cost (activity= labour cost)	225,000/10,000= 22.5 per machine hours (activity=machine hour)

b) The total costs and unit cost of Job no. CNG-011, would be as follows

	Dep A	Dep B	Total cost
Material issued (Rs.)	1500	2250	3750
Direct labour cost (Rs.)	1800	1250	3050
Factory overheads (actual activity*predetermined overhead rate)	2250	3375	5625
Total cost	5550	6875	12425
Number of units	50	50	50
Per unit cost (total cost/number of units)	111	137.5	248.5

c) The over / under applied overhead for each department would be as follows:

	Dep A	Dep B
Actual factory overheads	240,000	207,000
Applied factory overheads (actual activity*predetermined overhead rate)	277,500	202,500
(over) under applied factory overheads	(37,500)	4500

- *Example 05:*

Bright Limited (BL) is engaged in the manufacturing of two products, Shine and Glow. Both these products are processed through two production departments, A and B, while department X and Y provide services to both the production departments. Below is a summary of the indirect costs incurred by BL for manufacture of 100,000 units of Shine and 60,000 units of Glow during the year ended 31 December 2020:

	Rs. 000
Salaries and wages	115,000
Depreciation of machinery	80,000
Building insurance	25,000
Electricity	60,000
	280,000

Other information related to the four departments is given below:

	Department A	Department B	Department X	Department Y	Total
Cost of machinery (Rs. 000)	250,000	150,000			400,000
Floor area (square feet)	15,000	6,000	6,000	3,000	30,000
No. of employees	150	50	25	25	250
Services provided by					
- Department X	80%	20%			
- Department Y	75%	15%	10%		

The overhead absorption rates used by BL for allocation to Shine and Glow are Rs. 1,800 and Rs. 1,700 per unit respectively. Any under/over absorbed overheads are adjusted to cost of sales.

Required

a) Compute product wise actual overheads for shine and glow.

b) Compute under / over absorbed overheads.

▶ *Solution*

a) Computation of product wise actual overheads for shine and glow is given below:

Cost allocation to production departments

Items	Allocation basis	Total	Production departments		Service departments	
			A	B	X	Y
		Amount in Rs. 000				
Salaries & wages	No. of employees	115,000	69,000	23,000	11,500	11,500
Depreciation	Cost of machine	80,000	50,000	30,000		
Building insurance	Floor area	25,000	12,500	5,000	5,000	2,500
Electricity	Floor area	60,000	30,000	12,000	12,000	6,000
					28,500	**20,000**
Service departments:						
Department Y	75:15:10		15,000	3,000	2,000	(20,000)
Department X	80:20		24,400	6,100	(30,500)	
			200,900	**79,100**		

Cost allocation to Shine and Glow

	Shine	Glow	Total
Actual units produced	100,000	60,000	160,000
Overheads allocation on the basis of units			
		Rs. In 000	
- Department A	125,563	75,337	200,900
- Department B	49,437	29,663	79,100
	175,000	**105,000**	**280,000**

b) Computation of Under / Over absorbed overheads is given below.

	Absorbed overheads	Actual overheads	Under/(Over) absorbed
		Rs. In 000	
Shine @ Rs. 1,800 per unit	180,000	175,000	(5,000)
Glow @ Rs. 1,700 per unit	102,000	105,000	3000
	282,000	**280,000**	**(2,000)**

- *Example 06:*

Omega Industries Limited (OIL) produces two products Alpha and Beta. These products are processed through Fabrication and Finishing departments. Quality control and Logistics departments provide all the necessary support for the production.

OIL allocates production overheads to Alpha and Beta at a pre-determined rate of Rs. 1,300 and Rs. 500 per unit respectively. Any under/over absorbed overheads are adjusted to cost of sales.

Following actual data has been extracted from the cost records of OIL for the month of December 2015:

	Fabrication	Finishing	Quality control	Logistics	Total
Indirect labour Rs. in 000	1,500	1,200	500	400	3,600
Factory rent Rs. In 000					2,000
Power Rs. In 000					1,200
Depreciation-plant Rs. In 000					9,000
Other information:					
Cost of plant Rs. In 000	32,000	20,000	2,000	6,000	60,000
Floor area Square feet	10,000	5,000	3,000	2,000	20,000
Power KWH	50,000	40,000	4,000	6,000	100,000
Hours worked for Alpha	70%	60%			
Hours worked for Beta	30%	40%			
Services provided by:					
- Quality Control	40%	60%			100%
- Logistics	60%	35%	5%		100%

8,000 units of Alpha and 10,000 units of Beta were produced during the month of December 2015.

Required

a) Calculate product wise actual overheads for Alpha and Beta.

b) Make journal entries to record:

  i. applied production overhead

  ii. under/ over absorbed production overheads

- *Solution*

a) Product wise actual overheads for Alpha and Beta are calculated below.

Items	Allocation basis	Total	Production departments		Service departments	
			Fabrication	Finishing	Quality control	Logistics
		Amount in Rs. 000				
Indirect labour	Given	3,600	1,500	1,200	500	400
Factory rent	Floor area	2,000	1,000	500	300	200
Power	KWH	1,200	600	480	48	72
Depreciation	Plant cost	9,000	4,800	3,000	300	900
					1,148	**1,572**
Service departments:						
Logistics	60:35:5	1,572	943	550	79	(1,572)
Quality control	40:60	1,227	491	736	(1,227)	
			9,334	**6,466**		

Cost allocation to Alpha and Beta

	Alpha	Beta	Total
Actual units produced	8,000	10,000	18,000
Overheads allocation on the basis of hours worked			
		Rs. In 000	
- Fabricating in the ratio of 70:30	6,534	2,800	9,334
- Finishing in the ratio of 60:40	3,880	2,586	6,466
	10,414	**5,386**	**15,800**

b) Journal entries to record (i) applied production overhead and (ii) Under/ over absorbed production overheads are given as under.

	Debit	Credit
	Rs. In 000	
Work in process (8,000 x 1,300) + (10,000 x 500) Factory overheads control account ***(Overheads charged to production at pre-determined rate)***	15,400	 15,400
Cost of sales (15,800 – 15,400) Factory overheads control account ***(Under applied overheads charged to cost of sales)***	400	 400

► *Example 07:*

Alpha Limited is preparing its departmental budgets and product cost estimates for the next year. The costs and related data for the year ending 31 December 2014 have been estimated as follows:

	Machining	Assembly	Finishing	Maintenance	Total
			Rs. In 000		
Direct wages	274	146	328		748
Indirect wages	46	27	36	137	246
Direct materials	365	46	18		429
Indirect materials	68	18	36	91	213
Power					465
Light and heat					46
Depreciation					108
Rent and rates					114
Warehousing cost					98
Other data:					
Direct labour hours	12,000	8,000	16,000	6,000	42,000
Machine hours	40,000	2,000	3,000		45,000
No. of employees	6	4	8	3	21
Floor area (sqm)	1,000	400	300	300	2,000
Net book value of fixed assets (Rs. 000)	20,000	8,000	3,000	4,000	35,000

80% of the maintenance department's time is used in the maintenance of machines whereas the remaining time is consumed in cleaning and maintenance of factory buildings.

Required.

Compute appropriate absorption rates for machining, assembly and finishing departments.

- *Solution*

Overhead analysis sheet for Alpha Limited for the year ending 31 December 2014:

	Base	Machining	Assembly	Finishing	Maintenance	Total
		Rs. In 000				
Indirect wages	Actual	46	27	36	137	246
Indirect materials	Actual	68	18	36	91	213
Power	Machine hours	413	21	31		465
Light and heat	Floor area	23	9	7	7	46
Depreciation	NBV	62	25	9	12	108
Rent and rates	Floor area	57	23	17	17	114
Warehousing cost	Direct materials	83	11	4		98
		752	134	140	264	1,290
Reallocation of Maintenance costs	80% based on machine hours	188	9	14	(211)	
	20% based on floor area	31	13	9	(53)	
		971	156	163	-	1,290

Overhead absorption rates of each department

	Machining	Assembly	Finishing
Overheads (Rs. 000)	971	156	163
Base	40,000 Machine hours	8,000 Direct labour hours	16,000 Direct labour hours
Overhead absorption rate (Rs.)	**24.28**	**19.50**	**10.19**

- *Example 08:*

Zaiqa Limited (ZL) is engaged in the business of manufacturing fruit jam. It has three production and two service departments. Following information is available from ZL's records for the month of August 2013:

	Rupees
Rent and rates	85,000
Indirect wages	60,000
General lighting	75,000
Power	150,000
Depreciation machinery	50,000

Following further information relating to the departments is also available:

	Production Departments			Service Departments	
	Selection	Jam making	Bottling	Storage	Distribution
Direct wages (Rs.)	60,000	80,000	32,000	8,000	20,000
Power consumed (KWH)	1,000	6,000	2,000	1,000	-
Floor area (Sq. ft.)	1,500	2,000	1,250	1,000	500
Light points (Nos.)	10	20	15	5	10
Production hours	1,533	3,577	1,815	-	-
Labour hours per bottle	0.10	0.25	0.15	-	-
Cost of machinery (Rs.)	600,000	1,200,000	900,000	300,000	-

After production, the jam bottles are finally packed in a carton consisting of 12 bottles. The service departments costs are apportioned as follows:

	Production Departments			Service Departments	
	Selection	Jam making	Bottling	Storage	Distribution
Storage	10%	30%	40%	-	20%
Distribution	20%	50%	30%	-	-

Raw and packing material costs of Rs. 36 and labour cost of Rs. 25 is incurred on each bottle.

Required

Compute cost of each carton.

▶ *Solution*

Cost of each carton is calculated as under:

Primary Distribution of overheads

	Basis of Apportionment	Total overheads	Production Departments			Service Departments	
			Selection	Jam making	Bottling	Storage	Distribution
Direct wages (Rs.)	Given	28,000				8,000	20,000
Rent and rates	Floor area	85,000	20,400	27,200	17,000	13,600	6,800
General lighting	Light points	75,000	12,500	25,000	18,750	6,250	12,500
Indirect wages	Direct wages	60,000	18,000	24,000	9,600	2,400	6,000
Power	KWH cons.	150,000	15,000	90,000	30,000	15,000	-
Depreciation	Cost of mach.	50,000	10,000	20,000	15,000	5,000	-
Total departmental overheads		448,000	75,900	186,200	90,350	50,250	45,300

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Secondary Distribution of overheads

	Total overheads	Production Departments			Service Departments	
		Selection	Jam making	Bottling	Storage	Distribution
Total overheads	448,000	75,900	186,200	90,350	50,250	45,300
Storage (1:3:4:2)		5.025	15,075	20,100	(50,250)	10,050
Distribution (2:5:3)		11,070	27,675	16,605	-	(55,350)
Total	448,000	91,995	228,950	127,055		
Production hours		1,533	3,577	1,815		
Rate per hour (Rs.)		60.0	64.0	70.0		

Cost of one carton

	Rupees	Rupees
Packing and raw materials (36 x 12)		432
Direct labour (25 x 12)		300
Overheads:		
Selection (0.1 x 12 x 60)	72	
Jam making (0.25 x 12 x 64)	192	
Bottling (0.15 x 12 x 70)	126	390
Total		**1,122**

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STICKY NOTES

Manufacturing expenses are of two types: Direct expenses and Indirect Expenses.

Direct expenses are fully traceable to the product/service/department being costed. e.g. Direct material, Direct Labour and direct expenses. Indirect expenses (Production overheads) –incur in the course of making a product/providing service/ running department but cannot be traced directly and fully to the product, service or department

Costs are often categorized as variable cost that vary with the level of output and fixed cost that remained constant irrespective of the level of output.

Production Overheads incur in relation to the production processes (also called manufacturing overheads / factory overheads). Non-Production Overheads incur to support the overall objectives of the business. (classified as 'Administrative Expenses, Marketing, Selling and Distribution Expenses' in the Statement of Comprehensive Income.)

Estimated factory overheads can be calculated using physical output, direct material cost, direct labour cost, prime cost, direct labour hours, machine hours.

In addition to the selection of bases, the following factors are also considered to estimate factory overheads:

1. **Activity level: at which the business performs its production activities**
2. **Inclusion or exclusion of fixed overheads: Absorption costing / conventional costing/full costing or Marginal Costing/Direct Costing**
3. **Single rate or several rates Blanket rate/Plant-wide rate, Departmental rates or Cost centers/cost pool rates.**

The overhead costs of servicing departments are transferred to production departments and service departments in the proportion of the facilities used

When service departments share services with each other, reciprocal apportionment of cost is carried with one of the following methods:

a) Repeated distribution method

b) Simultaneous equation method

All the production related overhead costs are to be accumulated at the smallest segment of the production process

Budgeted overhead rate is calculated to allocate cost to the products

At the period end, actual overhead is compared with applied

Overhead rate to calculate the over or under absorption

ACTIVITY BASED COSTING

IN THIS CHAPTER

AT A GLANCE

Activity Based Costing is alternate to absorption costing in which cost is charged to cost object on the basis of activities, rather than volume.

Cost pool is accumulation of cost for each activity cost centre whereas cost driver which drives the cost and provides basis for apportionment of cost.

In absorption costing, cost is absorbed into products on the basis of volume, whereas in activity-based costing, cost is absorbed into products on the basis of activities, rather than volume only.

More realistic costing can be made under activity-based costing technique as more than one rates are used to absorbed cost to cost object.

1. ACTIVITY BASED COSTING

Activity based costing (ABC) is alternative technique to traditional absorption costing technique, which is used to absorb indirect cost to cost object. It is a costing method that assigns indirect cost to activities and products based on each product's use of activities. In simple words, in ABC, "Products consume activities and activities consume resources".

ABC involves the process of identification of the factors which results the costs of an organisation's major activities (Cost Pool). Overheads are allocated and apportioned to activity cost centres or cost pool. The overhead costs are ultimately absorbed into product on the basis of usage of activities. Products using more activities should be charged with high cost of respective 'cost pool' cost, irrespective of high or low volume. The absorption rate for each activity is cost per unit of relevant cost driver.

Activity based costing can be defined as: ***"method of costing which involves identifying the costs of the main support activities and the factors that drive the costs of each activity. Support overheads are charged to products by absorbing cost on the basis of the product's usage of the factor driving the overheads."***

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2. REASONS FOR THE DEVELOPMENT OF ACTIVITY BASED COSTING

Absorption costing is based on the fact that production overheads are driven by units of products as higher units will be produced, higher production overheads are absorbed into products. These are normally absorbed into products on the basis of volume i.e. labour hours, machine hours etc. However, activity-based costing is based on various cost driver rates because of the following.

Traditional absorption costing was developed in a time when most manufacturers produced small range of products which underwent similar operations. It was justified to include similar proportion of overheads into product cost. In addition to above, overhead costs comprised of small fraction of total production cost or in other words, the proportion of direct cost was higher than indirect cost. With the introduction of advanced manufacturing technologies or computer-aided manufacturing, the proportion of indirect costs were increased significantly. The drastic shift from direct to indirect cost requires more complex system of absorption and therefore, ABC was developed in order to calculate realistic cost of product.

In the past, most of the manufacturing was considered as labour-intensive and machine depreciation cost was not significant, but with introduction of modern manufacturing environment, the dependence on machines was enhanced, resulting higher depreciation cost. It increased the indirect cost to higher extent than direct cost because of manufacturing environment was shifted from labour-intensive to machine-intensive.

The increase in market competition and more complex manufacturing environments, the product range have increased. In this environment, the use of absorption costing may result in over-statement of cost due to higher volume or understatement of cost to product with low volume. ABC attempts to overcome this problem.

3. COST POOL AND COST DRIVER

Cost Pool

A cost pool is an activity which consumes resources and for which overheads costs are identified and allocated. Cost pool is major activity which accumulates the cost relevant to this specific activity. The term activity and cost pool are often used interchangeably.

For example, set up or batch cost is cost pool and it accumulates any indirect cost relating to batch. More cost will be incurred in case of more batches are produced.

Cost Driver

A cost driver is a factor that influences or drives the level of cost of an activity. For example, number of batches is the cost driver as increase in number of batches will influence or drive the set-up cost.

Following table explains the relation of cost pool and cost driver:

Cost Pool	Cost driver
Machine set up cost	Number of batches or set ups
Materials handing cost	Number of production runs
Dispatching cost	Number of orders dispatched
Ordering cost	Number of customer's orders
Machine operational cost	Number of machine hours
Production scheduling cost	Number of production runs

4. COSTING UNDER ACTIVITY BASED COSTING

Cost of product can be calculated under activity-based costing with help of five basic steps:

Step-I

Identify an organization's major activities that support the manufacture of the organization's products or services.

Step-II

Use cost allocation and apportionment methods to accumulate overhead costs to each of the organisation's major activities. In other words, group production overheads into major activities of the organization. The costs that accumulate for each activity cost centre is called cost pool.

Step-III

Identify the factors which determine the size of the costs of an activity. It is called the cost driver and these are identified for each cost pool.

Step-IV

Calculate overhead absorption rate for each activity, which can be calculated by dividing the cost pool by its cost driver.

Step-V

Absorb the activity costs into products after charging overhead costs on the basis of their usage of the activity. Overheads are charged by absorbing them into product costs at a rate per unit of cost driver.

► *Example 01:*

Mustajab Limited manufacturers four products, A, B, C and D. Output and cost data for the period just ended are as follows:

Products	Output units	Number of production runs	Material cost per unit Rs.	Direct labour hours per unit	Machine hours per unit
A	10	2	200	10	10
B	10	2	800	30	30
C	100	5	200	10	10
D	100	5	80	30	30

Overhead costs are given as under:

Overhead costs	Rs.
Short run variable costs	30,800
Set up costs	109,200
Expediting and scheduling costs	91,000
Material handling costs	77,000
Total	**308,000**

Labour cost per hour is Rs. 50.

Required:

Calculate unit cost for each product using Activity based costing.

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	A	B	C	D
	Amount in Rupees			
Direct materials	2,000	8,000	20,000	80,000
Direct labour	500	1,500	5,000	15,000
Production overheads:				
Short run variable cost W-1	700	2,100	7,000	21,000
Set up costs W-1	15,600	15,600	39,000	39,000
Expediting and scheduling costs W-1	13,000	13,000	32,500	32,500
Materials handling costs W-1	11,000	11,000	27,500	27,500
Total cost (A)	42,800	51,200	131,000	215,000
Unit produced (B)	10	10	100	100
Unit cost (A) / (B)	4,280	5,120	1,310	2,150

W-1

Activity	Cost pool Rs.	Cost Driver	Rate per cost driver
Short run variable costs	30,800	4,400 machine hours	Rs. 7 per machine hour
Set up costs	109,200	14 production runs	Rs. 7,800 per production run
Expediting and scheduling costs	91,000	14 production runs	Rs. 6,500 per production run
Material handling costs	77,000	14 production runs	Rs. 5,500 per production run

- *Example 02:*

Rajput Enterprises manufactures two products, J and K, using the same equipment and similar processes. An extract of the production data for these products for the month of June is shown below:

	Product J	Product K
Quantity produced in units	5,000	7,000
Direct labour hours per unit	1	2
Machine hours per unit	3	1
Set-ups in the period	10	40
Orders handled in the period	15	60

Overhead costs for the month of June are given below:

	Rupees
Machine related costs	220,000
Production run set-ups costs	20,000
Order handling costs	45,000
Total	**285,000**

Production overheads absorbed by one unit of each product using Activity based costing, is as follows:

	Product J	Product K
Machine related costs (15,000x10)/(7,000x10)	150,000	70,000
Production run set-ups costs (10x400)/(40x400)	4,000	16,000
Order handling costs (15x600)/(60x600)	9,000	36,000
Total overhead cost (A)	163,000	122,000
Units produced (B)	5,000	7,000
Unit cost (A) / (B)	**32.60**	**17.43**

W-1

Activity	Cost pool Rs.	Cost Driver	Rate per cost driver
Machine related costs	220,000	22,000 machine hours	Rs. 10 per machine hour
Production run set-ups costs	20,000	50 set ups	Rs. 400 per set up
Order handling costs	45,000	75 orders handled	Rs. 600 per order

▶ *Example 03:*

Star Limited produces three products, Sky, Moon and Sun and relevant data for the month of March 2021 is given in the following table.

	Sky	Moon	Sun
Actual units produced and sold	500,000	150,000	250,000
Machine hours per unit	0.01	0.05	0.04
Number of production set-ups	3	1	26
Number of components	8	12	20
Number of customer orders	21	4	25

The overhead cost incurred by Star Limited during the month of March 2021 is given below.

	Rupees
Machining cost	36,000
Component cost	100,000
Set-up cost	180,000
Packing cost	150,000
Total	**466,000**

Using ABC, calculation of product-wise overhead cost in total and per unit, is given below.

	Sky	Moon	Sun
Machining cost	8,000	12,000	16,000
Component cost	20,000	30,000	50,000
Set-up cost	24,000	36,000	120,000
Packing cost	63,000	12,000	75,000
Total overhead cost (A)	115,000	90,000	261,000
Units produced (B)	500,000	150,000	250,000
Unit cost (A) / (B)	**0.23**	**0.60**	**1.044**

W-1

Activity	Cost pool Rs.	Cost Driver	Rate per cost driver
Machining cost	36,000	22,500 W-2 machine hours	Rs. 1.60 per machine hour
Component cost	100,000	40 components	Rs. 2,500 per component
Set-up cost	180,000	30 set-ups	Rs. 6,000 per set up
Packing cost	150,000	50 orders	Rs. 3,000 per order

W-2 Machine hours

Products	Units produced	Machine hours per unit	Machine hours
Sky	500,000	0.01	5,000
Moon	150,000	0.05	7,500
Sun	250,000	0.04	10,000
Total			**22,500**

5. MERITS AND DEMERITS OF ACTIVITY BASED COSTING

Merits

1. The complexity of manufacturing has increased due to use of advance technologies and multiple products range, along with shorter product life cycles. Activity based costing recognizes this complexity with multiple cost drivers.
2. In competitive environment, entities must be able to assess its product profitability in more realistic manner. Activity based costing technique helped entities to absorb indirect costs into products on the basis of activities in order to calculate realistic product cost.
3. Activity based costing can be applied to all overhead costs, and not restricted to production overheads.
4. Activity based costing can be used easily in service costing as in product costing.

Demerits

1. Activity based costing will be of limited benefit if overhead costs are primarily volume related or overhead costs is not significant proportion of total costs.
2. Cost apportionment may still be required at the cost poling stage for shared items of costs like rent, depreciation of building. Apportionment can be an arbitrary way of sharing costs.
3. The cost of implementing and maintaining an activity-based costing system might exceed the benefits of improved accuracy in product or service costs.
4. This model is difficult to understand and even can create problems in implementation due to fair understanding activities and their related costs.
5. The choice of both activities and cost drivers might be inappropriate.

6. COMPREHENSIVE EXAMPLES

- *Example 01:*

Giga Incorporations is at the leading edge of paint-spraying technology. It has three customers A, B and C, who produce G-101, G-102 and G-103 products respectively. These products are finished by Giga Incorporation after final completion. Product G-101 requires 6 coats of paint, product G-102 requires 4 coats and product G-103 requires 3 coats of paint. All products are of different shapes and sizes therefore, different quantities of paint are needed. Paint is delivered in batches of various sizes, depending upon the finishing required.

Products	Litres per unit
G-101	7
G-102	5
G-103	4

Production details for each product are budgeted as follows for the coming month:

Description	G-101	G-102	G-103
Units sprayed	500	400	300
Batches of paint required	10	8	6
Machine attendant time in minutes	45	60	50
Cost of paint per unit Rs.	550	500	450

Machine attendants are paid Rs. 86 per hour.

Estimated overheads in the coming month are given below:

	Rupees
Paint stirring and quality control	50,000
Electricity	150,000
Filling of spraying machines	90,000

Cost drivers used for each activity are as follows:

Activity	Cost driver
Paint stirring and quality control	Batches of paint
Electricity	Coats of paint
Filling of spraying machines	Litres of paint

Required:

Calculate the unit cost of each product using activity-based costing.

Calculation of Cost per unit of each product

	G-101	G-102	G-103
Paint	550.00	500.00	450.00
Labour at Rs. 86 per hour	64.50	86.00	71.67
Paint stirring and quality control W-1	41.67	41.67	41.67
Electricity W-2	163.64	109.09	81.82
Filling of spraying machines W-3	94.03	67.16	53.73
Unit cost	**913.84**	**803.92**	**698.89**

W-1 Paint stirring and quality control

Description	G-101	G-102	G-103
Units (A)	500	400	300
Batches	10	8	6
Share of overheads (10:8:6)- (B)	20,833	16,667	12,500
Unit cost (B)/(A)	41.67	41.67	41.67

W-2 Electricity

Description	G-101	G-102	G-103
Units (A)	500	400	300
Coats per unit (B)	6	4	3
Total coats (A) x (B)	3,000	1,600	900
Share of overheads (30:16:9)- (C)	81,818	43,636	24,546
Unit cost (C)/(A)	163.64	109.09	81.82

W-2 Filling of spraying machine

Description	G-101	G-102	G-103
Units (A)	500	400	300
Liters per unit (B)	7	5	4
Total coats (A) x (B)	3,500	2,000	1,200
Share of overheads (35:20:12)- (C)	47,015	26,866	16,119
Unit cost (C)/(A)	94.03	67.16	53.73

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▶ *Example 02:*

Rizwan Industries has six standard products from stainless steel and brass. The company's most popular product is RI-11 and following budgeted data is given for product RI-11.

Activity	Cost driver	Cost driver volume/year	Cost pool Rs.
Purchasing costs	Purchase orders	15,000	750,000
Setting costs	Batches produced	28,000	1,120,000
Material handling costs	Material requisition	80,000	960,000
Inspection costs	Inspections	28,000	700,000
Machining costs	Machine hours	500,000	1,500,000

Rizwan manufacturing industries data relating to RI-11 for the month of July, 2021 is given below.

Description	
Purchase orders	25
Output in units	15,000
Production batch size in units	100
Material requisition per batch	6
Inspections per batch	1
Machine hours per unit	0.1

Required:

Calculate the unit overhead cost of product RI-11 using activity-based costing.

Overhead Cost per unit of Product RI-11

	Rupees
Purchasing costs (25 x 50 W-1)	1,250
Setting costs (15,000/100 = 150 x 40 W-1)	6,000
Material handling costs (6 x 150 x 12 W-1)	10,800
Inspection costs (1 x 150 x 25 W-1)	3,750
Machining costs (15,000 x 0.1 x 3 W-1)	4,500
Total overhead cost (A)	26,300
Units produced (B)	15,000
Unit cost (A) / (B)	**1.75**

W-1

Activity	Cost driver	Cost driver volume/year (A)	Cost pool Rs. (B)	Cost per driver Rs. (B)/(A)
Purchasing costs	Purchase orders	15,000	750,000	Rs. 50
Setting costs	Batches produced	28,000	1,120,000	Rs. 40
Material handling costs	Material requisition	80,000	960,000	Rs. 12
Inspection costs	Inspections	28,000	700,000	Rs. 25
Machining costs	Machine hours	500,000	1,500,000	Rs. 3

▶ *Example 03:*

JAM Enterprises, is engaged in the manufacturing of fishing equipment for fishing industry since a decade. Recently, some of other manufacturers newly entered in to the same business of JAM Enterprises. As a result, a price competitive situation has occurred in the market, to handle this situation JAM Enterprises wants to offer best prices for the products as compare to competitors; JAM Enterprises changed his costing approach to ABC, from traditional full costing approach.

The following budgeted information is related to JAM Enterprises for the forthcoming period:

Activity	Product J	Product A	Product M
Sales and production (units)	30,000	20,000	10,000
Selling price per unit	4,600	9,600	7,400
Prime cost per unit	3,100	8,300	6,400
Machine hours per unit	2.5	5.5	4.5
Labour hours per unit	7.5	3.5	3.5

The overheads that could be re-analyzed in to cost pools for the purpose of Activity based costing, are as follows:

Cost pool	Rs. 000	Cost driver	Quantity for the period
Machine services	18,400	Machine hours	230,000
Assembly services	18,150	Direct labour hours	330,000
Set-up costs	1,200	Set-ups	250
Order processing	7,200	Customer orders	16,000
Purchasing	4,004	Supplier orders	5,600

Following estimates have also been provided for the period:

Cost drivers	Product J	Product A	Product M
Number of set-ups	70	100	80
Number of customer orders	4,800	4,500	6,700
Number of supplier orders	1,800	2,200	1,600

Required:

Calculate the product-wise profit statement, using activity-based costing.

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Product-wise profit Statement

Cost drivers	Product J	Product A	Product M
	Rupees in thousands		
Sales W-1	138,000	192,000	74,000
Less: Prime costs W-2	(93,000)	(166,000)	(64,000)
Less: Overheads W-3	(22,158)	(16,728)	(10,068)
Profit	**22,842**	**9,272**	**(68)**

W-1 Sales

Products	Units	Sales price Rs.	Sales in Rs. 000
Product J	30,000	4,600	138,000
Product A	20,000	9,600	192,000
Product M	10,000	7,400	74,000

W-2 Prime cost

Products	Units	Prime cost per unit Rs.	Prime cost in Rs. 000
Product J	30,000	3,100	93,000
Product A	20,000	8,300	166,000
Product M	10,000	6,400	64,000

W-3 Overhead rate per driver

Cost Pool	Rs. In 000	Cost drivers	Quantity for the period	Rate per driver
Machine services	18,400	Machine hours	230,000	80
Assembly services	18,150	Direct labour hours	330,000	55
Set-up costs	1,200	Set-ups	250	4,800
Order processing	7,200	Customer orders	16,000	450
Purchasing	4,004	Supplier orders	5,600	715

W-4 Overhead cost

Cost drivers	Product J	Product A	Product M
Machine hours W-5 (A)	75,000	110,000	45,000
Labour hours W-6 (B)	225,000	70,000	35,000
Number of set-ups (C)	70	100	80
Number of customer orders (D)	4,800	4,500	6,700
Number of supplier orders (E)	1,800	2,200	1,600
Cost absorbed:	**Rupees in thousands**		
Machine services (A) x Rs. 80	6,000	8,800	3,600
Assembly services (B) x Rs. 55	12,375	3,850	1,925
Set-up costs (C) x Rs. 4,800	336	480	384
Order processing (D) x Rs. 450	2,160	2,025	3,015
Purchasing (E) x Rs. 715	1,287	1,573	1,144
Total overhead costs	**22,158**	**16,728**	**10,068**

W-5 Machine hours

Products	Units	Machine hours per unit	Machine hours total
Product J	30,000	2.5	75,000
Product A	20,000	5.5	110,000
Product M	10,000	4.5	45,000
Total:			**230,000**

W-6 Labour hours

Products	Units	Labour hours per unit	Labour hours total
Product J	30,000	7.5	225,000
Product A	20,000	3.5	70,000
Product M	10,000	3.5	35,000
Total:			**330,000**

STICKY NOTES

Activity based costing is alternate method of costing which involves identifying the costs of the main support activities and the factors that drive the costs of each activity. Support overheads are charged to products by absorbing cost on the basis of the product's usage of the factor driving the overheads

Indirect costs are absorbed into product costs on the basis of activities and volume, and not merely on the basis of volume

A cost pool is an activity which consumes resources and for which overheads costs are identified and allocated. Cost pool is major activity which accumulates the cost relevant to this specific activity. The term activity and cost pool are often used interchangeably.

A cost driver is a factor that influences or drives the level of cost of an activity. For example, number of batches is the cost driver as increase in number of batches will influence or drive the set-up cost.

CHAPTER 5

LABOUR COSTING

IN THIS CHAPTER

AT A GLANCE

Labour is an important element in a production cost, as most of the industries are labour intensive and labour constitutes major cost of total cost of production

Industries that are dependent on human workforce have to adopt strategies that benefit them in terms of human resource retention as well as keeping their labour cost low.

Various wage systems are designed to achieve these objectives, termed as incentive wage plans.

Management must have to monitor labour performance in terms of productivity (efficiency) and effectiveness (cost).

A quantitative method called 'Learning Curve' is used to calculate in advance the expected time to be taken by the labour when they become fully conversant with the work.

1. INTRODUCTION TO LABOUR COSTING AND LABOUR COST CONTROL

Labour cost is the second important element of the cost of production after material cost. Labour costs constitute a major portion of the total cost of a product or service that may take the form of wages, salaries and/or other incentives of employee remunerations. The profitability and growth of the entity depends greatly upon the proper utilization of the human resources that in turn needs to be properly recoded and controlled.

Most of the industries produce goods and services, requiring higher amount of labour cost and these are known as labour intensive industries. The share of labour cost in these industries is significant and therefore, labour cost control become more important. Main labour intensive industries are agriculture, mining, hospitality and food service etc.

1.1. Types of labour cost:

The labour cost has two types:

a) **Direct Labour Cost:** Direct labour cost is any cost that is specifically incurred for or can be readily charged to or recognized with any specific contract, job or work order. In cost accounting it is classified as direct labour cost which becomes part of prime cost. For example: In a watch manufacturing factory, a worker operating a molding machine to produce a part of wrist watch.

b) **Indirect Labour Cost:** Where the direct labour can be recognized with and charged to the job, the indirect labour cannot be so charged and hence is treated as part of the factory overheads. For example: Wages paid to supervisor of a factory or salary paid to driver of delivery van used for distribution of the product.

Wage payments are generally based on the productivity, time and skill or their combination. Proper control and accounting for this cost factor and motivation of worker is important in bringing efficiency to an enterprise.

▶ *For example:*

Wage payment based on productivity: Wages paid on the basis of number of units produced, like stitching 2000 pieces of shirts at Rs. 75 per piece. The wage payment based on productivity are termed as piece wage system.

Wage payment based on time: Wages paid on the basis of number of hours a worker performed his in a production line, like 160 hours paid at Rs. 175 per hour. Its normal to pay per hour and known as time-based wages.

Wage payment based on skill: A wage differentiation due to varied skills, like skilled workers are paid higher than apprentice for the same job.

1.2. Measuring labour activity:

It is important to differentiate between “production” and “productivity” while measuring labour activity.

- **Production:** Production refers to the quantity or volume of the output produced i.e. the total number of units produced. Production therefore is a measure of quantity of work.
- **Productivity:** Productivity unlike production is a measure of efficiency with which the units have been produced.

▶ *Example 01:*

Mr. X is supposed to produce six units in every hour at work. The standard productivity rate is six units per hour for every employee. During the week he made 252 units in 38 hours of work.

Required:

Calculate the productivity ratio?

▶ *Solution:*

The productivity ratio is worked out as:

The total production in the week is 252 units.

Productivity is a relative measure of the hours actually taken and the hours that should have been taken to make the output. It might be determined in either of the following two methods

Method 1:

252 units should take (252/6)	42 hours
But it took	38 hours
Productivity ratio = 42/38 x 100	110.5%

Method 2:

In 38 hours Mr. X should make (38 x 6)	228 units
But made	252 units
Productivity ratio = 252/228 x 100	110.5%

Comment: A productivity ratio greater than 100% indicates that the actual performance is better than the standard or expected level of efficiency.

1.3. Labour payment methods:

The choice of appropriate labour payment method is very important for any organization as it:

- may affect the cost of the finished products specially when it is a labour intensive organization,
- casts a major impact on the morale and efficiency of the employees and serious consideration should therefore be given to the possible motivational impact of the remuneration method being adopted.

The two widely known basic labour payment methods are time rate and piece work. These are discussed in detail below:

Time rate

Time rate/ time work or basic pay is where the employee gets paid on the basis of his time spent at work. The most common form of this type is a day-rate system.

The formula used for calculating wages under this method is:
Wages = Hours worked x Per hour pay rate

- If an employee works for more hours than the basic daily requirement or on days which do not constitute a part of the working week (e.g. Saturdays and Sundays), then he may be entitled to an **overtime payment**. The overtime hours are usually paid at a premium rate such as "time and a quarter", "time and a half" or "double-time".

  Time and a quarter for example, means that 1.25 times the basic hourly rate is paid for hours worked in excess of the basic requirement. The overtime premium is the extra rate paid over and above the basic rate.

  If employees work unsocial hours, e.g. overnight, then they are entitled to a shift premium which is quite similar to an overtime premium and means that the employees are paid at an increased hourly rate.

▶ *Example 02:*

If the basic rate of pay per hour is Rs. 6 and overtime rate is time and a half, then calculating the overtime premium for 12 hours worked in excess of the basic requirement of 8 hours per day would involve below working:

	Rs.
Basic Pay (12 x Rs. 6)	72
Overtime premium (4 x Rs. 3)	12
Total (8 x 6) + (4 x 9)	84

Piece rate system:

Under this method the employee is paid an agreed amount for each unit of output completed or for each task carried out. Output units per hour may also be an agreed upon number that is referred to as "standard hour produced". It is also normal under piecework scheme that the employees get a guaranteed minimum wage regardless of the number of units produced. This safeguards them from loss of earnings when the production is low and is not on account of their own fault.

The wages under the piecework system can be calculated as:

Wages = Units produced x Per unit pay rate

- *Example 03:*

Straight piecework with guaranteed minimum wage

Sara is paid Rs. 20 for each unit produced with a guaranteed wage of Rs. 2,000 for a 40-hour week. For a series of 4 weeks of the month she produced 140, 160, 180 and 200 units.

Required.

Calculate total wages for the month.

Solution

In order to calculate total amount for the month, please see below:

	Rs.
Week 1 [(140 units x Rs. 20) + Rs. 2000]	4,800
Week 2 [(160 units x Rs. 20) + Rs. 2000]	5,200
Week 3 [(180 units x Rs. 20) + Rs. 2000]	5,600
Week 4 [(200 units x Rs. 20) + Rs. 2000]	6,000
Total for the month	21,600

1.4. Basis of labour cost control:

Labour cost control requires analysis of labour cost with different angles and perspectives, such as, cost per hour, cost by departments, by product lines, by direct and indirect cost perspective , by rates, by jobs or processes.

Labour cost controls aim to achieve maximum efficiency without compromising the quality and effectiveness of the operations. Cost analysis and wage system help in achieving this objective.

- *Example 04:*

ABC Publishers Limited pays wages to workers working on book binding machine at the rate of Rs. 17 per book. Workers are not paid for the misaligned binding and such book is scraped for Rs. 15 per kg. The policy motivates the workers to work hard and maximize productivity. However, the rate of wastage in ABC is 3% as against industry average of 1%.

ABC re-visited the wage policy and felt that it is likely that workers tend to compromise the quality because of insignificant loss they suffer due to bad quality. It intends to bring a policy whereby a deduction of Rs. 70 will be made from the wages for each misaligned binding beyond 1% industry average. However, it is estimated that such policy will reduce the efficiency of workers because they would reduce the speed to achieve desired quality benchmark and avoid deduction.

The cost controller of ABC is supposed to work out the differential cost and revenue to evaluate the policy before implementation. For this purpose, cost controller needs precise data with reasonable accuracy about the machine capacity, labour related wastage, impact of slow speed and contribution margin per unit.

Effective labour cost control is achieved through different tools including;

- analyzing the targeted production,
- preparing labour budget and standardizing labour cost per unit,
- monitoring output, quality, wastage ratios, rework cost due to bad workmanship
- wage incentive systems.

2. MANAGEMENT OF PRODUCTIVITY AND EFFICIENCY

2.1. Labour Productivity:

Labour productivity can be described as a ratio between labour hours and units produced. Productivity may be defined as the measurement of production performance using the expenditure of human effort as a yardstick. Greater productivity can be achieved by better processes, improved or modern equipment and other factor that improves the utilization of manpower. Productivity can be measured by following formula.

$$Productivity = \frac{Actual\ Production}{Standard\ Production} x\ 100$$

2.2. Labour Efficiency:

Labour efficiency measures how efficiently workers produce a given quantity of units. It can be calculated by creating the ratio between standard hours and actual hours. Efficiency can be calculated with the help of following formula.

$$Efficiency = \frac{Standard\ hours}{Actual\ hours} x\ 100$$

Productivity can be stated in one figure, such as; in Engine Installation Department of Motor company, 3 units per 8 labour hours is the productivity of the department. In assessing efficiency, a single figure would not suffice. There should be any comparable figure, like own historical data, industry average or budgeted productivity.

If Motor company achieved 3 units per 8 labour hours' productivity in 2018 in Engine Installation Department as against 2.8 units per 8 labour hours in 2017. The department efficiently utilized its human resources in the year 2018 as compared to 2017.

Efficiency is achieved through high motivation and skills of workers and by better processes and quality of machines and tools. Improved productivity positively impacts the business profits and the earnings of workers.

It may be noted that productivity and efficiency measures generally indicate number of output as against the labour input and do not usually refer to the quality and level of bad workmanship. The quality aspect is also important to achieve the objectives of cost controls.

2.3. The importance of measuring productivity and efficiency:

In a competitive business environment where the price of a product is difficult to be controlled by the producers, the efficient utilization of resources is one of the key factors. Labour cost in many industries is so significant that its efficiency can make the difference. A producer should be able to set standards of performance in terms of hours and cost per hour or cost per unit of production.

The performance standards measure the performance in unit and rupee term and variances help the managers to focus around the problem areas.

► *Example 05:*

In a production department the performance standards for a production of 3,000 units are set as 2,000 hours at Rs. 90 per hour. If 2,200 hours are used at standard rate of Rs. 90 per hour to produce 3,000 units then there is an unfavorable labour efficiency ratio of 90.91% (2,000 /2,200). In rupee term the unfavorable variance is Rs. 18,000 computed as (100%-90.91%) x 2,200 x 90

There can be a variance as against the performance standards, which arises due to difference in wage rates. Therefore, a total variance between the performance standards and actual results is analyzed in a way that we arrive at the break up of both variances, namely, labour efficiency variance and labour rate variance. These variances will be discussed in detail in chapter "Variance Analysis".

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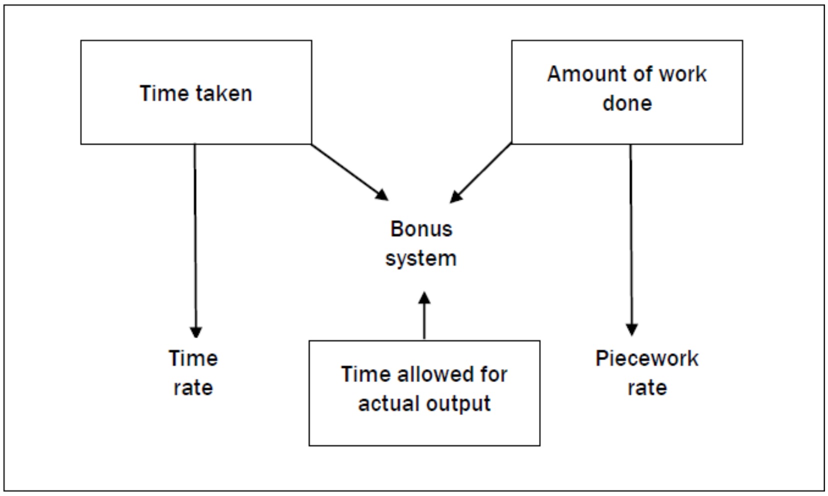
3. WAGE INCENTIVE PLANS

In the modern industrial enterprise of mass production and many employees, a worker's wage is based on various factors which includes negotiated labour contracts with union, productivity analysis, job evaluation process, profit sharing schemes and most important wage incentive plans. Initially, bonus/incentive schemes had been introduced for workers who had been working under a time-based system, in order to compensate them for their inability to increase their earnings. Wage incentive plans refer to performance linked compensation paid to improve motivation and productivity. Incentive schemes may either be short-term or long-term schemes.

3.1. Bonus Systems:

Bonus systems base workers' earnings on a combination of extra time served and work done. The indirect labour is usually paid on a weekly or monthly basis, such wages and salaries may also be increased by bonus payments.



Characteristics of bonus systems:

- A target is set and the performance is matched against that target.
- Employees feel trusted and motivated, the productivity increase and they are paid more for their increased efficiency.
- Despite of the organization's labour cost being increased in terms of bonus payments, the total unit cost of the output stands reduced and the profit per unit of sale is increased.

Note: Only those schemes should be applied, which provides benefits to both employer or employee. The employer benefit can be judged from decrease in unit labour cost whereas employee's benefit can be highlighted by higher earnings in per hour rate.

The widely known bonus/ incentive schemes are discussed in the following paragraphs.

3.2. High day-rate system:

Under a high day-rate system employees get paid at a higher than average hourly rate provided they agree to produce a given amount of product at a given quality. A target is given to employee and if employee attains target, then higher rate per hour is applied, otherwise, normal rate is applicable.

► *Example 06:*

Shahid makes 200 units in a 40-hour week if he was paid Rs. 4 per hour, but 240 units if he was paid Rs. 5 per hour.

Required

(a) Calculate the amount to be paid to Shahid in both the cases.

(b) Calculate labour cost per unit.

(c) Calculate cost per unit of output if the production overhead is recorded at the rate of Rs. 4 per direct labour hour.

(d) Write advantages and disadvantages of high day-rate system.

Solution:

a) The amount to be paid to Shahid in both the cases, would be calculated as:

				Rs.
i.	Amount to be paid to Shahid			
	a.	Under low day-rate scheme	40 hours x Rs. 4	160
	b.	Under high day-rate scheme	40 hours x Rs. 5	200

b) In order to calculate labour cost per unit, amount paid would be:

ii.	Labour cost per unit			
	a.	Under low day-rate scheme	$\frac{(40 \times 4)}{200}$	0.80/unit
	b.	Under high day-rate scheme	$\frac{(40 \times 5)}{240}$	0.833/unit

c) cost per unit of output if the production overhead is recorded at the rate of Rs. 4 per direct labour hour, would be as follows:

Cost per unit			
a.	Under low day-rate scheme	$\frac{(40 \times 8)}{200}$	1.60/unit
b.	Under high day-rate scheme	$\frac{(40 \times 9)}{240}$	1.50/unit

Comment:

Though in the given example the labour cost per unit is lower under the low day-rate scheme but the total unit cost is lower under the high day-rate scheme. Therefore, we see that the high day-rate scheme in the given scenario would reward both i.e. the employer (a lower unit cost by 10p) and employee (an extra Rs.1 earned per hour).

d) The advantages and disadvantages of high day-rate system are as follows:

Advantages

- It is easier to calculate and understand.
- It assures the employee a consistently high wage.

Disadvantages

- Employees cannot go beyond the fixed hourly rate for the extra effort they put in. In the example given above if the employee makes 280 units instead of 240 units in a 40 hours week, the cost per unit would decrease even further but all the savings would go to the benefit of the employer and none would go to the employee.
- The high wages might become the accepted wage level for normal working. Management might need to keep checks on the productivity and efficiency levels of the employees.

3.3. Individual bonus schemes:

An individual bonus scheme sets out performance objectives/targets and usually forms part of the performance appraisal systems of organizations. Every individual's bonus is calculated separately and is unique to every employee. More efficient employee gets more amount of bonus while less efficient employee might get lesser amount of bonus or even no bonus, if standard is not attained.

- *Example 07:*

Rs.100 per unit bonus is paid to an employee if he produced at least 500 units per month. If an employee achieves that performance standard, then he will be entitled to get a bonus on all units produced.

- *Example 08:*

Standard production of an employee in the Assembly department is 20 units per hour in an 8-hour day. The hourly rate is Rs. 30.

The first day of week, employee produced 150 units and on second day of week, he produced 180 units. On both days he worked for 8-hours.

Required

Calculate the earnings of employee, effective rate per hour and labour cost per unit:

(a) if bonus of 50% of time saved is applied.

(b) If bonus of 100% of time saved is paid to employee.

- *Solution*

(a) If bonus of 50% of time saved is applied, the earnings of employee, effective rate per hour and labour cost per unit is computed as under:

Day	Actual units	Standard units	Extra units	Bonus hours	Basic pay	Bonus	Total
			A	**A/ 20x 50%**	**--------------Rupees-----------**		
1	150	160	-	-	240	-	240
2	180	160	20	0.50	240	15	255

Calculation of effective rate and cost per unit on each day	Rs.
Day-1	
Effective earnings by employee per hour (240/ 8)	30.00
Cost per labour hour for employer point of view (240 / 150)	1.60
Day-2	
Effective earnings by employee per hour (255/ 8)	31.88
Cost per labour hour for employer point of view (255 / 180)	1.42

The above incentive plan is beneficial as it increases benefits to both employee and employer. From employee point of view, the effective earning rate per hour is increased from Rs. 30.00 per hour to Rs. 31.88 and from employer point of view, cost per labour hour was reduced from Rs. 1.60 per unit to Rs. 1.42 per unit.

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(b) If bonus of 100% of time saved is paid to employee; the earnings of employee, effective rate per hour and labour cost per unit is computed as under.

Day	Actual units	Standard units	Extra units	Bonus hours	Basic pay	Bonus	Total
			A	A/ 20	--------------Rupees-----------		
1	150	160	-	-	240	-	240
2	180	160	20	1	240	30	270

Calculation of effective rate and cost per unit on each day	Rs.
Day-1	
Effective earnings by employee per hour (240/ 8)	30.00
Cost per labour hour for employer point of view (240 / 150)	1.60
Day-2	
Effective earnings by employee per hour (270/ 8)	33.75
Cost per labour hour for employer point of view (270 / 180)	1.50

If bonus of time save is increased to 100%, then again the plan is beneficial as the effective earning rate per hour is increased from Rs. 30.00 per hour to Rs. 33.75 and from employer point of view, cost per labour hour was reduced from Rs. 1.60 per unit to Rs. 1.50 per unit.

3.4. Group bonus schemes:

In cases where individual efforts cannot be exactly measured and employees work as a team, individual incentive schemes become impracticable. In such scenarios, group incentive schemes are found to be more relevant and feasible. Even in cases where an individual alone cannot complete his job without the cooperation of his fellow workers, there too, group incentive schemes are given preference over the individual bonus schemes.

Group bonus plans reward all team members equally based on overall performance of the team members. It usually comes into play when individual output cannot be measured with accuracy. Therefore, team performance is evaluated on the basis of time taken to complete the job rather than output produced. Usually, the bonus earned by the group is divided among the group members in accordance with their respective base rates.

Advantages

- Group schemes reduce the clerical efforts to be put in for the calculations of individual incentive schemes.
- They are easy to be administered.
- Group schemes improve the team cohesion.

Disadvantages

- Employees might demand for minimum targets for accepting the scheme.
- Employees doing the best and the worst might fall victim to team's politics.

3.5. Profit sharing schemes:

A profit sharing scheme offers the employees a certain proportion of the organization's profits. In these schemes, there might be few conditions, and bonus is payable to employees who vests the conditions mentioned in this scheme. For example, condition is imposed by entity that only those employees are eligible for profit sharing scheme, who have completed at least one year of service with the company.

Advantages

- The biggest advantage is that the organization will pay only what it can afford to pay out of the actual profits earned. In case of low profit, low proportion of bonus is declared and paid.
- Such schemes can be offered to indirect labour and other administrative staff.

Disadvantages

- Employees may be putting in best of their efforts yet the organization might still incur losses on account of issues beyond the control of the employees.
- It is a long term commitment that the organization is asking for. The employees have to wait for the bonus until the year ends. The reward is not an immediate one.

3.6. Share incentive schemes:

A share incentive scheme is where the employees of the company are given an option to acquire the shares as an incentive. In this way the employees' morale rises so does their loyalty due to the feeling that they now have a stake in the company they work for.

4. LEARNING CURVE THEORY

4.1. Learning Effect:

Learning is the process by which an individual acquires skill, knowledge and ability. When a new product or process is started, the performance of the worker is relatively low since the job has just recently started but if it is fairly repetitive in nature then the learning phenomenon takes place. When the experience is gained, the worker is likely to become more confident and knowledgeable about the task thus the performance improves, which in turn reduces the time taken per unit and increases the productivity.

The effect that learning casts on employees, can be represented by a line called a learning curve. It displays the relationship between the production time per unit and the cumulative number of units produced. Learning curve has a direct impact on direct labour wages.

Eventually when the worker has had enough experience and nothing more is left for him to learn, then the learning process stops i.e. the learning would stop after a certain time limit and beyond specific number of units produced.

Assumptions

- The amount of time required to complete a unit of a product or a given task will decrease every time the task is undertaken.
- The unit time will decrease at a decreasing rate, and
- The time reductions will have a predictable pattern.

4.2. Learning curve theory:

The learning curve theory refers to the phenomenon that the cumulative average time required per unit will decrease by a constant percentage every time total output of the product doubles. Doubling of output is an important part of the measurements determining the learning effect. In other words, learning effect is based on Geometric progression such as 1 unit, then 2 units, then 4 units and so on.

For example, if we take 80% learning effect, the cumulative average time required per unit is reduced to 80% of the previous cumulative average time when the output is doubled. Note that the cumulative average time is the average time per unit for all units produced till now, inclusive of the first unit made.

4.3. Importance of Learning curve effect:

Learning curve theory helps users to predict how much time is required to complete the future tasks. It is helpful in determination of realistic cost of labour and is also useful in planning, control and decision-making. In pricing decisions, it is extremely important to know the average time incorporating the learning effect, otherwise, cost will be higher if it is based on first unit which requires maximum time. In planning and control, learning curve is also important because in standard costing, cost of one unit is calculated. If the learning effect is ignored, then standard cost will be overstated, resulting unrealistic variances at period end.

4.4. Methods of learning curve:

The learning effect can be calculated with the help of two methods:

1. Tabular Method
2. Mathematical Method

► *Example 09:*

If the first unit of output requires 100 hours and a 70% learning effect occurs, then determine the production times for:

- Total production
- Incremental total hours
- Incremental hours per unit

Cumulative no. of units produced		Cumulative avg. time/unit		Total Time	Incremental time		
					Total time		Time per unit
		Hours		Hours	Hours		Hours
1		100.0	(x1)	100			
2	(70%)	70.0	(x2)	140	40	÷ 1	40
4	(70%)	49.0	(x4)	196	56	÷ 2	28
8	(70%)	34.3	(x8)	274.4	78.4	÷ 4	19.6

- *Formula:*

Y = axb

Where

Y = cumulative average time per unit to produce x units

a = the time taken for the first unit of output

x = the cumulative number of units produced (output)

b = the learning curve factor (i-e. log LR/log2)

LR = the learning rate as a decimal

- *Example 10:*

Find the value of b when a 90% learning curve effect takes place.

- *Solution*

b = log 0.9/log 2

= -0.0458/0.3010

= -0.152

- *Example 11:*

Calculate labour time to produce 50 units assuming learning rate of 80% will continue till first 30 units. Time taken to produce first unit is 10 hours.

- *Solution*

First calculate total time required to produce first 30 units.

$$Y = aX^b$$

Whereas b = log 0.80/log 2

= -0.3219

$$Total\ time\ to\ produce\ 30\ units = 10\ x\ 30^{-0.3219}\ x\ 30$$

= 100.38 hours

The next 20 units will take equal time per unit and will be equal to time taken by 30th unit.

The calculation of time taken by 30th unit is calculated by difference between total time for 30 units (as calculated above) and total time for 29 units.

$$Total\ time\ to\ produce\ 29\ units = 10\ x\ 29^{-0.3219}\ x\ 29$$

= 98.10 hours

Hence, time taken to produce 29th unit is 2.28 hours (100.38-98.10).

Total time required to produce next 20 units (2.28 x 20) = 45.60 hours

Labour time to produce 50 units (100.38+45.60) = 145.98 hours

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5. RECORDING AND ACCOUNTING FOR LABOUR COST

5.1 Recording labour costs

There are various departments within an organization that are involved in collecting, recording and costing of labour. The procedures involve production planning, time and motion study, timekeeping, labour budgeting, etc. A brief detail of the departments involved and procedures performed by them in the due process is discussed below.

Human Resource department

The HR department is primarily responsible for the hiring of employees, engaging them, their transfer, departure and termination etc. This department maintains employees' records and issues the reports for the management to facilitate the decision making process of HR related issues.

Production Planning department

The Production Planning department schedules work, issues the job orders to production departments and chases up jobs in the factory when they run late.

Time keeping department

The timekeeping department keeps track of the time spent in the factory by each worker and the time spent by each worker on each job. The time keeping activity might be carried out using any of the following tools with reference to the relevance and importance to the nature of activity.

- **Daily time sheets:** The daily time sheet is filled in by the employee on everyday basis. It will record how his/ her time in the factory has been spent. The total time on the sheet should however correspond to the record on the attendance form.

- **Weekly time sheets:** They are similar to the daily time sheets but are sent to the cost office towards the end of every week.

- **Job cards:** Job cards are job specific and are prepared for every job or batch separately. In a time sheet the worker if engaged with many jobs will have several entries related to the respective jobs wherein in case of job cards, each job card will contain the detail of activities carried out by the employee in respect to that specific job only.

- **Piecework or operation card:** A Piecework ticket contains the record of total number of items produces by the employee and the total number of the units rejected. Payment would be made for only the items that are as per the required standards.

Cost accounting department

The cost accounting department accumulates and classifies all the data related to the labour costs. The information is then shared with the management to help determine the control measures if required.

5.2 Journal entries for recording labour costs

The primary journal entry for payroll is the summary-level entry that is compiled from the payroll register and which is recorded in either the payroll journal or the general ledger. This entry usually includes debits for the direct labour expense, salaries and the company's portion of payroll taxes. There will also be credits to the liability for payroll taxes that have not been paid, as well as for the amount of cash already paid to employees for their net pay. The basic entry (assuming no further breakdown of debits by individual department) is:

(i) to record the total wages earned		
	Debit	**Credit**
Payroll	xxx	
Accrued Payroll tax		xxx
Payroll advances		xxx
Payroll deductions		xxx
Accrued Payroll		xxx
(ii) to record payment of the payroll		
	Debit	**Credit**
Accrued Payroll	xxx	
Cash/Bank		xxx
(iii) To record the closure of the Payroll account		
	Debit	**Credit**
W-I-P – Direct Labour	xxx	
FOH – Indirect Labour	xxx	
Selling Expenses Control a/c – Sales Salaries	xxx	
Administrative Expenses – Office Salaries	xxx	
Payroll		xxx

AT A GLANCE

SPOTLIGHT

STICKY NOTES

6. COMPREHENSIVE EXAMPLES

- *Example 01:*

Quality Plastics Limited (QPL) produces plastic bodies of various appliances according to the customers' specifications. It has received an order for supply of 10,000 plastic bodies of a washing machine. The supply is to be made within 30 days.

The following information is available:

i. QPL carries out production process in batches of 100 units each. Cost of the first batch is estimated as under:

	Rupees
Direct material (inclusive of 10% input losses) - 1,100 kg	66,000
Direct labour cost at normal rate - 200 hours	44,000
Overheads at normal rate 200 hours	30,000

ii. It is estimated that due to learning curve effect, completion of the first, second, third and fourth batch would require 200, 160, 148 and 140 hours respectively.

This learning effect would continue till completion of 64 batches only.

Learning effect at various learning levels is as under:

80%	85%	90%
−0.322	−0.235	−0.152

iii. It is estimated that after completion of the first 16 batches, material input losses would be reduced from 10% to 6%.

iv. QPL works a single shift of 8 hours per day. For the above order, QPL can spare 8,000 direct labour hours. Overtime hours can be worked at 1.5 times the normal rate. During the overtime hours, overheads would be 1.25 times the normal rate.

Required

Calculate the price that QPL should quote in order to earn a margin of 25% of the selling price.

- *Solution*

The price that QPL should quote in order to earn a margin of 25% of the selling price would be computed as follows:

Material	**Rs.**
First 16 batches (16 x 66,000)	1,056,000
Next 84 batches 84 x (66,000 x 0.90/0.94)	5,308,085
Direct labour cost	
Normal hours (8.000 x 220)	1,760,000
Overtime hours (2,079 W-1 x 220 x 1.50)	686,070
Overheads	
Normal hours (8,000 x 150)	1,200,000
Overtime hours (2,079 W-1 x 150 x 1.25)	389,813
Total costs	10,399,968
Order price at a margin of 25% of the selling price	13,866,624

W.1: Learning curve %:			
Batch No.	**Cumulative hours**	**Average hours per batch**	**Learning curve %**
1	200.00	200.00	
2	(200+160) 360.00	180.00	(180/200) 90%
4	(360+148+140) 648.00	162.00	(162/180) 90%
Hours for first 64 batches		64*200*(64)-0.152	6,803
Hours for first 63 batches		63*200*(63) -0.152	(6,712)
Hours per batch after 63rd batch			91
Hours required:			
First 64 batches			6,803
Last 36 batches		(91×36)	3,276
Total hours			10,079
Overtime hours		(10,079 – 8,000)	2,079

► *Example 02:*

Smart Processing Limited (SPL) is considering to sign a contract for manufacturing 10,000 auto parts for a large automobile assembler. The parts would be produced in batches of 500 units each. The estimated cost of the first batch is as under:

	Rupees
Direct material (kg)	135,000
Direct labour (1,500 hours)	225,000
Variable overheads (Rs. 120 per direct labour hour)	180,000
Set-up cost per batch	40,000
Fixed costs:	
- Depreciation of equipment purchased for the project	45,000
- Allocation of existing overheads @ Rs. 16 per hour	24,000
Cost of first batch	649,000

Additional information:

i. The set-up cost per batch would be reduced by 5% for each subsequent batch. However, there would be no further reduction in the set-up cost from the 5th batch onward.

ii. Learning curve effect is estimated at 90% but would remain effective for the first eight batches only.

iii. The index of 90% learning curve is -0.152.

Required

Compute the contract price that would enable SPL to earn an incremental profit of 30% of the contract price.

AT A GLANCE SPOTLIGHT STICKY NOTES

▶ *Solution*

The contract price that would enable SPL to earn an incremental profit of 30% of the contract price would be computed as follows:

Computation of contract price				**Rupees**
Cost of material			135,000×20	2,700,000
Direct labour cost:				
- For the first 8 batches	(W-1)	8,748		
- For the last 12 batches	(W-1) 937×12	11,244		
		19,992	×150	2,998,800
Variable overheads		19,992	×120	2,399,040
Batch set-up cost:				
- For the first 4 batches	40,000+[40,000×(0.95)¹]+[40,000×(0.95)²]+[40,000×(0.95)³]			148,395
- For the last 16 batches			[(40,000×(0.95)³)]×16	548,720
Fixed costs:				
- Depreciation on equipment purchased for the project			45,000×20	900,000
- Allocation of existing fixed overheads			Irrelevant cost	-
Total incremental cost of the contract			A	9,694,955
Contract price			(A÷70%)	13,849,936

W-1: Direct labour hours per batch for batch 9 onward:		**Hours**
Direct labour hours for the first 8 batches	$8 \times 1{,}500 \times (8)^{-0.152}$	8,748
Direct labour hours for the first 7 batches	$7 \times 1{,}500 \times (7)^{-0.152}$	(7,811)
Hours per batch for 8th and onward batches		937

▶ *Example 03:*

Toy Limited is engaged in the production of a single product. On the basis of past history, the management has estimated the cost of production per unit, as follows:

	Rupees
Raw material – 5 kg @ Rs. 40 per kg	200
Labour – 10 hours @ Rs. 25 per hour	250
Variable overheads – 60% of direct labour	150
Total	600

The annual production requirement is 100,000 units.

AT A GLANCE SPOTLIGHT STICKY NOTES

The management has been deeply concerned with the performance of its labour as it has been witnessing various inefficiencies. The industrial relations department has recently carried out a study under the guidance of a consultant. It has put forward a plan whereby the company's wage policy is to be revised as under:

- Rate of wages would be increased by 12%.
- Workers who perform their tasks in less than the estimated time of 10 hours per unit would be given a premium of Rs. 18 per hour saved.

The consultant is of the view that the following efficiencies can be brought about by introducing the above change:

(i) Raw material input per unit includes wastage of 7%. It would reduce to 3%.

(ii) 70% of the workers would work more efficiently and improve their efficiency by 20%.

(iii) Overheads will be reduced to 55% of the revised cost of direct labour (including premium).

(iv) The quality of production will improve and the rate of rejection will be reduced from 4% to 3%. Rejected units are sold for Rs. 150 each.

Required

Determine that the wage plan recommended by the industrial relations department would be beneficial for the company or not.

▶ *Solution*

Determination of wage plan recommended by the industrial relations department whether it would be beneficial for the company or not, would be calculated as under:

Net benefit from proposed plan

	Rupees
Savings in raw material consumption W-1	824,000
Increase in labour cost W-2	(1,600,000)
Savings in overheads W-3	370,000
Decrease in rejections W-4	470,742
Net Savings	**64,742**

W-1 Raw material consumption

	Rupees
Raw materials consumption per unit – current-	5.000
Present wastage (5 x 7/100)	(0.350)
Raw materials forming part of finished goods	4.650
Raw materials consumption per unit as revised (4.650/0.97)	4.794
Savings in raw material consumption (5.000-4.794) x 100,000 x 40	824,000

W-2 Labour cost

	Rupees
Labour hours – current	10.00
Saving in labour hours due to efficiency (10 x 70% x 20%)	(1.40)
Labour hours – revised	8.60
Labour cost: Revised wages (8.60 x 25 x 1.12)	240.80
Premium on hours saved (1.40 x 18)	25.20
Revised labour cost per unit	266.00
Increase in labour cost (Rs. 266-250) x100,000	1,600,000

W-3 Overheads

	Rupees
Current overheads per unit	150.00
Revised overheads per unit (266 x 0.55)	146.30
Saving in overheads (150-146.30) x 100,000	370,000

W-4 Rejections

	Rupees
Present rejections {(100,000/0.96)-100,000}	4,167
Rejections in the new situation {(100,000/0.97)-100,000}	3,093
Present cost of rejections of 4,167 units @ Rs. 450 (600-150)	1,875,150
Revised cost of rejection for 3,093 units: {(4.794 x 40)+266+146.30-150} x 3,093	1,404,408
Decrease in rejection (1,875,150-1,404,408)	470,742

▶ *Example 04:*

Pakair Limited manufactures special tools. Information pertaining to payroll costs for the month of April 2010 is as under:

Department	Gross salaries excluding overtime	Overtime	Income tax deductions
	Rupees in thousands		
Machining	1,000	75	25
Assembly	400	40	15
Tool-room	25	5	-
Warehouse	75	15	-

Details of other benefits are as under:

(i) 35 paid leaves are allowed per year including annual, casual and sick leaves.

(ii) Annual bonus equal to one month salary is paid in June.

(iii) The company maintains a contributory Provident Fund in which 8.33% of the monthly salary is contributed by the employer as well as the employees.

(iv) During April 2010, the employees availed leaves that cost Rs. 85,000.

(v) Advances paid and recovered during the month amounted to Rs. 17,000 and Rs. 28,000 respectively.

(vi) The company follows a policy of accruing bonus and paid leaves on a monthly basis.

Required.

Make Journal entries to record pay roll and its disbursement.

▶ *Solution*

The journal entries to record pay roll and its disbursement are given below:

Journal Entries	Debit	Credit
	Rupees in '000	
Payroll expense (W-1)	2,030.83	
Provision for vacations pay (vacations availed during the month)	85.00	
Payroll payable (1,635-193+85)		1,527.00
Contribution to provident fund payable (Co. & employees)		250.00
Provision for bonus		125.00
Provision for vacation pay		145.83
Employees' income tax payable		40.00
Advance against salary		28.00
(To record payroll cost, liability and provisions)		
Work in process (1,338.88+545.56)	1,884.44	
Factory overheads (36.60+109.79)	146.39	
Payroll expenses		2,030.83
(To allocate payroll cost to WIP and factory overheads)		
Advance against salary	17.00	
Payroll payable	1,527.00	
Contribution to provident fund payable (Co. & employees)	250.00	
Employees' income tax payable	40.00	
Bank		1,834
(To record disbursement of payroll and payment of liabilities)		

W-1 Calculation of payroll

Cost	Machining	Assembly	Tool room	Stores	Total
	WIP		**Overheads**		
	Rupees in '000				
Payroll cost (A)	1,000.00	400.00	25.00	75.00	1,500.00
Overtime	75.00	40.00	5.00	15.00	135.00
	1,075.00	440.00	30.00	90.00	1,635
Employer's contribution to PF (A x 0.833)	83.33	33.34	2.09	6.25	125.00
Provision for year-end bonus (A/12)	83.33	33.34	2.09	6.25	125.00
Provision for paid vacation (A x 35/360)	97.22	38.89	2.43	7.29	145.83
	1,338.88	545.56	36.60	109.79	2,030.83

Cost	Machining	Assembly	Tool room	Stores	Total
Deductions from employees:					
Employee income tax	25.00	15.00	-	-	40.00
Employees' contribution to PF (A x 0.833)	83.33	33.33	2.08	6.25	125.00
Salary advance recoveries					28.00
	108.33	48.33	2.08	6.25	193.00

- *Example 05:*

Zircon Limited (ZL) manufactures and supplies footballs for both domestic and international markets. Following information is available from the company's records.

Number of skilled workers	250
Standard working hours per month	200
Actual hours per unit of product	1.5
Standard labour rate per hour (Rupees)	42
Variable overhead rate per labour hour (Rupees)	75

The company manufactures 40,000 footballs per month. Overtime is paid to the workers at the rate of 75% over and above the standard wage rate.

In order to increase the production efficiency and reduce the cost of conversion, the management is currently evaluating various wage incentive plans. The production manager has suggested the following options to the management.

Option 1: Introduce a piece wage system at the rate of Rs. 72 per unit. It is expected to improve the current production efficiency from 65% to 78%.

Option 2: Introduce a monthly group bonus plan with a guaranteed wage of Rs. 48 per hour based on a standard 1.4 hours per unit of product. This plan is expected to reduce the overtime by 60%.

Required

Evaluate the above options in contrast with the existing schemes and advise management about most economical option.

- *Solution*

The evaluation of above options in contrast with the existing schemes along with advise to management about the most economical option is given below:

Conversion cost under existing scheme

Conversion cost	Rupees
Normal hours (50,000 × Rs. 42)	2,100,000
Overtime hours (10,000 W-1 × Rs. 73.50)	735,000
Total labour cost	2,835,000
Variable overhead (60,000 × Rs. 75)	4,500,000
Total conversion cost	7,335,000

Conversion cost under option 1

Conversion cost	
No. of hours required per unit (1.5 × 0.65/ 0.78)	1.25
Total no. of hours required (40,000 × 1.25)	50,000
	Rupees
Piece wages (40,000 × 72)	2,880,000
Variable overhead (50,000 × 75)	3,750,000
Total conversion cost	6,630,000

Conversion cost under option 2

Conversion cost	Hours
Labour hours available (250 × 200)	50,000
Overtime hours (10,000 × 40%)	4,000
Total labour hours	54,000
Standard hours allowed for the bonus plan (40,000 × 1.4)	56,000
	Rupees
Guaranteed wages (56,000 × 48)	2,688,000
Variable overhead (54,000 × 75)	4,050,000
Total conversion cost	6,738,000

Recommendation: By implementing option 1 the conversion cost would be reduced to Rs 165.75 per unit from the existing Rs. 183.38 per unit. The workers would be paid Rs. 2.880 million which is better than option 2. The workers would certainly try to earn this amount in the least possible time.

Therefore, option 1 would be the most economical choice for both the workers and the management.

W-1 Overtime hours

	Hours
No. of labour hours required (40,000 × 1.5)	60,000
Labour hours available at standard rate (250 × 200)	50,000
Overtime hours	10,000

- *Example 06:*

a) The following information relates to a week's work for three employees:

	Employee A	Employee B	Employee C
Output (units)	160	276	68
Time allowed (hours per unit)	0.5	0.25	0.75
Basic hourly wage rate (Rupees)	80	100	70
Hours worked as direct labour	48	54	30
Hours worked as indirect labour	-	-	12

The normal working week is 42 hours. For the first six hours, overtime is paid at 50% above the normal rate. Any further overtime is paid at double the normal rate. Bonus is paid at three-fifth of the normal rate for the hours saved.

Required:

a) Calculate total wages of each employee.

b) Make a summary of payroll of LMN Factory Limited for the month of February 2014.

c) Make journal entries to record payroll cost for the month of February 2014.

▶ *Solution*

a) Total wages of each employee is calculated below:

Particulars	Employee A	Employee B	Employee C
Hours worked	48	54	42
Normal hours per week	42	42	42
Overtime hours	6	12	-
Normal wages (48×80), (54×100), (42×70)	3,840	5,400	2,940
First six overtime hours (6×80×50%), (6×100×50%)	240	300	-
Overtime hours > 6 hours (6×100)	-	600	-
Total wages in Rs. (A)	4,080	6,300	2,940
Bonus amount			
Hours allowed (160×0.5), (276×0.25), (68×0.75)	80	69	51
Direct hours worked	48	54	30
Bonus hours earned/Time saved	32	15	21
Hourly bonus rate - at three fifth of the normal rate	(80×3/5)=48	(100×3/5)=60	(70×3/5)=42
Bonus in Rs. (B)	1,536	900	882
Total wages in Rs. (A + B)	5,616	7,200	3,822

b) The following is a summary of payroll of LMN Factory Limited for the month of February 2014:

	Rupees
Basic salary	420,000
Allowances	147,000
Gross salary	567,000
Deductions :	
Loans to staff	(13,000)
Income tax	(15,500)
Employees' provident fund contribution	(35,000)
Net salary	503,500

The company is also required to pay the following:

- Company's contribution to the provident fund which is equal to employees' contribution
- 5% of the basic salary to a government organisation.

c) Journal Entries to record payroll cost for the month of February 2014 are given below:

Journal Entries	Debit	Credit
	Rupees	
Salaries	420,000	
Allowances	147,000	
Loans to staff		13,000
Staff income tax payable		15,500
Trustees- provident fund payable		35,000
Salary payable/bank		503,500
(Payroll for the month of February 2014)		
Co's contribution to provident fund	35,000	
Trustees- provident fund payable		35,000
(Being Co. contribution to PF for February 2014		
Contribution to the Government organization	21,000	
Account payable - Government organization		21,000
(Amount payable to a government organisation at 5% of basic salary for February 2014)		

STICKY NOTES

Labour cost is measured with respect to 'Production' and 'Productivity'

Labour intensive industries tend to develop labour and production designated wage policies

Labour performances are worked out at each period end to analyze the cost and productivity outcome

Learning curve is used to quantify the expected output in the expected time

Payroll account generally includes debit for direct labour expense, salaries and the company's portion of payroll taxes. Credit would be liability or amount of cash paid to the employees.

CHAPTER 6

COST FLOW IN PRODUCTION

IN THIS CHAPTER

AT A GLANCE

Accounting is a systematic process of identifying, recording, measuring, classifying, verifying, summarizing, interpreting and communicating financial information

Cost accounting is primarily about costing of the product and Management accounting is all about Planning, Control and Decision Making.

Accounting for the production of inventory mirrors the cost flow from Raw Material accounts, wages control account, Production overhead control account to WIP account and then to finished goods and P&L account.

Integrated accounts combine both financial and cost accounts in one system of ledger accounts. Interlocking systems contain separate cost accounting and financial accounting ledgers.

1. ACCOUNTING FOR INVENTORY

There are two main methods of recording inventory.

- Periodic inventory method (period end system)
- Perpetual inventory system

Each method uses a ledger account for inventory but these have different roles.

Periodic inventory method

In periodic inventory method, inventory is measured at period-end on the basis of physical count and no record is maintained in the form of stock ledger card. At year-end, closing inventory is valued and recorded in books. In this system, opening inventory in the trial balance (a debit balance) and purchases (a debit balance) are both transferred to cost of sales thus clearing both accounts.

Closing inventory is recognized in the inventory account as an asset (a debit balance) and the other side of the entry is a credit to cost of sales. Cost of sales comprises purchase in the period adjusted for movements in inventory level from the start to the end of the period.

Cost of sales = Opening inventory + Purchases (net) – Closing inventory.

Perpetual inventory method

In perpetual inventory method, stock ledger is maintained showing movements of inventory at the time of occurrence. Inventory account is maintained and all movements in inventory is recorded in it. The inventory account is used to show the current cost of inventory in hand. In this type of accounting, a separate account for purchases is not maintained as part of double entry records. The account is also used to record all issues out of inventory. These issues constitute the cost of sales.

When the perpetual inventory method is used, when inventory is bought, it is debited to inventory account but when it is sold, inventory is credited and cost of sales is debited.

Each issue of inventory is assigned a cost, and the cost of the items issued is either the actual cost of the inventory (if it is practicable to establish the actual cost i.e. the inventory is individually identifiable) or a cost obtained using a valuation method.

Each receipt and issue of inventory is recorded in the inventory account. This means that a purchases account becomes unnecessary, because all purchases are recorded in the inventory account. Though a separate detail of purchases may be maintained for vendor documentation purposes.

All transactions involving the receipt or issue of inventory must be recorded, and at any time, the balance on the inventory account should be the value of inventory currently held. Though there is no need for inventory count but one at the end of each period is conducted to maintain control over the integrity of records.

1.1 Accounting for the production of inventory

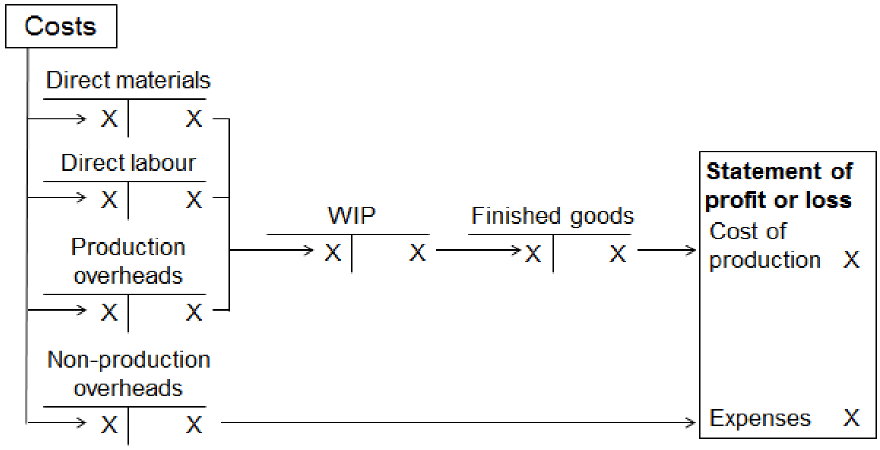
Cost Flow

Cost flow represents movement of cost and inventories through various ledgers until cost are sold and closed to cost of sales. In this chapter, we will discuss how three elements of cost (Material, Labour and Production overheads) combine to compute cost of sales.

As a simple starting point:

- For a retail company, the cost of goods sold is simply the purchase price of the goods.
- For a manufacturing company, the cost of goods sold is the total production cost including direct materials, direct labour and production overheads. The accounting systems must identify these costs and then transfer them into finished goods (usually via work-in-progress) and thus into cost of sales.

▶ *Illustration: Cost flow*



This diagram implies that cost accounting can be studied as a series of steps:

Step No.	Stage of inventory	Accounting treatment
1.	The inventory is purchased	Recognize costs in appropriate cost accounts
2.	The inventory is issued to the production process	Transfer costs from the cost accounts into work-in- progress
3.	Finished products are obtained at the end of manufacturing process	Transfer costs from work-in-progress into finished goods
4.	Finished goods are sold	Transfer costs from the finished goods account into the statement of profit or loss (income statement) to become part of cost of sales

1.2 Explanation of Inventory ledgers

Raw materials

Raw materials ledger is inventory account and it shows the inventory movement. When raw material is purchased it is debited and when material is issued, it is credited and transferred to work in progress account. The balance at year end represents raw material inventory on hand and is shown in statement of financial position.

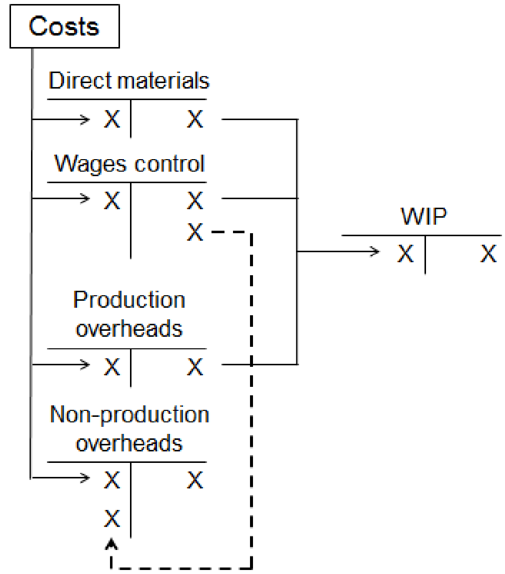
Work in progress

Work in progress is another inventory account in manufacturing concern and it shows that goods are in progress. It includes direct labour cost and absorbed production overheads, in addition to direct materials transferred from raw material ledger. The work completed during the year is credited to work in progress and transferred to Finished goods. The year-end balance of work in progress is production cost which is not yet completed and shown as inventory in statement of financial position.

Finished goods

Finished goods is third inventory account which is maintained by manufacturing concern. This account is debited by amount transferred from work in progress and represents completed goods. When the goods are sold, finished goods account is credited and ultimately transferred to cost of sales, to complete the cost flow. The year-end balance represents unsold goods and treated as inventory which is shown in statement of financial position.

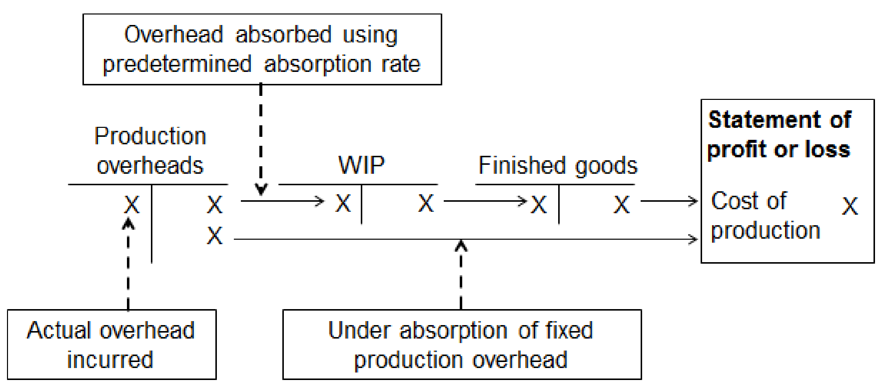
- *Illustration: Cost flows showing reclassification of non-production wages*



Over (under) absorption of fixed production overhead

The fixed production overheads account is debited with the actual fixed production overhead incurred in the period. Fixed production overheads are transferred into WIP using a pre-determined absorption rate (as discussed in chapter 3 earlier). The difference between the absorbed overhead and the actual overhead is over (under) absorption. This must be adjusted in the statement of profit or loss.

- *Illustration:*



- *Example 01*

A company manufactures and sells a range of products in a single factory. Its budgeted production overheads for Year 6 were Rs.150,000, and budgeted direct labour hours were 50,000 hours.

Actual results in Year 6 were as follows:

	Rs.	
Direct materials costs	130,000	
Direct labour costs	160,000	
Fixed production overhead	140,000	(40,000 hours)

There was no opening or closing inventory at the beginning or end of Year 6.

The company uses an absorption costing system, and production overhead is absorbed using a direct labour hour rate.

The information would be accounted for as follows.

Recognition of costs		
	Debit	Credit
Materials control	130,000	
Salaries & Wages control	160,000	
Production overhead control	140,000	
Cash/payables		430,000

Transfer of costs into work-in-progress

	Debit	Credit
WIP	130,000	
Materials control		130,000
WIP	160,000	
Salaries & wages control		160,000
WIP (see working below)	120,000	
Production overhead control		120,000

Working

The predetermined absorption rate is Rs.150,000/50,000 hours = Rs.3 per direct labour hour.

Therefore, the amount transferred = Rs. 120,000 (40,000 hours × Rs. 3)

Transfer of costs from work-in-progress into finished goods

	Debit	Credit
Finished goods	410,000	
WIP		410,000

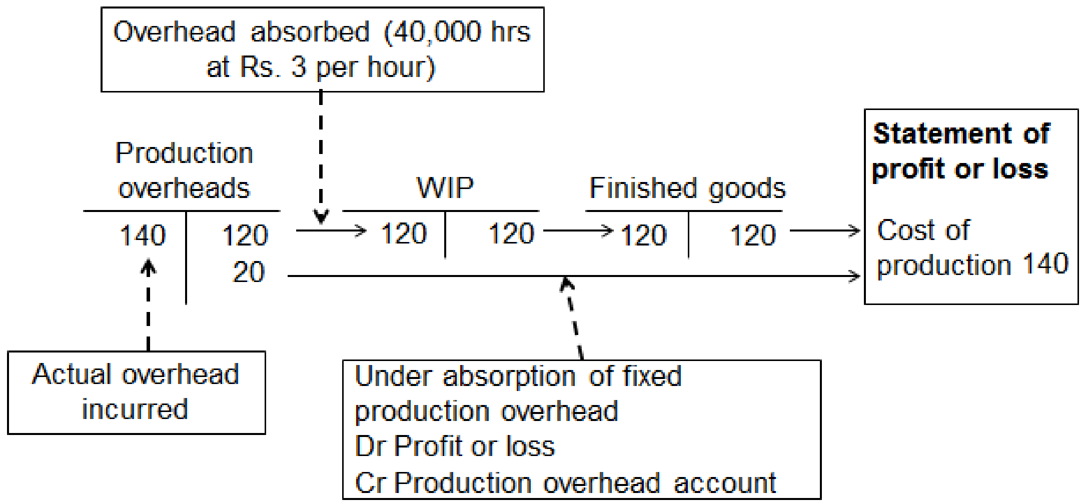
Accounting for under-absorption of fixed production overhead

	Debit	Credit
Statement of profit or loss (see working below)	20,000	
Production overhead control		20,000

Working: Under absorption

	Rs.
Overhead absorbed (40,000 hours @ RS. 3 per hour)	120,000
Overhead incurred (actual cost)	(140,000)
Under absorption of overheads	(20,000)

This can be represented (in part) by the following diagram (figures in Rs. 000)



1.3 Accounting entries in the cost accounting system

The following suite of journals describes the typical accounting entries that might be posted within a cost accounting system that uses perpetual inventory system.

Journals to recognize expenses as incurred

Entries related to raw materials		
	Debit	**Credit**
Purchase of raw materials		
Inventory control (raw materials)	X	
Payables (or cash)		X
Issue of raw materials to production		
Work in progress control (Direct materials)	X	
Production overhead control (Indirect materials)	X	
Inventory control (raw materials)		X
Return of raw materials from production to store		
Inventory control (raw materials)	X	
Work in progress control (Direct materials)		X
Production overhead control (Indirect materials)		X
Raw materials returned to vendor		
Payables (or cash)	X	
Inventory control (raw materials)		

Entries related to labour		
	Debit	Credit
Preparation of payroll		
Salaries & wages control	X	
Deductions		X
Accrued salaries & wages control		X
Payment of payroll		
Accrued salaries & wages control	X	
Cash		X
Transfer of salaries & wages to proper head of accounts		
Work in progress control (direct labour)	X	
Production overhead control (indirect labour)	X	
Administrative cost	X	
Selling & marketing cost	X	
Salaries & wages control		X
Recording of employer's contribution		
Production overhead control	X	
Administrative cost	X	
Selling & marketing cost	X	
Contribution payable		X

Entries related to Production overheads		
	Debit	Credit
Recording of actual production overheads		
Production overheads control	X	
Payables or cash or accumulated depreciation		X
Absorbed production overheads to product cost		
Work in progress control	X	
Production overheads control		X
Close under or over absorbed overheads		
In case of under absorbed overheads		
Cost of sales (Income statement)	X	
Production overheads control		X

Transfer of completed goods to finished goods		
	Debit	**Credit**
Transfer of costs on completion of production		
Finished goods inventory	X	
Work in progress control		X
Entries when goods are sold		
	Debit	**Credit**
Recording of sales		
Accounts receivables (or cash)	X	
Sales		X
Recording of cost of sales		
Cost of sales	X	
Finished goods inventory		X
Closing entries		
	Debit	**Credit**
Close Cost of sales		
Income statement	X	
Cost of sales		X
Close sales account		
Sales	X	
Cost of sales		X

2. COST BOOKKEEPING SYSTEMS

Cost book-keeping systems can be categorized into two types in terms of how the cost accounts relate to other ledger accounts. These two systems are called:

- integrated accounts;
- interlocking accounts.

2.1 Integrated accounts

Integrated accounts can be defined as

- A single set of accounting records that provide financial and cost accounts using a common input of data.
- A system where all information (both financial and costing) is kept in a single set of books.

As the name suggests, the cost accounts are integrated into the entity's bookkeeping system. There is a single general ledger which includes the cost accounts.

Double entry is simply the normal double entry associated with maintaining a set of accounts including the entries described above.

In practice most companies and ERP solutions available in the market use integrated accounting system.

Advantages of integrated accounts

- This system avoids duplication of effort between cost and financial accounting systems, by eliminating unnecessary duplicate record.
- There is no need to reconcile the profits of cost and financial accounting, as single set of accounts calculates profits for both.
- This system helps to reduce the cost of keeping two separate set of accounts.

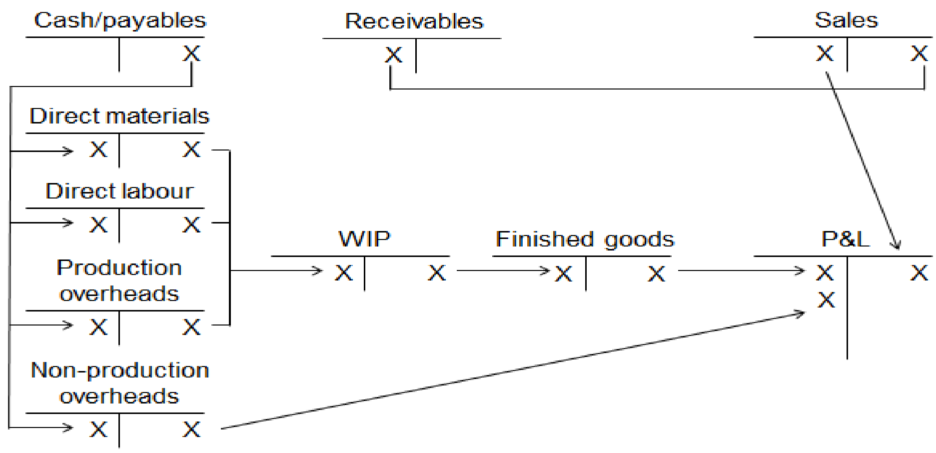
Disadvantages of integrated accounts

- Using a single system for external reporting and the provision of management information reduces flexibility. For example, inventory must be valued at full absorption cost for external reporting purposes (in accordance with IAS 2: *Inventories*) but management might require marginal cost information for decision making.
- The system causes delay in providing information to management. Since this system is developed to provide information to both financial and cost accounting, it might get complicated.
- This system creates difficulty for large entities which require detailed cost and financial information on on-going basis.

▶ *Illustration:*

This diagram shows the various ledger accounts and accounting entries used within integrated accounts.

Chart of accounting flow in an integrated accounts system



The direct materials account above might be named differently, for example, raw materials a/c, inventory (raw materials) a/c, stores etc. Similarly, the WIP account might be described as inventory (WIP) a/c and the finished goods account as inventory (finished goods) a/c.

The above diagram does not show it but there may well be a need for an entry to account for Over (under) absorption of fixed production overhead as explained earlier in this chapter (section 1.5).

Profit or loss is calculated in the usual way as the balance on the P&L account. The balance would be transferred to the accumulated profit account (retained earnings account).

2.2 Integrated accounts: Comprehensive illustration

The following illustration applies the accounting entries to ledger accounts for a comprehensive example.

The following balances and transactions relate to a manufacturing company.

Opening inventories	raw materials	10,000kg	Rs.25,000
	work in progress	nil	
	finished goods	1,000 units	Rs.100,000
Materials	Purchases	28,000 kg	Rs.77,000
	issues to production	30,000kg	FIFO
Labour	Paid	16,000 hours	Rs.96,000
	Direct labour	15,000 hours	
Production overhead			Rs.250,000
Standard overhead rate per hour			Rs.20
Completed production		4,000 units	
Closing inventories	raw materials	see above	
	work in progress	nil	
	finished goods	500 units	FIFO
Sales revenue		see above	Rs. 540,000

The Journal entries of above transactions are given below:

Entries related to materials	**Debit**	**Credit**
Materials Control	77,000	
Payables		77,000
(Purchases of raw materials)		
Work in progress control W-1	80,000	
Materials Control		80,000
(Direct materials issued to production)		
W-1 Material issues on FIFO basis	**Rupees**	
From opening inventory-10,000 kg	25,000	
From current purchase- 20,000 kg (77,000 x 20,000/28,000)	55,000	
	80,000	

Entries related to labour	**Debit**	**Credit**
Salaries & Wages control	96,000	
Cash		96,000
(Payment of wages made)		
Work in progress control	90,000	
Production overheads control W-2	6,000	
Salaries & Wages control		96,000
(Transfer of wages to proper head of accounts)		
W-2		
Number of hours: 16,000 – 15,000		1,000
Hourly rate: Rs. 96,000/16,000 hours		Rs.6
Transfer (Rs.)		6,000

Entries related to production overheads	**Debit**	**Credit**
Production overheads control	250,000	
Payables		250,000
(Actual production overheads recorded)		
Work in progress control (15,000 x 20)	300,000	
Production overheads control		300,000
(Production overheads were absorbed)		

Transfer of costs from WIP into finished goods	**Debit**	**Credit**
Finished goods inventory	470,000	
Work in progress control W-3		470,000

W-3: Balance in WIP before transfer	Rs.
Opening WIP	–
Raw materials	80,000
Direct labour	90,000
Overhead absorbed	300,000
	470,000
Less: Closing WIP	–
Balance transferred to finished goods	470,000

Note:

Cost per unit = Rs. 470,000 /4,000 units Rs. 117.50

Transfer of finished goods to cost of sales	Debit	Credit
Cost of sales W-4	511,250	
Finished goods inventory		511,250

W-4	Units	Rs.
Opening inventory of finished goods	1,000	100,000
Production	4,000	470,000
	5,000	570,000
Closing inventory of finished goods (@ Rs. 117.50)	(500)	(58,750)
	4,500	511,250
Over-absorption of overhead		
Production overhead control W-5	44,000	
Cost of sales		44,000

W-5:	Rs.
Overhead incurred	250,000
Transfer from wages control a/c	6,000
Actual overheads	256,000
Overhead absorbed	300,000
Over absorption	44,000

Recognition of sales	Debit	Credit
Receivables	540,000	
Sales		540,000
Sales	540,000	
P&L control a/c		540,000
Closing of cost of sales	**Debit**	**Credit**
P&L control a/c	511,250	
Cost of sales		511,250

Transfer of profit to accumulated profit	Debit	Credit
P&L control a/c W-6	72,750	
Accumulated profit		72,750

W-6: Profit for the period	Rs.
Sales	540,000
Cost of sales	
Opening inventory	-
Raw materials	25,000
Finished goods	100,000
	125,000
Production costs	
Raw materials	77,000
Wages	96,000
Overheads	250,000
	423,000
Closing inventory	
Raw materials	22,000
Finished goods	58,750
	(80,750)
	(467,250)
Profit	72,750

The general ledger T accounts after the double entries are as follows:

Raw materials

	Rupees		Rupees
Balance b/f	25,000		
Payables	77,000	Work in progress control	80,000
		Balance c/f	22,000
	102,000		102,000

Salaries & Wages control

	Rupees		Rupees
Cash	96,000	Overhead control	6,000
		Work in progress control	90,000
	96,000		96,000

Production Overhead control			
	Rupees		Rupees
Payables	250,000	Work in progress control	300,000
Salaries & Wages control	6,000		
Cost of sales	44,000		
	300,000		300,000

Work in progress control			
	Rupees		Rupees
Materials control	80,000	Finished goods	470,000
Salaries & Wages control	90,000		
Production Overhead control	300,000		
	470,000		470,000

Finished goods			
	Rupees		Rupees
Balance b/f	100,000	Cost of sales	511,250
Work in progress control	470,000	Balance c/f	58,750
	570,000		570,000

Sales			
	Rupees		Rupees
P&L control a/c	540,000		
		Receivables	540,000
	540,000		540,000

Cost of sales			
	Rupees		Rupees
Finished goods	511,250	Production overheads control	44,000
		Profit & Loss a/c	467,250
	511,250		511,250

P&L control a/c			
	Rupees		Rupees
Cost of sales	467,250	Sales	540,000
Profit for the period	72,750		
	540,000		540,000

2.3 Interlocking accounts

Interlocking accounts involve using separate ledgers for costing and for financial reporting purposes. Each of these ledgers includes an account (or accounts) to reflect the relationship with the other ledger (thus they are said to interlock). Interlocking systems can vary in the range of transactions reflected in the cost ledger.

- In some systems the cost ledger includes only costing information.
- In other systems the cost ledger recognizes sales and the subsequent calculation of profit. For ease of description we will describe this system as being fully interlocking.

There are separate records but these are kept in agreement or are readily reconcilable.

It is convenient to think of a business split into two entities (but remember that this is not necessarily the case):

- The head office maintains the general ledger which is used to generate external reports; and
- A factory maintains the cost ledger (or factory ledger) which is used to record manufacturing.

Each ledger contains an account which reflects each entity's relationship with the other entity. Thus:

- The general ledger contains a **Factory Ledger Control Account (FLC a/c)**. This is a receivable and shows the assets that the head office owns that are held by the factory.
- The factory ledger contains a **General Ledger Control Account (GLC a/c)**. This is a payable that shows the assets that the factory is holding on behalf of the head office. At each period end this would be the sum of raw materials, WIP and finished goods not yet sold.

The balances on these accounts are a mirror image of each other and should agree.

Advantages of interlocking accounts

- Allows greater flexibility

Disadvantages of interlocking accounts

- Duplication of effort as entries need processing in both sets of ledgers
- Different profit figures may emerge
- Inventory valuations will be different between the two systems
- Reconciliation may be necessary (which takes time and effort)

The general ledger reflects this with the following double entries.

Illustration: Expenses incurred by the head office for the factory

General ledger	Debit	Credit
Purchase of direct materials		
Factory ledger control a/c	X	
Payables		X
Payment for direct labour		
Factory ledger control a/c	X	
Cash		X
Production overhead incurred		
Factory ledger control a/c	X	
Cash/payables		X

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The result of the above is that the factory ledger control account in the general ledger shows that the factory "owes" these amounts to the head office. They are amounts the head office has invested in the factory.

The amounts are entered in the factory ledger as follows.

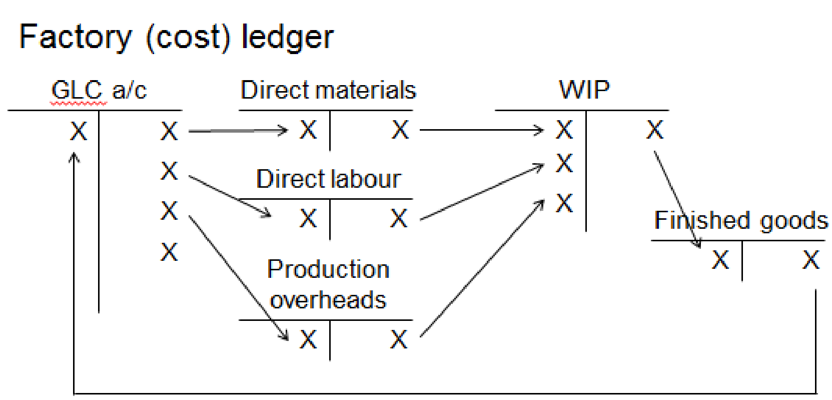
Illustration: Expenses incurred by the head office for the factory		
Factory ledger	**Debit**	**Credit**
Purchase of direct materials		
Materials control	X	
General ledger control a/c		X
Payment for direct labour		
Work in progress control	X	
General ledger control a/c		X
Production overhead incurred		
Production overheads control	X	
General ledger control a/c		X

In the factory ledger, costs are transferred from the cost accounts into WIP and hence on to finished goods as previously described. The finished goods are the output the head office receives from the factory for onwards sale. The following entries are then made to reflect the completion and transfer of production. The goods may not be physically moved from factory to head office but become available for sale.

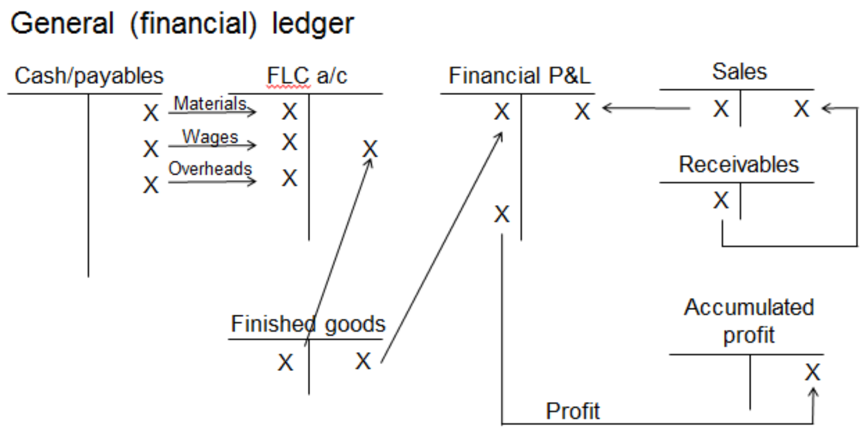
Illustration: Completion of production	Debit	Credit
Completion of production: Factory ledger		
General ledger control a/c	X	
Finished goods inventory		X
Completion of production: General ledger		
Cost of sales	X	
Factory ledger control a/c		X

- *Illustration:*

The following diagram provides an overview of the various ledger accounts and the flow of information represented by the accounting entries used within interlocking accounts.



General ledger control account



FLC a/c = Factory ledger control account

2.4 Interlocking accounts: Comprehensive illustration

Continuing the same example given in section 2.3; the following pages will show how the balances and transactions would be recorded in the cost ledger and the financial ledger.

Factory ledger

Entries related to materials	Debit	Credit
Materials control	77,000	
General ledger control a/c		77,000
(Materials purchased)		
Work in progress control	80,000	
Materials control		80,000
(Materials issued to production)		

Entries related to labour	Debit	Credit
Work in progress control	90,000	
Production overheads control	6,000	
General ledger control a/c		96,000
(Transfer of salaries & wages to proper head of accounts)		

Entries related to production overheads	Debit	Credit
Production overheads control a/c	250,000	
General ledger control a/c		250,000
(Payment of production overheads by head office)		
Work in progress control	300,000	
Production overheads control a/c		300,000
(Overheads absorbed in production)		

Goods transferred to finished goods	Debit	Credit
Finished goods inventory	470,000	
Work in progress control		470,000
(Goods completed and transferred to finished goods)		
Record cost of goods sold	**Debit**	**Credit**
General ledger control a/c	511,250	
Finished goods inventory		511,250
Close Over-absorption of overhead	**Debit**	**Credit**
Production Overhead control a/c	44,000	
General ledger control a/c		44,000

The Factory Ledger T accounts after the double entries are as follows:

Raw materials Control

	Rupees		Rupees
Balance b/f	25,000		
General ledger control a/c	77,000	Work in progress control	80,000
		Balance c/f	22,000
	102,000		102,000

Production Overhead control

	Rupees		Rupees
General ledger control a/c	250,000	Work in progress control	300,000
General ledger control a/c	6,000		
General ledger control a/c	44,000		
	256,000		256,000

Work in progress control

	Rupees		Rupees
Materials control	80,000	Finished goods	470,000
General ledger control a/c	90,000		
Production Overhead control	300,000		
	470,000		470,000

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Finished goods			
	Rupees		Rupees
Balance b/d	100,000	General ledger control a/c	511,250
Work in progress control	470,000	Balance c/f	58,750
	570,000		570,000

General Ledger Control Account			
	Rupees		Rupees
		Balance b/f	125,000
		Materials control	77,000
Finished goods	511,250	Work in progress control	90,000
		Production overheads control	6,000
		Production overheads control	250,000
Balance c/f	80,750	Production overheads control	44,000
	592,000		592,000

General ledger

Entries related to materials, labour and production overheads	Debit	Credit
Factory ledger control a/c	77,000	
Payables		77,000
(Purchases of raw materials by factory)		
Salaries & Wages control	96,000	
Cash		96,000
(Payment of wages by head office)		
Factory ledger control a/c	96,000	
Salaries & wages control		96,000
(Transfer of factory wages to factory ledger)		
Factory ledger control a/c	250,000	
Payables		250,000
(Recording of liability against production overheads)		

Recognition of sales and cost of sales	Debit	Credit
Receivables	540,000	
Sales		540,000
(Recording of goods sold)		
Cost of sales	511,250	
Factory ledger control a/c		511,250
(Recording cost of goods sold)		

Closing of over absorbed to cost of sales	Debit	Credit
Factory ledger control a/c	44,000	
Cost of sales		44,000
(Recording of goods sold)		
Closing of cost of sales	**Debit**	**Credit**
P&L control a/c	467,250	
Cost of sales		467,250
Closing of sales	**Debit**	**Credit**
Sales	540,000	
P & L control a/c		540,000
Transfer of profit to accumulated profit	**Debit**	**Credit**
P&L control a/c	72,750	
Accumulated profit		72,750

Note: Workings are shown in comprehensive example in section 2.3.

The general ledger T accounts after the double entries are as follows:

Payables			
	Rupees		Rupees
		Factory ledger control	77,000
Balance c/f	327,000	Factory ledger control	250,000
	327,000		327,000

Cash			
	Rupees		Rupees
Balance b/f	X	Salaries & Wages control	96,000
		Balance c/f	X
	X		X

Salaries & Wages control			
	Rupees		Rupees
Cash	96,000	Factory ledger control	96,000
	96,000		96,000

Sales			
	Rupees		Rupees
P&L control a/c	540,000	Receivables	540,000
	540,000		540,000

Profit & Loss Control Account			
	Rupees		Rupees
Cost of sales	467,250	Sales	540,000
Profit for the year	72,750		
	540,000		540,000

Factory Ledger Control Account (FLC a/c)			
	Rupees		Rupees
Balance b/f	125,000		
Payables	77,000	Cost of sales	511,250
Salaries & Wages	96,000		
Payables	250,000		
Cost of sales	44,000	Balance c/f	80,750
	592,000		592,000

Cost of Sales			
	Rupees		Rupees
Factory ledger control a/c	511,250	Factory ledger control a/c	44,000
		Profit & loss control a/c	467,250
	540,000		540,000

Cost ledger control account (CLC)

This account is used for 'the other side' of cost accounting double entries within interlocking accounts to replace accounts that are not included (as being of no interest for costing purposes). This account is sometimes called 'the dustbin account'.

Examples of such accounts include:

- Cash
- Bank
- Trade receivables
- Trade payables

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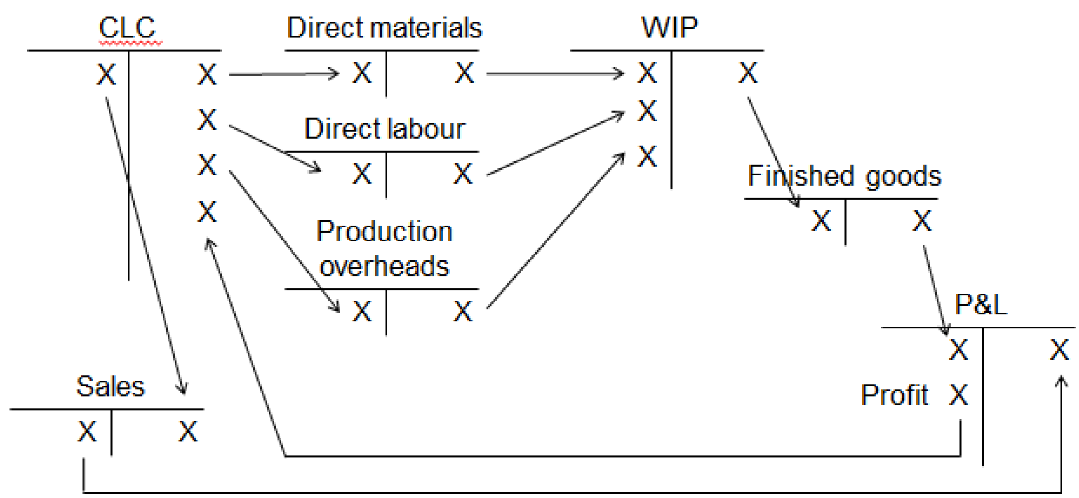
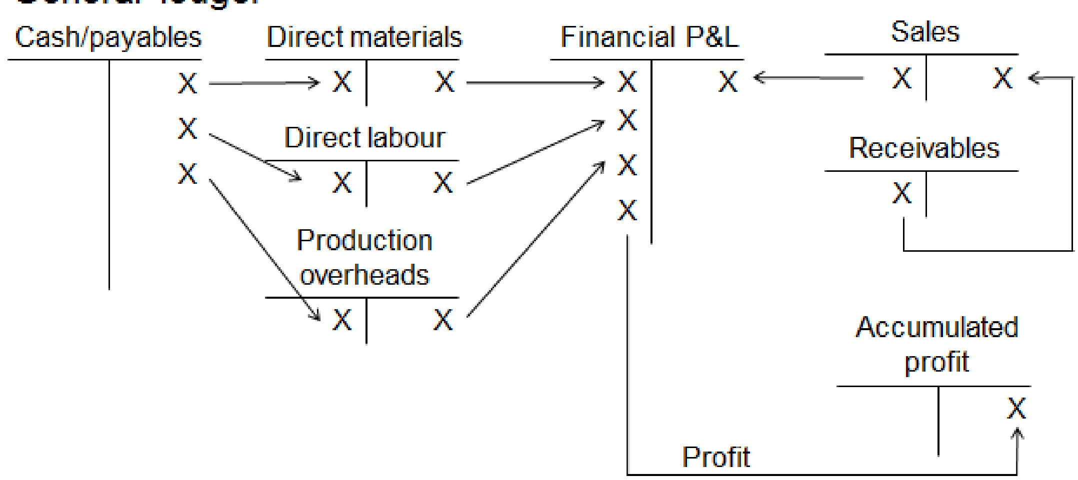
▶ *Illustration:*

The following diagram provides an overview of the various ledger accounts and the flow of information represented by the accounting entries used within fully interlocking accounts.

Cost ledger



General ledger



3. COMPREHENSIVE EXAMPLES

- *Example 01:*

At 1 July a manufacturing company had the following balances in the general ledger adjustment account in its cost ledger:

	Rs.
Balance brought forward (credit)	5,625
Stores ledger control account	2,125
Finished goods stock control account	1,500
Work in progress control account	2,000

Required

(a) Open ledger accounts for the above items in the cost ledger,

(b) Post the following items which occurred in the four-month period up to 31 October

(c) Open up other accounts as considered necessary, including a costing profit and loss account.

Stock material purchased	12,000
Stock materials issued to production	12,500
Stock materials issued to maintenance department	1,000
Wages – direct	10,830
Included in direct wages is indirect work	600
Factory overheads incurred	4,200
Factory overheads absorbed into production	5,800
Work transferred to finished stock, at cost	24,000
Factory cost of sales	22,500
Sales at selling price	28,750
Administrative and selling costs (to be written off against profits)	4,250

General ledger control a/c

	Rs.		Rs.
		Balance b/d	5,625
Sales account	28,750	Stores	12,000
		Wages	10,830
		Production overhead	4,200
		Administration and selling expenses	4,250
Balance c/d	10,155	Profit and loss a/c	2,000
	38,905		38,905
		Balance b/d	10,155

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Stores ledger control a/c

	Rs.		Rs.
Balance b/d	2,125	Work in progress	12,500
General ledger control	12,000	Production overhead	1,000
		Balance c/d	625
	14,125		14,125
Balance b/d	625		

Wages control a/c

	Rs.		Rs.
General ledger control	10,830	Production overhead	600
		Work in progress	10,230
	10,830		10,830

Production overhead control a/c

	Rs.		Rs.
Stores ledger control	1,000	Work in progress	5,800
Wages control	600		
General ledger control	4,200		
	5,800		5,800

Administration and selling expenses control a/c

	Rs.		Rs.
General ledger control	4,250	Profit and loss a/c	4,250
	4,250		4,250

Sales a/c

	Rs.		Rs.
Profit and loss a/c	28,750	General ledger control	28,750
	28,750		28,750

Work in progress control a/c

	Rs.		Rs.
Balance b/d	2,000	Finished goods control	24,000
Stores	12,500		
Wages	10,230		
Production overhead	5,800	Balance c/d	6,530
	30,530		30,530
Balance b/d	6,530		

Finished goods control a/c			
	Rs.		Rs.
Balance b/d	1,500	Cost of sales	22,500
Work in progress	24,000		
		Balance c/d	3,000
	25,500		25,500
Balance b/d	3,000		

Cost of goods sold			
	Rs.		Rs.
Finished goods stock	22,500	Profit and loss a/c	22,500
	22,500		22,500

Profit and loss a/c			
	Rs.		Rs.
Cost of goods sold	22,500	Sales	28,750
Administration and selling expenses	4,250		
Profit (to general ledger control)	2,000		
	28,750		28,750

- *Example 02:*

Kaat Ltd operates separate cost accounting and financial accounting systems. The following manufacturing and trading statement has been prepared from the financial accounts for the quarter ended 31 March.

	Rs.	Rs.
Raw materials		
Opening stock	48,000	
Purchases	108,800	
	156,800	
Closing stock	(52,000)	
Raw materials consumed		104,800
Direct wages		40,200
Production overhead		60,900
Production cost incurred		205,900
Work in progress		
Opening stock	64,000	
Closing stock	(58,000)	6,000
Cost of goods produced carried down		211,900

	Rs.	Rs.
Sales		440,000
Cost of goods sold		
Finished goods opening stock	120,000	
Cost of goods produced brought down	211,900	
	331,900	
Finished goods closing stock	(121,900)	(210,000)
Gross profit		230,000

The following information has been extracted from the cost accounts:

Control account balances at 1 January

	Rs.
Raw material stores	49,500
Work in progress	60,100
Finished goods	115,400

Transactions for the quarter

	Rs.
Raw materials issued	104,800
Cost of goods produced	222,500
Cost of goods sold	212,100
Loss of materials damaged by flood (insurance claim pending)	2,400

A notional rent of Rs.4,000 per month has been charged in the cost accounts. Production overhead was absorbed at the rate of 185% of direct wages. Profit at the end of the period is shown as Rs.238,970.

Required

(a) Prepare the following control accounts in the cost ledger:

(i) Raw materials stores

(ii) Work in progress

(iii) Finished goods

(iv) Production overhead.

(b) Prepare a statement reconciling the gross profit as per the cost accounts and the financial accounts.

► *Solution*

a) Preparation of the relevant control accounts in the cost ledger, would be as follows:

Raw materials stores a/c			
	Rs.		Rs.
Balance b/f	49,500	Work in progress	104,800
Purchases	108,800	Loss due to flood	2,400
		Balance c/f	51,100
	158,300		158,300
Balance b/f	51,100		

Work in progress control a/c			
	Rs.		Rs.
Balance b/f	60,100	Finished goods	222,500
Raw materials	104,800	Balance c/f	56,970
Direct wages	40,200		
Production overhead	74,370		
	279,470		279,470
Balance b/f	56,970		

Finished goods control a/c			
	Rs.		Rs.
Balance b/f	115,400	Cost of sales	212,100
Work in progress	222,500	Balance c/f	125,800
	337,900		337,900
Balance b/f	125,800		

Production overhead			
	Rs.		Rs.
General ledger control	60,900	Work in progress	74,370
Notional rent	12,000		
Overhead overabsorbed	1,470		
	74,370		74,370

b) Reconciliation statement

	Rs.	Rs.	Rs.
Profit as per financial accounts		230,000	
Difference in stock values			
Work in progress opening stock	3,900		
Finished goods opening stock	4,600		
Finished goods closing stock	3,900		
	———	12,400	
Raw materials opening stock	1,500		
Raw materials closing stock	900		
Work in progress closing stock	1,030		
		(3,430)	
			8,970
Profit as per cost accounts			238,970

Cost accounting profit and loss	Rs.	Rs.	Rs.
Sales			440,000
Cost of sales		212,100	
Loss of stores		2,400	
		214,500	
Overhead over-absorbed	1,470		
Notional rent	12,000		
		(13,470)	
			(201,030)
			238,970

- *Example 03:*

Mirza Limited is engaged in the manufacturing of spare parts for automobile industry. The company records the purchase and issue of materials in a store ledger which is not integrated with the financial ledger. It is the policy of the company to value inventories on weighted average basis. The valuation is carried out by the Finance Department using stores memorandum record. A physical stock count is carried out after every six months. Any shortage/excess is then adjusted in the financial as well as stores ledger.

On December 31, 20X3, physical stock count was conducted by the Internal Auditor of the company. He submitted the following statement to the Finance Department:

Item Code	Balance (in units)			Cost per unit (Rs.)	
	Store Ledger	Financial Records	Physical	Average	Current
010-09	20,500	20,500	20,000	2.00	2.25
013-25	10,000	10,000	10,000	4.00	1.50
017-10	5,500	5,500	5,000	1.00	1.10
022-05	4,000	4,500	5,500	2.00	2.00
028-35	1,200	1,200	1,000	2.75	2.50
035-15	640	600	600	3.00	3.50

On scrutinizing the details, Finance Department was able to ascertain the following reasons:

Item Code	Reasons
010-09	500 units were defective and therefore the Internal Auditor excluded them while taking the physical count.
013-25	This item is not in use and is considered obsolete. The net realizable value is Rs. 0.60 per unit.
017-10	Shortage is due to theft.
022-05	A receipt of 1,000 units was not recorded. The remaining difference is due to errors in recording the quantity issued.
028-35	200 units returned to a supplier were not recorded. The invoiced cost was Rs. 3 per unit.
035-15	Discrepancy is due to incorrect recording of a Goods Receipt Note.

Required

a) Prepare necessary Journal entries to record the adjustments in the financial ledger.

b) State how would you make the necessary adjustments in the stores ledger.

▶ *Solution*

a)

Journal Entries in Financial Ledger

		Dr.	Cr.
		Rupees	**Rupees**
(i)	Cost of sales/ FOH/ Abnormal loss	1,000	
	Stores Ledger A/c		1,000
	(Record the normal loss of item # 010-09)		
(ii)	Cost of sales/ FOH	34,000	
	Provision for obsolescence		34,000
	(Record the provision for obsolescence against item # 013-25)		
(iii)	Cost of sales/ FOH/ Abnormal loss	500	
	Stores Ledger A/c		500
	(Record the theft of item # 017-10)		
(iv)	(a) Stores Ledger A/c	2,000	
	Creditors / Cash		2,000
	(Record the purchase of items # 022-05)		
	(b) No adjustment		
(v)	Creditors/ Cash	600	
	Stores Ledger A/c		600
	(Record the return of item # 028-35)		
(vi)	No adjustment		

b) **Recording in Stores Ledger**

i. The quantity should be shown as issued in the stores ledger.

ii. No adjustment.

iii. 500 units should be shown in the issue column and adjust the balance accordingly.

iv. a) 1,000 units should be recorded on the receipt side of individual stores ledger account.

b) The issue column of the individual stores ledger account should be reduced by 500 units.

v. 200 units should be reduced from the receipt and accordingly adjust the balance columns of the individual stores ledger account.

vi. The postings of incorrectly recorded Goods Receipt Note should be corrected.

► *Example 04*

Sapphire limited (SL) fabricates parts for auto manufacturers and follows job order costing. The company's head office is situated in Lahore but the factory is in Karachi. A separate set of records is kept at the head office and at the factory. Following details were extracted from SL's records for the month of February 20X4.

	Jobs		
	A	B	C
Materials issued to production (units)			
• Material X	40,000	-	10,000
• Material Y	-	75,000	25,000
Direct labour hours worked (hours)	6,000	9,000	15,000
Labour rate per hour (Rs.)	75	60	65

The other related information is as follows:

i. Materials purchased on account:
   - 100,000 units of material X at Rs. 25 per unit
   - 150,000 units of material Y at Rs. 35 per unit

ii. The head office prepared the payroll and deducted 8% for payroll taxes. The payroll amounted to Rs. 3.0 million out of which Rs. 1.0 million pertained to selling and administrative staff salaries. After charging direct labour cost to each job the balance amount of payroll cost was attributed to general factory overhead.

iii. Factory overhead was applied to the jobs at Rs. 25 per direct labour hour.

iv. Actual factory overheads amounted to Rs. 700,000 including depreciation on machinery amounting to Rs. 400,000. All payments were made by head office.

v. Over or under-applied factory overheads are closed to cost of goods sold account.

vi. Jobs A and B were completed during the month. Job A was sold for Rs. 2.0 million to one of the auto manufacturer on credit. The customer however, agreed to settle the transaction at 2% cash discount.

vii. Selling and administrative expenses, other than salaries paid during the month were Rs. 500,000.

Required

Record journal entries to record all the above transactions in SL's factory ledger and general ledger for the month of February 20X4.

► *Solution*

Journal entries to record all the above transactions in SL's factory ledger and general ledger for the month of February 20X4, would be prepared as follows:

General Journal entries					
Particulars	Factory Ledger		Particulars	General Ledger	
	Debit	Credit		Debit	Credit
Material X	2,500,000		Factory Ledger	7,750,000	
Material Y	5,250,000		Trade Creditors		7,750,000
General Ledger		7,750,000			

General Journal entries					
Particulars	**Factory Ledger**		**Particulars**	**General Ledger**	
	Debit	**Credit**		**Debit**	**Credit**
(Purchase of material)					
Payroll	2,000,000		Factory Ledger	2,000,000	
General Ledger		2,000,000	Selling and administrative expenses	1,000,000	
			Accrued Payroll		2,760,000
(Payroll accrual)			Payroll taxes		240,000
No Entry			Accrued payroll	2,760,000	
			Payroll Taxes	240,000	
			Bank		3,000,000
			(Payment of payroll & taxes)		
Work in process A	1,000,000				
Work in process B	2,625,000				
Work in process C	1,125,000		No Entry		
Material X		1,250,000			
Material Y		3,500,000			

General Journal entries					
Particulars	**Factory Ledger**		**Particulars**	**General Ledger**	
	Debit	**Credit**		**Debit**	**Credit**
(Issuance of raw material to WIP)					
Work in process A	450,000				
Work in process B	540,000				
Work in process C	975,000		No Entry		
Factory overheads	35,000				
Payroll		2,000,000			
(Direct labour cost allocated to WIP)					
Work in process A	150,000				
Work in process B	225,000				
Work in process C	375,000		No Entry		
Factory overheads - applied		750,000			

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General Journal entries					
Particulars	**Factory Ledger**		**Particulars**	**General Ledger**	
	Debit	**Credit**		**Debit**	**Credit**
(Factory overheads applied to WIP)					
Factory overheads	700,000		Factory Ledger	700,000	
General Ledger		700,000	Bank		300,000
			Accumulated Depreciation		400,000
			(Actual factory overheads transferred)		
Factory overheads - applied	15,000		Factory Ledger	15,000	
General Ledger		15,000	Cost of goods sold		15,000
(Over applied overheads transferred to cost of goods sold)					
Finished goods A	1,600,000				
Finished goods B	3,390,000		No Entry		
Work in process A		1,600,000			
Work in process B		3,390,000			
(Jobs A and B completed and transferred to finished goods)					
General Ledger	1,600,000		Cost of goods sold	1,600,000	
Finished goods A		1,600,000	Factory Ledger		1,600,000
(Job A delivered and transferred to cost of goods sold)					
No Entry			Trade Debtors	2,000,000	
			Sales		2,000,000
			(Job A sold to customer)		
No Entry			Bank	1,960,000	
			Cash discount	40,000	
			Trade debtors		2,000,000
			(Amount realized from customer)		
No Entry			Selling and administrative expenses	500,000	
			Bank		500,000
			(Payment of Selling and admin. Expenses)		

- *Example 05:*

The following information is available for the month of December 2000 of Khalid Enterprises:

	Rs.
Accounts payable December 01	6,000
Work in process December 01	30,000
Finished goods December 01	50,000
Materials December 31	15,000
Accounts payable December 31	10,000
Finished goods December 31	60,000
Actual factory overheads	150,000
Cost of sales	300,000
Payment of accounts payable used only for material purchases	35,000

Factory overhead is applied at 200% of direct labour cost. Jobs still in process on December 31, have been charged Rs. 6,000 for material and Rs. 12,000 for direct labour hours (1,200 hours). Actual direct labour hours 10,000 @ Rs. 8.00 per hour.

Required

Calculate material purchases, cost of goods manufactured, applied factory overheads, Work in process December 31, Material used, Materials as on December 01 and under or over applied factory overhead.

- *Solution*

Calculation of material purchases, cost of goods manufactured, applied factory overheads, Work in process December 31, Material used, Materials as on December 01 and under or over applied factory overhead, along with relevant ledgers, are given below:

Materials Inventory

	Rs.		Rs.
Balance b/f (Bal. Fig.)	58,000	Work in progress	82,000
Purchases	39,000	Balance c/f	15,000
	97,000		97,000

Accounts payable

	Rs.		Rs.
Cash	35,000	Balance b/f	6,000
Balance c/f	10,000	Purchases (Balancing figure)	39,000
	45,000		45,000

Work in process

	Rs.		Rs.
Balance b/f	30,000		
Materials (Bal. Fig.)	82,000	Finished goods	310,000
Payroll	80,000		
Production overheads W-1	160,000	Balance c/f W-2	42,000
	352,000		352,000

Finished goods			
	Rs.		Rs.
Balance b/f	50,000	Cost of sales	300,000
Work in process (Bal. Fig.)	310,000	Balance c/f	60,000
	360,000		360,000

Production overheads			
	Rs.		Rs.
Cash	150,000	Work in process	160,000
Cost of sales	10,000		
	160,000		160,000

Cost of sales			
	Rs.		Rs.
Finished goods	300,000	Production overheads	10,000
		Profit & Loss	290,000
	290,000		290,000

W-1 Factory overhead applied and over absorbed overheads	Rs.
Factory overhead applied (80,000 x 200%)	160,000
Actual factory overheads	150,000
Over absorbed overheads	**10,000**

W-2 Closing inventory of work in process	Rs.
Materials	6,000
Labour	12,000
Factory overhead applied (12,000 x 200%)	24,000
	42,000

- *Example 06:*

The incomplete cost accounts for a period of Company A are given below:

Store ledger control account			
	Rs. 000		Rs. 000
Opening balance	2,640		
Financial ledger control	3,363		

Production wages control account			
	Rs. 000		Rs. 000
Financial ledger control	2,940		

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Production overhead control account			
	Rs. 000		Rs. 000
Financial ledger control	1,790		

Work in process control account			
	Rs. 000		Rs. 000
Opening balance	1,724		

The balances at the end of the period in Rs. 000 were:

Store ledger Rs. 2,543

WIP ledger Rs. 2,295

During the period 65,000 kilos of direct material were issued from stores at a weighted average price of Rs. 48 per kilo. The balance of materials issued from stores represented indirect materials.

Two thirds of the production wages are classified as 'direct'. Average gross wage of direct workers was Rs. 20 per hour. Production overheads are absorbed at a predetermined rate of Rs. 30 per direct labour hour.

Goods were delivered immediately after completion, as no finished goods store is maintained.

Required

Complete cost accounts for the period.

▶ *Solution*

Completion of cost accounts for the period, are given below:

Store ledger control account			
	Rs. 000		Rs. 000
Opening balance	2,640	Work in process control (65,000x48)	3,120
Financial ledger control	3,363	Production overheads (Bal)	340
		Closing balance	2,543
	6,003		6,003

Production wages control account			
	Rs. 000		Rs. 000
Financial ledger control	2,940	Work in process control (2,940,000 x 2/3)	1,960
		Production overheads (Bal)	980
	2,940		2,940

Production overhead control account			
	Rs. 000		Rs. 000
Financial ledger control	1,790	Work in process control (1,960,000 x 30/20)	2,940
Store ledger control	340		
Production wages control	980	Cost of sales (Under absorbed)	170
	3,110		3,110

Work in process control account			
	Rs. 000		Rs. 000
Opening balance	1,724	Cost of sales	7,449
Store ledger control	3,120		
Production wages control	1,960	Closing balance	2,295
Production overhead control	2,940		
	9,744		9,744

- *Example 07:*

Mr. Azad had provided you the following information from his factory ledger for the quarter ended 31 December 2005.

	Rs.
Control account balances as on October 1, 2005	
Materials	49,500
Work in process	60,100
Finished goods	115,400
Transaction for quarter ended 31 December 2005	
Material purchased	108,000
Direct wages	50,200
Payments for factory overheads	30,900
Depreciation of factory building and machine	42,000

Other related information is as under:

- Closing stock of raw materials and finished goods at December 31, 2005 amounted to Rs. 50,300 and Rs. 125,800 respectively.
- Cost of goods produced is Rs. 222,500.
- Factory overheads are absorbed in production @ 160% of direct wages.
- Diesel costing Rs. 2,000 included in the factory overheads was transferred to head office for use in generator.
- A bill for repairs amounting to Rs. 12,000 undertaken at the factory remained unpaid at the end of the quarter.
- Material costing Rs. 2,400 was destroyed by rain.

Required

Prepare Materials, Work in process, Finished goods, Factory overheads and Cost of sales ledgers.

▶ *Solution*

Preparation of Materials, Work in process, finished goods, Factory overheads and Cost of sales ledgers are given below.

Materials

	Rupees		Rupees
Balance b/f	49,500	Profit & Loss	2,400
Purchase	108,000	Work in process (Bal)	104,800
		Balance c/f	50,300
	157,500		157,500

Work in process

	Rupees		Rupees
Balance b/f	60,100	Finished goods	222,500
Wages	50,200		
Factory overhead	80,320		
Materials	104,800	Balance c/f	72,920
	295,420		295,420

Finished Goods

	Rupees		Rupees
Balance b/f	115,400	Cost of sales	212,100
Work in process	222,500	Balance c/f	125,800
	337,900		337,900

Factory overheads

	Rupees		Rupees
Cash	30,900	Work in process	80,320
Accumulated depreciation	42,000	General ledger	2,000
Payables	12,000	Cost of sales	2,580
	84,900		84,900

Cost of sales

	Rupees		Rupees
Finished goods	212,100	Profit and loss	214,680
Factory overheads	2,580		
	214,680		214,680

STICKY NOTES

The objective of accounting for production of inventory is to record and mirror the cost throughout the production process.

The cost flows from:

- **material account, wages control account, production overhead account to WIP account;**
- **then to finished goods accounts; and**
- **ultimately to Profit and loss account.**

Cost book-keeping systems can be categorized into two types in terms of how the cost accounts relate to other ledger accounts:

- **integrated accounts;**
- **interlocking accounts.**

Integrated accounts combine both financial and cost accounts in one system of ledger accounts. A reconciliation between cost and financial profits is not necessary with an integrated system.

Interlocking accounts are recorded in factory ledger for cost accounts and general ledger for other accounts, which are readily reconcilable.

CHAPTER 7

JOB AND SERVICE COSTING

IN THIS CHAPTER

AT A GLANCE

A costing method is one which is designed to suit the way goods are processed or manufactured or the way that services are provided.

A job is a cost unit which consists of a single order or contract. Job costing is a basic cost accounting method applicable where work consists of separate contracts, jobs or batches.

The cost of a job consists of direct material cost, direct labour cost, direct expenses, production overheads and administrative, selling and distribution overheads.

Service organizations do not make or sell tangible goods. Service costing differs from other costing methods. With many services the cost of direct materials consumed will be relatively small compared to labour, direct expenses and overheads cost.

The output of most service organizations is often intangible and difficult to define. A unit cost is therefore difficult to calculate.

Specific characteristics of services are intangibility, simultaneity, perishability and heterogeneity.

1. JOB COSTING

1.1 The nature of job costing

Job costing is used when a business entity carries out tasks or jobs to meet specific customer orders. Although each job might involve similar work, they are all different and are carried out to the customer's specific instructions or requirements. In order words, job order costing is used in situations where many different products are manufactured each period on request of customer.

Examples of 'jobs' include work done for customers by builders or electricians, audit work done for clients by a firm of auditors, and repair work on motor vehicles by a repair firm. Another example is printing work, where printing job is done on the specification of customers, not readily available for sales.

It is simplest method of costing, where each job is assigned a unique job number and all direct cost is allocated to respective jobs as they are incurred. However, indirect cost is assigned to job costing mostly on absorption costing principle, however, marginal costing may be used depending upon policy of company.

1.2 The cost of a job

As discussed in above paragraph, each job is given unique number for the purpose of measuring profit of each job, after allocating the costs to each job.

Job costing differs from most other types of costing system because every job is a cost unit which consists of a single order or contract and the costing is being done for every job separately. The expected cost of a job has to be estimated so that a price for the job can be quoted to a customer.

The features of Job costing are as follows:

- Work is undertaken to customer's special attention, thus, creating flexibility in creating customer demands. For example, specific design of furniture on request of customer is manufactured.
- Normally, each job takes short period of time, but still there might be chance of getting large order.
- Jobs move through processes and operations as a continuously identifiable unit.
- Each job usually differs in one or more respects from every other job and therefore a separate record must be maintained to show the details of a particular job.
- Job costs are allocated on a job cost sheet or job cost card.
- Rectification work is the cost of rectifying substandard work. it is to be charged as direct cost of the job concerned if not a frequent occurrence and can be directly attributable to a job. It is to be treated as production overhead if regarded as normal part of the work and it is of recurring nature.

A job costing system is usually based on absorption costing principles, and in addition a cost is included for non-production overheads, as follows.

Illustration: Job cost	Rs.
Direct materials	500
Direct labour	300
Direct expenses	200
Prime cost	1,000
Production overhead absorbed	750
Production cost of the job	1,750
Non-production overheads	400
Total job cost	2,150

In many cases, job costs include not just direct materials costs and direct labour costs, but also **direct expenses**, such as:

- the rental cost of equipment hired for the job

- the cost of work done for the job by sub-contractors
- the depreciation cost of equipment used exclusively on the job.

Production overheads might be absorbed on any suitable base as discussed in Chapter 3.

Non-production overheads might be added to the cost of the job:

- as a percentage of the prime cost of the job, or
- as a percentage of the production cost of the job.

1.3. Job cost card or sheet

A job order cost sheet or card is a form prepared for a job that record all manufacturing costs both direct and indirect and also non-manufacturing costs absorbed to specific job. It includes details of materials issued along with quantities; direct labour including time consumed on each job and other direct expenses incurred in connection with specific job. Indirect manufacturing cost and non-manufacturing costs are absorbed into product or service cost on the basis of absorption rate as discussed in section 1.2. above.

Following examples reflect process of recording the costs into job order cost sheet or card.

- *Example 01:*

The following cost information has been gathered about Job number 453.

The direct materials cost is Rs.10,000, the direct labour cost is Rs.6,000 and direct expenses are Rs.4,000. Direct labour costs Rs.20 per hour. Production overheads are charged at the rate of Rs.30 per direct labour hour and non-production overheads are charged at the rate of 40% of prime cost. Total production of job number 453 is 5,000 units.

The job cost and unit cost for Job 453 is calculated as follows:

Job cost: Job 453	Rs.
Direct materials	10,000
Direct labour	6,000
Direct expenses	4,000
Prime cost	20,000
Production overhead (6,000 x 30/20)	9,000
Production cost of the job	29,000
Non-production overheads (40% of prime cost i.e. Rs. 20,000)	8,000
Total job cost	37,000
Unit cost of job (37,000 / 5,000)	7.40

- *Example 02:*

A company operates a job costing system. Job number 6789 will require Rs.3,450 of direct materials and Rs.2,100 of direct labour, which is paid Rs.14 per hour. Production overheads are absorbed at the rate of Rs.30 per direct labour hour and non-production overheads are absorbed at the rate of 30% of production cost.

Expected sales price of the job, assuming above order contains 1,000 units and company expects 20% markup.

	Rs.
Direct materials	3,450
Direct labour	2,100
Prime cost	5,550
Production overheads (2,100 × Rs.30/ Rs. 14)	4,500
Full production cost	10,050
Non-production overheads (30% × Rs.10,050)	3,015
Full cost of sale for the job	13,065
Add: Markup at 20%	2,612
Sales value of job	15,678
Unit sales price (15,678/ 1,000)	15.68

1.4 Cost records and accounts for job costing

In order to establish the cost of each individual job in a costing system, it is necessary to have procedures for recording direct costs in such a way that they can be allocated to specific jobs. Production overheads and non-production overheads can be charged using overhead absorption rates within a system of absorption costing.

The procedure with accounting entry of each cost charged to job is given in following paragraphs.

Accounting for Materials

	Debit	Credit
Purchases of materials		
Materials control	X	
Accounts payable		X
Purchase returns of materials		
Accounts payable	X	
Materials control		X
Issuance of direct materials to job		
Work in progress- Job No. 123	X	
Materials control		X
Return of excess direct materials from job		
Materials control	X	
Work in progress- Job No. 123		X
Issuance of indirect materials to job		
Production overhead control	X	
Materials control		X

AT A GLANCE SPOTLIGHT STICKY NOTES

Accounting for Labour

	Debit	Credit
Recording of payroll		
Salaries & Wages control	X	
Accrued payroll (Assuming no deductions)		X
Recording of direct and indirect labour		
Work in progress- Job No. 123	X	
Production overhead control	X	
Salaries & wages control		X

Accounting for Production overheads

	Debit	Credit
Recording of actual production overheads		
Production overhead control	X	
Payable or cash or other credits		X
Absorption of production overheads to jobs		
Work in progress- Job No. 123	X	
Production overhead control		X

Accounting for completion and sales of job

	Debit	Credit
Completion of job and delivering it to customer without storing in finished goods		
Cost of sales	X	
Work in progress-Job No. 123		X
Sales of job		
Accounts receivables	X	
Sales		X

Illustration: Job cost account

Work in process account: Job 123			
	Rs.		Rs.
Materials control	1,800	Cost of sales	7,800
Salaries & wages control	3,000		
Production overhead control	3,000		
	7,800		7,800

When the job is finished, the total cost of the job is transferred to the cost of sales.

AT A GLANCE SPOTLIGHT STICKY NOTES

- *Example 03:*

The following information relates to job activity in the month of June.

	Job 0503	Job 0402	Job 0607
Contract price	Rs. 500,000	Rs. 980,000	Rs. 600,000
Commenced	3 May	2 April	7 June
Completed	25 June	Not completed	19 June
Opening WIP comprised:			Nil
Direct materials (all material X)	Rs. 5,000	Rs. 10,000	
Direct labour (all grade A)	Rs. 10,000	Rs. 18,000	
Variable production o'head	Rs. 12,000	Rs. 21,600	
Fixed production overhead	Rs. 12,800	Rs. 23,040	
	Rs. 39,800	Rs. 72,640	
Material issues from stores:			
Material X	200 kgs	800 kgs	900 kgs
Material Y	400 kgs	600 kgs	
Labour			
Grade A	60 hours	120 hours	150 hours
Grade B	25 hours	100 hours	20 hours
Costs:			
Material X		Rs. 220 per kg	
Material Y		Rs. 500 per kg	
Grade A		Rs. 250 per hour	
Grade B		Rs. 400 per hour	
Variable overhead recovery rate		Rs. 300 per hour	
Fixed production overhead is absorbed using direct labour hours			
Budgeted fixed production overhead		Rs. 160,000	
Budgeted labour hours		500 hours	
Actual fixed production overhead expenditure in the period		Rs. 161,000	

The company needed to hire a special machine for job 0402 at a cost of Rs. 5,000 in the current month.

20 kgs of raw material were returned to stores on completion of job 0607.

For internal profit reporting purposes administration and marketing expenses are added to cost of sales at 20% of full product cost at the time of completion of the job. Actual administration and marketing expense in the period was Rs. 130,000.

(Note: The system suggested is similar to that for the receivables control account backed up by the receivables ledger. In this case there is a WIP control account backed up by the job costing ledger).

Task 1 – Schedule of resources used in month

Material X	Kgs	Cost per kg	Rs.
Job 0503:	200	220	44,000
Job 0402	800	220	176,000
Job 0607	900	220	198,000
Less returns	(20)	220	(4,400)
	880	220	193,600
	1,880	220	413,600

Material Y	Kgs	Cost per kg	Rs.
Job 0503:	400	500	200,000
Job 0402	600	500	300,000
	1,000	500	500,000

Labour grade A	Hours	Cost per hour	Rs.
Job 0503:	60	250	15,000
Job 0402:	120	250	30,000
Job 0607:	150	250	37,500
	330	250	82,500

Labour grade B	Hours	Cost per hour	Rs.
Job 0503:	25	400	10,000
Job 0402:	100	400	40,000
Job 0607:	20	400	8,000
	145	400	58,000

Variable overhead		Hours	Cost per hour	Rs.
Job 0503:	60 + 25 =	85	300	25,500
Job 0402:	120 + 100 =	220	300	66,000
Job 0607:	150 + 20 =	170	300	51,000
		475	300	142,500

Fixed overhead	Hours	Cost per hour	Rs.
Job 0503:	85	320	27,200
Job 0402:	220	320	70,400
Job 0607	170	320	54,400
	475	320	152,000

Task 2 – Journal entries to record costs in the job accounts

	Debit	Credit
Issues of Material X		
Job 0503 account	44,000	
Job 0402 account	176,000	
Job 0607 account	198,000	
Material X inventory account		418,000

	Debit	Credit
Returns of Material X		
Material X inventory account	4,400	
Job 0607 account		4,400
Issues of Material Y		
Job 0503 account	200,000	
Job 0402 account	300,000	
Material Y inventory account		500,000
Grade A labour		
Job 0503 account	15,000	
Job 0402 account	30,000	
Job 0607 account	37,500	
Salaries & Wages control account		82,500
Grade B labour		
Job 0503 account	10,000	
Job 0402 account	40,000	
Job 0607 account	8,000	
Salaries & Wages control account		58,000
Variable overhead		
Job 0503 account	25,500	
Job 0402 account	66,000	
Job 0607 account	51,000	
Production overhead control account		142,500
Fixed overhead		
Job 0503 account	27,200	
Job 0402 account	70,400	
Job 0607 account	54,400	
Production overhead control account		152,000
Hire cost		
Job 0402 account	5,000	
Cash		5,000

Task 3 – Job cost accounts

Job 0503			
	Rs.		Rs.
Balance b/d	39,800		
Issues from stores:			
Material X	44,000		
Material Y	200,000		

Labour:			
Grade A	15,000		
Grade B	10,000		
Variable overhead	25,500		
Fixed overhead	27,200	Cost of sales	361,500
	361,500		361,500

Job 0402			
	Rs.		Rs.
Balance b/d	72,640		
Issues from stores:			
Material X	176,000		
Material Y	300,000		
Labour:			
Grade A	30,000		
Grade B	40,000		
Variable overhead	66,000		
Fixed overhead	70,400		
Machine hire	5,000	Balance c/d	760,040
	760,040		760,040

Job 0607			
	Rs.		Rs.
Issues from stores:		Returns to stores	
Material X	198,000	Material X	4,400
Labour:			
Grade A	37,500		
Grade B	8,000		
Variable overhead	51,000		
Fixed overhead	54,400	Cost of sales	344,500
	348,900		348,900

Task 4–Job cost cards (showing the resources allocated to the jobs and the allocation of administration and marketing expenses for the jobs completed in the period. Also incorporate the revenue for the period and show the profit or loss on those jobs completed)

	Job 0503	Job 0402	Job 0607
Material X			
In opening WIP	5,000	10,000	-
In period	44,000	176,000	193,600
	49,000	186,000	193,600
Material Y (in period)	200,000	300,000	
Grade A labour			
In opening WIP	10,000	18,000	-
In period	15,000	30,000	37,500
	25,000	48,000	37,500
Grade B labour	10,000	40,000	8,000
Variable overhead			
In opening WIP	12,000	21,600	
In period	25,500	66,000	51,000
	37,500	87,600	51,000
Fixed overhead			
In opening WIP	12,800	23,040	
In period	27,200	70,400	54,400
	40,000	93,440	54,400
Machine hire		5,000	
Factory cost	361,500	760,040	344,500
Administration and marketing @ 20%	72,300		68,900
Cost of sale	433,800		413,400
Contract price	500,000		600,000
Profit	66,200		186,600

Task 5– Journal entries to record costs in the general ledger (Assuming that the company operates a system using a control account in its general ledger for jobs show the double entry (as T-accounts) to account for job activity in the period)

The following journals were not asked for but they are included to help you to understand the double entry in the general ledger.

		Debit	Credit
a	**Issues of Material X**		
	WIP control account	418,000	
	Inventory control account		418,000
b	**Returns of Material X**		
	Inventory control account	4,400	
	WIP control account		4,400
c	**Issues of Material Y**		
	WIP control account	500,000	
	Inventory control account		500,000
d	**Grade A labour**		
	WIP control account	82,500	
	Payroll control account		82,500
e	**Grade B labour**		
	WIP control account	58,000	
	Payroll control account		58,000
f	**Variable overhead**		
	WIP control account	142,500	
	Variable overhead account		142,500
g	**Fixed overhead**		
	WIP control account	152,000	
	Fixed production overhead account		152,000
h	**Hire cost**		
	WIP control account	5,000	
	Cash		5,000
i	**Transfer of costs on completed sales**		
	Cost of sales account		
	Job 0503	361,500	
	Job 0607	344,500	
		706,000	
	WIP control account		706,000

WIP control			
	Rs.		Rs.
Balance b/d			
Job 0503	39,800		
Job 0402	72,640		
	112,440		
a) Inventory control	418,000	b) Inventory control	4,400
c) Inventory control	500,000		
d) Payroll control	82,500		
e) Payroll control	58,000		
f) Var. overhead	142,500		
g) Fixed overhead	152,000		
h) Hire cost	5,000	i) Cost of sales	706,000
		Balance c/d	760,040
	1,470,440		1,470,440
Balance b/d	760,040		

Cost of sales			
	Rs.		Rs.
i) WIP control a/c	706,000		

Fixed production overhead			
	Rs.		Rs.
Balance b/d	161,000	g) WIP control a/c	152,000
(Actual spend)			

We now need to recognize the following entries. Once again journals are provided for your convenience.

		Debit	Credit
j	**Administration and marketing mark-up (20% of cost of sales figure)**		
	Profit & Loss (20% of 706,000)	141,200	
	Administration and marketing control a/c		141,200
	Note that this is the same sum of the two figures shown on the job cost card in task 4 (72,300 + 68,900)		
k	**Transfer of balance on cost of sales to the income statement**		
	Income statement	706,200	
	Cost of sales account		706,200
l	**Under recovery of fixed production overhead**		
	Income statement (161,000 – 152,000)	9,000	
	Fixed production overhead account		9,000

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		Debit	Credit
m	**Over recovery of administration and marketing overhead**		
	Administration and marketing control a/c	11,200	
	Income statement (141,200 – 130,000)		11,200
n	**Recognition of revenue on finished jobs**		
	Receivables (500,000 + 600,000)	1,100,000	
	Income statement		1,100,000

- *Example-04:*

Ahmer and Company is engaged in production of engineering parts. It receives bulk orders from bicycle manufacturers and follows job order costing. On July 1, 20X3 two jobs were in progress whereas two jobs were opened during the year. The details are as follows:

	JOBS			
	A	**B**	**C**	**D**
Work in process – opening (Rs.)	1,400,000	2,500,000	-	-
Raw material issued from stores (Rs.)	800,000	1,200,000	1,500,000	600,000
Direct labour hours worked (Hours)	20,000	30,000	15,000	18,000
Rate of direct labour per hour (Rs.)	20	18	16	15

Other related information is as follows:

i. Factory overhead is applied to the jobs at Rs. 10 per labour hour.

ii. Actual factory overheads for the year amounted to Rs. 900,000.

iii. Under/over applied factory overheads are charged to profit and loss account.

iv. Job A was completed during the year. All the goods were shipped to the customers.

v. Job B was also completed during the year. However, about 10% of the goods were rejected during inspection. These were transferred to Job C where they will be used after necessary adjustments.

Journal entries to record all the above transactions can be prepared as follows:

General Journal entries				
Date	**Particulars**	**Ledger folio**	**Debit**	**Credit**
1	Work in process –Job A		800,000	
	Work in process –Job B		1,200,000	
	Work in process –Job C		1,500,000	
	Work in process –Job D		600,000	
	Materials control			4,100,000
	(Issuance of raw material to WIP)			
2	Work in process –Job A (20,000 x 20)		400,000	
	Work in process –Job B (30,000 x 18)		540,000	
	Work in process –Job C (15,000 x 16)		240,000	

General Journal entries				
Date	**Particulars**	**Ledger folio**	**Debit**	**Credit**
	Work in process –Job D (18,000 x 15)		270,000	
	Salaries & Wages control			1,450,000
	(Direct labour cost allocated to WIP)			
3	Work in process –Job A (20,000 x 10)		200,000	
	Work in process –Job B (30,000 x 10)		300,000	
	Work in process –Job C (15,000 x 10)		150,000	
	Work in process –Job D (18,000 x 10)		180,000	
	Production overhead control			830,000
	(Factory overheads applied to WIP @ Rs. 10 per direct labour hours)			
4	Profit and loss account (900,000-830,000)		70,000	
	Factory overheads Control			70,000
	(Factory overheads applied transferred to overheads control a/c and under applied overheads charged to P&L account)			
5	Finished goods A		2,800,000	
	(1,400,000+800,000+400,000+200,000)			
	Work in process –Job A			2,800,000
	(Job A completed and transferred to finished goods)			
6	Finished goods B		4,086,000	
	90% of (2,500,000+1,200,000+540,000+300,000)			
	Work in process –Job C		454,000	
	10% of (2,500,000+1,200,000+540,000+300,000)			
	Work in process –Job B			4,540,000
	(Job B completed and transferred to finished goods, 10% rejected items transferred to Job C)			
7	Cost of goods sold		6,886,000	
	Finished goods A			2,800,000
	Finished goods B			4,086,000
	(Jobs A and B delivered and transferred to cost of goods sold.)			

2. SERVICE COSTING

2.1 The nature of services and operations

It is usual to explain costing in terms of how to calculate and record the costs of manufactured products. However, many business entities do not make and sell products; they provide services.

Service organization do not make or sell tangible goods. Services are any activity carried out by a party to the benefit of another that is essentially intangible and does not result in the ownership of anything.

Examples include hotel services, consultancy services, legal and accounting services, providers of telephone services (telecommunications companies), providers of television and radio channels, entertainment services, postal services, medical services, and so on.

Characteristics of services

These are major characteristics of services:

- **Intangibility**: They do not have a physical substance unlike goods. They have no physical existence.
- **Inseparability**: Consumption and creation of a service cannot be separated. Services are consumed as they are created. A service does not exist until it is consumed by the person being served.
- **Variability**: Services face the problem of maintaining consistency in the standard of output. Goods can usually be supplied to a standard specification. This is more difficult to achieve for services, because each service is distinct from other service(s).
- **Perishability**: Services cannot be stored. They do not have a shelf life.
- **Lack of ownership**: Services do not result in the transfer of property in anything. The purchase of a service only confers on the customer a temporary benefit.
- **Heterogeneous**: a haircut is heterogeneous and so the exact service received will vary each time, not only will two hairdressers cut hair differently, but a hairdresser will not consistently deliver the same standard of haircut.

Operations

Operations are activities. Like services, they do not result in a finished product to sell to customers. Examples of operations include a customer service center taking telephone calls and e-mails from customers, and the staff canteen providing meals to employees.

2.2 Service costing, product costing and job costing compared

Costs can be established for services, such as hotel accommodation, telephone calls, auditing work, holidays and travel, and so on. The costs of a service are the sum of direct materials, direct labour, direct expenses (if any) and a share of operational overheads.

Costs can also be established for operations, in a similar way.

Service costing differs from costing in manufacturing industries in several ways.

- There is no production system; therefore, there are no production overheads.
- Direct materials costs are often a fairly small proportion of total costs (for example, the direct materials costs to a telecommunications company of providing telephone services are very small).
- In some service industries, direct labour costs are high (for example, in the film-making industry, accountancy and investment banking).
- General overhead costs can be a very high proportion of total costs.
- Inventory is usually very small; therefore, absorption costing is usually of little or no value for management information purposes.

Not all entities that provide services will use service costing. The purpose of service costing is to provide information to management about the costs of different services that the entity provides, and the profitability of each of the different services. Each service should be fairly standard. If they are not standard services, it is more sensible to use job costing to calculate the cost of each 'job' of service. For example:

- Service costing might be used by a hospital to record or calculate the cost of each of the different services provided by the hospital, such as the cost of treating a patient for a particular condition such as cardiac arrests etc.
- Job costing might be used by a professional firm such as a firm of accountants or solicitors, where the cost of each job depends largely on the amount of time spent on each job by the professional staff.

2.3 Cost units in service costing: composite cost units

One of the main problems with service costing is that it can be difficult to identify a suitable cost unit for the service. It is often appropriate to use a composite cost unit in service costing. It is known as composite cost unit like in railway industry where cost is calculated on the basis of passenger/km. This is a cost that is made up from two variables, such as a cost per man per day (a cost per 'man/day'). Here, the two variables are 'men' (the number of employees) and 'days'.

Examples of composite **cost units used in service costing** are as follows:

- The cost per room per night. This is a useful unit cost in the hotel services industry.
- The cost per passenger mile or the cost per passenger kilometer (the average cost of transporting a passenger for one mile or one kilometer). This unit measure of cost is used by transport companies that provide bus or train services.
- The cost per ton mile delivered (the average cost of transporting one ton of goods for one mile). This unit cost is commonly used for costing freight services and delivery operations.
- The cost per patient/day (the average cost of treating one patient for one day) or the cost per hospital bed/day (the cost of maintaining one hospital bed in a hospital for one day). These costs are used by health service providers.
- The cost per man day. This unit cost is widely used in professional services, such as auditing, legal services and consultancy services.

Composite cost units can be used in addition to a 'job costing' type of service costing system. For example, a firm of accountants might calculate the cost of each job performed for a client. In addition, it might calculate the average cost per man day for the professional services such as taxation, auditing, consultancy etc. that it provides.

- The cost of each service 'job' enables management to monitor costs and profits on individual jobs for a customer.
- The composite cost, which is an average cost for all 'jobs' allows management to monitor the general level of costs.

2.4 Calculating the cost per unit of service (or operation)

The cost of a service unit (or composite cost unit) is calculated as follows.

► *Formula*

$$\text{Cost per unit of service} \quad \frac{\text{Total costs of the service}}{\text{Number of units of service}}$$

In case of absorption cost, total costs include direct material, direct labour and production overheads whereas in marginal cost, total costs include direct material, direct labour and variable production overheads.

The total number of service units might be a bit more difficult to calculate. Here are a few examples.

- *Example 05:*

  A hotel has 80 standard twin-bedded rooms. The hotel is fully-occupied for each of the 350 days in each year that it is open. The total costs of running the hotel each year are Rs. 3,360,000.

  What would be a useful measure of the cost of providing the hotel services?

  A useful unit cost is the cost per room/day. This is the average cost of maintaining one room in the hotel for one day.

  Room available in a year = 80 rooms × 350 days = 28,000

  Cost per room/day = Rs. 3,360,000/28,000 = Rs 120.

- *Example 06:*

  A train company operates a service between two cities, Southtown and Northtown. The distance between the cities is 400 miles. During the previous year, the company transported 200,000 passengers from Southtown to Northtown and 175,000 passengers from Northtown to Southtown. The total costs of operating the service were Rs.60 million.

  What would be a useful measure of the cost of providing the train service between the two cities?

  A useful unit cost is the cost per passenger/mile. This is the average cost of transporting one passenger for one mile.

  Passenger/miles per year = (200,000 × 400) + (175,000 × 400) = 150 million.

  Mile = Rs. 60,000,000/150,000,000 = Rs.0.40.

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3. COMPREHENSIVE EXAMPLES

- *Example 01:*

RI Limited (RIL) is engaged in the manufacturing of spare parts for industrial machines. RIL receives bulk orders from its customers and follows job order costing. Following data pertains to two of the jobs which were started in the month of February 2018:

	Job F01	Job F02
Size of job order (Units)	5,400	3,600
Labour hours used	27,500	21,600
Labour rate per hour	Rs. 360	Rs. 400

i. Each unit of both jobs require 24 kg of raw material S40. Purchase price of S40 was Rs. 30 per kg.

ii. The inventory of S40 at beginning and end of the month was Rs. 2,940,000 and Rs. 1,740,000 respectively.

iii. Wages were paid on 28 February 2018. Income tax withheld from the wages amounted to Rs. 500,000 which would be deposited in government treasury in the following month.

iv. Job F01 was in process at month-end. However, Job F02 was completed during the month of February and finished goods were sent to warehouse. During the delivery to the customer, 500 units were damaged badly and their realizable value is 50% of the cost.

Total labour hours utilized during the month were 100,000. Factory overheads are applied at Rs. 120 per direct labour hour. Under/over applied factory overheads are charged to cost of sales at month-end. Total actual factory overheads amounted to Rs. 11,000,000, out of which 40% were fixed.

Required: Prepare journal entries to record the transactions for the month of February 2018.

Solution

Journal entries to record the transactions for the month of February 2018 can be prepared as follows:

Journal entries

Date	Particulars		Debit	Credit
			----- Rs. in '000 -----	
1	Materials control	(W-1)	5,280	
	Supplier/cash			5,280
	(Purchased raw material)			
2	Work in process -JobF01	(W-1)	3,888	
	Work in process -JobF02	(W-1)	2,592	
	Materials control			6,480
	(Allocated raw material consumed to the jobs)			
3	Work in process -JobF01	(27,500×360)	9,900	
	Work in process -JobF02	(21,600×400)	8,640	
	Payroll			18,540

Date	Particulars		Debit	Credit
			----- Rs. in '000 -----	
	(Allocated direct labour to the jobs)			
4	Payroll		18,540	
	Accrued payroll tax			500
	Bank/Cash			18,040
	(Paid of payroll)			
5	Work in process -JobF01	(27,500×120)	3,300	
	Work in process -JobF02	(21,600×120)	2,592	
	Factory overheads applied			5,892
	(Applied factory overheads to the jobs @ Rs. 120 per direct labour hour)			
6	Finished goods	(2,592+8,640+2,592)	13,824	
	Work in process -JobF02			13,824
	(Transferred WIP of job F02 to finished goods)			
7	Damaged goods inventory (at NRV) (13,824/3,600×500×50%)		960	
	Abnormal loss - P&L (13,824/3,600×500×50%)		960	
	Finished goods			1,920
	(Recorded 500 damaged units)			
8	Cost of sales	(13,824–1,920)	11,904	
	Finished goods			11,904
	(Transferred total finished goods to cost of sales)			
9	Factory overheads applied	(100,000×120)	12,000	
	Cost of sales (overhead over applied)			1,000
	Factory overheads control			11,000
	(Transferred applied factory overheads to control a/c and charged under applied overheads to cost of sales)			
10	Factory overheads control		11,000	
	Cash/suppliers			11,000
	(Recorded actual factory overheads incurred)			

W-1: Purchase of raw materials		Rs. In 000
Material consumption - F01	(5,400×24×30)	3.888.00
Material consumption - F02	(3,600×24×30)	2,592.00
Add: Closing stock of raw material	*Given*	1,740.00
Less: Opening stock of raw material	*Given*	(2,940.00)
Purchases - Raw material		5,280.00

▶ *Example 02:*

Modern Engineering Workshop (MEW) is engaged in production of customized spare parts of textile machinery. The following information pertains to the jobs worked by MEW during the month of June 2014:

	Job 101	Job 202
Size of job order	4,000 units	5,000 units
	----------- Rs. in '000 -----------	
Opening work in process	15,000	-
Raw material consumed	10,000	31,000
Direct labour used (Rs. 100 per hour)	5,000	8,000

i. Overheads are applied to jobs at Rs. 25 per direct labour hour. Under/over applied overheads are transferred to cost of sales.

ii. Job 101 was completed during the month and the goods were sent to the warehouse for delivery to the customer. During the transfer to the warehouse, 160 units were damaged. Net realizable value of the damaged units was Rs. 500,000. Remaining units were transferred to the customer.

iii. Job 202 is in process; however, 2,000 units are fully complete and were transferred to the warehouse during the month while 3,000 units are 70% complete as at 30 June 2014.

iv. Actual overheads for the month of June 2014 amounted to Rs. 4,000,000.

Required: Prepare journal entries to record the above transactions.

▶ *Solution*

In order to prepare journal entries to record the above transactions, please see below:

Journal entries			
Date	Particulars	Debit	Credit
		Rs. in '000	
1	Work in process Job # 101	10,000	
	Work in process Job # 202	31,000	
	Materials control		41,000
	(Raw material consumed for jobs)		
2	Work in process Job # 101	5,000	
	Work in process Job # 202	8,000	
	Payroll		13,000
	(Direct labour cost allocated to jobs)		
3	Work in process Job # 101 5,000/100*25	1,250	
	Work in process Job # 202 8,000/100*25	2,000	
	Factory overheads applied		3,250
	(Overheads applied to the jobs @ Rs. 25 per direct labour hour)		

Journal entries			
Date	Particulars	Debit	Credit
		Rs. in '000	
4	Factory overheads applied	3,250	
	Cost of sales – overhead under applied (4,000–3,250)	750	
	Factory overheads control		4,000
	(Transfer of applied factory overheads to control a/c and under applied overheads charged to cost of sales)		
5	Finished goods (Job # 101) (15,000+10,000+5,000+1,250)*3,840/4,000	30,000	
	Damaged goods (at NRV)	500	
	Profit and loss account (damaged goods cost exceeding NRV) (31,250×160/4,000)-500	750	
	Work in process Job # 101		31,250
	(WIP of Job order # 101 transferred to finished goods)		
6	Cost of sales	30,000	
	Finished goods		30,000
	(Finished goods of Jobs # 101 transferred to cost of sales)		
7	Finished goods (31,000+8,000+2,000)/(2,000+3,000*0.7)*2,000	20,000	
	Work in process Job # 202		20,000
	(Units fully completed for Job # 202 transferred to finished goods)		

▶ *Example 03:*

The Composite Manufacturing Company uses job order costing. At the beginning of May, two jobs were in process:

	Job 469	Job 475
	-------------Rs. In ‘000---------------	
Materials	9,000	7,500
Direct labour	4,200	3,300
Applied production overhead	6,300	4,950

There was no inventory of finished goods on May 1. During the month Job 476 to 481 were started. Materials requisitions for May totaled Rs. 55,300; direct labour cost Rs. 48,600 and actual production overheads Rs. 75,000. Production overhead is absorbed at the rate of 150% of direct labour cost.

The only job still in process at the end of May is Job 481, with costs of Rs. 5,900 for materials and Rs. 4,200 for direct labour.

Job 479, the only finished job on hand at the end of May, has a total cost of Rs. 9,500.

Required

Prepare:

a) T accounts for work in process, finished goods, cost of goods sold and factory overhead control.

b) General entries to record the cost of goods manufactured, cost of goods sold and closing of over or under absorbed production overheads to cost of goods sold,

► *Solution*

a)

Work in process control			
	Rs. In '000		Rs. In '000
Balance b/d W-1	35,250	Finished goods (Bal. Fig.)	195,650
Materials control	55,300		
Salaries & wages control	48,600		
Production overhead control (48,600 x 150%)	72,900	Balance c/d W-2	16,400
	212,050		212,050

Finished goods			
	Rs. In '000		Rs. In '000
Work in process control	195,650	Cost of sales (Bal. Fig.)	186,150
		Balance c/d	9,500
	195,650		195,650

Cost of goods sold			
	Rs. In '000		Rs. In '000
Finished goods	186,150		
Production overheads control	2,100	Profit & Loss account	188,250
	188,250		188,250

Production overheads control			
	Rs. In '000		Rs. In '000
Cash or payables (Actual)	75,000	Work in process control	72,900
		Cost of sales	2,100
	75,000		75,000

W-1 Opening Inventory of WIP	Job 469	Job 472	Total
	---------Rs. In '000------------		
Materials	9,000	7,500	16.500
Direct labour	4,200	3,300	7,500
Applied production overhead	6,300	4,950	10,250
Total	19,500	15,750	35,250

W-2 Closing Inventory of WIP-Job 481	Rs. In '000
Materials	5,900
Direct labour	4,200
Applied production overhead (4,200 x 150%)	6,300
Total	16,400

(b) Journal entries

Date	Particulars	Debit	Credit
		Rs. in '000	
	Finished goods	195,650	
	Work in process control		195,650
	(Recording of cost of goods manufactured)		
	Cost of goods sold	186,150	
	Finished goods		186,150
	(Recording of cost of goods sold)		
	Cost of goods sold	2,100	
	Production overhead control		2,100
	(Closing of under absorbed production overheads)		

- *Example 04:*

Best Products Limited, provided the following data for January 2021.

	Rs. In 000
Materials:	
Inventory, January 1, 2021	12,000
Purchases on account	36,000
Labour:	
Accrued, January 1, 2021	3,600
Paid during January	30,000
Factory overhead costs:	
Supplies (issued from materials)	1,800
Indirect labour	4,200
Depreciation	1,200
Other production overheads (all from outside suppliers on account)	17,400

Work in process:	Job A	Job B	Job C
	Rs. In '000		
Work in process January 1, 2021	1,200	-	-
Jobs costs during January, 2021:			
Direct materials	4,800	7,200	6,000
Direct labour	6,000	9,600	8,400
Absorbed production overheads	6,000	9,600	8,400

Job A: Started in December, 2020, finished during January and sold to customer for Rs. 25,200,000.

Job B: Started in January, 2021, not yet finished.

Job C: Started in January 2021, finished during January 2021 and now in the finished goods warehouse awaiting customer's disposition. There was no finished goods inventory at start of January, 2021.

Required

Prepare relevant ledger accounts for the month of January, 2021.

► *Solution*

Materials control

	Rs. In '000		Rs. In '000
Balance b/d	12,000	Production overheads control	1,800
Accounts payable	36,000	Work in process –Job A	4,800
		Work in process –Job B	7,200
		Work in process –Job C	6,000
		Balance c/d	28,200
	48,000		48,000

Work in process –Job A

	Rs. In '000		Rs. In '000
Balance b/d	1,200		
Materials control	4,800		
Payroll	6,000		
Production overhead control	6,000	Finished goods	18,000
	18,000		18,000

Work in process –Job B

	Rs. In '000		Rs. In '000
Materials control	7,200		
Payroll	9,600		
Production overhead control	9,600	Balance c/d	26,400
	26,400		26,400

Work in process –Job C			
	Rs. In '000		Rs. In '000
Materials control	6,000		
Payroll	8,400		
Production overhead control	8,400	Finished goods	22,800
	22,800		22,800

Finished Goods			
	Rs. In '000		Rs. In '000
Work in process- Job A	18,000	Cost of sales	18,000
Work in process- Job B	22,800	Balance c/d	22,800
	40,800		40,800

Production overheads control			
	Rs. In '000		Rs. In '000
Materials control	1,800	Work in process –Job A	6,000
Payroll	4,200	Work in process –Job B	9,600
Accumulated depreciation	1,200	Work in process –Job C	8,400
Accounts payable	17,400	Cost of sales	600
	24,600		24,600

Payroll			
	Rs. In '000		Rs. In '000
Accrued payroll	28,200	Work in process –Job A	6,000
		Work in process –Job B	9,600
		Work in process –Job C	8,400
		Production overheads	4,200
	28,200		28,200

Accrued Payroll			
	Rs. In '000		Rs. In '000
Cash	30,000	Balance b/d	3,600
Balance c/d	1,800	Payroll	28,200
	31,800		31,800

Cost of sales			
	Rs. In '000		Rs. In '000
Finished goods	18,000		
Production overheads control	600	Profit and Loss	18,600
	18,600		18,600

Sales			
	Rs. In '000		Rs. In '000
Profit and Loss	25,200	Accounts receivables	25,200
	25,200		25,200

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STICKY NOTES

Job costing is a costing method used where each cost unit is separately identifiable. The work is undertaken to customer's specific requirements and the job is of short duration. The main focus of Job costing is to calculate cost of a specific job or batch.

Costs for each job are collected on a job cost card. Costs includes Material, labour and overheads. Overheads are absorbed in to the cost of jobs using pre-determined overhead absorption rates.

Service costing can be used by companies operating in a service industry often by companies wishing to establish the cost of services carried out by some of their departments

Service costing differs from the other costing methods. With many services the cost of direct materials consumed will be relatively small compared to the labour, direct expenses and overheads cost.

CHAPTER 8

PROCESS COSTING

IN THIS CHAPTER

AT A GLANCE

Process Costing is used where production is a continuous process and it is not possible to identify separate units of Production.

The output of one process is the input to a subsequent process until product is transferred to Finished Goods.

There is often a loss in process which is called normal loss due to spoilage, wastage, evaporation etc.

If actual loss is greater than normal loss the difference is called abnormal loss and if actual loss is less than normal loss, we treat the difference as abnormal gain.

Losses and Gain can occur at different stages in the process

Loss or spoilage may have a scrap value; the scrap value of normal loss will probably be deducted from the cost of material in the process.

The scrap value of abnormal loss (or abnormal Gain) will probably be set off against its cost, in an abnormal loss and abnormal gain account, and only the balance on the account will be written to the P & L account at the end of the period.

Process account may have closing and opening WIP, there are two methods to deal with opening WIP – FIFO and Weighted Average.

1. INTRODUCTION TO PROCESS COSTING

1.1 Process costing

A process costing system is used in those industries where masses of similar products or services are produced. Products are produced in the same manner and consume the same amount of direct costs and overheads. It is, however, difficult to assign costs to individual units of output. The completed product may take several process and in this case, the output of one process is the input to a subsequent process until a completed product is produced.

Examples, of manufacturing industries where process costing is widely used, are:

- chemicals manufacturing;
- petroleum refining
- the manufacture of liquids;
- brewing industry and
- the continuous processing of high volumes of low-cost food items such as tins of peas or beans, or bottles of tomato ketchup.

In these types of production process, losses in process might occur and there are often problems in measuring exactly the amount of unfinished work-in-process at the end of a period. The losses and their accounting treatment are discussed in later section of this chapter.

The basic principle of costing is the same as for other types of costing. The cost of a unit of output from a process is measured as the total cost of resources consumed by the process divided by the total units produced.

1.2 Features of Process Costing

Process costing provides a system of costing where any or all of these characteristics occur.

- The output of one process is the input to a subsequent process until conversion into finished product.
- Output is normally measured in total quantities, such as tones or liters produced, or in very large quantities of small units (such as the number of cans or tins).
- Materials might be added in full at the start of a process or sometimes during specific percentage of completion or might be added gradually throughout the process. The materials are processed to produce the final output. In a process costing system, it is usual to distinguish between:
  - direct materials; and
  - conversion costs, which are direct labour costs and production overheads.
- There might be losses in the process (due to evaporation, spoilage, wastage or chemical reaction) so the quantity of output might therefore be less than the quantity of materials input. Process costing provides a system of costing that allows for expected losses in the manufacturing process.
- When there is a continuous production process there will usually be closing work in process and it is difficult to measure the quantity of work-in-process (incomplete production) at the end of a financial period. Process costing provides a method of measuring and costing incomplete WIP.
- Output from production might be a single product, but there may be joint products and by products.
- In some process manufacturing systems, there is a series of sequential processes. For example, a manufacturing system might consist of three consecutive processes: raw materials are input to Process 1, then the output from Process 1 goes onto the next process (Process 2) and the output from Process 2 then goes into a final process, Process 3. The output from Process 3 is the final product. Each process is different and all these characteristics do not occur in all processes.

1.3 Flow of cost in process costing and comparison with Job order costing

The major differences between process costing and job order costing is that in process costing production moves from one process to subsequent process, until final completion occurs. Final product is then transferred to finished goods after accumulation cost process. Whereas in job order costing, cost to each job is assigned separately and transferred to finished goods after completion of independent job.

The cost accumulation procedure follows this production flow and control accounts are established for each department or process and all direct and indirect costs are assigned to each process. The cost of first process is transferred to second process and accumulates with cost of second process. This cost accumulation procedure continues, until goods are completed and transferred to finished goods.

1.4 The basics of Process Costing

Where a series of separate processes is required to manufacture the finished product the output of one process becomes the input to the next until the final output is made in the final process. For example, if two processes are required the accounts would be like this.

► *Illustration:*

Simple process account

Process 1 Account					
	Units	Rs.		Units	Rs.
Materials	100	1,000			
Conversion cost		500	Transfer to Process 2	100	1,500
	100	1,500		100	1,500

Process 2 Account					
	Units	Rs.		Units	Rs.
Material from process 1	100	1,500			
Added materials	50	500			
Direct labour		700			
Production overhead		400	Output to Finished Goods	150	3,100
	150	3,100		150	3,100

Note that direct labour and production overhead may be treated together as conversion cost.

Added material, labour and production overheads in process 2 are added gradually throughout the process. Cost transfer from process 1 to process 2 is treated 'materials from process 1' for Process 2.

1.5 Addition of Materials in Subsequent Process

Many industries that utilize process costing have more than one processes through which the units pass through before being turned into finished goods e.g. In oil refining the crude oil passes through distillation, reforming, isomerization etc. before turning into a final finished product.

As the production passes through different products, the finished goods output of one process becomes the raw materials input of the next process, in addition to the units from the previous process, new materials may also be added in the next process. In order to separately distinguish the costs incurred in different processes or department the cost from the previous process are labelled as "Direct Materials – Process 1".

▶ *Example 01*

ABC company manufactures product A101 which is produced in two processes and following data represents 500 units produced during the month of March 2019.

	Units	Rs.
Material input – Process I	500	35,000
Added material – Process II		5,200
Conversion cost – Process I		12,750
Conversion cost – Process II		17,450

There is no losses and work in progress in both processes and all input units are converted into finished product.

Process I and II accounts for the month of March 2019 are given below:

Process I Account					
	Units	**Rs.**		**Units**	**Rs.**
Materials	500	35,000			
Conversion cost		12,750	Process II	500	47,750
		47,750			**47,750**

Process II Account					
	Units	**Rs.**		**Units**	**Rs.**
Materials-Process I	500	47,750			
Added material		5,200			
Conversion cost		17,450	Finished goods	500	70,400
		70,400			**70,400**

Cost per unit of Product A101 is Rs. 140.80 (70,400/ 500)

2. LOSSES

2.1. Normal loss

A feature of process manufacturing is that there is often some loss or wastage in production and output quantities are less than input quantities of materials.

Normal loss is the expected loss in the process due to evaporation of liquids, wastage or rejected units.

- *Formula: Normal loss*

Normal loss = Quantity of material input – Expected output	OR
Quantity of material input = Normal loss + Expected output	OR
Expected output = Quantity of material input – Normal loss	

Normal loss is usually expressed as a percentage of the input units of materials.

- *Example 02:*

Normal loss of a process is 10%.

A company puts 5,000 liters into the process.

Normal loss is 10% of 5,000 = 500.

Expected output from the process would be 90% of 5,000 liters = 4,500 liters

Normal loss is unavoidable in the normal course of events. It is inherent in the physical and chemical reactions that take place in a process.

2.1.1. Normal loss with no recovery value

The normal losses are inherent to production process and cannot be avoided. Therefore, in process account, if it has no scrap value (like in case of evaporation), then no cost is assigned (credited) to normal loss in process account. As consequence, the cost per unit of finished product will increase.

- *Example 03:*

A person buys one liter tin of soup for Rs. 500.

Normal evaporation during cooking is 10%.

When the soup is ready to eat there is 0.9 liters left.

The person has paid Rs. 500 for 0.9 liters and this is unavoidable.

The implication of this simple example is as follows.

The normal loss is something that is unavoidable in order to get the good output. The cost of the lost units is part of the cost of obtaining the good output.

All of the cost should be assigned to the good output and none to the normal loss.

The cost of input per liter is Rs. 500 whereas cost of output per liter is Rs. 555.55 as the cost of normal loss is assigned to good units.

- *Formula: Unit cost of good output*

$$\text{Per unit Cost of good output} = \frac{\text{Total process costs}}{\text{Expected units of output}}$$

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- *Example 04:*

The following information relates to a production process:

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,800 liters
Direct materials cost	Rs. 3,600
Direct labour cost	Rs. 300
Production overhead absorbed	Rs. 600

The cost per unit produced can be calculated as follows:

	Rs.
Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	Rs.2.50

- *Example 05:*

Descriptions	Process X	Process Y
Materials Added (KGs)	10,000	2,000
Materials (Rs.)	30,000	3,000
Direct Wages (Rs.)	16,000	40,000
Production OH as % of Direct Wages	25%	30%
Normal Loss%	5%	5%

There is no work in process and abnormal losses in both processes. The losses have no scrap value.

The process X and Process Y accounts are prepared, as follows.

Process X A/c					
	KGs	Rs.		KGs	Rs.
Direct Materials	10,000	30,000	Normal Loss	500	-
Direct Wages		16,000	Process Y	9,500	50,000
Production OH		4,000			
	10,000	**50,000**		**10,000**	**50,000**

Process Y A/c					
	KGs	Rs.		KGs	Rs.
Process X	9,500	50,000	Normal Loss	575	-
Direct Materials	2,000	3,000	Output	10,925	105,000
Direct Wages		40,000			
Production OH		12,000			
	11,500	**105,000**		**11,500**	**105,000**

Process account in the cost ledger

The process cost account (shown above) is a work-in-progress account for the process. The debit side of the account records input as direct materials, direct labour costs and production overheads absorbed. The credit side of the WIP account records the cost of the finished output.

The account also includes memorandum columns for the quantities of direct materials input and the quantities of output and loss. Normal loss is shown so that the quantities columns add up to the same amount on the debit or credit sides, but the normal loss has no cost (as it's cost is built into the cost of output).

Note that it is always useful to draft a process account at the start of an answer as it focuses the mind on what needs to be done.

2.1.2. Normal loss with recovery value

In some cases, loss units in a process are in physical form and have a scrap value. The normal loss quantity might not be physically lost but is changed in some way, so that it is not the same as good output. For example, there might be some kind of chemical separation with a substance scraped off the top of the liquid in the process and whatever is scraped off might have a scrap value.

If normal loss has a scrap value, the company is able to recover some of the input costs to the process. The scrap value reduces the cost of the process.

To reflect this in the process account the normal loss is credited at its scrap value and the calculation of the cost of good output can be calculated with the help of following formula.

- *Formula:*

$$\text{Per unit Cost of good output} = \frac{\text{Total process costs} - \text{Scrap value of the normal loss}}{\text{Expected units of output}}$$

The concept can be easily understood with the help of following example.

- *Example 06:*

The following information relates to a production process X.

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,800 liters
Scrap value of normal loss	Rs. 0.9 per liter
Direct materials cost	Rs. 3,600
Direct labour cost	Rs. 300
Production overhead absorbed	Rs. 600

The cost per unit produced can be calculated as follows:	Rs.
Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Less scrap value of normal loss (200 litres × 0,9)	(180)
	4,320
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	Rs.2.40

The process account can be completed as follows

Process X					
	Liters	Rs.		Liters	Rs.
Materials	2,000	3,600	Output (actual) at Rs. 2.4 each	1,800	4,320
Direct labour		300			
Prod. O'hd		600	Normal loss	200	180
	2,000	4,500		2,000	4,500

2.1.3.Normal loss with cost of disposal

In other cases, a company might have to pay to dispose-off losses in a process and additional cost might be incurred to its disposal. The substance scraped off the top of the liquid in the process might be toxic and has to be disposed-off safely.

The cost of disposal represents an additional cost to the process.

To reflect this in the process account the normal loss is measured at zero but the expected costs of disposal are debited to the process account.

- *Formula:*

$$\text{Per unit Cost of good output} = \frac{\text{Total process costs + Disposal costs of the normal loss}}{\text{Expected units of output}}$$

- *Example 07:*

The following information relates to a production process X

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,800 liters
Disposal cost of normal loss	Rs. 1 per liter

The cost per unit produced can be calculated as follows:	Rs.
Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Disposal costs of normal loss (200 litres × 1)	200
	4,700
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	Rs. 2.6111

The process account can be completed as follows

Process X					
	Liters	Rs.		Liters	Rs.
Materials	2,000	3,600	Output (actual) at Rs. 2.6111 each	1,800	4,700
Direct labour		300			
Prod. overhead		600			
Disposal cost of normal loss		200	Normal loss	200	–
	2,000	4,700		2,000	4,700

2.2. Abnormal Loss

As discussed above, normal loss is the expected amount of loss in a process. However, actual loss might be more than the expected or normal loss. When actual loss exceeds normal loss, there is abnormal loss. The difference between total actual loss and normal loss is abnormal loss.

- *Formula:*

Abnormal loss = Actual loss – Expected (normal) loss

From earlier:

Quantity of material input = Normal loss + Expected output

But:

Expected output = Actual output + Abnormal loss

Therefore:

Quantity of material input = Normal loss + Actual output + Abnormal loss

Total loss = Normal loss + Abnormal loss.

Abnormal loss is not expected and might occur due to negligence, carelessness or natural disaster. It is, therefore, important to assign it cost. By giving a cost to abnormal loss, management information about the loss can be provided, and management can be made aware of the extent of any problem that might exist with excessive losses in process.

2.2.1. Accounting for abnormal loss

If it is assumed that all losses in process occur at the end of the process, units of abnormal loss are cost in exactly the same way in the as units of finished output. This might seem a little strange but the idea is to highlight the impact of the loss.

The cost per unit of abnormal loss is therefore the same as the cost of units of good output. This is exactly the same as before.

- *Formula:*

$$\text{Per unit Cost of good output} = \frac{\text{Total process costs} - \text{Scrap value of the normal loss}}{\text{Expected units of output}}$$

The cost of units of abnormal loss is treated as an expense for the period, and charged as an expense in the income statement for the period.

- *Example 08:*

The following information relates to a production process X.

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,700 liters
Therefore abnormal loss	100 liters

The cost per unit produced can be calculated as follows:	Rs.
Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	Rs. 2.5

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Costing:

Cost of finished output = 1,700 units × Rs.2.50 = Rs.4,250.

Cost of abnormal loss = 100 units × Rs.2.50 = Rs.250.

The process account can be completed as follows

Process X					
	Liters	Rs.		Liters	Rs.
Materials	2,000	3,600	Output (actual) at Rs. 2.5 each	1,700	4,250
Direct labour		300	Abnormal loss	100	250
Production overheads		600			
			Normal loss	200	–
	2,000	4,500		2,000	4,500

Abnormal loss can be prepared as follows, assuming that it has no scrap value.

Abnormal Loss Account					
	Liters	Rs.		Liters	Rs.
Process X	100	250	Profit & Loss A/C	100	250
		250			250

The appropriate abnormal loss double entry in the cost ledger is:

	Debit	Credit
Abnormal loss account	X	
Process accounts		X

The entry to close the abnormal loss account at period end is:

	Debit	Credit
Profit and Loss Account	X	
Abnormal Loss Account		X

At the end of the financial period, the balance on the abnormal loss account is written off as a cost in the costing income statement. Unlike normal loss the cost of abnormal loss is not built into inventory, however, the cost of abnormal loss is treated as a period cost rather than a product cost.

2.2.2. Abnormal loss with recovery value

When loss has a scrap value, the scrap value of normal loss is deducted from the process cost, as explained earlier.

Abnormal loss will also have a scrap value but this is treated differently to the scrap value of normal loss.

- The cost of expected units of output is calculated in the usual way and scrap value of abnormal loss will not affect cost per unit of output.
- The scrap value of normal loss is normal loss units × scrap value per unit (as usual).
- In the process account the cost of abnormal loss is measured at the cost of expected units (just as before).
- Periodically the units in the normal loss account are transferred to a scrap account at scrap value.

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- The balance on the abnormal loss account is an expense for the period (measured at the cost of the units less the scrap value of abnormal loss).
- This means that scrap value of abnormal loss is set off against the cost of abnormal loss in the abnormal loss account, not in process account.

► *Example: 09:*

The following information relates to a production process X.

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,700 liters
Therefore abnormal loss	100 liters
Scrap value of losses	Rs. 0.9 per liter

The cost per unit produced can be calculated as follows:	**Rs.**
Direct materials	3,600
Direct labour	300
Production overheads	600
Scrap value of normal loss (200 × Rs.0.90)	(180)
Total production cost	4,320
Expected output (90% of 2,000)	÷1,800 liters
Cost per litre	Rs. 2.4

Costing:

Cost of finished output = 1,700 units × Rs. 2.40 = Rs. 4,080.

Cost of abnormal loss = 100 units × Rs. 2.40 = Rs. 240.

Normal loss = 200 units × Rs. 0.9 = Rs. 180

The process account can be completed as follows

Process X					
	Liters	**Rs.**		**Liters**	**Rs.**
Materials	2,000	3,600	Output	1,700	4,080
Direct labour		300	Abnormal loss	100	240
Prod. Overhead		600	Normal loss	200	180
	2,000	4,500		2,000	4,500

Abnormal loss account with scrap value is prepared as follows.

Abnormal loss account					
	Liters	Rs.		Liters	Rs.
Process X account	100	240	Scrap account	100	90
			Income statement		150
	100	240		100	240

Scrap account					
	Liters	Rs.		Liters	Rs.
Process X account (normal loss)	200	180	Cash	300	270
Abnormal loss account	100	90			
	300	270		300	270

The appropriate abnormal loss double entry in the cost ledger is:

	Debit	Credit
Abnormal loss account	X	
Process accounts		X

The entry to close the abnormal loss account at period end is:

	Debit	Credit
Profit and Loss Account	X	
Scrap account	X	
Abnormal Loss Account		X

3. ABNORMAL GAIN

Abnormal loss occurs when actual loss is more than the expected (normal) loss. Abnormal gain occurs when the actual loss is less than normal loss. Abnormal gain is the difference between the expected normal loss and the actual loss. It might be due to enhanced efficiency of the manufacturing process, if the gain is expected to be permanent then the expected loss ratio should be revised.

- *Formula: Abnormal gain*

Abnormal gain = Expected (normal) loss – Actual loss

From earlier:

Expected output = Actual output + Abnormal loss

Gain is opposite in sign so goes to the other side of the expression:

Expected output + Abnormal gain = Actual output

Actual loss = Normal loss – Abnormal gain

3.1. Accounting for abnormal gain: no scrap value for loss

The method of costing for abnormal gain is the same in principle as for abnormal loss. If it is assumed that all losses occur at the end of the process, the cost per unit of finished output and the value/cost of abnormal gain are calculated as the cost per expected unit of output. (i.e. the cost of good output)

The unit cost credited to abnormal gain is therefore the same as the cost of units of good output. This is exactly the same as before.

- *Formula: Cost of good output*

$$\text{Per unit Cost of good output} = \frac{\text{Total process costs – Scrap value of the normal loss}}{\text{Expected units of output}}$$

The differences between costing for abnormal loss and costing for abnormal gain are that:

- Abnormal gain is a benefit rather than an expense. Whereas abnormal loss is written off as a cost at the end of the financial period, abnormal gain is an adjustment that increases the profit for the period.
- Abnormal gain account has credit balance and is recorded as a debit entry in the process account, because it is a benefit.
- The other side of the double entry is recorded in an abnormal gain account. At the end of the period, the balance on the abnormal gain account is then transferred to the income statement as a benefit for the period, adding to profit.

- *Example 10:*

The following information relates to a production process X.

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,850 liters
Therefore abnormal gain	50 liters

The cost per unit produced can be calculated as follows:	Rs.
Direct materials	3,600
Conversion costs (direct labour + production overheads)	900
Total production cost	4,500
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	Rs. 2.5

Costing:

Cost of finished output = 1,850 units × Rs. 2.50 = Rs. 4,625.

Cost of abnormal gain = 50 units × Rs. 2.50 = Rs. 125.

Normal loss = zero (as there is no scrap value).

The process account can be completed as follows

Process X					
	Liters	Rs.		Liters	Rs.
Materials	2,000	3,600	Output	1,850	4,625
Conversion cost		900			
Abnormal gain	50	125	Normal loss	200	nil
	2,050	4,625		2,050	4,625

Abnormal gain account					
	Liters	Rs.		Liters	Rs.
Income statement	50	125	Process X	50	125
	50	125		50	125

The balance on this account is taken to the costing income statement at the end of the period, and added to the reported profit.

The appropriate double entry in the cost ledger is:

	Debit	Credit
Process account	X	
Abnormal gain account		X

3.2. Abnormal gain where loss has a scrap value

When loss has a scrap value, the value of abnormal gain is actually less than the amount shown in the process account. The process has been more efficient and produced more good output than expected but there are less normal loss units so the revenue from scrap is less than expected.

Accounting for the scrap value of abnormal gain is similar to accounting for the scrap value of abnormal loss.

- In the process account (WIP), abnormal gain is valued at the cost per expected unit of output.
- The scrap value of normal loss is normal loss units × scrap value per unit (as usual).

- The scrap value of abnormal gain is recorded as a debit entry in the abnormal gain account (in a similar way to recording the scrap value of abnormal loss as a credit entry in the abnormal loss account).
- The scrap value of the abnormal gain is set off against the value of the abnormal gain in the abnormal gain account, not in process account.
- The balance on the abnormal gain account is the net value of abnormal gain (value of abnormal gain minus the scrap value not earned from the normal loss). This balance is transferred as a net benefit to the cost accounting income statement at the end of the accounting period.

▶ *Example 11:*

Abnormal gain where loss has scrap value.

The following information relates to a production process X.

Input quantities	2,000 liters
Normal loss	10%
Therefore expected output	1,800 liters
Actual output	1,850 liters
Therefore abnormal gain	50 liters
Scrap value of losses	Rs. 0.9 per liter

The cost per unit produced can be calculated as follows:	**Rs.**
Direct materials	3,600
Direct labour	300
Production overheads	600
Scrap value of **normal loss** (200 × Rs.0.90)	(180)
Total production cost	4,320
Expected output (90% of 2,000)	÷1,800 liters
Cost per litre	Rs. 2.4

Costing:

Cost of finished output = 1,850 units × Rs. 2.40 = Rs. 4,440.

Cost of abnormal gain = 50 units × Rs. 2.40 = Rs. 120.

Normal loss = 200 units × Rs. 0.90 = Rs. 180.

The process account can be completed as follows

Process X					
	Liters	**Rs.**		**Liters**	**Rs.**
Materials	2,000	3,600	Output	1,850	4,440
Conversion cost		900			
Abnormal gain	50	120	Normal loss	200	180
	2,050	4,620		2,050	4,620

Accounting for the abnormal gain and the normal loss

The double entry to account for the losses can be completed as follows

Abnormal gain account					
	Liters	**Rs.**		**Liters**	**Rs.**
Scrap account	50	45	Process X account	50	120
Income statement		75			
	50	120		50	120

The balance on this account is Rs.75. This is treated as an addition to profit in the cost accounting income statement for the period.

Scrap account					
	Liters	**Rs.**		**Liters**	**Rs.**
Process X a/c (normal loss)	200	180	Abnormal gain account	50	45
			Cash	150	135
	200	270		200	180

The company expected to be able to sell 200 liters of scrap product. The abnormal gain means that they only have 150 liters to sell. The scrap value of 50 liters is adjusted against abnormal gain account.

- *Example 12:*

AK chemicals process high quality plastic sheeting in a continuous manufacturing operation. All materials are input at the beginning of the process. Conversion costs are incurred evenly throughout the process. The cost in process is given in the following table.

	Process Rs.
Materials cost	90,000
Conversion costs	72,650

40,000 units were put into process and 36,000 units were transferred to finished goods. There is no opening or closing work in progress. Past experience indicates that approximately 7.5% of the units started are found to be defective on inspection by quality control. The scrap value of loss is Rs. 1.80 per unit.

Process account and abnormal loss account is prepared as below.

Process Account					
	Units	**Rs.**		**Units**	**Rs.**
Materials	40,000	90,000	Normal loss	3,000	5,400
Conversion cost		72,650	Abnormal loss	1,000	4,250
			Finished goods	36,000	153,000
	40,000	162,650		40,000	162,650

Calculation of cost per unit = (162,650 – 5,400) / 37,000 = Rs. 4.25

Cost assigned to output (Finished goods) = 36,000 x 4.25 = Rs. 153,000

Cost assigned to Abnormal Loss = 1,000 x 4.25 = Rs. 4,250

Abnormal loss account					
	Units	Rs.		Units	Rs.
Process account	1,000	4,250	Scrap account	1,000	1,800
			Income statement		2,450
	1,000	4,250		1,000	4,250

- *Example 13:*

HL Limited manufactures product B201 which was produced in two processes i.e. Process A and Process B.

Relevant data for the month of April 2020 is given below.

	Process A	Process B
Units started/ received from process A	60,000	55,000
Units lost in process	5,000	2,500
Units transferred to Process B/ Finished goods	55,000	52,500
Normal Loss in %	5%	5%
Cost data:	**Rupees**	**Rupees**
Materials	65,200	-
Conversion cost	102,500	35,600

There shall be no work in progress in both process. Scrap value of losses in process A is Rs. 0.80 per unit whereas in process B Rs. 1.20 per unit. Assuming all losses were occurred at end of both process.

Process A, Process B and Abnormal loss/ gain accounts for the month of April 2020 are prepared, as under.

Process I Account					
	Units	Rs.		Units	Rs.
Materials	60,000	65,200	Normal loss	3,000	2,400
Conversion cost		102,500	Abnormal loss	2,000	5,800
			Finished goods	55,000	159,500
	60,000	167,700		60,000	167,700

Calculation of cost per unit = (167,700 – 2,400) / 57,000 = Rs. 2.90

Cost assigned to normal loss = 3,000 x 0.80 = Rs. 2,400

Cost assigned to output (Finished goods) = 55,000 x 2.90 = Rs. 159,500

Cost assigned to Abnormal Loss = 2,000 x 2.90 = Rs. 5,800

Process II Account					
	Units	Rs.		Units	Rs.
Process I- Materials	55,000	159,500	Normal loss	2,750	3,300
Conversion cost		42,350			
Abnormal gain	250	950	Finished goods	52,500	199,500
	55,250	202,800		55,250	202,800

Calculation of cost per unit = (201,850 – 3,300) / 52,250 = Rs. 3.80

Cost assigned to normal loss = 2,750 x 1.20 = Rs. 3,300

Cost assigned to output (Finished goods) = 52,500 x 3.80 = Rs. 199,500

Cost credited to Abnormal Gain = 250 x 3.80 = Rs. 950

4. PROCESS COSTING WITH CLOSING WORK IN PROGRESS

4.1. Sharing out process costs between finished units and unfinished inventory

When manufacturing is a continuous process, there may be unfinished work-in-progress (WIP) at the start and end of a period. This section looks at closing WIP, whereas opening WIP will be dealt later in this chapter. In all the examples in this section it is assumed that there is no opening WIP.

It stands to reason that the cost or value of an unfinished unit is less than the cost of a completed unit. The costs of the process must be shared between finished output and unfinished work-in-process on a fair basis.

Previous sections have explained that costs are allocated to output by calculating a cost per unit. This involves dividing a cost figure by the number of units of expected output.

We normally assume that all costs occur evenly throughout the process unless stated otherwise. For instance, if it is written that material was added at start of process, then it is treated as 100% at start of process. But in normal circumstances, 70% completion means that costs should be allocated to 70% to respective units.

In order to allocate the cost to closing work in progress, it is important to know about equivalent production unit concept, normally termed as 'equivalent units'.

4.2. Equivalent units

Equivalent units represent the production in terms of completed units. At the end of any given period there are likely to be partly completed units (work in process). It is evident that some of the costs pertaining to this period are attributable to partially completed units. A number of partially complete units is the equivalent of a number of complete units depending on their degree of completion. It is assumed that the costs are added uniformly throughout the process, unless otherwise mentioned.

▶ *Illustration:*

200 units that are 50% complete are equivalent to 100 (50% × 200) complete units

The above indicates that cost incurred on partially completed 200 units is equal to 100 completed units. The easiest way of calculation is multiplying the WIP units with percentage of completion, assuming that cost occur evenly throughout the process.

Complication

In all of the previous examples a cost per unit was calculated by dividing the total process costs (perhaps adjusting for expected normal loss or cost of disposal) by the expected number of units.

The existence of work in progress complicates this because the work in progress might be complete to different degrees in respect of different cost inputs. For example, a unit in the closing work in progress might be 80% complete with respect to material but only 50% complete with respect to labour.

In this case, the number of equivalent units of direct materials cost in a period will therefore differ from the number of equivalent units of labour.

A cost per unit is calculated for each type of cost using the equivalent units for that cost. The cost of output is then based on these individual costs.

Costs for finished output and closing inventory can be calculated from the number of equivalent units and the cost per equivalent unit.

4.3. A three-stage calculation

We recommend a three-stage calculation:

- Prepare a statement of equivalent units to calculate the equivalent units for each type of cost in the output from the process and for closing WIP

- Next, prepare a statement of cost per equivalent unit for each type of cost and it is known as per unit cost of each cost element.
- Third, prepare a statement to calculate the cost of finished output and closing WIP from the statement of equivalent units and statement of cost per equivalent unit.

4.4 Example related to closing WIP without losses (single process)

▶ *Example 14:*

The following information relates to a production process X.

Input quantities	4,000 units
Completed output	3,500 units
Closing WIP	500 units

All the direct materials are added to production at the beginning of the process.

Closing inventory of 500 units is therefore 100% complete for materials but is only 40% complete for conversion

The costs incurred in the period were:	Rs.
Direct materials	24,000
Converison costs:	7,400

Statement of equivalent units would require be as follows:

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Finished output	3,500	100%	3,500	3,500
Closing WIP:				
Materials	500	100%	500	
Conversion		40%		200
	4,000		4,000	3,700

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs	Rs.24,000	Rs.7,400
Equivalent units	÷ 4,000	÷ 3,700
Cost per equivalent unit	Rs.6	Rs.2

Statement of evaluation

	Rs.
Cost of finished goods (3,500 × (Rs. 6 + Rs. 2))	28,000
Cost of closing WIP	
Materials (500 units × Rs. 6)	3,000
Conversion (200 units × Rs. 2)	400
	3,400

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Direct materials	4,000	24,000	Finished goods	3,500	28,000
Conversion costs	-	7,400	Closing WIP	500	3,400
	4,000	31,400		4,000	31,400

4.5 Example related to closing WIP without losses (two processes)

- *Example 15:*

A manufacturing company operates two processes. Output from Process 1 is transferred as input to Process 2. Output from Process 2 is the finished product.

Data for the two processes in January are as follows:

Process 1	
Opening work in process	Nil
Units put into the process	14,000
Units completed and transferred to the next process (Process 2)	10,000
Closing work-in-progress	4,000
Material cost added during the period	Rs.70,000
Conversion cost added during the period	Rs.48,000

Materials are input into Process 1 at the start of the process and conversion costs are incurred at a constant rate throughout processing. The closing work-in-progress in Process 1 at the end of January is estimated to be 50% complete for the conversion work.

Process 2	
Opening work-in-process	Nil
Units transferred into the process from Process 1	10,000
Closing work-in-progress	1,000
Units completed and transferred to finished goods inventory	9,000
Costs for the period:	
Conversion cost added during the period	Rs.57,000
Added materials during Process 2	Rs.36,000

The materials from Process 1 are introduced at the start of processing in Process 2, but the added materials are introduced at the end of the process 2. Conversion costs are incurred at a constant rate throughout processing. The closing work-in-progress in Process 2 at the end of January is estimated to be 50% complete.

It is required to:

a) Calculate the cost of completed output from Process 1 and Process 2

b) Calculate the cost of the closing work-in-process in each process at the end of January.

c) Prepare the Process 1 account and the Process 2 account for January.

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▶ *Solution*

There is no opening inventory in either process; therefore, there is no difference between the weighted average cost and FIFO valuation methods.

Process 1

Equivalent units	Total	Direct materials		Conversion costs
	Total units	Equivalent units		Equivalent units
Completed units	10,000	10,000		10,000
Closing inventory	4,000	4,000	(4,000 × 50%)	2,000
Total equivalent units	14,000	14,000		12,000
Cost		Rs.70,000		Rs.48,000
Cost per equivalent unit		Rs.5		Rs.4

Cost assigned to units transferred to Process 2	Rs.
Cost of finished goods (10,000 × (Rs. 5 + Rs. 4))	90,000

Cost assigned to closing WIP inventory	Rs.
Materials (4,000 x 5)	20,000
Conversion cost (4,000 x 50% x 4)	8,000
	28,000

The process account is prepared as follows:

Process 1 account					
	units	Rs.		units	Rs.
Direct materials	14,000	70,000	Process 2 account	10,000	90,000
Conversion costs		48,000	Closing inventory c/f	4,000	28,000
	14,000	118,000		14,000	118,000

Process 2

Equivalent units	Total	Materials from Process 1	Conversion costs	Added materials
	Total units	Equivalent units	Equivalent units	Equivalent units
Completed units	9,000	9,000	9,000	9,000
Closing inventory	1,000	1,000	500	0
Total equivalent units	10,000	10,000	9,500	9,000
Cost		Rs.90,000	Rs.57,000	Rs.36,000
		Rs.9	Rs.6	Rs.4

Note: The added materials are added at the end of the process, which means that there are no added materials in the (unfinished) closing inventory.

Cost assigned to units transferred to Finished goods	**Rs.**
Cost of finished goods (9,000 × (Rs. 9 + Rs. 6 + Rs. 4))	171,000

Cost assigned to closing WIP inventory	**Rs.**
Cost of process I (1,000 x 9)	9,000
Conversion cost (1,000 x 50% x 6)	3,000
	12,000

The process account is prepared as follows:

Process 2 account

	units	**Rs.**		**units**	**Rs.**
Materials from Process 1	10,000	90,000	Finished goods	9,000	171,000
Conversion costs		57,000			
Added materials		36,000	Closing inventory c/f	1,000	12,000
	10,000	183,000		10,000	183,000

5. OPENING WORK IN PROGRESS

5.1. Introduction to opening work in progress

Closing work in progress in one period is treated as opening work in progress in next period of same process. Opening work in progress adds another level of complexity.

When there is opening work in progress there are two types of cost on the debit side of the account. These are the costs that were incurred last period and brought forward as work in progress and the costs that were incurred in the current period. The issue is whether they should be treated together or separately. It depends upon selection of inventory method by management for WIP. Following are two methods of valuation of WIP.

- weighted average cost method treats all costs on the debit side of the account in the same way.
- first-in, first-out (FIFO) method allocates the costs in opening WIP to the finished goods and then spreads the remaining costs elsewhere.

5.2. Opening Work In Progress: Weighted Average Cost Method

5.2.1. The underlying principle

When the weighted average cost method is used, the assumption is that all units produced during the period and all units of closing inventory should be valued at the same cost per equivalent unit for materials and the same cost per equivalent unit for conversion costs.

An average cost per equivalent unit is calculated for all units of output and closing inventory. This includes the units that were partly-completed at the beginning of the period (and which were therefore valued as closing WIP at the end of the previous period).

The calculation of equivalent units is based on the number of units finished in the period (it does not matter when they were started) and the number of units in closing WIP.

5.2.2. The three-stage calculation

The costs are worked out in a similar way to the previous example (where there was no opening WIP).

- **Statement of equivalent units**. Prepare a statement of equivalent units for finished output and for closing WIP. It is similar to equivalent units calculated in above examples.
- **Statement of cost per equivalent unit**. Calculate the cost per equivalent unit for direct materials and the cost per equivalent unit for conversion costs. However, remember to include the cost of the opening WIP. The materials cost of the opening WIP should be included in the total direct materials cost, and the conversion costs in the opening WIP should be added to the conversion costs for the current period.

You will normally have to calculate a separate cost per equivalent units for materials and for conversion costs. This is because the equivalent units of closing inventory will be different for materials and conversion costs.

- **Statement of evaluation**. Having calculated the equivalent units and a cost per equivalent unit, prepare a statement of evaluation in which cost is assigned to all units accordingly.

▶ *Example 16:*

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete)	Rs. 12,600
Conversion costs in opening WIP (30% complete)	Rs. 970
During the month	
Input quantities	7,000 units
Completed output	8,000 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units

All the direct materials are added to production at the beginning of the process.

Closing inventory of 2,000 units is therefore 100% complete for materials but is only 60% complete for conversion.

The costs incurred in the period were:	Rs.
Direct materials	28,000
Converison costs:	17,430

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Finished output	8,000	100%	8,000	8,000
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
	10,000		10,000	9,200

And the Statement of cost per equivalent unit, would be as follows

	Direct materials	Conversion costs
Total costs		
Costs in opening WIP	Rs. 12,600	Rs. 970
Costs in the period	Rs. 28,000	Rs.17,430
	Rs. 40,600	Rs.18,400
Equivalent units	÷ 10,000	÷ 9,200
Cost per equivalent unit	Rs. 4.06	Rs. 2.00

Statement of evaluation

	Rs.
Cost of finished goods (8,000 × (Rs. 4.06 + Rs. 2.00))	48,480
Cost of closing WIP	
Materials (2,000 units × Rs. 4.06)	8,120
Conversion (1,200 units × Rs. 2.00)	2,400
	10,520

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Opening WIP	3,000	13,570			
Direct materials	7,000	28,000	Finished goods	8,000	48,480
Conversion costs	-	17,430	Closing WIP	2,000	10,520
	10,000	59,000		10,000	59,000

5.2.3. Weighted average cost method: summary

The weighted average cost method for process costing with opening WIP can be summarized as follows:

- All output and closing inventory is valued at the same cost per equivalent unit
- Cost of opening inventory + Costs in the period = Total costs
- Units of closing inventory + Units of output in the period = Total equivalent units
- Cost per equivalent unit = Total costs/Total equivalent units

Illustration for the summary of weighted average calculation of cost per unit, is below

	Direct materials	Conversion costs
Cost of opening inventory	X	X
Costs incurred in the period	X	X
Total costs	X_m	X_{cc}
Number of units output	Y	Y
Equivalent units of closing inventory	Y	Y
Total equivalent units	Y_m	Y_{cc}
Cost per equivalent unit	(X_m/Y_m)	(X_{cc}/Y_{cc})

5.3. Opening Work In Progress: FIFO Method

5.3.1. FIFO method in process costing

The first-in, first-out (FIFO) method of process costing is based on the assumption that the opening units of work-in-process at the beginning of the month will be the first units completed. The cost of these units is their value at the beginning of the period plus the cost to complete them in the current period. Therefore, cost of opening WIP is not merged with cost of current production units, rather, it is separately allocated to units transferred on first-om-first-out basis.

It is necessary to calculate the number of equivalent units of work done in the period. This consists of:

- The equivalent units of direct materials and conversion costs required to complete the opening WIP. These are the first units completed in the period.
- The equivalent units of finished output in the period that was started as well as finished in the period. These have one equivalent unit of direct materials and one equivalent unit of conversion costs. The total number of these units is:
  - the total finished output in the period
  - minus the quantity of opening WIP (which are completed first)
- The equivalent units of closing WIP (calculated in the normal way).

5.3.2. The three-stage calculation

The three-stage calculation with the FIFO method is similar to the calculation method previously described, with the exception that in the statement of evaluation, the cost of finished output consists of:

- The finished cost of opening WIP which is the sum of:
  - the costs in the opening WIP value at the start of the period; plus
  - the costs in the current period to complete these units; plus
- the cost of finished output started as well as finished in the period.

Study the following example carefully.

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▶ *Example 17:*

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete – therefore 0% is needed in this period)	Rs. 12,600
Conversion costs in opening WIP (30% complete – therefore 70% is needed in this period)	Rs. 970
	Rs. 13,570

During the month	
Input quantities	7,000 units
Completed output	8,000 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units

All the direct materials are added to production at the beginning of the process.

Closing inventory of 2,000 units is therefore 100% complete for materials but is only 60% complete for conversion.

The costs incurred in the period were:	Rs.
Direct materials	28,000
Conversion costs:	17,430

In solving for Statement of equivalent units, please see below:

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Started last period				
Opening WIP	3,000			
Materials		0%	nil	
Conversion		70%		2,100
Started and finished in the period	5,000	100%	5,000	5,000
Finished in period	8,000		5,000	7,100
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
	10,000		7,000	8,300

Statement of cost per equivalent unit

Total costs in current period	Rs. 28,000	Rs.17,430
Equivalent units	÷ 7,000	÷ 8,300
Cost per equivalent unit	Rs. 4.00	Rs. 2.10

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Statement of evaluation

	Rs.
Cost of goods finished in the period (8,000 units)	
Started in previous period but finished in this period	
Opening WIP (3,000 units)	13,570
Conversion cost to finish opening WIP (2,100 × Rs. 2.10)	4,410
	17,980
Started and finished in this period [5,000 × (Rs. 4.00 + Rs. 2.10)]	30,500
	48,480
Cost of closing WIP	
Materials (2,000 units × Rs. 4.00)	8,000
Conversion (1,200 units × Rs. 2.10)	2,520
	10,520

These costs would be recorded in the process account as follows

Process (WIP) account					
	units	**Rs.**		**units**	**Rs.**
Opening WIP	3,000	13,570			
Direct materials	7,000	28,000	Finished goods	8,000	48,480
Conversion costs	-	17,430	Closing WIP	2,000	10,520
	10,000	59,000		10,000	59,000

(**Tutorial note:** If you compare this example using FIFO with the previous example using the weighted average cost method, you will see that the cost of finished output and value of closing WIP is the same in each case. This is a coincidence. Normally, the two methods provide different costs for finished output and different closing WIP valuations.)

5.3.3. FIFO method: summary

The first-in, first-out method for process costing with opening WIP can be summarized as follows.

- The cost of the opening units completed in the current period is calculated separately from the cost of the units that are started and finished in the current period.
- A cost per equivalent unit is calculated **for the current period**, as follows:

▶ *Illustration for the summary of weighted average calculation of cost per unit, is given below*

	Direct materials	Conversion costs
Costs incurred in the current period	TC_m	TC_c
Equivalent units of work in the current period:		
to complete opening WIP	X	Y
to start and finish units	X	Y
to make closing WIP	X	Y
Total equivalent units of work in this period	X_m	Y_{cc}
Cost per equivalent unit in the current period	TC_m / X_m	TC_c / Y_{cc}

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- These costs are used to apportion the process costs in the current period between:
  - the cost of completing the opening WIP
  - the cost of units started and finished in the current period
  - the value of closing inventory.
- Having calculated costs for the current period, the valuation of output from the process is calculated as follows:

and illustration for the summary of evaluation of outputs under the FIFO method, is given below:

	Rs.
Cost of Items started in the previous period and finished in this period	
Opening WIP	X
Cost of finishing the opening WIP	
To complete material	X
To complete other costs	X
	X
Cost of items started and finished in this period	X
Cost of items finished in the period	X
Cost of items started in this period	
Material	X
Other costs	X
	X
Total process costs	X

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6. WORK IN PROGRESS AND LOSSES

6.1. Introduction

Earlier in the chapter, we explained that normal loss is not assigned any cost, unless it has scrap value and in this case, normal loss shall be assigned, equal to its scrap value. This recognized that the scrap recovery reduces the overall cost of the process.

We saw that abnormal loss is measured in the same way as good production, because we assume that losses were occurred at end of process. The number of abnormal loss units are included in the expected good output used in the cost per unit calculation.

The same principles are followed when a question requires the calculation of cost per unit by component through the calculation of equivalent units. The number of equivalent units taken to build the abnormal loss must be included in the total number of equivalent units.

The following examples help to understand the treatment of normal and abnormal losses along with closing work in progress.

▶ *Example 18:*

Following data is related to process I of ABC Limited for the month of May, 2020.

Process 1	
Opening work in process	Nil
Units started	20,000
Units transferred to process 2	15,000
Units in process (80% completed)	3,000
Normal loss	10%
Cost data:	
Direct materials Rs.	78,000
Conversion cost Rs.	121,800

Normal loss has scrap value of Rs. 3 per unit. Material was added at start of the process 1 and conversion cost was spread evenly throughout the process.

Process 1 account for the month of May, 2020 and its relevant calculation is given below:

Calculation of equivalent units:

Equivalent units	Total	Direct materials	Conversion costs	
	Total units	Equivalent units		Equivalent units
Completed units	15,000	15,000		15,000
Closing inventory	3,000	3,000	(3,000 × 80%)	2,400
Total equivalent units	18,000	18,000		17,400

Calculation of Unit cost

	Cost Rs.	Equivalent Unit	Unit Cost Rs.
Direct materials	78,000		
Less: scrap value of normal loss (2,000 x 3)	(6,000)		
	72,000	18,000	4.00
Conversion cost	121,800	17,400	7.00
Total unit cost			11.00

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Cost assigned to units transferred to Finished goods	**Rs.**
Cost of finished goods (15,000 × 11)	165,000

Cost assigned to closing WIP Inventory	**Rs.**
Direct materials (3,000 x 4)	12,000
Conversion cost (3,000 x 80% x 7)	16,800
	28,800

Process I Account is given as under:

Process 1 account					
	units	**Rs.**		**units**	**Rs.**
Direct materials	20,000	78,000	Normal loss	2,000	6,000
Conversion costs		121,800	Process 2	15,000	165,000
			Closing inventory	3,000	28,800
	14,000	199,800		14,000	199,800

- *Example 19:*

Following data is related to process I of ABC Limited for the month of May, 2020.

Process 1	
Opening work in process	Nil
Units started	20,000
Units transferred to process 2	15,000
Units in process (80% completed)	3,000
Normal loss	8%
Cost data:	
Direct materials Rs.	95,200
Conversion cost Rs.	106,800

Normal loss has scrap value of Rs. 2 per unit. Material was added at start of the process 1 and conversion cost was spread evenly throughout the process.

Process 1 account for the month of May, 2020 and its relevant calculation is given below:

Calculation of equivalent units:

Equivalent units	**Total**	**Direct materials**		**Conversion costs**
	Total units	**Equivalent units**		**Equivalent units**
Completed units	15,000	15,000		15,000
Closing inventory	3,000	3,000	(3,000 × 80%)	2,400
Abnormal loss	400	400		400
Total equivalent units	18,400	18,400		17,800

Calculation of Unit cost

	Cost Rs.	Equivalent Unit	Unit Cost Rs.
Direct materials	95,200		
Less: scrap value of normal loss (1,600 x 2)	(3,200)		
	92,000	18,400	5.00
Conversion cost	106,800	17,800	6.00
Total unit cost			11.00

Cost assigned to units transferred to Finished goods	Rs.
Cost of finished goods (15,000 × 11)	165,000

Cost assigned to closing WIP Inventory	Rs.
Direct materials (3,000 x 5)	15,000
Conversion cost (3,000 x 80% x 6)	14,400
	29,400

Cost assigned to units transferred to Abnormal loss	Rs.
Cost of finished goods (400 × 11)	4,400

Process I Account is given as under:

Process 1 account					
	units	Rs.		units	Rs.
Direct materials	20,000	95,200	Normal loss	1,600	3,200
Conversion costs		106,800	Process 2	15,000	165,000
			Abnormal Loss	400	4,400
			Closing inventory	3,000	29,400
	14,000	202,000		14,000	202,000

▶ *Example 20:*

The following information relates to a production process X

Input quantities	4,000 units
Normal loss (all units having a scrap recovery of Rs. 1)	10% of input
Completed output	3,000 units
Closing WIP	500 units

All the direct materials are added to production at the beginning of the process.

Inspection of the units occurs when they are 50% complete. (Note that this must relate to conversion as they are 100% complete for material).

Closing inventory of 500 units is therefore 100% complete for materials but is 60% complete for conversion.

AT A GLANCE SPOTLIGHT STICKY NOTES

The costs incurred in the period were:	Rs.
Direct materials	24,016
Converison costs:	7,370

It is useful to construct an extra working with these questions to show the physical number of units.

Closing work in progress and losses – (Preliminary working)

	Units
Opening WIP	0
Input	4,000
Total possible units	4,000
Normal loss (10% of input)	(400)
Expected good output	3,600
Actual good output	(3,000)
Closing WIP	(500)
Abnormal loss	100

Closing work in progress and losses

Statement of equivalent units

			Equivalent units	
Output	Total units	Percentage complete	Direct materials	Conversion costs
Finished output	3,000	100%	3,000	3,000
Closing WIP:				
Materials	500	100%	500	
Conversion		60%		300
Abnormal loss				
Materials	100	100%	100	
Conversion		50%		50
	3,600		3,600	3,350

Statement of cost per equivalent unit

Total costs	Rs.24,016	Rs.7,370
Expected scrap recovery of normal loss (10% × 4,000 units × Rs. 1)	Rs. (400)	
	Rs.23,616	Rs.7,370
Equivalent units	÷ 3,600	÷ 3,350
Cost per equivalent unit	Rs.6.56	Rs.2.20

Statement of evaluation

	Rs.
Cost of finished goods (3,000 × (Rs. 6.56 + Rs. 2.20))	26,280
Cost of closing WIP	
Materials (500 units × Rs. 6.56)	3,280
Conversion (300 units × Rs. 2.20)	660
	3,940
Cost of closing abnormal loss	
Materials (100 units × Rs. 6.56)	656
Conversion (50 units × Rs. 2.20)	110
	766

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Direct materials	4,000	24,016	Finished goods	3,000	26,280
			Normal loss	400	400
Conversion costs	-	7,370	Abnormal loss	100	766
			Closing WIP	500	3,940
	4,000	31,386		4,000	31,386

6.2. Opening WIP and losses (Weighted average)

- *Example 21:*

The following information relates to a production process X

Opening inventory	3,000 units
Material cost in opening WIP (100% complete)	Rs. 12,600
Conversion costs in opening WIP (30% complete)	Rs. 970
During the month	
Input quantities	7,000 units
Normal loss (all units having a scrap recovery of Rs. 1)	5% of Current input
Completed output	7,500 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units

All the direct materials are added to production at the beginning of the process.

Inspection of the units occurs when they are 50% complete. (Note that this must relate to conversion as they are 100% complete for material).

Closing inventory of 2,000 units is therefore 100% complete for materials but is 60% complete for conversion.

The costs incurred in the period were:	Rs.
Direct materials	28,000
Conversion costs:	17,430

Calculation of abnormal loss:

	Units
Opening WIP	3,000
Input	7,000
Total possible units	10,000
Normal loss (5% of input)	(350)
Expected good output	9,650
Actual good output	(7,500)
Closing WIP	(2,000)
Abnormal loss	150

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Finished output	7,500	100%	7,500	7,500
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
Abnormal loss				
Materials	150	100%	150	
Conversion		50%		75
	9,650		9,650	8,775

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs	**Rs.**	**Rs.**
Costs in opening WIP	12,600	970
Costs in the period	28,000	17,430
Expected scrap recovery of normal loss (5% × 7,000 units × Rs. 1)	(350)	
	40,250	18,400
Equivalent units	÷ 9,650	÷ 8,775
Cost per equivalent unit	4.17098	2.09687

Statement of evaluation

In order to avoid difference due to rounding off, it is important to take values of unit cost up to 5 decimal places.

	Rs.
Cost of finished goods (7,500 × (Rs. 4.17098 + Rs. 2.09687))	47,009
Cost of closing WIP	
Materials (2,000 units × Rs. 4.17098)	8,342
Conversion (1,200 units × Rs. 2.09687	2,516
	10,858

	Rs.
Abnormal loss	
Materials (150 units × Rs. 4.17098)	626
Conversion (75 units × Rs. 2.09687)	157
	783

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Opening WIP	3,000	13,570	Finished goods	7,500	47,009
Direct materials	7,000	28,000	Normal loss	350	350
Conversion costs	-	17,430	Abnormal loss	150	783
			Closing WIP	2,000	10,858
	10,000	59,000		10,000	59,000

6.3 Opening WIP and losses (FIFO)

▶ *Example 22:*

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete	Rs. 12,600
Conversion costs in opening WIP (30% complete)	Rs. 970
	Rs. 13,570
During the month	
Input quantities	7,000 units
Normal loss (all units having a scrap recovery of Rs. 1)	5% of current input
Completed output	7,500 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units

All the direct materials are added to production at the beginning of the process.

Inspection of the units occurs when they are 50% complete. (Note that this must relate to conversion as they are 100% complete for material).

Closing inventory of 2,000 units is therefore 100% complete for materials but is 60% complete for conversion.

The costs incurred in the period were:	Rs.
Direct materials	28,000
Converison costs:	17,430

AT A GLANCE SPOTLIGHT STICKY NOTES

Calculation of abnormal loss (units)

	Units
Opening WIP	3,000
Input	7,000
Total possible units	10,000
Normal loss (5% of input)	(350)
Expected good output	9,650
Actual good output:	
Started in the previous period but finished in this period	(3,000)
Started and finished in this period	(4,500)
Output in this period	(7,500)
Closing WIP	(2,000)
Abnormal loss	150

Statement of equivalent units

Output			Equivalent units	
	Total units	Percentage complete	Direct materials	Conversion costs
Started last period				
Opening WIP	3,000			
Materials		0%	nil	
Conversion		70%		2,100
Started and finished in the period	4,500	100%	4,500	4,500
Finished in period	7,500		4,500	6,600
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
Abnormal loss				
Materials	150	100%	150	
Conversion		50%		75
	9,650		6,650	7,875

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs in current period	28,000	17,430
Expected scrap recovery of normal loss (5% × 3,500 units × Rs. 1)	(350)	
	27,650	17,430
Equivalent units	÷ 6,650	÷ 7,875
Cost per equivalent unit	Rs. 4.15789	Rs. 2.21333

Statement of evaluation

In order to avoid difference due to rounding off, it is important to take values of unit cost up to 5 decimal places.

	Rs.
Cost of goods finished in the period (7,500 units)	
Started in previous period but finished in this period	
Opening WIP (3,000 units)	13,570
Conversion cost to finish opening WIP (2,100 × Rs. 2.21333)	4,648
	18,218
Started and finished in this period (4,500 × (Rs. 4.15789 + Rs. 2.21333))	28,670
	46,888

Cost of closing WIP	Rs.
Materials (2,000 units × Rs. 4.15789)	8,316
Conversion (1,200 units × Rs. 2.21333)	2,656
	10,972
Cost of abnormal loss	
Materials (150 units × Rs. 4.15789)	624
Conversion (75 units × Rs. 2.21333)	166
	790

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Opening WIP	3,000	13,570			
Direct materials	7,000	28,000	Finished goods	7,500	46,888
Conversion costs	-	17,430	Normal loss	350	350
			Abnormal loss	150	790
			Closing WIP	2,000	10,972
	10,000	59,000		10,000	59,000

Tutorial note: FIFO stock valuation is more common than the weighted average method, and should be used unless an indication in given to the contrary. You may be presented with limited information about the opening stock which forces you to use either the FIFO or the weighted average method. The rules are as follows:

1. If you are given with degree of completion of each element of opening stock but not the value of each element, then you must use FIFO method.
2. If you are not given the degree of completion of each element in opening stock but you are given with value, then you must use weighted average method.

7. LOSSES AND GAINS AT DIFFERENT STAGES IN THE PROCESS

7.1 Assumptions about when loss occurs

In the earlier explanation of accounting for abnormal loss and abnormal gain, it was assumed that losses occur at the end of the production process. This assumption is not relevant for normal loss, but it is relevant for abnormal loss and abnormal gain, because these are given a value.

If it is assumed that losses occur at the end of a process, units of abnormal loss or gain are given a cost or value as if they are fully completed units – and so one equivalent unit each.

If losses occur at a different stage in the process, this assumption should not be applied. Instead, the concept of equivalent units should be used to decide the cost of the abnormal loss or the value of the abnormal gain. Equivalent units can be used provided that an estimate is made of the degree of completion of units at the time that loss occurs in the process. Differing degrees of completion might be used for direct materials and conversion costs.

7.2 Equivalent units and abnormal loss part-way through the process

When loss occurs part-way through a process, the cost of any abnormal loss should be calculated by:

- establishing the equivalent units of direct materials and conversion costs for the loss
- calculating a cost per equivalent units
- using the calculations of equivalent units and cost per equivalent unit to obtain a cost for finished output and abnormal loss in the period.

▶ *Example 23:*

Abnormal loss and loss part-way through a process

The following information relates to a production process X.

Input quantities	10,000 units
Normal loss	10%
Therefore expected output	9,000 units
Actual output	8,500 units
Therefore abnormal loss	500 units

Direct materials are added in full at the beginning of the process, and loss occurs 60% of the way through the process.

The costs incurred in the period were:	Rs.
Direct materials	27,000
Converison costs:	13,200

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Finished output	8,500	100%	8,500	8,500
Abnormal loss				
Materials	500	100%	500	
Conversion		60%		300
Expected output	9,000		9,000	8,800

Statement of cost per equivalent unit

	Direct materials	Conversion costs
	Rs. 27,000	Rs.13,200
Equivalent units	÷ 9,000	÷ 8,800
Cost per equivalent unit	Rs. 3.00	Rs. 1.50

Statement of evaluation

	Rs.
Cost of finished goods (8,500 × (Rs. 3.00 + Rs. 1.50))	38,250
Abnormal loss	
Materials (500 units × Rs. 3.00)	1,500
Conversion (300 units × Rs. 1.50)	450
	1,950

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Direct materials	10,000	27,000	Finished goods	8,500	38,250
			Abnormal loss	500	1,950
Conversion costs	-	13,200	Normal loss	1,000	nil
	10,000	40,200		10,000	40,200

7.3 Equivalent units and abnormal gain part-way through the process

The same principles apply to the valuation of abnormal gain where the loss/gain occurs part-way through the process. However, there is one important difference. Equivalent units of abnormal gain are given a negative value and are subtracted from the total equivalent units of output in the period.

Perhaps the easiest way to think of the reason for this is that abnormal gain is on the opposite side of the process account (the debit side) from actual finished output (credit side) and abnormal gain equivalent units are subtracted because they offset the cost of the finished output.

▶ *Example 24:*

Abnormal gain part-way through a process

The following information relates to a production process X.

Input quantities	6,000 units
Normal loss	10%
Therefore expected output	5,400 units
Actual output	5,600 units
Therefore abnormal gain	200 units

Direct materials are added in full at the beginning of the process, and loss occurs 40% of the way through the process.

The costs incurred in the period were:	Rs.
Direct materials	27,000
Converison costs	11,040

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Finished output	5,600	100%	5,600	5,600
Abnormal gain	(200)			
Materials		100%	(200)	
Conversion		40%		(80)
Expected output	5,400		5,400	5,520

Statement of cost per equivalent unit

	Direct materials	Conversion costs
	Rs. 27,000	Rs.11,040
Equivalent units	÷ 5,400	÷ 5,520
Cost per equivalent unit	Rs. 5	Rs. 2

Statement of evaluation

Cost of finished goods (5,600 × (Rs. 5 + Rs. 2))	39,200
Cost of abnormal gain	
Materials (200 units × Rs. 5)	1,000
Conversion (80 units × Rs. 2)	160
	1,160

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Direct materials	6,000	27,000	Finished goods	5,600	39,200
Conversion costs	-	11,040			
Abnormal gain	200	1,160	Normal loss	600	nil
	6,200	39,200		6,200	39,200

8. COST OF REWORK

Sometimes the loss incurred in processing is not scrapped but is subject to a further rectification process, this extra processing cost is referred to as rework. Rework might occur when benefit generated from rework exceeds the scrap value of losses.

Rework might be performed on units that are either classified as normal or abnormal loss:

8.1. Normal Rework

The rework cost is charged to the normal processing cost. Rework may involve some material use, labour use etc. Hence the entry is:

	Debit	Credit
Process account	X	
Materials Account		X
Payroll Account		X

8.2. Abnormal Rework

Abnormal rework is not charged to process account, rather it shall be charged to abnormal loss account and it then be closed to profit and loss account:

	Debit	Credit
Abnormal loss account	X	
Materials account		X
Payroll Account		X

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9. COMPREHENSIVE EXAMPLES

- *Example 01:*

XYZ operates several process production systems.

a) For Process 5, the FIFO method of valuing opening work-in-progress is used, and the following details relate to September Year 5.

Opening work-in-process was 600 units, each 80% processed as to materials and 60% processed as to conversion costs.

Finished output was 14,500 units. There were no abnormal losses or gains.

Closing work-in-process was 800 units, each 70% processed as to materials and 40% processed as to conversion costs.

Costs of processing during the current period were:

Materials: Rs. 36,450

Conversion costs: Rs. 17,352.

Calculation for the cost per equivalent unit of output produced during September (one unit started and completed during the month), would be as follows.

FIFO method

Equivalent units	Total	Direct materials		Conversion costs	
	Units	Equivalent units		Equivalent units	
Completion of opening WIP	600	(20%)	120	(40%)	240
Other completed units	13,900		13,900		13,900
	14,500		14,020		14,140
Closing inventory	800	(70%)	560	(40%)	320
Total equivalent units (A)	15,300		14,580		14,460
Costs in the current period (B)			Rs.36,450		Rs.17,352
Cost per equivalent unit (B/A)			Rs.2.50		Rs.1.20

Cost per equivalent unit of fully completed units in the current period = Rs.2.50 + Rs.1.20 = Rs.3.70.

b) The following details relate to Process 16 in September Year 5:

Opening work-in-progress	2,000 litres, fully complete as to materials and 40% complete as to conversion. The cost of materials in the opening WIP was Rs.9,860 and conversion costs in the opening WIP were Rs.4,700.
Material input	24,000 litres, cost Rs.130,540
Conversion costs in the month	Rs.82,960
Output to process 2	23,000 litres
Closing work-in-progress	3,000 litres, fully complete as to materials and 45% complete as to conversion.

The weighted average cost system is used for inventory valuation in Process 16.

Calculation of the cost per unit of output from this process during September, would be as follows:

Weighted average cost

Equivalent units	Total	Direct materials		Conversion costs	
	Total units	Equivalent units		Equivalent units	
Completed units	23,000		23,000		23,000
Closing inventory	3,000	(100%)	3,000	(45%)	1,350
Total equivalent units (A)	26,000		26,000		24,350
Costs:			Rs.		Rs.
Opening WIP			9,860		4,700
Current period costs			130,540		82,960
Total costs (B)			140,400		87,660
Cost per equivalent unit			Rs.5.40		Rs.3.60

Cost per equivalent unit of fully completed units in the current period = Rs.5.40 + Rs.3.60 = Rs.9.00.

- *Example 02:*

Yahya Limited produces a single product that passes through three departments, A, B and C.

The company uses FIFO method for process costing. A review of department A's cost records for the month of January 20X4 shows the following details:

	Units	Material Rs.	Labour Rs.
Work in process inventory as at January 1, 20X4 (75% complete as to conversion costs)	16,000	64,000	28,000
Additional units started in January 20X4	110,000	-	-
Material costs incurred	-	430,500	-
Labour costs incurred	-	-	230,000
Work in process inventory as at January 31, 20X4 (50% complete as to conversion costs)	18,000	-	-
Units completed and transferred in January 20X4	100,000	-	-

Overhead is applied at the rate of 120% of direct labour. Normal spoilage is 5% of output. The spoiled units are sold in the market at Rs. 6 per unit.

Required

Compute the following for the month of January:

(a) Equivalent production units.

(b) Costs per unit for material, labour and factory overhead.

(c) Cost of abnormal loss (or gain), closing work in process and the units transferred to the next process.

▶ *Solution*

a) Equivalent production units.

	Material Units	FOH/ Labour Units
Units completed and transferred out	100,000	100,000
Less: Beginning inventory (all units)	16,000	16,000
Started and completed in January	**84,000**	**84,000**
Beginning inventory (completed in January)		
Labour and FOH (25%)		4,000
Closing inventory (completed in January)		
Material (100%)	18,000	
Labour and FOH (50%)	-	9,000
Abnormal loss	3,000	3,000
	105,000	**100,000**

b) Costs per unit for material, labour and factory overhead.

	Cost in Rs.	Eq. Units	Cost per unit
Materials	430,500		
Less: Scrap value of normal loss (5,000 x 6)	(30,000)		
	400,500	105,000	3.81429
Labour	230,000	100,000	2.30000
Factory overheads (120% of DL)	276,000	100,000	2.76000
Total			8.87429

c) Cost of abnormal loss (or gain), closing work in process and the units transferred to the next process.

	Rupees
Cost of abnormal loss	
3,000 units @ Rs.8.87429	26,622
Closing work in process	
Material (18,000 x Rs. 3.81429)	68,657
Labour (18,000 x Rs. 2.30 x 50%)	20,700
FOH (18,000 x Rs. 2.76 x 50%)	24,840
	114,197
Cost of units transferred to next process	
From beginning inventory	
Beginning Inventory-Already incurred costs	
Materials	64,000
Labour	28,000
Factory Overhead (Rs. 28,000 x 120%)	33,600

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	Rupees
Beginning Inventory-Costs incurred in January	
Labour (16,000 x Rs. 2.30 x 25%)	9,200
FOH (16,000 x Rs. 2.76 x 25%)	11,040
Units fully produced during the current month (84,000 x Rs. 8.87429)	745,441
	891,281

- *Example 03:*

Smart Processing Limited produces lubricants for industrial machines. Material COX is introduced at the start of the process in department A and subsequently transferred to department B. Normal loss in department A is 5% of the units transferred.

In department B, material COY is added just after inspection which takes place when the production is 60% complete. 10% of the units processed are evaporated before the inspection stage. However, no evaporation takes place after adding material COY. During the year, actual evaporation in department B was 10% higher than the estimated normal losses because of high level of Sulphur contents in natural gas used for processing.

Other details for the year ended December 31, 20X3 are as under:

	Department A	Department B
	Rupees	
Opening work in process	2,184,000	2,080,000
Material input - 600,000 Liters	17,085,000	
- 500,000 Liters		9,693,000
Labour	8,821,000	6,389,000
Overheads	2,940,000	3,727,000

	Department A			Department B		
	Liters	Completion %		Liters	Completion %	
		Material	Conversion costs		Material	Conversion costs
Opening WIP	64,500	100	60	40,000	100	60
Closing WIP	24,000	100	70	50,000	100	80

Conversion costs are incurred evenly throughout the process in both departments. The company uses FIFO method for inventory valuation.

Required

(a) Equivalent production units

(b) Cost of abnormal loss and closing WIP

(c) Cost of finished goods produced

▶ *Solution*

a) Calculations for the equivalent production units, would be:

Quantity Schedule (in liters)	Dept. A	Dept. B
WIP opening	64,500	40,000
Started in process / material added	600,000	500,000
Received from preceding department	-	610,000
	664,500	1,150,000
Transferred out to B (664,500-24,000)x100/105	610,000	-
Transferred to finished goods (1,150,000-50,000-61,000-6,100)	-	1,032,900
WIP closing	24,000	50,000
Normal loss – A (664,500-24,000)x5/105	30,500	-
Normal loss – B (10% x 610,000)	-	61,000
Abnormal loss – B (10% x 61,000)	-	6,100
	664,500	1,150,000

Equivalent production unit (in liters)				
	Department A		Department B	
	Material	Conversion	Material	Conversion
Units completed and transferred out	610,000	610,000	1,032,900	1,032,900
Opening Inventory (60% completed)	(64,500)	(38,700)	(40,000)	(24,000)
Abnormal loss (B: 6,100 x 60%)	-	-	-	3,660
Closing inventory (A: 70%, B: 80%)	24,000	16,800	50,000	40,000
	569,500	588,100	1,042,900	1,052,560

b) The cost of abnormal loss and closing WIP, would be calculated as:

Cost of abnormal loss (Department B)	Department A			Department B		
	Quantity	Rate	Amount	Quantity	Rate	Amount
	Units	Rs.	Rs.	Units	Rs.	Rs.
From department A (610,000 x 10% x 10%)				6,100	(W-2) 54.60	333,044
Labour (60%)				3,660	6.07	22,216
Overheads (60%)				3,660	3.54	12,956
			-			368,216
WIP-closing costs						
From department A	-	-	-	50,000	(W-2) 28.42	1,421,000
Material	24,000	30.00	720,000	50,000	9.29	464,500
Labour (70%, 80%)	16,800	15.00	252,000	40,000	6.07	242,800
Overheads (70%, 80%)	16,800	5.00	84,000	40,000	3.54	141,600
			1,056,000			2,269,900

c) For the cost of finished goods produced, calculations would be as follows:

	Rupees
Total costs charged to department (W-1)	51,863,000
Less: WIP closing costs (Computed above)	(2,269,900)
Less: Cost of abnormal loss (Computed above)	(368,216)
Costs transferred to finished goods	49,224,884

W-1: Cost charged to department:						
	Department A			Department B		
	Equivalent Units	Cost (Rs.)	Unit cost (Rs.)	Equivalent Units	Cost (Rs.)	Unit cost (Rs.)
WIP - opening inventory		2,184,000			2,080,000	
Cost from department A					29,974,000	
Material	569,500	17,085,000	30.00	1,042,900	9,693,000	9.29
Labour	588,100	8,821,000	15.00	1,052,560	6,389,000	6.07
Overheads	588,100	2,940,000	5.00	1,052,560	3,727,000	3.54
Total cost to be accounted for		31,030,000	50.00		51,863,000	18.90

W-2: Allocation of cost received from department A:			
	Quantity	Amount (Rs.)	Unit cost (Rs.)
Units received from A	610,000		
Normal loss at 10%	(61,000)		
	549,000	*29,974,000	54.60
Abnormal loss at 1%	(6,100)	(333,044)	54.60
Units after inspection	542,900	29,640,956	54.60
Addition of material COY	500,000		
	1,042,900	29,640,956	28.42

**Rs. 31,030,000 (Total cost) – Rs. 1,056,000 (Closing WIP) = Rs. 29,974,000*

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► *Example 04:*

Hornbill Limited (HL) produces certain chemicals for textile industry. The company has three production departments. All materials are introduced at the beginning of the process in Department-A and subsequently transferred to Department-B. Any loss in Department-B is considered as a normal loss.

The following information has been extracted from the records of HL for Department-B for the month of August 20X3:

	Department B
Opening work in process (Liters)	Nil
Closing work in process (Liters)	10,500
Units transferred from Department-A (Liters)	55,000
Units transferred to Department-C (Liters)	39,500
Labour (Rupees)	27,520
Factory overhead (Rupees)	15,480

Materials from Department-A were transferred at the cost of Rs. 1.80 per liter.
The degree of completion of work in process in terms of costs originating in Department-B was as follows:

WIP	Completion %
50% units	40%
20% units	30%
30% units	24.5%

Required

Prepare the following for department B for the month:

a) A statement of equivalent units.

b) A statement showing cost per equivalent unit.

c) A statement showing the evaluation of output.

d) A process account

(Tip: Treat the costs transferred from department A in the same way as material costs introduced at the start of the department B process and treat department B costs in the same way as conversion costs).

Preliminary working:	Units
Opening WIP	0
Received from Process A	55,000
Total possible units	55,000
Actual good output	(39,500)
Closing WIP	(10,500)
Normal loss (as specified in the question)	5,000

a) For the given examples, Statement of equivalent units would be:

Statement of equivalent units				
			Equivalent units	
Output	Total units	Percentage complete	Materials (input from Dept. A)	Department B costs
Finished output	39,500	100%	39,500	39,500
Closing WIP:				
Materials	10,500	100%	10,500	
Dept. B costs		50% × 40%		2,100
Dept. B costs		20% × 30%		630
Dept. B costs		30% × 24.5%		770
				3,500
	55,000		50,000	43,000

b) Statement of Statement of cost per equivalent unit

	Materials (input from Dept. A)	Department B costs
Total costs:		
Input from department A (55,000 units × Rs. 1.80)	Rs.99,000	
Department B costs (27,520 + 15,480)		Rs. 43,000
Equivalent units (÷)	50,000	4,300
Cost per equivalent unit	Rs.1.98	Rs.1.00

c) Statement of evaluation of units would be

	Rs.
Cost of finished goods (39,500 × (Rs. 1.98 + Rs. 1.00))	117,710
Cost of closing WIP	
Materials (10,500 units × Rs. 1.98)	20,790
Conversion (3,500 units × Rs. 1.00)	3,500
	24,290

d) Process WIP would be accounted for as follows:

Process (WIP) account					
	units	Rs.		units	Rs.
Transfers from A	55,000	99,000	Finished goods (transfer to C)	39,500	117,710
Labour		27,520	Normal loss	5,000	–
Overhead		15,480	Closing WIP	10,500	24,290
	55,000	142,000		55,000	142,000

▶ *Example 05:*

Ababeel Foods produces and sells chicken nuggets. Boneless chicken is minced, spiced up, cut to standard size and semi-cooked in the cooking department. Semi-cooked pieces are then frozen and packed for shipping in the finishing department.

Inspection is carried out when the process in the cooking department is 80% complete. Normal loss is 5% of input and comprises of:

2% weight loss due to cooking; and

3% rejection of nuggets. The rejected nuggets are sold at Rs. 60 per kg.

Overheads are applied at the rate of 120% of direct labour cost. Inventory is valued using weighted average cost. Following information pertains to cooking department for the month of June 2014:

	Kg.	Material	Labour
		----- Rs. in '000 -----	
Opening work in progress (100% complete to material and 50% complete to conversion)	30,000	6,260	1,288
Costs for the month	420,000	50,000	20,000
Weight after cooking	440,000	-	-
Transferred to finishing department	362,000	-	-
Closing work in progress (100% complete to material and 65% complete to conversion)	65,000	-	-

Required:

Prepare process account for cooking department for the month of June 2014.

▶ *Solution*

Ababeel Foods					
Cooking department production and cost for June 2014					
Process Account - Cooking department					
	Kg.	**Rs. in '000'**		**Kg.**	**Rs. in '000'**
Opening WIP	30,000	**(W-2)**9,094	**Normal loss:**		
Material	420,000	50,000	▪ weight loss **(W.1)**	7,700	-
Labour		20,000	▪ rejection **(W.1)**	11,550	693
Overheads (20,000*1.2)		24,000	**Abnormal loss:**		
			▪ weight loss **(W.1)**	2,300	
			▪ rejection **(W.1)**	1,450	
			(W.2)	3,750	829
			Transferred out **(W.2)**	362,000	88,328
			Closing WIP **(W.2)**	65,000	13,244
	450,000	**103,094**		**450,000**	**103,094**

W-1: Normal and abnormal losses:	Total loss	Normal loss (Cooking loss at 2% & rejection loss at 3% of input)		Abnormal loss (Balancing)
	Kg.			
Weight loss:				
Opening WIP	30,000			
Input for the month	420,000			
	450,000			
Transferred to finishing department	(362,000)			
Closing WIP	(65,000)			
Total loss	23,000			
Weight loss (450,000-440,000)	10,000	**(450,000-65,000)×2%**	7,700	2,300
Rejection loss (balancing)	13,000	**(450,000-65,000)×3%**	11,550	1,450
	23,000		**19,250**	**3,750**

W-2: Cost and equivalent quantity:		Material cost	Conv. cost	Total cost
		Rs. in '000'		
Opening WIP	1,288 x 2.20	6,260	2,834	9,094
Cost added	20,000 x2.20	50,000	44,000	94,000
Normal rejection valued @ Rs. 60 per kg	11,550x60	(693)	-	(693)
Total cost	**(A)**	**55,567**	**46,834**	**102,401**
		Rupees		
Cost per kg.	(A×1,000)÷(B)	**129.0**	**115.0**	**244.0**

		Equivalent kg.		Total cost (Rs. in '000)
		Material	Conv.	
Finished goods		362,000	362,000	88,328
Closing WIP (100% to material and 65% to conv.)		65,000	42,250	13,244
Total abnormal loss (100% to material and 80% to conv.)		3,750	3,000	829
Total equivalent quantity and cost	**(B)**	**430,750**	**407,250**	**102,401**

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▶ *Example 06:*

Bela Enterprises (BE) produces a chemical that requires two separate processes for its completion. Following information pertains to process II for the month of August 2016:

	kg	Rs. in '000
Opening work in process (85% to conversion)	5,000	2,000
Costs for the month:		
Received from process I	30,000	18,000
Material added in process II	15,000	10,000
Conversion cost incurred in process II	-	11,000
Finished goods transferred to warehouse	40,000	-
Closing work in process (60% to conversion)	4,000	-

In process II, material is added at start of the process and conversion costs are incurred evenly throughout the process. Process losses are determined on inspection which is carried out on 80% completion of the process. Process loss is estimated at 10% of the inspected quantity and is sold for Rs. 100 per kg.

BE uses FIFO method for inventory valuation.

a) A statement of equivalent production units, would be prepared as follows:

Statement of equivalent units:		Equivalent units		Quantity schedule
		Material	Conversion	
		------------------ kg	------------------	
Opening WIP (85% to conversion)		(5,000)	(4,250)	5,000
Received from process I				30,000
Material added in process II				15,000
				50,000
Transferred to finished goods		40,000	40,000	40,000
Goods started and completed during the month	A	35,000	35,750	
Closing WIP (60% to conversion)	B	4,000	2,400	4,000
Normal loss at 10% (50,000–5,000–4,000)×10%				4,100
Abnormal loss (80% conversion) (Balancing)	C	1,900	1,520	1,900
	D	40,900	39,670	50,000

b) Computation of costs would be as follows

		Material	Conversion	Total
Cost per unit		**---------- Rs. in '000 ----------**		
Opening WIP		-	-	2,000
Cost for the month:	Process I	18,000	-	18,000
	Process II	10,000	11,000	21,000
Normal loss quantity at sale price (4,100×100)		(410)	-	(410)
Total cost	E	27,590	11,000	40,590
		---------------- Rupees ----------------		
Cost per unit	F=(E÷D)	674.57	277.29	

(i)	**Cost of finished goods:**		**-------------- Rs. in '000 ------------**		
	Opening WIP				2,000
	Cost for the month	A×F	23,610	9,913	33,523
					35,523
(ii)	Cost of closing WIP	B×F	2,698	666	3,364
(iii)	Cost of abnormal loss	C×F	1,282	421	1,703

c) Accounting entries to account for production losses for the month would be as follows

Accounting entries to account for production losses:			
Date	**Description**	**Debit**	**Credit**
		--- Rs. in '000 ---	
1	Scrap inventory (normal loss quantity) 4,100×100	410	
	WIP – II		410
	(Normal loss quantity credited to WIP at sales value)		
2	Scrap inventory (abnormal loss quantity) 1,900×100	190	
	Profit and loss account (Balancing)	1,513	
	WIP – II As (iii) above		1,703
	(Loss on abnormal loss quantity debited to profit and loss account)		

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► *Example 07:*

KS Limited operates two production departments A and B to produce a product XP-29.

Following information pertains to Department A for the month of December 2014.

	Liters	Rs. in '000
Opening work in process (Material 100%, conversion 80%)	15,000	
• Material		5,000
• Direct labour and overheads		2,125
Actual cost for the month:		
• Material	120,000	36,240
• Overheads		14,224
• Direct labour		11,500
Expected losses	5%	
Closing work in process (Material 100%, conversion 80%)	17,000	
Units transferred to Department B	110,000	

KS uses FIFO method for inventory valuation. Direct materials are added at the beginning of the process. Expected losses are identified at the time of inspection which takes place at the end of the process. Overheads are applied at the rate of 80% of direct labour cost.

a) Equivalent production units

KS Limited			
Equivalent production:		**Material**	**Conversion**
		------------ Liters ------------	
Units completed and transferred out		110,000	110,000
Closing WIP (100% material and 80% conversion)		17,000	13,600
Opening WIP (100% material and 80% conversion)		(15,000)	(12,000)
Abnormal loss	W.1	2,100	2,100
Equivalent production	(A)	114,100	113,700

Cost per liter:		---------- Rupees ----------	
Cost incurred in December 2014	(B)	36,240,000	25,603,200 (14,224,000×1.8)
Cost per liter	(B÷A)	317.62	225.18

b) Cost of goods transferred to Department B

		Rs. in '000
From opening WIP:		
- Cost incurred prior to 1 Dec. 2014	*5,000+2,125*	7,125
- Conversion cost incurred in Dec. 2014	*15,000×20%×225.18*	676
		7,801
From units started and completed in Dec. 2014 *[(110,000-15,000)×(317.62+225.18)]*		51,566
		59,367

W.1: Abnormal loss		Liters
Opening WIP		15,000
Units started in December 2014		120,000
Closing WIP		(17,000)
Units completed in December 2014		118,000
Transferred to department B		(110,000)
Normal loss	*118,000 × 5%*	(5,900)
Abnormal loss		**2,100**

c) Accounting entries for the month of December 2014 are as follows

Date	Description	Debit	Credit
		Rs. in '000	
31-Dec-14	WIP - Department A	61,843	
	Raw material		36,240
	Payroll		14,224
	Applied overheads 14,224×80%		11,379
	(Cost charged / overheads applied to department A)		
31-Dec-14	Applied overheads	11,379	
	Cost of sale (under applied overheads)	121	
	Overhead control account		11,500
	(Under-absorbed overheads charged to P&L account)		
31-Dec-14	WIP - Department B	59,367	
	P&L account (abnormal loss) [2,100×(317.62+225.18)]	1,140	
	WIP - Department A		60,507
	(Units transferred to B and abnormal loss charged to department B and P&L account respectively)		

▶ *Example 08:*

Quality Chemicals (QC) produces one of its products through two processes A and B. Following information has been extracted from the records of process A for the month of January 2016.

	Quantity	Material	Conversion
	Units	--------Rs. In '000'-------	
Opening work in process	5,000	2,713	1,499
Input during the month	20,000	10,000	5,760
Transferred to process B	18,000	-	-
Closing work in process	6,000	-	-

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Additional information:

i. Materials are introduced at the beginning of the process. In respect of conversion, opening and closing work in process inventories were 40% and 60% complete, respectively.

ii. Inspection is performed when the units are 50% complete. Expected rejection is estimated at 5% of the inspected units. The rejected units are not processed further and sold at Rs. 100 per unit.

iii. QC uses 'weighted average method' for inventory valuation.

a) Computation of equivalent production units and cost per unit, would require

Process A - production and cost for the month of January 2016	Quantity schedule	Equivalent units	
Equivalent units under weighted average method:		**Material**	**Conv.**
	------------- No. of units -------------		
Opening WIP (40% to conversion)	5,000		
Input for the month	20,000		
A	25,000		
Transferred to process B	18,000	18,000	18,000
Closing WIP (60% to conversion)	6,000	6,000	3,600
Normal loss-5% of the inspected units (A×5%)	1,250	-	-
Abnormal gain (50% to conv.) (Bal.)	(250)	(250)	(125)
Normal equivalent units B	25,000	23,750	21,475
Cost per unit:		**------ Rs. in '000 ------**	
Opening WIP		2,713	1,499
Cost for the month		10,000	5,760
Scrapped units at sale price	1,250×100	(125)	-
	C	12,588	7,259
Cost per unit	**C÷B**	530	338

b) Journal entries to record the above transactions would be as follows

Accounting entries			
Date	**Description**	**Debit**	**Credit**
		--- Rs. in '000 ---	
1	WIP - Process A	15,760	
	Raw material		10,000
	Labour and overheads		5,760
	(Material, labour and overheads charged to Process A)		

Accounting entries			
Date	**Description**	**Debit**	**Credit**
		--- Rs. in '000 ---	
2	WIP - Process A (250×530)+(125×338) *OR* (250×530)+(250×169)	175	
	Abnormal gain		175
	(To record abnormal gain)		
3	Scrapped units 1,250×100	125	
	WIP - Process A		125
	(Sales value of rejected units credited to WIP)		
4	WIP - Process B 18,000×(530+338)	15,624	
	WIP - Process A		15,624
	(Goods completed transferred to Process B)		
5	Abnormal gain (250×530)+(125×338)	175	
	Scrapped units 250×100		25
	Profit or loss account		150
	(Abnormal gain adjusted to profit or loss account)		

- *Example 09:*

Ravi Limited (RL) is engaged in production of industrial goods. It receives orders from steel manufactures and follows job order costing. The following information pertains to an order received on 1 December 2016 for 6,000 units of a product:

Production details for the month of December 2016:

	Units
Produced and transferred to finished goods	3,200
Delivered to the buyer from the finished goods	3,000
Units rejected during inspection	120
Closing work in process (100% material and 80% conversion)	680

Actual expenses for the month of December 2016:

	Rupees
Direct material	1,140,000
Direct labour (6,320 hours)	948,000
Factory overheads	800,000

Additional information:

- Factory overheads are applied at Rs. 120 per hour. Under/over applied factory overheads are charged to profit and loss account.
- Units completed are inspected and transferred to finished goods. Normal rejection is estimated at 10% of the units transferred to finished goods. The rejected units are sold as scrap at Rs. 150 per unit.
- RL uses weighted average method for inventory valuation.

a) Work in process for the month of December 2016 would be

WIP					
Description	**Units**	**Rupees**	**Description**	**Units**	**Rupees**
Raw material W.1 (A)	4,000	1,140,000	Finished goods [3,200×778.23 (W-2)]	3,200	2,490,336
Direct labour		948,000	Norm al loss (320×150)	320	48,000
Applied overheads (6,320×120)		758,400	Closing WIP *(Bal.)	680	463,710
Abnormal gain [200×(778.23)]	200	155,646			
	4,200	3,002,046		4,200	3,002,046
*(680×296.74)+(544×481.49)					

		Equivalent units	
W-1: Equivalent units and costs applied to the job	**Quantity schedule**	**Material**	**Conversion**
Transferred to finished goods	3,200	3,200	3,200
Closing WIP 680×80%	680	680	544
Normal loss at 10% of the units completed 3,200×10%	320		
	4,200		
Abnormal gain 120–320	(200)	(200)	(200)
Normal production A	**4,000**	**3,680**	**3,544**

W-2: Cost per unit		----------- Rupees -----------	
Raw material		1,140,000	
Direct labour		-	948,000
Applied overheads	6,320×120	-	758,400
Normal loss - sales price	320×150	(48,000)	
	B	1,092,000	1,706,400
	(B÷A)	296.74	481.49
		778.23	

b) Accounting entries to record over/under applied overheads and production loss/gains

Date	Description	Debit	Credit -
		--------- Rupee ---------	
31-Dec 2016	Factory overhead applied (6,320×120)	758,400	
	P& L account–overheads under applied	41,600	
	Factory overheads control		800,000
	(Transfer of applied factory overheads to control a/c and under applied overheads charged to P&L account)		
31-Dec 2016	WIP (200×778.23)	155,64 6	
	Abnormal gain		155,646
	(To record abnormal gain)		
31-Dec2016	Scrap inventory (320×150)	48,000	
	WIP		48,000
	(Sales value of rejected units credited to WIP)		
31-Dec2016	Abnormal gain (200×778.23)	155,646	
	Scrap inventory (320- 120)×150		30,000
	P&L account		125,646
	(Abnormal gain adjusted to P&L account)		

▶ *Example 10:*

Tulip Enterprises (TE) manufactures a product Alpha that requires two separate processes, A and B. Following information has been extracted from the cost records of Process B for the month of February 2019:

	Quantity	Process A cost	Process B cost	
			Material	Conversion
	Liters	-----------------Rs. In '000'---------------		
Opening work-in-process – Process B (80% complete as to conversion)	10,000	1,500	600	400
Cost for the month:				
- Received from process A	90,000	14,000	-	-
- Added during process B	12,000	-	7,000	5,600
Closing work-in-process – Process B (70% complete as to conversion)	9,500	-	-	-

Additional information:

i. Materials are added at start of the process.

ii. Normal loss is estimated at 5% of the input. Loss is determined at completion of the process. Loss of each liter results in a solid waste of 0.75 kg. During the month of February 2019, solid waste produced was 6,000 kg.

iii. Solid waste is sold for Rs. 170 per kg after incurring further cost of Rs. 20 per kg.

iv. TE uses weighted average method for valuation of inventory.

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Accounting entries to record the transactions of process B are as follows (Narrations to accounting entries are not required)

Accounting entries for Process B			
Date	**Description**	**Debit**	**Credit**
		------ Rs. in '000 ------	
1	WIP - Process B	26,600	
	WIP - Process A		14,000
	Raw material		7,000
	Labour and overheads		5,600
2	Scrapped inventory (Normal loss) [C×0.75×170]	653	
	Bank [C×0.75×20]		77
	WIP - Process B (Normal loss) **(W-1)**		576
3	Scrapped inventory (Abnormal loss) [D×0.75×170]	367	
	Profit or loss account **Balancing**	448	
	Bank [D×0.75×20]		43
	WIP - Process B (Abnormal loss) (D×H)		772
4	Finished goods (E×H)	25,366	
	WIP - Process B		25,366

W-1: Equivalent production and cost per liter - Weighted average method					
			Quantity Schedule	**Equivalent units**	
				Material	**Conversion**
			----------------- Liters -----------------		
Opening WIP (80% complete as to conversion)			10,000		
Input for the month -	Process A		90,000		
	Process B		12,000		
Total input		**A**	**112,000**		
Closing WIP (70% complete as to conversion)		**B**	9,500	9,500	6,650
Normal loss	(A–B)×5%	**C**	5,125	-	-
Abnormal loss [(6,000÷0.75)–C]		**D**	2,875	2,875	2,875
Transferred to finished goods **Balancing**		**E**	94,500	94,500	94,500
		F	**112,000**	**106,875**	**104,025**

		Process A & material costs	Process B conversion costs
		------ Rs. in '000 ------	
Opening WIP	Process A	1,500	
	Process B	600	400
Cost for the month	Process A	14,000	
	Process B	7,000	5,600
Scrapped inventory (Recovery from normal scrapped units) (C×0.75)×(170–20)		(576)	
Total cost	**G**	**22,524**	**6,000**
		Rupees	
	G÷F×1,000	**210.74**	**57.68**
Total - Cost per liter	**H**	**268.42**	

▶ *Example 11:*

Mehnat Limited (ML) manufactures a product KLM which goes through two processes, Process A and Process B. Following information pertains to process A for the month of February 2021:

	Kg	Rs. In 000
Opening work in process (80% complete)	2,000	5,000
Materials added during the month	18,000	36,000
Conversion costs		12,000
Transferred to Process B	16,000	-
Closing work in process (60% complete)	3,000	-

Additional information relating to Process A:

i. Costs of opening work in process consisted of Rs. 3,600,000 as to material and Rs. 1,400,000 as to conversion costs.

ii. Materials are added at the start of the process and conversion costs are incurred evenly throughout the process.

iii. Process loss is determined on inspection which is carried out at 75% of completion.

iv. Process loss is estimated at 12% of the input which is sold as scrap at Rs. 400 per kg.

v. Inventory is valued using weighted average method.

(a) Statement of equivalent production units is prepared as under.

		Equivalent units	
Process A	**Quantity schedule**	**Material Kg**	**Conversion Kg**
Opening WIP	2,000	-	-
Material	18,000	-	-
	20,000		
Goods transferred during the month	16,000	16,000	16,000
Closing WIP (60% converted)	3,000	3,000	1,800
Normal loss (18,000-3,000) x 12%	1,800	-	-
Abnormal gain (75% converted)	(800)	(800)	(600)
(A)	20,000	18,200	17,200

(b) Computation of costs of finished goods, closing work in process and production gain/loss, are calculated below.

Computation of costs	Material	Conversion
	--------Rs. In ‘000’-------	
Opening WIP	3,600	1,400
Costs for the month	36,000	12,000
Normal loss (1,800 x 400)	(720)	-
(B)	38,880	13,400

	--------Rupees-------		
	Material	**Conversion**	**Total**
Cost per unit (B/A)	2,136	779	2,915
	--------Rs. In ‘000’-------		
Finished goods	34,176	12,464	46,640
Closing WIP	6,408	1,402	7,810
Abnormal gain	1,709	467	2,176

(c) Accounting entries for production losses are given below.

Accounting entries for Production losses		
Description	Debit	Credit
	------ Rs. in '000 ------	
Scrap inventory	720	
WIP - Process A		720
WIP – Process A	2,176	
Scrap inventory (800 x 400)		320
Profit and Loss account (Balancing)		1,856

- *Example 12:*

A manufacturing company makes a product by two processes and the data below relates to the second process for the month of June 2002.

Work in process as on June 01, 2002 was 1,200 units represented by the following costs:

	Rupees
Direct materials (100%)	54,000
Direct wages (60%)	34,200
Overheads (60%)	36,000

During June 4,000 units were transferred from first process @ Rs.37.50 per unit. This cost is treated as material cost of second process.

Other costs were as follow:

	Rupees
Additional materials	24,150
Direct wages	164,825
Overhead	177,690

Quantitative data shows the following:

	Units
Finished goods transferred to warehouse	3,200
Finished goods in hand	500
Normal loss	520
Work in process (100% materials and 50% wages and overheads)	980

Average pricing method is used.

(a) Equivalent production unit statement for June 2002, is prepared as under.

Equivalent production:	Material	Conversion
	----------- Units -----------	
Units completed and transferred out	3,200	3,200
Units completed but still on hand	500	500
Units in process (Materials 100%; Conversion 50%)	980	490
	4,680	**4,190**

(b) Process account for the month of June 2002 is given as under:

Process Account					
Description	**Units**	**Rupees**	**Description**	**Units**	**Rupees**
Opening WIP	1,200	124,200	Normal loss	520	-
Process I-Material	4,000	150,000	Finished goods	3,200	471,200
Additional material		24,150	WIP	1,480	169,665
Direct wages		164,825			
Overheads		177,690			
	5,200	**640,865**		**5,200**	**640,865**

W-1 Computation of costs	Material	Labour	Overheads
	--------Rupees-------		
Opening WIP	54,000	34,200	36,000
Process I	150,000	-	-
Cost added	24,150	164,825	177,690
(A)	228,150	199,025	213,690
Equivalent units (B)	4,680	4,190	4,190
Unit cost	48.75	47.50	51.00

W-2 Cost assigned to units transferred	Rupees
Cost- Finished goods transfer [3,200 x (48.75+47.50+51.00)	471,200

W-3 Cost assigned to WIP	Rupees
Cost- Finished goods on hand [500 x (48.75+47.50+51.00)	73,625
Cost assigned to partially completed units- 980 units	
Materials (980 x 48.75 x 100%)	47,775
Labour (980 x 47.50 x 50%)	23,275
Overheads (980 x 51.00 x 50%)	24,990
	169,665

- *Example 13:*

Tata Cools manufactures a range of products including Air conditioners which pass through three processes before transfer to finished goods store. Production department for the current month has given the following production data.

		PROCESS			
		1	2	3	Total
Basic raw material (10,000 kg)	Rs.	6,000			6,000
Raw material addition	Rs.	8,500	9,500	5,500	23,500
Direct wages	Rs.	4,000	6,000	12,000	22,000
Production overheads (to be allocated on direct wages base)	Rs.				16,500
Output	Units	9,200	8,700	7,900	
Normal loss in process of input	%	10	5	10	
Scrap value of each lost unit	Rs.	0.20	0.50	1.00	

There was no stock at start or at the end in any process.

(a) Process 1 account for the current month, is given below.

Calculation of Abnormal loss/ gain

	PROCESS		
	1	2	3
Units started/Received from preceding process	10,000	9,200	8,700
Transferred out	(9,200)	(8,700)	(7,900)
Normal loss	(1,000)	(460)	(870)
Abnormal loss (gain)	**(200)**	**40**	**(70)**

Process 1 Account					
Description	**Units**	**Rupees**	**Description**	**Units**	**Rupees**
Materials	10,000	6,000	Normal loss	1,000	200
Added material		8,500			
Direct wages		4,000	Process 2 Account	9,200	21,773
Overheads W-1		3,000			
Abnormal gain	200	473			
	10,000	**21,973**		**10,000**	**21,973**

(b) Process 2 account for the current month is given below.

Process 2 Account					
Description	**Units**	**Rupees**	**Description**	**Units**	**Rupees**
Process 1-Material	9,200	21,773	Normal loss	460	230
Added material		9,500	Abnormal loss	40	190
Direct wages		6,000	Process 3 Account	8,700	41,353
Overheads W-1		4,500			
	9,200	**41,773**		**9,200**	**41,773**

(c) Process 3 account for the current month is given below.

Process 3 Account					
Description	**Units**	**Rupees**	**Description**	**Units**	**Rupees**
Process 2 Material	8,700	41,353	Normal loss	870	870
Added material		5,500			
Direct wages		12,000	Process 2 Account	7,900	67,582
Overheads W-1		9,000			
Abnormal gain	70	599			
	8,770	**68,452**		**8,770**	**68,452**

W-1 Allocation of overheads to process accounts	Rupees
Process 1 (16,500 x 4,000/22,000)	3,000
Process 2 (16,500 x 6,000/22,000)	4,500
Process 3 (16,500 x 12,000/22,000)	9,000

W-2 Unit cost Calculation	Rupees
Process 1 (21,500 – 200)/9,000)	2.36667
Process 2 (41,773 - 230/8,740)	4.75320
Process 3 (67,853 - 870/7,830)	8.55466

W-3 Evaluation of cost	Rupees
Transferred to process 2 (9,200 x 2.36667)	21,773
Abnormal gain in process 1 (200 x 2.36667)	473
Transferred to process 3 (8,700 x 4.75320)	41,353
Abnormal loss in process 2 (40 x 4.75320)	190
Transferred to finished goods (7,900 x 8.55466)	67,581
Abnormal gain in process 3 (70 x 8.55466)	599

(d) Abnormal Loss and Abnormal Gain accounts are given below.

Abnormal loss account					
	Liters	Rs.		Liters	Rs.
Process 2 account	40	190	Scrap account	40	80
			Income statement		150
	100	240		100	240

Abnormal gain account					
	Liters	Rs.		Liters	Rs.
Scrap account	200	100	Process 1	200	473
Scrap account	70	70	Process 2	70	599
Income statement		902			
	270	1,072		270	1,072

- *Example 14:*

Following is the data of Department B of EFG Company for December, 2003:

	Units	Rupees
Work in process (opening); completed as to material 20% and conversion cost 25%	8,500	43,860
Work in process (ending); completed as to material 50% and conversion cost 25%	11,540	
Current period transactions are:		
Transferred from Department A	12,000	45,600
Units mishandled and lost before start of any process	460	
Material consumed		27,654
Conversion cost incurred		47,689
Units transferred out	7,500	

Normal spoilage is 6% of units transferred and inspection is done at the end of the process. Company uses FIFO method for inventory valuation.

Preparation of Process B account including all relevant workings are given as under.

Equivalent units		
Process B	**Material Units**	**Conversion Units**
Units transferred from opening WIP- 7,500 units Material 80%; Conversion cost 75%	6,000	5,625
Units converted into closing WIP from opening WIP- 1,000 units; Material 30%; Conversion cost 0%	300	-
Normal loss	450	450
Abnormal loss	550	550
Closing WIP from current production- 10,540 units Materials 50%; Conversion cost 25%	5,270	2,635
	12,570	9,260

W-1 Unit cost Calculation	Rupees
Department A (45,600/12,000)	3.80
Material (27,654/12,570)	2.20
Conversion cost (47,689/9,260)	5.15
Total	**11.15**

W-2 Evaluation of cost	Rupees
Abnormal Loss:	
Units lost at start of process (460 x 3.80)	1,748
Units lost at end of process (550 x 11.15)	6,132
	7,880
Cost of goods transferred out:	
From opening WIP (43,860 x 7,500/8,500)	38,700
Material added (7,500 x 2.20 x 80%)	13,200
Conversion cost added (7,500 x 5.15 x 75%)	28,969
Normal loss cost added (450 x 11.15)	5,018
	85,887
Value of closing WIP:	
From opening WIP (43,860 x 1,000/8,500)	5,160
Material cost added (1,000 x 2.20 x 30%)	660
	5,820
From current production	
Cost of department A (10,540 x 3.80)	40,052
Material added (10,540 x 2.20 x 50%)	11,594
Conversion cost added (10,540 x 5.15 x 25%)	13,570
	65,216
	71,036

Note: It is assumed that all losses were occurred at end of process and from current production only.

Department B Account					
Description	**Units**	**Rupees**	**Description**	**Units**	**Rupees**
Opening WIP	8,500	43,860	Normal Loss	450	-
Department-A	12,000	45,600	Abnormal loss W-2	1,010	7,880
Materials		27,654	Transferred out W-2	7,500	85,887
Conversion cost		47,689	Closing WIP W-2	11,540	71,036
	20,500	**164,803**		**20,500**	**164,803**

STICKY NOTES

Process costing is used where production is a continuous process, the output of one process will be input to the next until a finished product is being produced

Losses may occur in process. If a certain level of loss is expected this is called normal loss. If losses are greater than expected the difference is abnormal loss and if losses are less than normal the difference is known as abnormal gain

Scrap value of normal loss to be deducted from the cost of materials before cost per equivalent unit is calculated. Units of normal loss are valued at their scrap vale in the process account

Abnormal loss and gains have no concern with the cost of goods units of production. The scrap value of the abnormal losses is not credited to the process account, and abnormal loss and gain units carry the same full cost as a good unit of production

When units are partly completed at the end of a period (closing WIP) it is necessary to calculate the equivalent units of production in order to determine the cost of a completed unit

There are two methods to deal with opening work in progress i.e. FIFO and weighted average cost method.

In the weighted average method, no distinction is made between units of opening stock and new units introduced to the process during the period. The cost of opening stock is added to costs incurred during the period and units of opening stock are each given a value of one full equivalent unit off production

If there is opening and closing WIP, losses during the process and the loss has no scrap value the following rules should be followed.

- **Costs should be divided between finished output, closing stock and abnormal loss/gain using equivalent units as a basis of apportionment**
- **Units of abnormal loss / gain are often taken to be one full equivalent unit each, and are valued on this basis**
- **Abnormal loss units are an addition to the total equivalent units produced but abnormal gain units are subtracted in arriving at the total number of equivalent units produced**

When loss has a scrap value and the equivalent units are a different percentage of the total units for materials, labour and overheads, it is conventional that the scrap value of normal loss is deducted from the cost of materials before a cost per equivalent unit is calculated

If units are rejected as scrap or loss at an inspection stage before the completion of processing, units of abnormal loss should count as a proportion of an equivalent unit, according to the volume of work done and materials added up to the point of inspection

CHAPTER 9

JOINT AND BY-PRODUCT COSTING

IN THIS CHAPTER

AT A GLANCE

By-product is generally referred to one or more products with relatively less in value but produced in common process in joint products production.

By-product is treated similar to normal loss as its scrap value is deducted from joint cost.

The products manufactured simultaneously by common process or processes and each product has significance and controlled by management.

In volume method of joint product, equal cost per unit is allocated to each product with assumption that all products receive same benefits from joint cost.

Sales value at split-off method is used to allocate the joint cost on the basis of sales value. This method is used where joint products have sales value at split off point.

Net realizable value method is used on products which require further processing, before these are sold. These joint products have no sales value at split off point and joint cost is allocated on the basis of net realizable value of each joint product.

1. BY-PRODUCTS

1.1 Concept and definition of By-products

The products manufactured from common production process for joint products and relatively insignificant in value are known as by-products. While producing joint products from common process, there might be another product or products which have insignificant value as compared to joint products. In simple words, it is treated as wastage from common process which can be sold as scrap. In pursuance to produce main products, by-products are produced as unavoidable result and has negligible sales value.

1.2 Examples of by-product

Examples of by-products in different manufacturing entities are given below.

- During the process of sugar refining, a by-product "Sugar beet molasses" are produced. This by-product can be used as fodder for animals or is used in some foods for flavouring and colouring.
- While processing fruit juice and other related beverages, few by-products are also produced. These are fruit pulp, seeds and peels, and these can be used in cosmetic industry for their medicine properties.
- Ethylene is another example of by-product, which is related with petroleum refinery. This by-product is essential in polythene based products like plastic products.

1.3 Accounting treatment of by-products

Normal accounting treatment of by-products is simple and similar to treatment of normal loss as discussed in chapter 7 earlier. The scrap value of by-product is deducted from joint cost, before allocating to joint products. Joint cost is not allocated to by-products, but it is reduced by sales value of by-products. However, it can be recognized as other income but in this case, joint cost is not allocated to by-products.

Treatment of proceeds of sale	Measurement of by-product in joint process account
As other income	No cost is allocated to the by product.
As a deduction from joint process costs (this is the most commonly used method).	By-product is measured at scrap value (the accounting treatment is very similar to that used for normal loss).

► *Example 01:*

AB Limited produces two joint products viz. Product A and Product B from common process. As consequence of production of two main products, one by-product X is produced which can be sold at Rs. 8 per unit.

During the month of December, 2020 total joint cost of Rs. 600,000 is incurred including direct and indirect cost. 6,000 units were produced in joint process.

The treatment of by-product is enumerated as under.

1. The sales value of Rs. 48,000 (6,000 x 8) of by-product X is recognized as other income and joint cost of Rs. 600,000 is allocated to joint products A and B.
2. The sales value of Rs. 48,000 (6,000 x 8) of by-product X is deducted from joint cost and remaining joint cost of Rs. 552,000 (600,000 – 48,000) is allocated to joint products A and B.

► *Example 02:*

RS manufacturing company is engaged in production of chemicals in common process. At end of process, Chemical K was resulted as by-product. RS manufacturing company deducts the sales value of by-product from cost of main products.

In the month of November 2020, 5,000 liters of by-product Chemical A was produced. The liquid is converted into solid waste and 10 liters is converted into 7 kg, which can be sold at Rs. 25 per kg.

The scrap value of Chemical A (solid waste) of Rs. 87,500 (5,000 x 7/10 x 25) is deducted from joint cost, before allocation it to joint products.

2. JOINT PRODUCTS

2.1 Definition of joint products

In some manufacturing processes, two or more different products are produced and both are main products, termed as joint products. Joint product costs can be defined as:

- Joint products are two or more products generated simultaneously, by a single manufacturing process or series of processes using common input, and being substantially equal in value

Until the joint products are produced in the manufacturing process, they cannot be distinguished from each other. The same input materials and processing operation produces all the joint products together.

Each joint product has a substantial sale value relative to each other joint product. An increase in one product's output will bring about an increase in other products quantity, not necessarily in the same proportion.

2.2 Examples of joint products

The examples of joint products manufactured from common process are given below.

Oil industry produces gasoline, fuel oil, lubricants, paraffin, coal tar, asphalt and kerosene oil as joint products from common process with crude oil.

Production of butter, cream and cheese from Milk.

3. JOINT PRODUCTS AND BY-PRODUCTS DISTINGUISHED

The main points of distinction between joint products and by-products are apparent from the following.

- Joint products are of equal values and importance while by-products are relatively small in economic value.
- Joint products are produced simultaneously while by-products are produced incidentally in the manufacturing of main products.
- Joint products are crucial to the commercial viability of an organization, whereas by-products are not.

4. METHODS OF ALLOCATING JOINT COST

The costs of the common process that produces the joint products are common costs. In order to calculate a cost for each joint product, these common costs must be shared (apportioned) between the joint products. The common costs of the process must be apportioned between the joint products on a fair basis, in much the same way that overhead costs are apportioned between cost centers.

One of the following three methods of apportionment is normally used:

- **Physical Measures Method**: Common costs are apportioned on the basis of the total number of units produced. The cost per unit is the same for all the joint products. (This is also described as the physical quantities basis).
- **Sales value at the split-off point basis**: Common costs are apportioned on the basis of the sales value of the joint products produced, at the point where they are separated in the process (the 'split off point').
- **Net realizable value (sales value less further processing costs basis)**: Common costs are apportioned on the basis of their eventual sales value after they have gone through further processing to get them ready for sale.

► *Example 03:*

During the month of July, the NV Company processes a basic raw material through a manufacturing process that yields three products – products X, Y and Z. There were no opening inventories and the products are sold at the split-off point without further processing. Company uses physical measurement method for allocating the joint costs.

In the month of July, joint costs of Rs. 600,000 was incurred and 40,000 units, 20,000 units and 60,000 units of product X, Y and Z were produced.

The joint costs allocated to each product is computed as under.

Calculation of per unit cost of each product	
Joint cost (A)	600,000
Production	**Units**
Product X	40,000
Product Y	20,000
Product Z	60,000
Total units produced (B)	120,000
Unit cost (A/B)	5.00

Joint costs allocated to each product	Rupees
Product X (40,000 x 5)	200,000
Product Y (20,000 x 5)	100,000
Product Z (60,000 x 5)	300,000

- *Example 04:*

The Tracy Company manufacturers joint products X and Y as well as by-product Z. Cumulative cost data for the period show Rs. 204,000 incurred in refining department. Costs are assigned to X and Y by volume method. Additional data is given below.

Products	Units	Rs.
Product X	8,000	
Product Y	10,000	
Product Z (Sales price of Rs. 4.80 per unit)	2,000	9,600

Joint cost allocated to all joint and by-products is given below.

Calculation of per unit cost of each product	Rupees
Joint cost	204,000
Cost assigned to by-product Z (2,000 x 4.80)	(9,600)
Joint cost to be allocated to main products (A)	**194,400**
Production	**Units**
Product X	8,000
Product Y	10,000
Total units produced (B)	**18,000**
Unit cost (A/B)	**10.80**

Joint costs allocated to each product	Rupees
Product X (8,000 x 10.80)	86,400
Product Y (10,000 x 10.80)	108,000
Product Z	9,600
Total Joint cost allocated	**204,000**

- *Example 05:*

The Buildon Company produces three joint products, Buildon, Buildeze and Buildrite. Total joint production cost for November 2020 was Rs. 216,000.

The units produced and unit sales prices at the split off point were.

Products	Units	Unit sales price Rs.
Buildon	6,000	22.00
Buileze	8,000	12.50
Buildrite	10,000	12.80

Company is using "sales value at split off method" for allocating the joint cost to all joint products.

Allocation of the joint production cost, using sales value at split off, is given below.

Products	Units Produced	Unit sales price Rs.	Total Sales value Rs.	% of sales value to total	Joint cost allocated Rs.
Buildon	6,000	22.00	132,000	36.66667%	79,200
Buileze	8,000	12.50	100,000	27.77778%	60,000
Buildrite	10,000	12.80	128,000	35.55556%	76,800
			360,000		**216,000**

- *Example 06:*

The Star Company manufactures three joint products from a single raw material. A summary of production costs shows:

	Products			
	S	**K**	**A**	**Total**
Output in kilograms	80,000	200,000	160,000	440,000
Selling price per kilogram Rs.	0.75	1.00	1.50	

	Products			
	S	**K**	**A**	**Total**
Production costs:				
Materials	-	-	-	90,000
Direct labour Rs.	3,000	20,000	30,000	80,000
Variable production overheads Rs.	2,000	10,000	16,000	45,000
Fixed productin overheads Rs.	15,000	34,000	30,000	115,000

All separable costs have been assigned to products but the joint cost has not been allocated. All of the year's output was sold.

Gross profit for each product, after allocating the joint cost by sales value method, is calculated as under.

	Products			
	S	**K**	**A**	**Total**
	------------------Rupees-----------------			
Sales (80,000x0.75/200,000x1/160,000x1.50)	60,000	200,000	240,000	500,000
Less: Cost of sales:				
Direct labour	(3,000)	(20,000)	(30,000)	(53,000)
Variable production overheads	(2,000)	(10,000)	(16,000)	(28,000)
Fixed production overheads	(15,000)	(34,000)	(30,000)	(79,000)
Joint cost allocated W-1	(20,400)	(68,000)	(81,600)	(170,000)
	(40,400)	(132,000)	(157,600)	(330,000)
Gross profit	**19,600**	**68,000**	**82,400**	

W-1 Allocation of Joint cost

Products	Units Produced	Unit sales price Rs.	Total Sales value Rs.	% of sales value to total	Joint cost allocated Rs. W-2
S	80,000	0.75	60,000	12%	20,400
K	200,000	1.00	200,000	40%	68,000
A	160,000	1.50	240,000	48%	81,600
			500,000		**170,000**

W-2 Calculation of Joint Cost

Description	Rupees
Materials	90,000
Direct labour (80,000 – 3,000- 20,000 – 30,000)	27,000
Variable production overheads (45,000- 2,000- 10,000- 16,000)	17,000
Fixed production overheads (115,000- 15,000- 34,000- 30,000)	36,000
Total joint cost to be allocated	**170,000**

► *Example 07:*

Two joint products JP1 and JP2, are produced from a common process.

During March, 8,000 units of materials were input to the process. Total costs of processing (direct materials and conversion costs) were Rs. 135,880.

Output was 5,000 units of JP1 and 3,000 units of JP2.

JP1 has a sales value of Rs. 40 per unit when it is output from the process and can be sold for Rs.120 per unit after further processing costs of Rs.25 per unit.

JP2 has a sales value of Rs. 55 per unit when it is output from the process and can be sold for Rs.80 per unit after further processing costs of Rs.15 per unit.

Joint costs allocation under all of the above mentioned methods, is calculated as under.

Volume/ Physical measurement method

Output	Units
JP1	5,000
JP2	3,000
	8,000

Costs:	Rs.
JP1: $^{5,000\text{ units}}/_{8,000\text{ units}}$ × Rs.135,880.	84,925
JP2: $^{3,000\text{ units}}/_{8,000\text{ units}}$ × Rs.135,880.	50,955
	135,880

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Processing cost	8,000	135,880	JP1	5,000	84,925
			JP2	3,000	50,955
	8,000	135,880		8,000	135,880

Sales value at point of split off, assuming no further processing is required and products are sold at split off point.

Sales value	Rs.
JP1 (5,000 units × Rs. 40)	200,000
JP2 (3,000 units × Rs. 55)	165,000
	365,000
Costs:	**Rs.**
JP1: $^{\text{Rs. }200,000}/_{\text{Rs. }365,000}$ × Rs.135,880.	74,455
JP2: $^{\text{Rs. }165,000}/_{\text{Rs. }365,000}$ × Rs.135,880.	61,425
	135,880

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Processing cost	8,000	135,880	JP1	5,000	74,455
			JP2	3,000	61,425
	8,000	135,880		8,000	135,880

Net realizable value at the point of split off

NRV value	Rs.
JP1 (5,000 units × Rs. 120 – Rs. 25)	475,000
JP2 (3,000 units × Rs. 80 – Rs. 15)	195,000
	670,000
Costs:	**Rs.**
JP1: $^{\text{Rs. }475,000}/_{\text{Rs. }670,000}$ × Rs.135,880.	96,333
JP2: $^{\text{Rs. }195,000}/_{\text{Rs. }670,000}$ × Rs.135,880.	39,547
	135,880

These costs would be recorded in the process account as follows.

Process account					
	units	Rs.		units	Rs.
Processing cost	8,000	135,880	JP1	5,000	96,333
			JP2	3,000	39,547
	8,000	135,880		8,000	135,880

- *Example 08:*

Physical unit basis

In a joint process, two joint products are made, Product A and Product B. There is no inventory of work-in-process. Information relating to last month's production is set out in the table below.

Joint product	Opening inventory	Closing inventory	Sales
	Units	**units**	**units**
A	800	1,200	8,000
B	700	300	10,000

The costs of the joint process in the month were Rs. 144,000. These are apportioned between the joint products on the basis of units produced.

The joint processing costs for the month that are charged to each product can be calculated as follows:

	Production
	units
Joint product A: (1,200 + 8,000 – 800)	8,400
Joint product B: (300 + 10,000 – 700)	9,600
Total production	18,000
Joint processing costs	Rs.144,000
Joint processing costs per unit	Rs.8

Apportionment of joint costs	Rs.
To Joint product A: (8,400 × Rs.8)	67,200
To Joint product B: (9,600 × Rs.8)	76,800
	144,000

- *Example 09:*

Two joint products JP1 and JP2, are produced from a common process.

During March, 9,000 units of materials were input to the process. Total costs of processing (direct materials and conversion costs) were Rs. 135,880.

Output was 5,000 units of JP1 and 3,000 units of JP2 and 1,000 units of by-product BP3.

JP1 has a sales value of Rs. 40 per unit when it is output from the process and can be sold for Rs.120 per unit after further processing costs of Rs.25 per unit.

JP2 has a sales value of Rs. 55 per unit when it is output from the process and can be sold for Rs.80 per unit after further processing costs of Rs.15 per unit.

BP3 has a sales value of Rs.1.58 per unit.

The company's policy is to treat the proceeds of sale of a by-product as a reduction of joint process costs

Apportionment of the process costs between the joint products on the basis of net realizable sales value at the split off point, would be as follows.

Net realizable value at the point of split off

Common process costs	Rs.
Total process costs	135,880
Deduct: Sales value of by-product (1,000 × Rs.1.58)	(1,580)
	134,300

NRV value	Rs.
JP1 (5,000 units × Rs. 120 – Rs. 25)	475,000
JP2 (3,000 units × Rs. 80 – Rs. 15)	195,000
	670,000

Costs:	Rs.
JP1: $^{\text{Rs. }475{,}000}/_{\text{Rs. }670{,}000}$ × Rs. 134,300.	95,213
JP2: $^{\text{Rs. }195{,}000}/_{\text{Rs. }670{,}000}$ × Rs. 134,300.	39,087
	134,300

These costs would be recorded in the process account as follows.

Process account					
	units	Rs.		units	Rs.
Processing cost	9,000	135,880	JP1	5,000	95,213
			JP2	3,000	39,087
			By product	1,000	1,580
	9,000	135,880		9,000	135,880

- *Example 10:*

Two joint products XX and YY, are produced from a common process.

During July, 11,000 units of materials were input to the process. Total costs of processing (direct materials and conversion costs) were Rs. 100,000.

Output was 6,000 units of XX and 4,000 units of YY and 1,000 units of by-product Q.

XX has a sales value of Rs. 24 per unit when it is output from the process.

YY has a sales value of Rs. 12 per unit when it is output from the process.

Q has a sales value of Rs.1 per unit

The company's policy is to apportion joint costs based on sales value at the point of split off.

80% of the output of both XX and YY was sold by the month end.

The proceeds of sale of the by-product could be treated in one of the following ways.

Sales value at point of split off deducting proceeds of sale of the by-product from the joint process cost (as before)

Sales value	Rs.
XX (6,000 units × Rs. 24)	144,000
YY (4,000 units × Rs. 12)	48,000
	192,000

By-product deducted from costs	Rs.
XX: Rs. 144,000/ Rs. 192,000 × (Rs.100,000 – Rs. 1,000)	74,250
YY: Rs. 48,000/ Rs. 192,000 × (Rs.100,000 – Rs. 1,000).	24,750
	99,000

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Processing cost	11,000	100,000	XX	6,000	74,250
			YY	4,000	24,750
			Q	1,000	1,000
	11,000	100,000		11,000	100,000

The income statement would show the following:

	Rs.
Revenue:	
Sales of XX (80% × 6,000 units × Rs. 24)	115,200
Sales of YY (80% × 4,000 units × Rs. 12)	38,400
	153,600
Cost of sales:	
Production costs	(99,000)
Less: Closing inventory (20% × 99,000)	19,800
	(79,200)
Profit	74,400

Sales value at point of split off treating proceeds of sale of the by-product as other income

Sales value	Rs.
XX (6,000 units × Rs. 24)	144,000
YY (4,000 units × Rs. 12)	48,000
	192,000

By-product deducted from costs	Rs.
XX: Rs. 144,000/ Rs. 192,000 × Rs.100,000	75,000
YY: Rs. 48,000/ Rs. 192,000 × Rs.100,000	25,000
	100,000

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	Rs.		units	Rs.
Processing cost	11,000	100,000	XX	6,000	75,000
			YY	4,000	25,000
			Q	1,000	nil
	11,000	100,000		11,000	100,000

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The income statement would show the following:

Revenue:	
Sales of XX (80% × 6,000 units × Rs. 24)	115,200
Sales of YY (80% × 4,000 units × Rs. 12)	38,400
	153,600

Cost of sales:	
Production costs	(100,000)
Less: Closing inventory (20% × 100,000)	20,000
	(80,000)
Gross profit	73,600
Other income	1,000
Profit	74,600

The profit in the above example is higher than the profit in the previous example by Rs. 200.

This is because the whole sales proceeds from the sale of the by-product has been recognized as other income.

When the sales proceeds from the sale of the by-product are deducted from the joint process cost part of that deduction is carried forward to the next period in the valuation of closing inventory. The deduction in joint process costs was Rs. 1,000 and 80% of the inventory to which it relates has been sold leaving 20% (Rs. 200) to be carried forward to the next period.

- *Example 11:*

PQR Limited produces two joint products – P and Q- together with a by-product R, from a single main process (process 1). Product P is sold at the point of separation for Rs. 5 per kg, whereas product Q is sold for Rs. 7 per kg after further processing into product Q2 in process 2. By-product R is sold without further processing for Rs. 1.75 per kg.

Process 1 is closely monitored by a team of chemists, who planned the output per 1,000kg of input materials to be as follows:

Products	Kg
P	500
Q	350
R	100
Toxic waste	50

The toxic waste is disposed of at a cost of Rs. 1.50 per kg, and arises at the end of processing.

Process 2, which is used for further processing of product Q into Q2, has the following cost structure.

	Rs.
Fixed costs per week	3,450
Variable cost per kg processed	2.00

The following actual data relate to the first week of accounting period 10:

Process 1	Rs.
Opening work in process	Nil
Materials 10,000 kg input	15,000
Direct labour	10,000
Variable production overhead	4,000
Fixed production overhead	4,000
Output:	**Kg**
Product P	4,800
Product Q	3,600
Product P	1,000
Toxic waste	600
Closing work in process	Nil
Process 2	**Kg**
Opening work in process	Nil
Input of product Q	3,600
Output of product Q2	3,300
Closing work in process (50% coverted)	300

Conversion costs were incurred evenly throughout the process.

(a) Preparation of process 1 account, is given below.

Process 1 Account					
	Kg	Rs.		Kg	Rs.
Materials	10,000	15,000	Normal loss	500	-
Direct labour		10,000	Abnormal loss W-1	100	400
Variable overheads		4,000	Product R (1,000 x 1.75)	1,000	1,750
Fixed overheads		6,000	Product P W-4	4,800	21,000
Disposal cost (600x x1.50)		750	Product Q W-4	3,600	12,600
	10,000	**35,750**		**10,000**	**35,750**

W-1 Abnormal loss in units and Rs.

	Kg
Input	10,000
Product P	(4,800)
Product Q	(3,600)
Product R	(1,000)
Normal loss (50/1,000 x 10,000)	(500)
Abnormal loss in units	**100**
x Unit cost W-2	4.00
Cost assigned to abnormal loss	**400**

W-2 Unit cost

	Rs.
Input cost	35,000
Disposal cost of toxic waste	750
	35,750
Sales value of by-product	(1,750)
Total cost	**34,000**
Expected output (10,000-1,000-500)	8,500
Unit cost (34,000/8,500)	4.00

W-3 Joint cost to be allocated

	Rs.
Total input cost plus disposal cost W-1	34,000
Cost assigned to abnormal loss W-2	(400)
	33,600

W-4 Allocation of Joint cost

Product	Prod. Units	Final Sales price Rs.	Further cost per unit Rs. W-5	NRV per unit Rs.	% of sales value to total	Joint cost allocated Rs. W-2
P	4,800	5.00	-	24,000	62.5%	21,000
Q	3,600	7.00	(3.00)	14,400	37.5%	12,600
				38,400		**33,600**

W-5 Further processing cost of Product Q per unit

	Rs.
Fixed cost	3,450
Variable cost (3,300 x 2)+ (300 x 2 x 50%)	6,900
Total further processing cost (A)	**10,350**
Equivalent units:	**Units**
Units completed and transferred	3,300
Units in process (300 x 50%)	150
Equivalent Unit (B)	**3,450**
Unit cost of further processing (A/B)	**3.00**

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5. COMPREHENSIVE EXAMPLES

- *Example 01:*

A chemical is manufactured by passing through two processes X and Y using two types of direct material, A and B. In process Y, a by-product is also produced which is then transferred to process Z where it is completed. For the first week of a month, the actual data has been as follows:

		Process		
		X	Y	Z
Output of main product	(kgs)	9,400	8,000	
Output of by-product	(kgs)		1,400	1,250
Direct material - A (9,500 units)	(Rs.)	123,500		
Direct material - B added in process	(kgs)	500	300	20
Direct material - B added in process	(Rs.)	19,500	48,100	1,651
Direct wages	(Rs.)	15,000	10,000	500
Scrap value	(Rs. per unit)	5	10	6
Normal loss of units in process	(%)	4	5	5

The factory overheads are budgeted @ 240% of direct wages and are absorbed on the basis of direct wages. Actual factory overheads for the week amounted to Rs. 65,000. Estimated sales value of the by-product at the time of transfer to process Z was Rs. 22 per unit.

Preparation the required accounts for the given example are as follows

a) Process accounts for X, Y and Z.

Process X A/c					
	Kgs	Rs.		Kgs	Rs.
Direct materials – A	9,500	123,500	Normal loss A/c	400	2,000
Direct material – B	500	19,500	Abnormal loss A/c	200	4,000
Direct wages		15,000	Transfer to process Y	9,400	188,000
Production overheads @ 240% of direct wages		36,000			
	10,000	194,000		10,000	194,000

Working:	
Cost per unit of good units and abnormal loss units	**Rupees**
Total cost less scrap (194,000 – 2,000)	192,000
No. of units including abnormal losses (9,400 + 200)	9,600
Cost per unit (Rs.)	20

Process Y A/c					
	Kgs	Rs.		Kgs	Rs.
Transfer from process X	9,400	188,000	Normal loss A/c	485	4,850
Direct materials – B	300	48,100	Finished goods	8,000	240,000
Direct wages		10,000	Byproduct	1,400	30,800
Production overheads @ 240% of direct wages		24,000			
	9,700	270,100			
Abnormal gain A/c	185	5,550			
	9,885	275,650		9,885	275,650

Working:	
Cost per unit of good units and abnormal loss units	**Rupees**
Total cost less scrap and by-product cost (270,100 – 4,850 – 30,800)	234,450
Less: Total No. of units less normal losses and by-product (9700-485-1400)	7,815
Cost per unit (Rs.)	30

Process Z A/c					
	Kgs	Rs.		Kgs	Rs.
Input	1,400	30,800	Normal loss A/c	71	426
Direct materials – B	20	1,651	Abnormal loss A/c	99	2,475
Direct wages		500	Finished goods	1,250	31,250
Production overheads @ 240% of direct wages		1,200			
	1,420	34,151		1,420	34,151

Working: Cost per unit of good and abnormal loss units	Rupees
Total cost less scrap (34,151 – 426)	33,725
No. of units including abnormal losses (1,420 – 71)	1,349
Cost per unit (Rs.)	25

b) Abnormal loss and abnormal gain accounts.

Abnormal Loss A/c					
	Units	Rs.		Units	Rs.
Process X	200	4,000	Bank Account	200	1,000
Process Z	99	2,475	Bank account	99	594
			Costing P & L A/c		4,881
	299	6,475		299	6,475

Abnormal Gain A/c					
	Units	Rs.		Units	Rs.
Bank A/c / normal loss A/c	185	1,850	Process Y	185	5,550
Costing P & L A/c		3,700			
	185	5,550		185	5,550

c) Factory overhead account.

Factory overheads A/c			
	Rs.		Rs.
Cash/bank/payables (actual overheads)	65,000	Charged to process accounts:	
		Process X	36,000
		Process Y	24,000
		Process Z	1,200
		Cost of goods sold accounts:	
		Overheads under absorbed	3,800
	65,000		65,000

- *Example 02:*

Platinum Limited (PL) manufactures two joint products Alpha and Beta and a by-product Zeta from a single production process. Following information is available from PL's records for the month of February 20X4:

Direct material	25,000 kg. @ Rs. 25 per kg.
Direct labour @ Rs. 15 per hour	Rs. 432,000
Normal process loss	20% of the material consumed

Overheads are allocated to the products at the rate of Rs. 10 per direct labour hour. The normal loss is sold as scrap at the rate of Rs. 8 per kg.

Following data relates to the output from the process:

Product	Output ratio	Selling price per kg. (Rs.)
Alpha	75%	95.0
Beta	15%	175.0
Zeta	10%	52.5

Alpha is further processed at a cost of Rs. 30 per unit, before being sold in the market. Joint costs are allocated on the basis of net realizable value.

a) Computation of the total manufacturing costs for February 20X4 would be as follows.

Total cost of output:	Kg.	Rupees
Direct material [25,000 x Rs. 25]	25,000	625,000
Direct Labour		432,000
Overheads [432,000 / Rs. 15 x Rs. 10]		288,000
		1,345,000
Less: Sale of scrap [25,000 x 20% x Rs. 8]	(5,000)	(40,000)
Total cost of products	20,000	1,305,000

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b) And the calculation for the profit per kg for Alpha, Beta would be as follows:

Profit per kg of Alpha and Beta:	Rupees
Joint costs of products	1,305,000
Less: Sale of Zeta [20,000 x 10% x Rs. 52.5]	(105,000)
	1,200,000

Product	Kg.	NRV at split-off	Total NRV	% of NRV to total	Joint cost allocation	Total profit	Profit per Kg.
Alpha	15,000	95-30=65	975,000	65%	780,000	195,000	13
Beta	3,000	175	525,000	35%	420,000	105,000	35
	18,000		**1,500,000**		**1,200,000**		

▶ *Example 03:*

Oceanic Chemicals manufactures two joint products Sigma and Beta in a single process at its production department. Incidental to the production of these products, it produces a by-product known as ZEE. Sigma and ZEE are sold upon completion of processing in production department whereas Beta goes to refining department where it is converted into Theta.

Joint costs are allocated to Sigma and Beta on the basis of their net realizable values. Proceeds from sale of by-product are treated as reduction in joint costs. In both the departments, losses up to 5% of the input are considered as a normal loss.

Actual data for the month of June 2015:

	Department	
	Production	Refining
Cost	------ Rs. in '000 ------	
Material input at Rs. 50 per kg	3,000	-
Direct labour at Rs. 100 per hour	2,500	350
Production overheads	1,850	890

Output	---------- Liters----------	
Sigma	34,800	-
Beta	16,055	-
ZEE (by-product)	5,845	-
Theta	-	15,200

Sigma, Theta and by-product ZEE were sold at Rs. 300, Rs. 500 and Rs. 40 per liter respectively. There was no work in process at the beginning and the end of the month.

The cost per liter of Sigma and Theta, for the month of June 2015 would require following calculations:

Oceanic Chemicals Product-wise cost of Sigma and Theta		Sigma	Theta
		----------- Rs. in '000' -----------	
Joint costs of production	**W.2**	4,303.49	2770.98
Cost of refining	(350+890)	-	1,240.00
	(A)	4,303.49	4,010.98
No. of units produced	Liter. **(B)**	34,800	15,252
Cost per Liter	Rs. **(A÷B)**	**123.66**	**262.98**

W.1: Joint cost of production		Rs. in '000'
Joint cost of production	(3,000+2,500+1,850)	7,350.00
Sale proceeds from by-product ZEE	(5,845×40)	(233.80)
		7116.20
Cost of abnormal loss of production	[7,116.20÷(34,800+16,055+300)×300]	(41.73)
		7,074.47

W.2: Allocation of joint costs	NRV at split-off	Units produced	Total NRV	Joint cost allocation
	Rs.	Liters	-------- Rs. in '000 --------	
Sigma	300.00	34,800	10,440.00	4,389.48
Beta 500,000 x (16,050x95%) - [350+890) = 6,386,125 / 16,050	397.76	16,055	6,386.03	2,684.99
			16,826.03	**7,074.47**

W.3: Abnormal loss quantity		Production	Refining
		---------- Liters ----------	
Input quantity	3,000,000÷50	60,000	16,055
Output quantity	(34,800+16,055+5,845)	(56,700)	(15,200)
Production losses		3,300	855
Normal losses up to 5% of input	(60,000×5%), (16,055×5%)	3,000	803
Abnormal loss		**300**	**52**

▶ *Example 04:*

Cricket Chemicals Limited (CCL) is a manufacturing concern and has two production processes. Process I produces two joint products i.e. X-1 and X-2. Incidental to the production of joint products, it produces a by-product known as Zee. X-1 is further processed in process II and converted into 'X1-Plus'.

Following information has been extracted from the budget for the year ending 31 August 2019:

i. Process wise budgeted cost:

	Process I	Process II
	------------- Rupees -----------	
Direct material (500,000 liters)	98,750,000	-
Conversion cost	72,610,000	19,100,000

ii. Expected output ratio from process I and budgeted selling prices:

Products	Output ratio in process I	Selling price (Rs. per liter)
Joint product – X-1	55%	-
Joint product – X-2	40%	532
By-product – Zee	5%	120
X1-Plus	-	768

Additional information:

i. Material is added at the beginning of the process and CCL uses 'weighted average method' for inventory valuation.

ii. Joint costs are allocated on the basis of net realizable value of the joint products at the split-off point. Proceeds from the sale of by-product are treated as reduction in joint costs.

iii. Joint product X-2 is sold after incurring packing cost of Rs. 75 per liter.

iv. Normal production loss in process I is estimated at 5% of the input which occurs at beginning of the process. Loss of each liter results in a solid waste of 0.7 kg which is sold for Rs. 10 per kg. No loss occurs during process II.

v. Budgeted conversion cost of process I and process II include fixed factory overheads amounting to Rs. 7,261,000 and Rs. 3,820,000 respectively.

a) Preparation of product wise budgeted income statement for the year ending 31 August 2019, under marginal costing is given below

Cricket Chemicals Limited			
Product wise budgeted income statement - (Marginal costing)		X1 - Plus	X2
		---- Rs. in million ----	
Sales [768×261,250 **(W-4)]**, [532×190,000**(W-4)]**		200.64	101.08
Variable production cost:			
Joint cost	(W-1)	(108.96)	(52.11)
Process II Conversion cost	(19.10m–3.82m)	(15.28)	-
Packing cost	(75×190,000)	-	(14.25)
Budgeted contribution margin		76.40	34.72
Fixed cost:			
Joint cost	(W-1)	(4.91)	(2.35)
Process II conversion cost		(3.82)	-
Budgeted profit		**67.67**	**32.37**
Total budgeted profit			**100.04**

W-1: Allocation of joint cost on the basis of NRV						
Joint products	NRV at split-off point (Rs. per unit) (A)	Production (Units) (B)	Total NRV (A×B)	Joint cost allocation on NRV basis (C)	Fixed cost (D)	Variable joint cost (C–D)
			-------------------- Rs. in million --------------------			
X1	694.89	261,250	181.54	113.87	4.91	108.96
	768–73.11 (W-3)	(W-4)		(168.33×181.5/ 268.37)	(7.26×181.54/ 268.37)	
X2	457.00	190,000	86.83	54.46	2.35	52.11
	(532–75)	(W-4)		(168.3×86.83/ 268.37)	(7.26×86.83/ 268.37) (W-1)	
			268.37	(W-2)168.33	7.26	161.07

W-2: Joint cost - Process I		Rs. in million
Direct material		98.75
Conversion cost		72.61
Proceeds from By product - Zee	(23,750 (W-4)×120)	(2.85)
Proceeds from sale of normal loss	(25,000(W-4)×0.7kg×10)	(0.18)
Total joint cost		**168.33**
W-3: Conversion cost -		
Process II (Rs. per unit)	[19,100,000 / 261,250 (W-4)]	73.11

W-4: Quantity schedule		Process I --- Liters ---
Input quantity		500,000
Joint product - X-1	(500,000–25,000)×55%	(261,250)
Joint product - X-2	(500,000–25,000)×40%	(190,000)
By product – Zee	(500,000–25,000)×5%	(23,750)
Normal loss	(500,000×5%)	(25,000)

b) CCL has recently received an offer from Football Industries Limited (FIL) to purchase the entire expected output of X-1 during the year ending 31 August 2019 at Rs. 670 per litter. It is estimated that if process II is not carried out, fixed costs associated with it would reduce by Rs. 2,500,000. Advise whether FIL's offer may be accepted.

Evaluation of offer from FIL	Rs. in million
Loss of revenue if offer is accepted {261,250 **(W-4)** ×(768–670)}	(25.60)
Variable cost saved in process-II (19.10m – 3.82m)	15.28
Fixed cost saved	2.50
(Decrease)/Increase in budgeted profits	(7.82)
Conclusion: Offer should not be accepted	

▶ *Example 05:*

Production at Platinum Chemicals (PC) involves two processes I and II. Following information pertains to the month of August 2017:

i. Actual cost:

	Process I	Process II
	--------- Rupees ---------	
Direct material (12,000 liters)	5,748,000	-
Conversion	2,610,000	1,542,000

ii. Production and sales

Description	Process I	Process II	Remarks
	------ Liters ------		
Products:			
Joint product – J101	5,000	-	Sold for Rs. 1,200 per liter after incurring packing cost of Rs. 120 per liter
Joint product – J202	4,500	-	Transferred to process II for conversion into a new product J-plus
By-product – BP01	1,000	-	Sold at the split-off point for Rs. 500 per liter
J-plus	-	3,400	Sold for Rs. 1,400 per liter
Work-in-process:			
Opening	-	-	
Closing	-	650	70% complete as to conversion

iii. Materials are introduced at the beginning of process I and PC uses 'weighted average method' for inventory valuation.

iv. Proceeds from sale of by-product are treated as reduction in joint costs. Joint costs are allocated on the basis of net realizable values of the joint products at split-off point.

v. Normal production losses in both processes are estimated at 10% of the input and are incurred at beginning of the process. Loss of each liter in process I results in a solid waste of 0.8 kg which is sold for Rs. 100 per kg. Loss of process II has no sale value.

a) The cost of sales of J101 and J-plus for the month of August 2017, would be calculated as follow:

Platinum Chemicals			
Cost of sales for the month of August 2017 - Product J101 and J-plus		**J101**	**J-plus**
Quantity sold	**Liters.**	**5,000**	**3,400**
		------------- Rupees -------------	
Allocated joint costs from process I	(W-1)	4,147,792	-
3,456,494(W-1)÷(3,400+650)×3,400		-	2,901,748
Process II – Conversion cost	(3,400×400)	-	1,360,000
Packing cost	(5,000×120)	600,000	-
		4,747,792	4,261,748

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W-1: Allocation of joint cost - Process I (on the basis of NRV)					
Joint product	NRV per unit at split-off		Units produced	Total NRV	Joint cost allocation
	------- Rs. -------		Liters	------- Rupees -------	
J101	(1,200-120)	1,080	5,000	5,400,000	4,147,792
J202	[1,400-400(W-3)]	1,000	4,500	4,500,000	3,456,494
				9,900,000	(W-2) 7,604,286

W-2: Joint costs - Process I		Rupees
Direct material		5,748,000
Proceeds from sale of solid waste - normal loss	1,200 (W-4)×80%×100	(96,000)
Proceeds from sale of by-product BP01	1,000(W-4)×500	(500,000)
		5,152,000
Cost of abnormal loss	5,152,000×300÷9,800	(157,714)
Conversion cost		2,610,000
Cost allocation between joint products J101 and J202		7,604,286

W-3: Conversion cost per unit - Process II		Rupees
Conversion cost of process II	A	1,542,000
Equivalent units	3,400(W-4)+(650×0.7) B	3,855
Cost per unit	(A÷B) C	400

W-4: Normal and abnormal losses quantity	Process I	Process II
	--------- Liters ---------	
Input quantity	12,000	4,500
Less: J101	(5,000)	-
J202 – Transfer to process II	(4,500)	
By-product BP01	(1,000)	-
J-plus	-	(3,400)
Closing work in process (70% conversion)	-	(650)
Normal loss - 10% of input (12,000×10%); (4,500×10%)	(1,200)	(450)
Abnormal loss	**300**	**-**

b) For the given example, accounting entries to record production gains/losses and their ultimate disposal, are as follows.

Journal entries to record production and disposal of solid waste			
Date	Description	Debit	Credit
		-------- Rupees --------	
30-Aug-2017	Solid waste inventory (normal loss at sale price) (W-2)	96,000	
	Solid waste inventory (abnormal loss at cost) (W-2)	157,714	
	WIP - Process I		253,714
	(Normal losses at sale price and abnormal losses at cost credited to WIP)		
30-Aug-2017	Bank (1,200+300)×0.8×100	120,000	
	Profit and loss account Balancing	133,714	
	Solid waste inventory		253,714
	(Sale of normal and abnormal solid waste)		

▸ *Example 06:*

Scents Limited produces three joint products P, Q and R. Raw material is added at the beginning of process I. On completion of process I, these three products are split in the ratio of 50:30:20 respectively. Joint costs incurred in process I are apportioned on the basis of net realizable value of the three products at split-off point. Products P and Q are sold in the same state whereas product R is further processed in process II before being sold in the market. A by-product TS is also produced in process II.

Following information relating to the two processes is available for the month of February 2020:

	Process I	Process II
Raw materials at Rs. 411 per kg	744,000 kg	
Direct labour at Rs. 200 per hour	611,568 hours	55,450 hours
Production overheads	RS. 91,456,000	RS. 7,230,000

Additional information:

i. Loss of 7% is considered normal in process I.

ii. Details of opening and closing stocks, estimated cost to sell and selling price are given as under:

	Selling price per kg (Rs.)	Cost to sell per kg (Rs.)	Opening stock Kg	Closing stock Kg
Product P	1.045	15	-	20,200
Product Q	960	10	-	15,140
Product R	1,021	12	7,800	48,134

iii. Values of opening and closing stocks of product R comprised of cost of both processes. Value of opening stock of product R is Rs. 5,850,000.

iv. In process II, 7450 kg of TS was produced and sold at Rs. 175 per kg. Proceeds from sale of TS are adjusted against cost of process II

v. Selling and administration costs are charged to P, Q and R at 12% of sales.

AT A GLANCE SPOTLIGHT STICKY NOTES

AT A GLANCE SPOTLIGHT STICKY NOTES

FIFO method is used for inventory valuation.

Product wise income statement for the month of February 2020 is given below.

	P	Q	R
	--------------Rupees-----------		
Sales (quantity sold × selling price)	340,419,200	184,738,560	92,502,600
Cost of sales			
Opening stock	-	-	5,850,000
Production cost	(W-1) 273,813,041	(W-1) 151,527,605	(W-5) 110,622,450
Less: Closing stock [Cost per kg (W-1)&(W-5)×quantity(W-1)	(16,010,318)	(11,067,794)	(40,666,973)
Cost of sales	(257,802,723)	(140,459,811)	(75,805,477)
Gross profit	**82,616,477**	**44,278,749**	**16,697,123**
Selling and administration costs @12% of revenue	(40,850,304)	(22,168,627)	(11,100,312)
Net profit	**41,766,173**	**22,110,122**	**5,596,811**

W-1 Quantity schedule

Process I	Qty Prod. [Total Qty W-2 x split ratio]	Closing stock	Qty transfer red/ sold	NRV of products W-3	Total cost (as per NRV ratio)	Cost per kg
	A				B	C= B/A
Product P-50%	345,960	20,200	325,760	356,338,800	274,203,639	792.59
Product Q-30%	207,576	15,140	192,436	197,197,200	151,743,761	731.03
Product R-20%	138,384	-	138,384	121,645,071	93,606,200	
	691,920	**35,340**	**656,580**	**675,181,071**	**519,553,600 W-4**	

Process II	Product R
	Kgs
Opening stock	7,800
Quantity produced (138,384- 7,450)	130,934
Closing stock	(48,134)
Quantity sold	**90,600**

W-2

	Kgs
Input material	744,000
Normal loss @ 7%	(52,080)
Total quantity produced	**691,920**

W-3

	P	Q	R
	-------------Rupees----------		
Selling price per kg	1,045	960	1,021
Less: Estimated cost to sell per kg	15	10	12
	1,030	**950**	**1,009**
Less: Estimated further processing cost per kg (Process II)			
- Labour cost (11,090,000(W-5)/130,934)	-	-	84.70
- Production overheads (7,230,000/130,934)	-	-	55.22
- Sales of by-product TS [(175×7,450)/130,934]	-	-	(9.96)
	-	-	129.96
Net realizable value per kg	**1,030**	**950**	**879.04**
Net realizable value [NRV per kg × quantity produced(W-1)]	**356,338,800**	**197,197,200**	**121,645,071**

W-4 Process I

	Rupees
Material cost (744,000×411)	305,784,000
Labour (611,568×200)	122,313,600
Production overheads	91,456,000
Total cost of process I	**519,553,600**

W-5 Process II

	Rupees
Cost transferred from PI (W-1)	93,606,200
Labour cost (55,450×200)	11,090,000
Production overheads	7,230,000
	111,926,200
Less: Sales of by-product TS (175×7,450)	(1,303,750
Total cost of process II	**110,622,450**
Cost/kg of final product R[110,622,450÷130,934 W-1)]	**844.87**

AT A GLANCE SPOTLIGHT STICKY NOTES

AT A GLANCE
SPOTLIGHT
STICKY NOTES

- *Example 07:*

Colon Limited (CL) manufactures two joint products Pollen and Stigma in the ratio of 65:35. The company has two production departments A and B. Pollen can either be sold at split off point or can further be processed at department-B and sold as a new product Seeds. Stigma is sold without further processing. Following information relating to the three products is available from CL's records:

	Pollen	Stigma	Seeds
	----------------Rupees--------------		
Sales price per kg	90	300	125
Total selling expenses	135,000	306,000	180,000

Following further information relating to the two departments is available:

	Department A	Department B
Material X	75,000 kg at Rs. 60 per kg	-
Material Y	-	12,000 kg at Rs. 25 per kg
Labour @ Rs. 150 per hour	12,000 hours	3,600 hours
Variable overheads	Rs. 125 per labour hour	Rs. 65 per labour hour
Fixed overheads	Rs. 100 per labour hour	Rs. 50 per labour hour
Material input output ratio	100:88	100:96

Material is added at the beginning of the process. Joint costs are allocated on the basis of net realisable value at split off point.

(a) Calculation of joint cost and its apportionment to two products, are given below.

Calculation of joint cost

Department A	Rupees in 000
Material X [75,000 × Rs. 60]	4,500
Labour [12,000 × Rs. 150]	1,800
Variable overheads [12,000 × Rs. 125]	1,500
Fixed overheads [12,000 × Rs. 100]	1,200
	9,000

Apportionment of Joint cost

Input of material X in dept. A	75,000 kg
Yield (88% of input material X)	66,000 kg
Ratio of output for Pollen and Stigma	65:35
Quantity of Pollen produced at split off point (66,000 × 65/100)	42,900 kg
Quantity of Stigma produced at split off point (66,000 × 35/100)	23,100 kg

Statement showing apportionment of joint costs:	Pollen	Stigma
	Rupees in 000	
Sales [42,900 × 90] and [23,100 × 300]	3,861	6,930
Less: Selling expenses	(135)	(306)
Net realisable value	3,726	6,624
Ratio	36%	64%
Allocation of joint costs [9,000 × 36%] and [9,000 × 64%]	**3,240**	**5,760**

(b) Advise to CL whether it should produce Seeds or sell Pollen without further processing, is based on following calculations:

Computation of output of seeds	Kg
Transfer of Pollen to dept. B for further processing	42,900
Input of material Y in dept. B	12,000
Total material in dept. B	54,900
Yield (96% of input material) [54,900 × 96%]	52,704

Statement showing profit earned from Seeds	Seed Rs. In 000
Sales [52,704 × 125]	6,588
Less: Expenses	
Joint costs	(3,240)
Cost incurred in dept. B W-1	(1,254)
Selling expenses	(180)
Profit from Seeds	**1,914**

If Pollen is sold without further processing, then the profitability would be as under:

	Rs. In 000
Net realisable value at split off point [(42,900 × 90) – 135,000]	3,726
Less: Joint costs	(3,240)
Profit from Pollen	**486**

Advise: The company's profit has increased by Rs. 1,428,000 (i.e. Rs. 1,914,000 – Rs. 486,000) on further processing of Pollen into Seeds. Therefore, it is advisable to CL to further process Pollen into Seeds.

W-1 Cost incurred in Department B

	Department B Rs. 000
Material Y [12,000 × Rs. 25]	300
Labour [3,600 × Rs. 150]	540
Variable overheads [3,600 × Rs. 65]	234
Fixed overheads [3,600 × Rs. 50]	180
Total cost	**1,254**

▶ *Example 08:*

Binary Limited manufactures three joint products viz. Aay, Bee and Cee in one common process. Following this process, product Aay and Bee are sold immediately while product Cee is subjected to further processing. Following information is available for the period ended June 30, 2007:

(i)

	Aye	Bee	Cee
Opening stock in kg	Nil	Nil	Nil
Production in kg	335,000	295,000	134,000
Sales in kg	285,000	212,000	-
Sales price per kg (Rs.)	30.85	40.38	

(ii) Total costs of production were Rs 17,915,800.

(iii) 128,000 kg of Cee were further processed during the period and converted into 96,000 kg of Zee. The additional cost of further processing was as follows:

	Rupees
Direct labour	558,500
Production overheads	244,700

(iv) 94,000 kg of Zee was sold during the period, with total revenue of Rs. 3,003,300. Opening stock of Zee was 8,000 kg, valued at Rs 172,800. FIFO method is used for pricing transfers of Zee to cost of sales.

(v) 8,000 kg of a bye-product Vee was also produced during further processing and sold @ Rs. 10 per kg. Sales proceeds of bye-product are adjusted against production cost of product Zee.

(vi) The cost of production is apportioned among Aay, Bee and Cee on the basis of weight of output.

(vii) Selling and administration costs of Rs. 2,500,000 were incurred during the period. These are allocated to all the main products based on sales value.

Preparation of profit and loss account for the period, identifying separately the profitability of each of the three main products, is given below.

Binary Limited
Profit and Loss Statement
For the year ended 30 June 2007

	Aye	Bee	Zee	Total
		------------Rupees------------		
Sales W-1	8,792,250	8,560,560	3,003,300	20,356,110
Cost of sales:				
Joint product cost W-2	(7,855,750)	(6,917,750)	(3,142,300)	(17,915,800)
Less: closing stock W-3	1,172,500	1,946,350	140,700	3,259,550
	(6,683,250	(4,971,400)	(3,001,600)	(14,656,250)
Further processing cost W-4	-	-	(723,200)	(723,200)
Less: closing stock of Zee W-5	-	-	77,600	77,600
	(6,683,500)	(4,971,400)	(3,647,200)	(15,301,850)
Gross profit (loss)	2,109,000	3,589,160	(643,900)	5,054,260
Selling & Administration cost W-6	(1,079,805)	(1,051,350)	(368,845)	(2,500,000)
Net profit	1,029,195	2,537,810	(1,012,745)	2,554,260

W-1 Sales

	Rupees
Aye (285,000 x 30.85)	8,792,250
Bee (212,000 x 40.38)	8,560,560

W-2 Joint cost allocation

	Kg
Total volume in Kg (335,000+ 295,000+ 134,000)	764,000
	Rupees
Joint cost	17,915,800
Joint cost per kg (17,915,800/ 764,000)	23.45
Cost apportion to joint products	**Rupees**
Aay (335,000 x 23.45)	7,855,750
Bee (295,000 x 23.45)	6,917,750
Cee (134,000 x 23.45)	3,142,300

W-3 Closing stock

	Aye	Bee	Cee
Production in kg	335,000	295,000	134,000
Sold in kg	(285,000)	(212,000)	-
Converted in Zee	-	-	(128,000)
Closing stock in kg	50,000	83,000	6,000
x cost per kg	23.45	23.45	23.45
Closing stock in Rs.	1,172,500	1,946,350	140,700

W-4 Further processing cost

	Rupees
Direct labour	558,500
Production overheads	244,700
	803,200
Less: scrap of Vee (8,000 x 10)	(80,000)
	723,000

W-5 Closing stock of Zee

	Rupees
Cost of production converted from Cee	3,001,600
Further processing cost	723,200
Total cost of Zee	3,724,800
Unit cost per kg (3,724,800/ 96,000)	38.80
Closing stock of Zee (2,000 x 38.80)	77,600

W-6 Selling and administration cost

	Rupees
Aye (2,500,000 x 8,792,250/ 20,356,110)	1,079,805
Bee (2,500,000 x 8,560,560/ 20,356,110)	1,051,350
Zee (2,500,000 x 3,003,300/ 20,356,110)	368,845

STICKY NOTES

By-product is generally referred to one or more products with relatively less in value but produced in common process in joint products production.

By-product is treated similar to normal loss as its scrap value is deducted from joint cost.

Joint products are two or more products generated simultaneously, by a single manufacturing process or series of processes using common input, and being substantially equal in value

In volume method of joint product, equal cost per unit is allocated to each product with assumption that all products receive same benefits from joint

Sales value at split-off method is used to allocate the joint cost on the basis of sales value. This method is used where joint products have sales value at split off point.

Net realizable value method is used on products which require further processing, before these are sold. These joint products have no sales value at split off point and joint cost is allocated on the basis of net realizable value of

MARGINAL COSTING AND ABSORPTION COSTING

IN THIS CHAPTER

AT A GLANCE

In marginal costing only variable production costs (marginal costs) are charged to the cost of inventory and variable selling cost is deducted to calculate contribution margin. Fixed costs are treated as period costs and are deducted from profit. They are charged in full against the profit of the period in which they are incurred.

In absorption costing variable production costs as well as fixed production costs are charged to the cost of making the product or service. Fixed production cost are absorbed using a predetermined absorption rate.

In marginal costing the closing stocks are valued at marginal (variable) production cost where as in absorption costing stocks are valued at their full production cost which includes absorbed fixed production overhead.

If the opening and closing stock levels differ the profit for the accounting period under the two methods of cost accumulation will be different because the two systems value stock differently.

Increase in stock level resulted higher profits in absorption costing and decrease in stock level resulted higher profits in marginal costing.

1. MARGINAL COST AND MARGINAL COSTING

1.1 Marginal cost

The marginal cost of an item is its variable cost.

- **Marginal production cost** includes direct materials, direct labour and variable production overheads.
- **Marginal cost of sale** for a **product** includes variable selling and administrative cost in marginal production cost.
- **Marginal cost of sale** for a **service** includes similar cost as mentioned in marginal production cost, only difference is that here marginal cost of service is included.

It is usually assumed that **direct labour costs** are variable (marginal) costs, but often direct labour costs might be fixed costs, and so would not be included in marginal cost. E.g. If the workers are not being paid on piece rate basis but rather on fixed salary.

Variable overhead costs might be difficult to identify. In practice, variable overheads might be measured using a technique such as high/low analysis or linear regression analysis, to separate total overhead costs into fixed costs and a variable cost per unit of activity.

- For variable production overheads, the unit of activity is often either direct labour hours or machine hours, although other suitable measures of activity might be used.
- For variable selling and distribution costs, the unit of activity might be sales volume or sales revenue.
- Administration overheads are usually considered to be fixed costs, and it is very unusual to come across variable administration overheads.

Marginal costing is also known as direct costing or variable costing, as in marginal costing, inventory is measured at variable product cost.

1.2 Marginal costing and its uses

Marginal costing is a method of costing in which inventories are measured with variable cost of production. It is an alternative to absorption costing as a method of costing. In marginal costing, fixed production overheads are treated as period cost and charged as expense in the year of occurrence.

There are arguments in support of using marginal costing:

- Marginal costing provides more useful information for decision-making. The separation of fixed and variable costs helps to provide relevant information for better decision-making. In addition, the estimation of costs at various level helps to judge appropriate level for decision-making as well.
- Another argument for using variable costing for internal reporting is that the internal profit statements may be used as a basis for measuring the managerial performance. In absorption costing, there might be chances of manipulating performance by enhancing closing inventory, where fixed cost is included in cost of closing inventory. Whereas in marginal costing, it is not possible for managers to manipulate profits, because fixed cost is not a part of inventory.
- The situation where market demand of product declines, the stock can be end up with surplus stock. In absorption costing, fixed cost proportion is included in the surplus stock. If this surplus stock cannot be sold, then profit calculation for the current period will be misleading. Marginal costing, in this situation, provides true picture of profits, as fixed cost is treated as period cost, not product cost. **(Drury, 6th Edition, p. 238)**

1.3 Marginal costing characteristics

- All elements of costs are segregated into fixed and variable, whether it is production or non-production cost.
- Variable cost per unit remains constant irrespective of level of production. However, total variable cost change in accordance with change in volume.
- Fixed cost is treated as period cost, and is charged to profit & loss in the period of occurrence.

- The inventories in marginal costing includes only variable production cost. All fixed costs and variable non-production costs are not part of inventory.
- Marginal costing technique helps to management in decision-making process. For example, large order from customer at discounted price can be judged from marginal costing technique. (Ashok, 2020)

1.4 Assumptions in marginal costing

For the purpose of marginal costing, the following assumptions are normally made:

- Every additional unit of output or sale, or every additional unit of activity, has the same variable cost as every other unit. In other words, the variable cost per unit is a constant value.
- Fixed costs are costs that remain the same in total in each period, regardless of how many units are produced and sold.
- Costs are either fixed or variable, or a mixture of fixed and variable costs. Mixed costs can be separated into a variable cost per unit and a fixed cost per period.
- The marginal cost of an item is therefore the extra cost that would be incurred by making and selling one extra unit of the item. Therefore, marginal costing is particularly important for decision making as it focuses on what changes as a result of a decision.

1.5 Contribution margin

Contribution is a key concept in marginal costing. Gross contribution margin is calculated by deducting the variable production cost from its revenue whereas net contribution margin, mostly known as contribution margin, is derived by deducting total variable costs from its revenue.

Gross Contribution margin = Sales – Variable Production costs

Contribution margin = Sales – Variable costs (Both production and non-production)

Fixed costs are a constant total amount in each period. To make a profit, an entity must first make enough contribution to cover its fixed costs. Contribution therefore means: 'contribution towards covering fixed costs and making a profit'.

Total contribution margin – Fixed costs = Profit

In simple words…

Contribution margin is sales minus all Variable costs

2. REPORTING PROFIT WITH MARGINAL COSTING

2.1 Total contribution minus fixed costs

Profit is measured by comparing revenue to the cost of goods sold in the period and then deducting other expenses.

The cost of goods sold is the total cost of all production costs in the period adjusted for the inventory movement.

In a marginal costing system, the opening and closing inventory is measured at its marginal product cost. The cost per unit only includes the variable costs of production (direct materials + direct labour + direct expenses + variable production overhead).

Format of marginal costing statement of profit is given below.

Format of marginal costing profit statement	Rs.	Rs.
Sales		X
Opening inventory	X	
Add: variable production cost:		
Direct materials cost (A)	X	
Direct labour cost (B)	X	
Variable production overheads (C)	X	
Less closing inventory (A+B+C)/units produced x closing inventory units	(X)	(X)
Gross contribution		X
Less: variable selling and administrative cost		(X)
Net contribution margin		X
Less: Fixed cost:		
Production	X	
Non-production	X	(X)
Net profit		X

Total contribution and contribution per unit

In marginal costing, it is assumed that the variable cost per unit of product (or per unit of service) is constant. If the selling price per unit is also constant, this means that the contribution earned from selling each unit of product is the same.

Total contribution can therefore be calculated as: Units of sale × Contribution per unit.

► *Example 01:*

A company manufactures and sells two products, A and B.

Product A has a variable cost of Rs.6 and sells for Rs.10, and product B has a variable cost of Rs.8 and sells for Rs.15.

During the period, 20,000 units of Product A and 30,000 units of Product B were sold.

Fixed costs were Rs.260,000. What was the profit or loss for the period?

Contribution per unit:

Product A: Rs.10 – Rs.6 = Rs.4

Product B: Rs.15 – Rs.8 = Rs.7

	Rs.
Contribution from Product A: (20,000 × Rs.4)	80,000
Contribution from Product B: (30,000 × Rs.7)	210,000
Total contribution for the period	290,000
Fixed costs for the period	(260,000)
Profit for the period	30,000

2.2 A marginal costing income statement with opening and closing inventory

- *Example 02:*

NT Enterprises provides the following data for month of March 2021, for calculation of profit under marginal costing principle.

	Units
Opening inventoy	3,000
Closing inventory	5,000
Units produced	25,000
Units sold	23,000
Other data:	**Rupees**
Direct material cost per unit	6.00
Direct labour cost per unit	3.50
Variable production overheads per unit	2.50
Sales price	22.00
Variable selling & administration cost	10% of sales
Fixed production overheads	50,000
Fixed selling & administration cost	28,000

If an income statement is prepared using marginal costing, the opening and closing inventory might be shown, as follows:

Marginal costing income statement for the period	Rs.	Rs.
Sales (23,000 x 22)		506,000
Opening inventory (3,000 x [6.00+3.50+2.50])	36,000	
Variable production costs		
Direct materials (25,000 x 6.00)	150,000	
Direct labour (25,000 x 3.50)	87,500	
Variable production overheads (25,000 x 2.50)	62,500	
	336,000	
Less: Closing inventory (5,000 x [6.00+3.50+2.50])	(60,000)	(276,000)
Gross contribution		230,000

Variable selling and distribution costs (10% of sales)		(50,600)
Contribution margin		179,400
Fixed costs:		
Production fixed costs	50,000	
Selling and administration costs	28,000	(78,000)
Profit		101,400

- *Example 03:*

Mingora Manufacturing makes and sells a single product:

	Rs.
Selling price per unit	150
Variable costs:	
Direct material per unit	35
Direct labour per unit	25
Variable production overhead per unit	10
Marginal cost per unit	70

Budgeted fixed production overhead		**Rs. 110,000 per month**
The following actual data relates to July and August:		
	July	**August**
Fixed production costs	Rs. 110,000	Rs. 110,000
Production	2,000 units	2,500 units
Sales	1,500 units	3,000 units

There was no opening inventory in July.

This means that there is no closing inventory at the end of August as production in the two months (2,000 + 2,500 units = 4,500 units) is the same as the sales (1,500 + 3,000 units = 4,500 units)

The profit statements for each month are shown below. Work through these carefully one month at a time.

	July	August
Sales:		
1,500 units × Rs. 150	225,000	
3,000 units × Rs. 150		450,000
Opening inventory	nil	35,000
Variable production costs		
Direct material: 2,000 units × Rs. 35	70,000	
Direct labour: 2,000 units × Rs. 25	50,000	
Variable overhead 2,000 units × Rs. 10	20,000	
Direct material: 2,500 units × Rs. 35		87,500
Direct labour: 2,500 units × Rs. 25		62,500
Variable overhead 2,500 units × Rs. 10		25,000
Closing inventory		
500 units @ Rs. 70 (35 + 25 + 10)	(35,000)	
Closing inventory		nil
Cost of sale	(105,000)	(210,000)
Contribution margin	120,000	240,000
Fixed production costs (expensed)	(110,000)	(110,000)
Profit for the period	10,000	130,000

In simple words…

To calculate profit, we have to deduct all Fixed Cost from Contribution Margin.

3. ABSORPTION COSTING

3.1 Absorption costing

In Chapter 3, we have discussed the use of factory overhead rate for product costing. When this is established, the production capacity volume must be selected, so that all costs and expenses can be expected to be recovered over a certain period of time. This concept of costing is known as "Absorption costing" and it is, sometimes, termed as "Full costing" or "Conventional costing". It includes direct materials, direct labour, direct expenses, variable production overheads and fixed production overheads. In absorption costing, fixed production cost is product cost, and inventory is valued at full production cost. Still, fixed non-production overheads are period cost and charged to profit or loss for the year.

At end of each period, differences between absorbed and fixed production overheads are closed to cost of sales. The under or over absorption of production overheads arise because of actual production level was less or more than budgeted or normal activity level.

3.2 Arguments in favour of absorption costing

- Absorption costing does not understate the importance of fixed production overheads. Inventory in this method is calculated on realistic cost of production because of inclusion of fixed production overheads.
- Absorption costing avoids fictitious losses being reported as in seasonal sales situation, it provides realistic profit or loss for the period. Unlike in marginal costing, where in low sales season, fixed cost in total is deducted from contribution margin, resulting losses.
- Another arguments towards absorption costing is that the production of goods is not possible without incurring fixed manufacturing cost. As a result, we add fixed production overhead in inventory valuation.
- Most important argument is that absorption costing is in consistent with external reporting.

3 REPORTING PROFIT WITH ABSORPTION COSTING

4.1 Reporting profit with absorption costing

Absorption costing is the 'traditional' way of measuring profit in a manufacturing company. Inventory is valued at the full cost of production, which consists of direct materials and direct labour cost plus absorbed production overheads (fixed and variable production overheads).

Fixed production overhead may be under- or over- absorbed because the absorption rate is a predetermined rate and calculated at specified level of activity. This was covered in chapter 3.

Over and under absorption is the difference between absorbed and actual overheads. If absorbed are greater than actual overheads, it is over absorption and vice versa.

Format of marginal costing statement of profit is given below.

Format of absorption costing profit statement	Rs.	Rs.
Sales		X
Opening inventory at full product cost of last period	X	
Add: production cost:		
Direct materials cost (A)	X	
Direct labour cost (B)	X	
Variable production overheads (C)	X	
Fixed production overheads absorbed (D)		
Less closing inventory (A+B+C+D)/units produced x closing inventory units	(X)	
	X	
Add: Under absorbed or Less: Over absorbed fixed production overheads	X (X)	(X)
Gross profit		
Less: Non-production overheads:		
Selling & distribution costs	X	
Administration costs	X	(X)
Net profit		X

4.2 Calculation of total absorption costing profit

The following example uses the same base scenario as that used to illustrate absorption costing, assuming no opening and closing inventories.

► *Example 04:*

Rashid Manufacturing Company manufactures single product X11. Following data is relevant for the preparation of income statement under absorption costing.

	Rs.
Selling price per unit	100
Variable costs:	
Direct material per unit	25
Direct labour per unit	20
Variable production overhead per unit	15
	60
Fixed overhead per unit (see below)	20
Total absorption cost per unit	80

Normal production	2,100 units per month
Budgeted fixed production overhead	Rs. 42,000 per month

Fixed overhead absorption rate	Rs. 42,000/2,100 units= Rs. 20 per unit

The following data relates to July 2020:

	July, 2020
Fixed production costs	Rs. 110,000
Production and Sales (Actual)	2,000 units

Total absorption cost profit statement for the month of July, 2020, is given below.

	Rupees
Sales (2,000 x 100)	200,000
Less: Cost of sales:	
Opening inventory	Nil
Production costs	
Direct material: 2,000 units × Rs. 25	(50,000)
Direct labour: 2,000 units × Rs. 20	(40,000)
Variable overhead 2,000 units × Rs. 15	(30,000)
Fixed production costs (absorbed) 2,000 x Rs. 20	(40,000)
	(160,000)
Less: Closing inventory	-
	(160,000)
Under absorbed fixed production overhead (2,100-2,000) x Rs. 20	(2,000)
Cost of sale	(162,000)
Profit	38,000

4.3 A marginal costing income statement with opening and closing inventory

► *Example 05:*

NT Enterprises provides the following data for month of March 2021, for calculation of profit under absorption costing principle.

	Units
Opening inventoy	3,000
Closing inventory	5,000
Units produced	25,000
Units sold	23,000
Budgeted level per month	20,000

Other data:	Rupees
Direct material cost per unit	6.00
Direct labour cost per unit	3.50
Variable production overheads per unit	2.50
Sales price	22.00
Variable selling & administration cost	10% of sales
Fixed production overheads	50,000
Fixed selling & administration cost	28,000

If an income statement is prepared using absorption costing, the opening and closing inventory might be shown, as follows:

Absorption costing income statement for the period	Rs.	Rs.
Sales (23,000 x 22)		506,000
Opening inventory (3,000 x [6.00+3.50+2.50+2.50 W-1])	43,500	
Variable production costs		
Direct materials (25,000 x 6.00)	150,000	
Direct labour (25,000 x 3.50)	87,500	
Variable production overheads (25,000 x 2.50)	62,500	
Absorbed fixed production overheads (25,000 x 2.50 W-1)	62,500	
	406,000	
Less: Closing inventory (5,000 x [6.00+3.50+2.50+2.50 W-1])	(72,500)	
	333,500	
Less: Over absorbed fixed production overheads [(25,000-20,000) x 2.50]	(12,500)	(321,000)
Contribution profit		185,000
Non-production overheads:		
Variable selling and administration cost (10% of 506,000)	50,600	
Fixed Selling and administration costs	28,000	(78,600)
Profit		106,400

W-1 Fixed production overhead rate	
Fixed production overheads (Rs.)	50,000
Budgeted level in units	20,000
Fixed overhead absorption rate (Rs.)- [50,000/ 20,000]	2.50

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▶ *Example 06:*

Silver Limited (SL) produces and markets a single product. Following budgeted information is available from SL's records for the month of March 2020:

Volumes	
Sales	100,000 units
Production	120,000 units
Standard costs:	
Direct materials per unit	0.8 kg at Rs. 60 per kg
Labour per unit	27 minutes at Rs. 80 per hour
Variable production overheads	Rs. 40 per labour hour
Variable selling expenses	Rs. 15 per unit
Fixed selling expenses	Rs. 800,000

Fixed production overheads, at a normal output level of 105,000 units per month, are estimated at Rs. 2,100,000. The estimated selling price is Rs. 180 per unit.

Assuming there are no opening stocks, preparation SL's budgeted profit and loss statement for the month of March 2020 using absorption costing would be as follows:

Absorption costing:	Rupees
Sales [100,000 x Rs. 180]	18,000,000
Less: Cost of sales:	
Opening stock	-
Add: Direct materials [0.8 x 120,000 x 60]	(5,760,000)
Direct labour [27/60 x 120,000 x 80]	(4,320,000)
Variable overheads [27/60 x 120,000 x 40]	(2,160,000)
Fixed overheads [2,100,000 / 105,000 x 120,000]	(2,400,000)
	(14,640,000)
Less: Closing stock [14,640,000 / 120,000 x 20,000]	2,440,000
Cost of sales	(12,200,000)
Less: Over-absorbed overheads [2,100,000 / 105,000 x 15,000]	300,000
	(11,900,000)
Gross profit	6,100,000
Less: Selling expenses:	
Variable [100,000 x 15]	(1,500,000)
Fixed	(800,000)
	(2,300,000)
Net profit	**3,800,000**

4 MARGINAL COSTING AND ABSORPTION COSTING COMPARED

4.1 The difference in profit between marginal costing and absorption costing

The profit for an accounting period calculated with marginal costing is different from the profit calculated with absorption costing if inventory level change over period. If opening and closing inventory level is same, then profit of marginal and absorption is equal.

The difference in profit is entirely due to the differences in inventory valuation as fixed overheads are treated as period cost in marginal costing and as product cost in absorption costing.

The main difference between absorption costing and marginal costing is that in absorption costing, inventory cost includes a share of fixed production overhead costs.

- The opening inventory contains fixed production overhead that was incurred last period. Opening inventory is written off against profit in the current period. Therefore, part of the previous period's costs is written off in the current period income statement provided that the opening inventory is sold during the current year.
- The closing inventory contains fixed production overhead that was incurred in this period. Therefore, this amount is not written off in the current period income statement but carried forward to be written off in the next period income statement.

The implication of this is as follows (assume costs per unit remain constant):

- When there is no change in the opening or closing inventory, exactly the same profit will be reported using marginal costing and absorption costing.
- If inventory increases in the period (closing inventory is greater than opening inventory), the fixed production overhead brought forward from last period will be less than share of production overhead carried forward to next period, thus the absorption costing profit would be higher than marginal costing profit.
- Similarly, if inventory decreases in the period (closing inventory is less than opening inventory), marginal costing profit would be higher than absorption costing.

The difference in the two profit figures is calculated by preparing reconciliation statement and format of this statement is given below.

Reconciliation statement	Rs.
Profit under absorption costing	X
Add: Difference in opening inventory (Units in opening inventory x FOAR/unit)	X
Less: Difference in Closing inventory (Units in closing inventory x FOAR/unit)	(X)
Profit under marginal costing	X

This concept is further explained with the help of following example.

► *Example 07:*

JSS Enterprises produces and sells a single product. Following budgeted information is related to this product for first 3-months.

	May	June	July
Units produced	6,000	5,000	7,000
Budgeted production	6,000	6,000	6,000
Units sold	5,500	5,300	7,000

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Data relating to cost and sales is given below.

	Rs.
Direct material per unit	18
Direct labour per unit	11
Variable production overhead per unit	6
Fixed production overhead total per month	30,000
Variable selling & administration cost	20% of sales
Fixed production & administration cost	25,000
Selling price per unit	60

a) Preparation of income statement under marginal costing principle from May to July, is given below.

Marginal costing income statement for 3-Months	May Rupees	June Rupees	July Rupees
Sales (5,500 x 60)/(5,300 x 60)/(7,000 x 60)	330,000	318,000	420,000
Variable cost of sales:			
Opening inventory	-	(17,500)	(7,000)
Variable production costs:			
Direct materials (6,000 x 18)/(5,000x18)/(7,000x18)	(108,000)	(90,000)	(126,000)
Direct labour (6,000 x 11)/(5,000x11)/(7,000x11)	(66,000)	(55,000)	(77,000)
Variable POH (6,000 x 6)/(5,000x6)/(7,000x6)	(36,000)	(30,000)	(42,000)
	(210,000)	(192,500)	(252,000)
Less: Closing inventory W-1	17,500	7,000	7,000
	(192,500)	**(185,500)**	**(245,000)**
Gross contribution	**137,500**	**132,500**	**175,000**
Variable selling and distribution costs (20% of sales)	(66,000)	(63,600)	(84,000)
Contribution margin	**71,500**	**68,900**	**91,000**
Fixed costs:			
Production fixed costs	(30,000)	(30,000)	(30,000)
Selling and administration costs	(25,000)	(25,000)	(25,000)
	(55,000)	**(55,000)**	**(55,000)**
Profit	**16,500**	**13,900**	**36,000**

W-1 Closing inventory	May	June	July
Units produced	6,000	5,000	7,000
Opening inventory (units)	-	500	200
Units sold	(5,500)	(5,300)	(7,000)
Closing inventory (units) **A**	500	200	200
Unit variable product cost:			
Direct material per unit	18	18	18
Direct labour per unit	11	11	11
Variable production overheads	6	6	6
Unit product cost **B**	35	35	35
Closing inventory (A x B) Rs.	**17,500**	**7,000**	**7,000**

b) Preparation of income statement under absorption costing principle from May to July, is given below.

Absorption costing income statement for 3-Months	May Rupees	June Rupees	July Rupees
Sales (5,500 x 60)/(5,300 x 60)/(7,000 x 60)	330,000	318,000	420,000
Cost of sales:			
Opening inventory	-	(20,000)	(8,000)
Production costs:			
Direct materials (6,000 x 18)/(5,000x18)/(7,000x18)	(108,000)	(90,000)	(126,000)
Direct labour (6,000 x 11)/(5,000x11)/(7,000x11)	(66,000)	(55,000)	(77,000)
Variable POH (6,000 x 6)/(5,000x6)/(7,000x6)	(36,000)	(30,000)	(42,000)
Absorbed Fixed POH (6,000 x 5)/(5,000x5)/(7,000x5)	(30,000)	(25,000)	(35,000)
	(240,000)	(220,000)	(288,000)
Less: Closing inventory W-2	20,000	8,000	8,000
	(220,000)	(212,000)	(280,000)
(Under) over absorbed overheads W-3	-	(5,000)	5,000
	(220,000)	**(217,000)**	**(275,000)**
Contribution profit	**110,000**	**101,000**	**145,000**
Non-production overheads:			
Variable selling & administration cost-20% of sales	(66,000)	(63,600)	(84,000)
Fixed Selling and administration costs	(25,000)	(25,000)	(25,000)
	(91,000)	**(88,600)**	**(109,000)**
Profit	**19,000**	**12,400**	**36,000**

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c) Reconciliation statement of profit calculated under absorption and marginal costing, is given below.

Reconiliation Statement	May Rupees	June Rupees	July Rupees
Profit under marginal costing	16,500	13,900	36,000
Less: Difference in opening inventory June 500 x 5; July 200 x 5	-	(2,500)	(1,000)
Add: Difference in closing inventory May 500 x 5; June and July 200 x 5	2,500	1,000	1,000
Profit under absorption costing	**19,000**	**12,400**	**36,000**

W-2 Closing inventory	May	June	July
Closing inventory (units) **A W-1**	500	200	200
Unit product cost:			
Unit variable cost as calculated in W-1	35	35	35
Fixed overhead per unit	5	5	5
Unit product cost **B**	40	40	40
Closing inventory (A x B) Rs.	**20,000**	**8,000**	**8,000**

W-3 Under over absorption of fixed overheads	May	June	July
Units produced	6,000	5,000	7,000
Budget level of production in units	(6,000)	(6,000)	(6,000)
(Less) Excess production	-	(1,000)	1,000
FOAR per unit (Rs. 30,000 / 6,000)	5	5	5
(Under) over absorption of fixed overheads	-	(5,000)	5,000

4.2 Summary: comparing marginal and absorption costing profit

To calculate the difference between the reported profit using marginal costing and the reported profit using absorption costing, you might need to make the following simple calculations.

- the increase or decrease in inventory during the period, in units.
- the fixed production overhead cost per unit.
- Multiplication of increase or decrease in inventory and fixed production overhead rate is equal to difference in both profits

The important points to remember are:

- If there has been an increase in inventory, the absorption costing profit is higher. If there has been a reduction in inventory, the absorption costing profit is lower.
- Ignore fixed selling overhead or fixed administration overhead. These are written off in full as a period cost in both absorption costing and marginal costing, and only fixed production overheads are included in inventory values.

- *Example 08:*

A company uses marginal costing. In the financial period that has just ended, opening inventory was Rs. 8,000 and closing inventory was Rs.15,000. The reported profit for the year was Rs. 96,000.

If the company had used absorption costing, opening inventory would have been Rs. 15,000 and closing inventory would have been Rs. 34,000.

What would have been the profit for the year if absorption costing had been used?

In doing so, please see the following:

There was an increase in inventory. It was Rs. 7,000 using marginal costing (Rs. 15,000 – Rs. 8,000). It would have been Rs. 19,000 using absorption costing.

	Rs.
Increase in inventory, marginal costing	7,000
Increase in inventory, absorption costing	19,000
Difference (profit higher with absorption costing)	12,000
Profit with marginal costing	96,000
Profit with absorption costing	108,000

The profit is higher with absorption costing because there has been an increase in inventory (production volume has been more than sales volume.)

- *Example 09:*

A company uses absorption costing. In the financial period that has just ended, opening inventory was Rs. 76,000 and closing inventory was Rs. 49,000. The reported profit for the year was Rs. 183,000.

If the company had used marginal costing, opening inventory would have been Rs. 40,000 and closing inventory would have been Rs. 28,000.

What would have been the profit for the year if marginal costing had been used?

There was a reduction in inventory. It was Rs.27,000 using absorption costing (Rs.76,000 – Rs.49,000). It would have been Rs. 12,000 using marginal costing.

	Rs.
Reduction in inventory, absorption costing	27,000
Reduction in inventory, marginal costing	12,000
Difference (profit higher with marginal costing)	15,000
Profit with absorption costing	183,000
Profit with marginal costing	198,000

Profit is higher with marginal costing because there has been a reduction in inventory during the period.

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- *Example 10:*

The following information relates to a manufacturing company for a period.

Production	16,000 units	Fixed production costs	Rs.80,000
Sales	14,000 units	Fixed selling costs	Rs.28,000

Using absorption costing, the profit for this period would be Rs.60,000. Assuming there is no opening inventory

What would have been the profit for the year if marginal costing had been used?

Ignore the fixed selling overheads. These are irrelevant since they do not affect the difference in profit between marginal and absorption costing.

There is an increase in inventory by 2,000 units, since production volume (16,000 units) is higher than sales volume (14,000 units).

If absorption costing is used, the fixed production overhead cost per unit is Rs.5 (Rs.80,000 / 16,000 units).

The difference between the absorption costing profit and marginal costing profit is therefore Rs.10,000 (2,000 units × Rs.5).

Absorption costing profit is higher, because there has been an increase in inventory.

Marginal costing profit would therefore be Rs.60,000 – Rs.10,000 = Rs.50,000.

- *Example 11:*

Red Company is a manufacturing company that makes and sells a single product. The following information relates to the company's manufacturing operations in the next financial year.

Opening stock:	Nil
Production:	18,000 units
Sales:	15,000 units
Fixed production overheads:	Rs.117,000
Fixed sales overheads:	Rs.72,000

Using absorption costing, the company has calculated that the budgeted profit for the year will be Rs.43,000.

What would be the budgeted profit if marginal costing is used, instead of absorption costing?

In completing the requirement, Production overhead per unit, with absorption costing, please see below:

= Rs.117,000/18,000 units

= Rs.6.50 per unit.

The budgeted increase in inventory = 3,000 units (18,000 – 15,000).

Production overheads in the increase in inventory = 3,000 × Rs.6.50 = Rs.19,500.

With marginal costing, profit will be lower than with absorption costing, because there is an increase in inventory levels.

Marginal costing profit = Rs.43,000 - Rs.19,500 = Rs.23,500.

▶ *Example 12:*

Entity T manufactures a single product, and uses absorption costing. The following data relates to the performance of the entity during October.

Profit	Rs.37,000
Over-absorbed overhead	Rs.24,000
Sales (48,000 units)	Rs.720,000
Non-production overheads (all fixed costs)	Rs.275,000
Opening inventory	Rs.144,000
Closing inventory	Rs.162,000

Units of inventory are valued at Rs.9 each, consisting of a variable cost (all direct costs) of Rs.3 and a fixed overhead cost of Rs.6. All overhead costs are fixed costs.

a) When required to calculate the actual production overhead cost for October and the profit that would have been reported in October if Entity T had used marginal costing, see below working.

	units
Opening inventory (Rs.144,000/Rs.9)	16,000
Closing inventory (Rs.162,000/Rs.9)	18,000
Increase in inventory in October	2,000
Sales	48,000
Production in October	50,000

	Rs.
Absorbed production overhead (50,000 × Rs.6)	300,000
Over-absorbed overheads	24,000
Actual production overhead expenditure	276,000

Since, inventory increased during October; therefore, the reported profit will be higher with absorption costing than with marginal costing, as below

	Rs.
Absorption cost profit	37,000
Increase inventory × fixed production overhead per unit	
(2,000 × Rs.6)	12,000
Marginal costing profit	25,000

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Proof:

	Rs.	Rs.
Sales		720,000
Variable cost of sales (48,000 × Rs.3)		144,000
Contribution		576,000
Fixed production overheads (see above)	276,000	
Other fixed overheads	275,000	
Total fixed overheads		551,000
Marginal costing profit		25,000

5 ADVANTAGES AND DISADVANTAGES OF ABSORPTION AND MARGINAL COSTING

The previous sections of this chapter have explained the differences between marginal costing and absorption costing as methods of measuring profit in a period. Some conclusions can be made from these differences.

- The amount of profit reported in the cost accounts for a financial period will depend on the method of costing used.
- Since the reported profit differs according to the method of costing used, there are presumably reasons why one method of costing might be used in preference to the other. In other words, there must be some advantages (and disadvantages) of using either method.

5.1 Advantages and disadvantages of absorption costing

Absorption costing has a number of advantages and disadvantages.

Advantages of absorption costing

- It helps to make pricing decision on the basis of cost as in absorption costing, cost of product is calculated on full cost including variable and fixed.
- It enables for management to compute correct profit in the situation of seasonal sales if compared to marginal costing.
- It helps to conform with accrual concept in which cost is matched with revenue for specified period of time.
- It indicates efficient or inefficient utilization of capacity by indicating the under or over absorbed production overheads.

Limitations of absorption costing

- Absorption costing is not useful tool for decision making such as make or buy decision, optimal production mix in limiting factor situation. In such situation, marginal costing plays vital role in realistic decisions.
- In absorption costing, portion of fixed cost included in closing inventory is transferred to next period, as this closing inventory is treated opening inventory for next period.
- The validity of product cost under this method depends upon the correct apportionment of fixed production overhead. But in practice, many fixed production overheads are apportioned on arbitrary basis which might result inaccuracy in calculation of product cost. **(Subho, 2020)**

5.2 Advantages and disadvantages of marginal costing

Marginal costing has a number of advantages and disadvantages.

Advantages of marginal costing

- It is easy to account for fixed overheads using marginal costing. Instead of being apportioned they are treated as period costs and written off in full as an expense in the income statement for the period when they occur.
- There is no under/over-absorption of overheads with marginal costing, and therefore no adjustment necessary in the income statement at the end of an accounting period.
- Marginal costing provides useful information for decision making.

Disadvantages of marginal costing

- Marginal costing does not value inventory in accordance with the requirements of financial reporting. (However, for the purpose of cost accounting and providing management information, there is no reason why inventory values should include fixed production overhead, other than consistency with the financial accounts.)
- Marginal costing can be used to measure the contribution per unit of product, or the total contribution earned by a product, but this is not sufficient to decide whether the product is profitable enough. Total contribution has to be big enough to cover fixed costs and make a profit.

6 COMPREHENSIVE EXAMPLES

- *Example 01:*

Entity RH makes and sells one product. Currently, it uses absorption costing to measure profits and inventory values. The budgeted production cost per unit is as follows:

		Rs.
Direct labour	3 hours at Rs.6 per hour	18
Direct materials	4 kilograms at Rs.7 per kilo	28
Production overhead	(Fixed cost)	20
		66

Normal output volume is 16,000 units per year and this volume is used to establish the fixed overhead absorption rate for each year.

Costs relating to sales, distribution and administration are:

Variable 20% of sales value

Fixed Rs.180,000 per year.

There were no units of finished goods inventory at 1 October Year 5.

The fixed overhead expenditure is spread evenly throughout the year.

The selling price per unit is Rs.140.

For the two six-monthly periods detailed below, the number of units to be produced and sold are budgeted as follows:

	Six months ending 31 March Year 6	Six months ending 30 September Year 6
Production	8,500 units	7,000 units
Sales	7,000 units	8,000 units

The entity is considering whether to abandon absorption costing and use marginal costing instead for profit reporting and inventory valuation.

a) Calculation of the budgeted fixed production overhead costs each year, is as follows.

Budgeted production overhead expenditure =

Normal production volume × Absorption rate per unit

= 16,000 units × Rs.20 = Rs.320,000.

Since expenditure occurs evenly throughout the year, the budgeted production overhead expenditure is Rs.160,000 in each six-month period.

b) Statements for management showing sales, costs and profits for each of the six-monthly periods using marginal and absorption costing would be prepared as follows

i. marginal costing

ii. absorption costing

Workings	Rs. per unit
Direct material	18
Direct labour	28
Marginal cost of sale	46

i. Marginal costing

	Six months to 31 March		Six months to 30 September	
Units sold		7,000		8,000
	Rs.	Rs.	Rs.	Rs.
Sales at Rs.140		980,000		1,120,000
Marginal cost of sales (at Rs.46)		322,000		368,000
		658,000		752,000
Variable admin & distribution (20% of sales value)		196,000		224,000
Contribution		462,000		528,000
Fixed costs				
Production (Rs.320,000/2)	160,000		160,000	
Other (Rs.180,000/2)	90,000	250,000	90,000	250,000
Profit		212,000		278,000

ii. Absorption costing

The fixed overhead absorption rate is based on the normal volume of production. Since budgeted output in each six-month period is different from the normal volume, there will be some under- or over-absorption of production overhead in each six-month period.

	Six months to 31 March		Six months to 30 September	
Units sold		7,000		8,000
	Rs.	Rs.	Rs.	Rs.
Sales at Rs.140		980,000		
Production cost of sales (at Rs.66)		462,000		528,000
		518,000		592,000
Production overhead absorbed	170,000		140,000	
(8,500 × Rs.20: 7,000 × Rs.20)				
Actual production overhead	160,000		160,000	
Over-/(under-) absorbed overheads		10,000		(20,000)
		528,000		572,000

	Six months to 31 March		Six months to 30 September	
Sales, distribution, admin costs				
Variable	196,000		224,000	
(7,000 × Rs.28: 8,000 × Rs.28)				
Other	90,000		90,000	
		286,000		314,000
Profit		242,000		258,000

c) An explanatory statement reconciling for each six-monthly period the profit using marginal costing with the profit using absorption costing, is prepared below.

Reconciliation of profit figures

Six months to 31 March Year 6		
Increase in inventory	(8,500 – 7,000 units)	1,500 units
Production overhead absorbed in these units (absorption costing)		Rs.20 per unit
Therefore absorption costing profit higher by		Rs.30,000
Six months to 30 SeptemberYear 6		
Reduction in inventory	(7,000 – 8,000 units)	1,000 units
Production overhead absorbed in these units (absorption costing)		Rs.20 per unit
Therefore absorption costing profit lower by		Rs.20,000

The difference in reported profits is due entirely to differences in the valuation of inventory (and so differences in the increase or reduction in inventory during each period).

▶ *Example 02:*

Zulfiqar Limited makes and sells a single product and has the total production capacity of 30,000 units per month. The company budgeted the following information for the month of January 20X4:

Normal capacity (units)	**27,000**
Variable costs per unit:	
Production (Rs.)	110
Selling and administration (Rs.)	25
Fixed overheads:	
Production (Rs.)	756,000
Selling and administration (Rs.)	504,000

The actual operating data for January 20X4 is as follows:

Production	**24,000 units**
Sales @ Rs. 250 per unit	22,000 units
Opening stock of finished goods	2,000 units

During the month of January 20X4, the variable factory overheads exceeded the budget by Rs. 120,000.

a) Preparation of profit statement for the month of January using marginal and absorption costing would be as follows

Profitability Statement under Marginal Costing	Rupees	
Sales (22,000 units @ Rs. 250)		5,500,000
Variable Costs:		
Production Costs:		
Cost of productions (24,000 x Rs.110)	2,640,000	
Additional Variable Costs.	120,000	
	2,760,000	
Less: Closing stocks (2,760,000 / 24,000 x 4,000)	(460,000)	
Add: Opening stocks (2,000 x Rs. 110)	220,000	
	2,520,000	
Selling and administrative expenses (22,000 x 25)	550,000	
		3,070,000
Contribution Margin		2,430,000
Less: Fixed costs		
Production	756,000	
Selling and administrative expense	504,000	
		1,260,000
Net Profit		**1,170,000**

Profitability Statement under Absorption Costing	Rupees	
Sales (22,000 units @ Rs. 250)		5,500,000
Cost of Goods Sold		
Cost of production (24,000 x Rs. 138 **(W-1)**	3,312,000	
Additional variable costs.	120,000	
	3,432,000	
Less: Closing stocks (3,432,000 / 24,000 x 4,000)	(572,000)	
Add: Opening stocks (2,000 x Rs. 138)	276,000	
	3,136,000	
Under applied factory overhead (3,000 **(W-2)** x Rs.28 **(W-1)**)	84,000	
		3,220,000
Gross Profit		2,280,000
Selling expenses		
(Rs. 504,000 + 22,000 x Rs.25)		1,054,000
		1,226,000

W-1:	Rupees
Variable overhead per unit	110
Fixed overhead per unit (Rs. 756,000 / 27,000)	28
	138

W-2:	Units
Budgeted production - Normal capacity	27,000
Actual production	24,000
Under-utilized capacity	3,000

b) Then, if required to reconcile the difference in profits under the two methods, please see below

	Rupees
Profit under absorption costing	1,226,000
Less: Closing stock (under-valued in marginal costing)	
(Rs. 572,000 - Rs. 460,000)	(112,000)
Add: Opening stock (under-valued in marginal costing)	
(Rs. 276,000 - Rs. 220,000)	56,000
Profit under marginal costing	**1,170,000**

- *Example 03:*

Following information has been extracted from the financial records of ATF Limited: Production during the year units 35,000

Finished goods at the beginning of the year	**units**	**3,000**
Finished goods at the end of the year	units	1,500
Sale price per unit	Rs.	200
Fixed overhead cost for the year	Rs.	1,000,000
Administration and selling expenses	Rs.	200,000
Annual budgeted capacity of the plant	units	40,000

The actual cost per unit, incurred during the year, was as follows:

	Rupees
Material	70
Labour	40
Variable overheads	30

Company uses FIFO method for valuation of inventory. The cost of opening finished goods inventory determined under the absorption costing method system was Rs. 450,000. Fixed overhead constituted 16% of the total cost last year.

a) Preparation of profit statements for the year, under absorption and marginal costing systems, would be as follows

	Absorption Costing (Rs.)	Marginal Costing (Rs.)
Sales (3,000 + 35,000-1,500) × Rs. 200	7,300,000	7,300,000
Cost of goods manufactured		
Opening Inventory	450,000	378,000*
Add: Cost of goods manufactured (35,000 × 165) & (35,000 / 140)	5,775,000	4,900,000
	6,225,000	5,278,000
Less: Ending inventory (1,500 x 165) & (1,500 × 140)	(247,500)	(210,000)
	(5,997,500)	(5,068,000)
Gross profit / contribution margin	1,322,500	2,232,000
Less: unabsorbed overheads [1,000,000 – (Rs. 25 × 35,000)]	(125,000)	-
Less: Administration and selling expenses	(200,000)	(200,000)
Fixed overheads	-	(1,000,000)
Net Profit	997,500	1,032,000

*Cost of opening finished goods under marginal costing Rs. 450,000 × (100%-16%) = Rs. 378,000

Computation of Cost of goods manufactured (COGM) & Ending Inventory:

	Rupees
Material Cost	70
Labour Cost	40
Variable overhead	30
Cost per unit under marginal costing system	140
Fixed overhead (Rs. 1,000,000/40,000)	25
Cost per unit under absorption costing system	165

b) Then, if required to reconcile net profits determined under each system, following computations would be required.

	Rupees
Net Profit under Absorption Costing	997,500
Add: Difference in opening finished goods (Rs. 450,000 – 378,000)	72,000
Less: Difference in ending finished goods (Rs. 247,500 – 210,000)	(37,500)
Net Profit under Marginal Costing	1,032,000

▶ *Example 04:*

Francisco Limited (FL) is a manufacturer of product Z and has annual operational capacity of 82,500 machine hours. FL uses absorption costing.

Below is a summary of FL's profit or loss statement for the years ended 31 August 2019 and 2020:

	31 August 2020		31 August 2019	
	Units	Rs. In 000	Units	Rs. In 000
Sales	9,950	149,250	10,500	155,000
Opening inventory-Finished goods	3,500	31,000	2,500	20,000
Cost of production	10,450	94,050	11,500	97,750
Closing inventory-Finished goods	4,000	(36,000)	3,500	(31,000)
Cost of goods sold		(89,050)		(86,750)
Gross profit		60,200		68,750
(Under) over absorbed production overheads		(400)		650
Selling and administrative cost		(20,900)		(22,475)
Net profit		38,900		46,925

In both years, the actual and standard machine usage per unit are 6 hours. However, the standard machine usage was 80% and 82% of the operational capacity in 2019 and 2020 respectively.

Fixed overhead absorption rate of Rs. 700 per machine hour was applied in 2019. FL revises its fixed overhead absorption rate for each year on the basis of prior year's actual fixed overhead expenditure.

(a) Calculation of budgeted and actual fixed overheads for 2019 and 2020, are computed below.

Budgeted and fixed overheads

	August 2020	August 2019
Budgeted machine hours A=[82,500×82%,80%]	67,650	66,000
Budgeted fixed overheads A×OAR**(W-2)**	47,625,600	46,200,000
Fixed overheads applied [actual machine hours **(W-1)**×OAR**(W-2)**]	44,140,800	48,300,000
Under/(over) absorbed fixed overheads [given]	400,000	(650,000)
Actual fixed overheads	44,540,800	47,650,000

(b) Profit and loss statement under marginal costing for the year ended 31 August 2020, is calculated below.

	Rs. 000
Sales	149,250
Opening inventory - finished goods **W-3**	(16,300)
Variable cost of production **W-4**	(49,909)
Closing inventory - finished goods **W-5**	19,104
Contribution margin	**102,145**

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	Rs. 000
Less: Fixed overheads actual	(44,541)
Less: Selling and admin expense	(20,900)
Net profit	**36,704**

(c) Reconciliation of profits under marginal and absorption costing are given below.

	Rs. 000
Actual profit under marginal costing	34,704
Add: Fixed cost included in the closing stock (4,000×6×704)	16,896
Less: Fixed cost included in opening stock (3,500×6×700)	(14,700)
Actual profit under absorption costing	**38,900**

Workings

W-1 Actual Machine hours

	Hours
-2019 (11,500 x 6)	69,200
-2020 (10,450 x 6)	62,700

W-2 Overhead Absorption Rate

	Hours
2019 [given]	700
2020	
Actual fixed overheads of 2019 **(Rs.)**	47,650,000
Budgeted machine hours	67,650
OAR – 2020 **(Rs.)** (47,650,000/67,650)	704

W-3 Opening inventory under marginal costing

	Rs. in 000
Opening inventory [given]	31,000
Less: Fixed overheads absorbed (3,500×700×6)	(14,700)
Opening inventory under marginal costing	**16,300**

W-4 Cost of production under marginal costing

	Rs. in 000
Cost of production [given]	94,050
Less: Applied fixed overheads (10,450×6×704)	(44,141)
Cost of production under marginal costing	**49,909**

W-5 Closing inventory under marginal costing

	Rs. in 000
Closing inventory [given]	36,000
Less: Fixed overheads absorbed (4,000×704×6)	(16,896)
Closing inventory under marginal costing	**19,104**

► *Example 05:*

Sigma Limited (SL) is a manufacturer of Product A. SL operates at a normal capacity of 90% against its available annual capacity of 50,000 machine hours and uses absorption costing. The following summarised profit statements were extracted from SL's budget for the year ending 31 December 2015.

	Actual-2014		Budget-2015	
	Units	Rs. In 000	Units	Rs. in 000
Sales	4,125	49,500	4,600	56,580
Opening inventory	400	(3,400)	600	(5,400)
Cost of production	4,325	(38,925)	4,500	(44,325)
Closing inventory	600	5,400	500	4,925
Under absorbed production overheads		(100)		
Selling and administration cost (30% fixed)		(3,000)		(5,250)
Net Profit		9,475		6,530

Other relevant information is as under:

	2014	Budget-2015
Standard machine hours per unit	10 hours	10 hours
Standard production overhead rate per unit	Rs. 2,000	Rs. 2,250
Estimated fixed production overheads at normal capacity	Rs. 3,600,000	Rs. 4,050,000
Actual production overheads (Actual machine hours 44,000)	Rs. 8,750,000	-

a) Budgeted profit and loss statement for the year ended 31 December 2015 under marginal costing, is as follows:

	Rs. in 000
Sales	56,580
Variable cost of sales:	
Opening inventory (600 x 8,200 W-1)	(4,920)
Cost of production (4,500 x 8,950 W-2)	(40,275)
Closing inventory (500 x 8,950 W-2)	4,475
	(40,720)
Gross contribution margin	15,860
Variable selling and administration cost (5,250 x 70%)	(3,675)
Contribution margin	12,185
Fixed cost:	
Production cost	(4,050)
Selling and administration cost (5,250 x 30%)	(1,575)
	(5,625)
Net profit	6,560

b) Analysis of budgeted profit under marginal and absorption cost is calculated with the help of following reconciliation statement.

	Rs. in 000
Net profit under marginal costing	6,560
Less: Difference in opening inventory (600 x 800)	(480)
Add: Difference in closing inventory (500 x 900)	450
Net profit under absorption costing	**6,530**

W-1 Variable unit product cost under marginal costing -Opening inventory

	Rs. in 000
Unit product cost under absorption costing (5,400,000/600)	9,000
Less: Fixed overhead cost per unit (3,600,000/4,500)	(800)
Unit product cost under marginal costing	**8,200**

W-1 Variable unit product cost under marginal costing –Production cost & closing inventory

	Rs. in 000
Unit product cost under absorption costing (44,325,000/4,500)	9,850
Less: Fixed overhead cost per unit (4,050,000/4,500)	(900)
Unit product cost under marginal costing	**8950**

▶ *Example 06:*

XY Limited manufactures and sells a single product. The selling price and costs for the year ended 31 December 2013 were as follows:

	Rs. Per unit
Selling price	1,600
Direct material	630
Direct labour	189
Production overheads (40% fixed)	220
Selling and distribution overheads (60% fixed)	165

Other information is as follows:

i. During the year, 12,000 units were produced.

ii. The opening and closing stocks were 4,000 and 3,000 units respectively

iii. Fixed overhead cost per unit is based on normal capacity which is 15,000 units.

iv. Overhead costs have increased by 10% over the previous year and raw material and labour by 5%.

v. The company uses FIFO method for costing its inventory.

(a) Profit and loss for the year ended 31 December 2013 under absorption costing and marginal costing, is computed below.

Profit and loss statement under absorption costing

	Rs. in 000
Sales (4,000+12,000-3,000 = 13,000 x 1,600)	20,800
Cost of sales:	
Opening stock (4,000 x 980 W-1)	(3,920)
Production cost (12,000 x 1,039 W-1)	(12,468)
	(16,388)
Closing stock (3,000 x 1,039 W-1)	3,117
	(13,271)
Under absorbed overheads (15,000-12,000) x 88 W-1	(264)
	(13,535)
Gross profit	7,265
Selling and distribution overheads (13,000 x 165)	(2,145)
Net profit	**5,120**

Profit and loss statement under marginal costing

	Rs. in 000
Sales (4,000+12,000-3,000 = 13,000 x 1,600)	20,800
Variable cost of sales:	
Opening stock (4,000 x 900 W-1)	(3,600)
Production cost (12,000 x 951 W-1)	(11,412)
	(15,012)
Closing stock (3,000 x 951 W-1)	2,853
	(12,159)
Gross contribution	8,641
Variable selling and distribution cost (13,000 x 165 x 40%)	(858)
Contribution margin	7,783
Fixed cost:	
Production (15,000 x 88 W-1)	(1,320)
Selling and distribution cost (13,000 x 165 x 60%)	(1,287)
	(2,607)
Net profit	**5,176**

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(b) Reconciliation of profit worked out under two methods as below.

	Rs. in 000
Profit under marginal costing	5,176
Less: Difference in opening stock (4,000 x 80)	(320)
Add: Difference in closing stock (3,000 x 88)	264
Profit under absorption costing	**5,120**

W-1 Cost of production per unit under both methods

	2013	2012
Calculation of per unit cost	**Rupees**	
Direct materials (2012: 630/1.05)	630	600
Direct labour (2012: 189/1.05)	189	180
Variable production overhead (2013: 220 x 60%)/ (2012: 132/1.10)	132	120
Product cost per unit for marginal costing	**951**	**900**
Fixed production overhead (2013: 220 x 40%)/ (2012: 88/1.10)	88	80
Product cost per unit for absorption costing	**1,039**	**980**

- *Example 07:*

Ali Limited makes and sells one product, the standard production cost of which is as follows for one unit:

	Rupees
Direct labour (3 hours @ Rs. 6 each)	18
Direct material (4 Kilogram @ Rs. 7 per kg)	28
Variable production overheads	3
Fixed production overheads	20
Standard product cost per unit	**69**

Normal output is 16,000 units per annum and this figure is used for the fixed production overhead calculation.

Costs relating to selling, distribution and administration are:

	Rupees
Variable	20% of sales price
Fixed per annum	180,000

The only variance is a fixed production overhead volume variance. There are no units in finished goods stock at 1 October 2020. The fixed overhead expenditure is spread evenly throughout the year. The selling price per unit is Rs. 140.

For each of the six monthly periods, the number of units to be produced and sold are budgeted as:

	Six months ending 31 March 2021	Six months ending 30 September 2021
Production (units)	8,500	7,000
Sales (Units)	7,000	8,000

(a) Statement for management showing sales, costs and profits for each of the six-monthly period under marginal costing, is prepared as under.

	Six months ending 31 March 2021	Six months ending 30 September 2021
	Rupees	**Rupees**
Sales (7,000 x 140)/ (8,000 x 140)	980,000	1,120,000
Variable cost of sales:		
Opening stock	-	(73,500)
Direct labour (8,500 x 18)/(7,000 x 18)	(153,000)	(126,000)
Direct material (8,500 x 28)/(7,000 x 28)	(238,000)	(196,000)
Variable production OH (8,500 x 3)/(7,000 x 3)	(25,500)	(14,000)
	(416,500)	(409,500)
Closing stock (1,500 x 49)/ (500 x 49)	73,500	24,500
	(343,000)	(385,000)
Gross contribution	637,000	735,000
Variable selling, distribution and administration cost (20% of sales)	(196,000)	(224,000)
Contribution margin	441,000	511,000
Fixed cost:		
Production (16,000 x 20 /2)	(160,000)	(160,000)
Selling, distribution & administration (180,000/2)	(90,000)	(90,000)
	(250,000)	(250,000)
Net profit	**191,000**	**261,000**

(b) Statement for management showing sales, costs and profits for each of the six-monthly period under absorption costing, is prepared as under.

	Six months ending 31 March 2021	Six months ending 30 September 2021
	Rupees	**Rupees**
Sales (7,000 x 140)/ (8,000 x 140)	980,000	1,120,000
Cost of sales:		
Opening stock	-	(103,500)
Direct labour (8,500 x 18)/(7,000 x 18)	(153,000)	(126,000)
Direct material (8,500 x 28)/(7,000 x 28)	(238,000)	(196,000)
Variable production OH (8,500 x 3)/(7,000 x 3)	(25,500)	(14,000)
Fixed production OH (8,500 x 20)/(7,000 x 20)	(170,000)	(140,000)
	(586,500)	(579,500)
Closing stock (1,500 x 69)/ (500 x 69)	103,500	34,500
	(483,000)	(545,000)
(Under) over absorbed OH (170,000-160,000)/(140,000-160,000)	10,000	(20,000)
	(473,000)	(565,000)
Gross profit	507,000	555,000
Selling, distribution and administration cost:		
Variable	(196,000)	(224,000)
Fixed	(90,000)	(90,000)
	(286,000)	(314,000)
Net profit	**221,000**	**241,000**

(c) Explanatory statement reconciling for each six-monthly profit using marginal costing and absorption costing is given below.

	Six months ending 31 March 2021	Six months ending 30 September 2021
	Rupees	**Rupees**
Profit under marginal costing	191,000	261,000
Less: Difference in opening stock (1,500 x 20)	-	(30,000)
Add: Difference in closing stock (1,500 x 20)/ (500 x 20)	30,000	10,000
Profit under absorption costing	**221,000**	**241,000**

► *Example 08:*

Khan Company is a small business which has the following budgeted marginal costing profit and loss account for the month ended June 30, 2020:

	Rupees
Sales	**96,000**
Variable cost of sales:	
Opening stock	(6,000)
Production cost	(72,000)
	(78,000)
Closing stock	14,000
	(64,000)
Gross contribution	32,000
Variable selling cost	(6,400)
Contribution margin	25,600
Fixed costs:	
Production	(8,000)
Administration	(7,200)
Selling	(2,400)
	(17,600)
Net profit	**8,000**

The standard cost per unit is:

	Rupees
Direct material (1 kg)	16
Direct labour (3 hours)	18
Variable production overheads	6

Budgeted selling price per unit is Rs. 60.

The company's normal level of activity is 4,000 units per month. It has budgeted fixed production costs at Rs. 8,000 per month and absorbed them on the normal level of the activity of units produced.

Budgeted statement of profit and loss under absorption costing for the month ended June 30, 2020, is given below.

	Rupees
Sales	96,000
Cost of sales:	
Opening stock {6,000 +(6,000/40 x 2 W-1)}	(6,300)
Production cost {72,000 +(72,000/40 x 2 W-1)}	(75,600)
	(81,900)
Closing stock {14,000 +(14,000/40 x 2 W-1)}	14,700
	(67,200)
(Under) absorbed OH (72,000/40-4,000) x 2	(4,400)
	(71,600)
Gross profit	24,400
Selling and administration cost:	
Variable	(6,400)
Fixed (7,200 + 2,400)	(9,600)
	(16,000)
Net profit	**8,400**

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In marginal costing, cost of product is variable production cost only but in absorption costing the cost of the product is variable plus fixed production cost

In marginal costing there is a concept of contribution margin i.e. Contribution Margin = Sales – all variable cost (both production and non-production)

To arrive at profit all Fixed cost (both production and non-production) should be deduced from contribution margin.

In Absorption costing the cost of the product includes variable production cost plus fixed production overheads estimated by using predetermined absorption rate

In absorption costing over / under absorbed overheads are calculated by comparing absorbed overheads with actual overheads.

In marginal costing the stock is valued at variable production cost only but in absorption costing it is valued at variable plus fixed production cost. This is the reason that the profit figure is different in marginal and absorption costing.

CHAPTER 11

STANDARD COSTING

IN THIS CHAPTER

AT A GLANCE

Standard costing is the preparation of standard costs to assist setting budgets and evaluating managerial performance.

A standard cost is carefully predetermined estimated unit cost, calculated at budgeted level of activity. It is usually a standard cost per unit of production or per unit of service rendered.

A standard cost when established is an average expected unit cost because it is only an average actual results will vary to some extent above and below the average.

The difference between standard and actual is known as variance. The process by which the total difference between standard and actual results is analyzed in known as variance analysis.

1. USING AND DERIVING STANDARD COSTS

1.1 Standard cost

A **standard cost is a predetermined unit cost** based on expected level of activity. A standard cost has two components: first standard and second cost. Standard is defined as norm and whatever is considered normal can generally be adopted as standard. A standard is expectation of usage of material in quantities, utilization of time of labour and percentage of plant capacity to be used. In order to complete standard cost, expected costs are assigned to it like expected cost of material per unit, expected rate per hour etc.

Standard costs of products are usually restricted to production costs only, not administration and selling and distribution overheads.

Overheads are normally absorbed into standard production cost at an absorption rate per direct labour hour, depending company is using absorption costing.

A typical standard cost card includes the following:

	Rs.
Direct materials:	
Material A: X litres at Rs. X per litre	X
Material B: X kilos at Rs. X per kilo	X
	X
Direct labour:	
Skilled labour: X hours at Rs. X per hour	X
Unskilled labour: X hours at Rs. X per hour	X
	X
Variable production overheads: X hours at Rs. X per hour	X
Fixed production overheads: X hours at Rs. X per hour	X
Standard cost of one unit of product	**X**

▶ *Example 01:*

ABC company provides the following data for preparation of standard cost of Product M01.

1. Product M01 requires two kg of material J and three liters of material K.
2. Standard price of material J and material K are Rs. 16 per kg and Rs. 7 per liter respectively
3. 90 minutes of unskilled labour and 45 minutes of skilled labour are required to produce one unit of M01.
4. Standard labour rate of skilled and unskilled labour is Rs. 60 and Rs. 30 per hour respectively.
5. Variable production overheads are absorbed at Rs. 15 per labour hour.
6. Budgeted fixed production overhead are estimated at Rs. 600,000 and budgeted level of activity are 50,000 skilled labour hours. Fixed production are absorbed on basis of skilled labour hours.

The standard cost card of Product M01, is prepared as under.

	Rs.
Direct materials:	
Material J: 2 kg at Rs. 16 per kg	32
Material K: 3 liters at Rs. 7 per liter	21
	53.00

	Rs.
Direct labour:	
Skilled labour: 45 minutes at Rs. 60 per hour (45/60 x 60)	45.00
Unskilled labour: 90 hours at Rs. 30 per hour (90/60 x 30)	45.00
	90.00
Variable production overheads: 135 minutes at Rs. 15 per hour (135/60 x 15)	33.75
Fixed production overheads: 45 hours at Rs. 12 per skilled labour hour (45/60 x 12) whereas FOAR/hour = (600,000/50,000)	9.00
Standard cost of one unit of product	**185.75**

1.2 Standard costing

Standard costing involves the establishment of predetermined estimates of the costs of products or services, the collection of actual costs and the comparison of the actual results with the predetermined estimates. The predetermined costs are known as standard costs and the difference between standard and actual is known as variance.

Features of standard costing

- It is comprehensive system in which inventories are recorded at standard cost. For example, standard cost card shows material price is Rs. 4.20 per kg, but actually purchased at Rs. 4.25 per kg. In standard costing, we will record the Material inventory at standard cost i.e. Rs. 4.25.
- Standard costing is a control technique that reports variances by comparing actual costs to pre-set standards so facilitating action through management by exception.
- The reasons for such variances are highlighted to judge whether these are due to controllable or uncontrollable factors.
- Corrective action is taken to avoid such variances in future.

Standard costing may be used with either a system of absorption costing or a system of marginal costing.

When is standard costing appropriate?

Standard costing can be used in a variety of situations.

- It is most useful when accounting for homogenous goods produced in large numbers, when there is a degree of repetition in the production process.
- A standard costing system may be used when an entity produces standard units of product or service that are identical to all other similar units produced.
- Standard costing is usually associated with standard products, but can be applied to standard services too.

A standard unit should have exactly the same input resources (direct materials, direct labour time) as all other similar units, and these resources should cost exactly the same. Standard units should therefore have the same cost.

Who sets standard costs?

Standard costs are set by managers with the expertise to assess what the standard prices and rates should be. Standard costs are normally reviewed regularly, typically once a year as part of the annual budgeting process.

- Standard prices for direct materials should be set by managers with expertise in the purchase costs of materials. This is likely to be a senior manager in the purchasing department (buying department).
- Standard rates for direct labour should be set by managers with expertise in labour rates. This is likely to be a senior manager in the human resources department (personnel department).
- Standard usage rates for direct materials and standard efficiency rates for direct labour should be set by managers with expertise in operational activities. This may be a senior manager in the production or operations department, or a manager in the technical department.

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- Standard overhead rates should be identified by a senior management accountant, from budgeted overhead costs and budgeted activity levels that have been agreed in the annual budgeting process.

1.3 The purposes of standard costing

Standard costing systems are widely used because they provide cost information for variety of purposes and these are given below.

- It provides prediction of future costs that can be used for decision making purposes.
- Standard costing system provides challenging target in order to motivate the individuals.
- It assists in setting budgets and evaluates the managerial performance. Variances are calculated and reasons are identified, to measure the manager performance.
- It is very useful technique which promotes possible cost reduction.

When there are large adverse variances, this might indicate that actual performance is poor, and control action is needed to deal with the weaknesses.

When there are large favorable variances, and actual results are much better than expected, management should investigate to find out why this has happened, and whether any action is needed to ensure that the favorable results continue in the future.

Variances and controllability

The principle of controllability should be applied in any performance management system.

When variances are used to measure the performance of an aspect of operations, or the performance of a manager, they should be reported to the manager who is:

- responsible for the area of operations to which the variances relate, and
- able to do something to control them.

The reasons of the variances are further analysed into controllable and uncontrollable factors. The managers are accountable for any material controllable variance, means his performance is measured on these bases.

On the contrary, it is also unreasonable to make a manager accountable for performance that is outside his control, and for variances that he can do nothing about.

1.4 Deriving a standard cost

A standard variable cost of a product is established by building up the standard materials, labour and production overhead costs for each standard unit. This will be the standard cost in marginal costing system.

In a standard absorption costing system, the standard fixed overhead cost is a standard cost per unit, based on budgeted data about fixed costs and the budgeted production volume.

Deriving the standard cost of materials

These are based on product specifications and derived from intensive study of input quantity. This study should include most suitable material for each product after keeping in view the product design and processes. On above study, the standard quantity for each material for different products is established.

Standard price information is obtained from procurement and purchase department. It is based on assumption that purchase and procurement department has made reasonable search for suppliers and price is based on most competitive price, at required quality.

Deriving the standard cost of labour

In order to set the labour standard, it is vital that activities should be analysed by different operation, after conducting the comprehensive study and implementing time and motion study. It helps to determine standard time required to produce one unit.

The standard rate per hour information is taken from human resource department, and it is based on contract made with employees, if already hired. Otherwise, market analysis should be carried out to gather information about cost of labour.

Deriving the standard cost of production overheads

The procedure for establishing standard manufacturing overhead rates for purpose of determination of overhead absorption rate, is similar as discussed in chapter 3. Separate rates for fixed and variable production overheads are determined in order to make better planning and control.

Selection of base for absorption of production overheads is of great immense. As we know that increase or decrease in activity level, might largely affect overhead absorption rate, therefore, comprehensive study should be taken place, before selection of base.

1.5 Types of standard & their behavioural aspects

Standards are predetermined estimates of unit costs but how is the level of efficiency inherent in the estimate determined? Should it assume perfect operating conditions or should it incorporate an allowance for waste and idle time? The standard set will be a performance target and if it seen as unattainable this may have a detrimental impact on staff motivation. If the standard set is too easy to attain there may be no incentive to find improvements.

There are four types of standard, and any of these may be used in a standard costing system. One of the purposes of standard costing is to set performance standards that motivates employees to improve performance. The type of standard used can have an effect on motivation and incentives. The types of standards and their behavioural aspects are given below:

Ideal standards.

These assume perfect operating conditions. No allowance is made for wastage, labour inefficiency or machine breakdowns. Standard cost in ideal standard represents minimum cost, as compared to other standards. The ideal standard cost is the cost that would be achievable if operating conditions and operating performance were perfect. In practice, the ideal standard is not achieved.

Ideal standards are unlikely to be achieved. They may be very useful as long term targets and may provide senior managers with an indication of the potential for savings in a process but generally the ideal standard will not be achieved. Consequently, the reported variances will always be adverse. Employees may be becoming de-motivated when their performance level is always worse than standard and they know that the standard is unachievable.

Attainable standards.

These assume efficient but not perfect operating conditions. An allowance is made for waste, break down and inefficiency. However, the attainable standard is set at a higher level of efficiency than the current performance standard, and some improvements will therefore be necessary in order to achieve the standard level of performance.

Attainable standards are the most likely to motivate employees to improve performance as they are based on challenging but attainable targets. It is for this reason that standards are often based on attainable conditions. However, a problem with attainable standards is deciding on the level of performance that should be the target for achievement.

Current standards.

These are based on current working conditions and what the entity is capable of achieving at the moment. Current standards do not provide any incentive to make significant improvements in performance, and might be considered unsatisfactory when current operating performance is considered inefficient.

Current standards may be useful for producing budgets as they are based on current levels of efficiency and may therefore give a realistic guide to resources required in the production process. However current standards are unlikely to motivate employees to improve their performance, unless there are incentives for achieving favourable variances (for achieving results that are better than the standard), such as annual cash bonuses.

Basic standards.

These are standards which remain unchanged over a long period of time. Variances are calculated by comparing actual results with the basic standard, and if there is a gradual improvement in performance over time, this will be apparent in an improving trend in reported variances.

Basic standards will not motivate employees to improve their performance as they are based on achievable conditions at some time in the past. They are also not useful for budgeting because they will often be out of date. In practice, they are the least common type of standard.

When there is waste in production, or when idle time occurs regularly, current standard costs may include an allowance for the expected wastage or expected idle time. This is considered in more detail later.

▶ *Example 02:*

A company produces bookshelves. Each bookshelf requires three planks of wood. A box of wood contains 15 planks and costs Rs.45.

Currently 20% of wood is wasted during production. Management would like to reduce this wastage to 10%.

Calculate a standard material cost for a bookshelf based on

a) Ideal conditions
Standard cost per plank = Rs.45/15 planks = Rs.3 per plank
Ideal standard: 3 planks × Rs.3 = Rs.9 per bookshelf

b) Current conditions
Current standard: 3/0.80 planks = 3.75 planks at Rs.3 = Rs.11.25 per bookshelf

c) Attainable conditions
Attainable or target standard: 3/0.9 = 3.33 planks at Rs.3 = Rs.10 per bookshelf

1.6 Reviewing standards

How often should standards be revised? There are several reasons why standards should be revised regularly.

Regular revision leads to standards which are meaningful targets that employees may be motivated to achieve (for example, through incentive schemes).

Variance analysis is more meaningful because reported variances should be realistic.

In practice, standards are normally reviewed annually. Standards by their nature are long-term averages and therefore some variation is expected over time. The budgeting process can therefore be used to review the standard costs in use.

▶ *Example 03:*

Makhdoom Limited makes and sells a single product, Product Q, with the following standard specification for material, labour and production overheads. The information is related to recently prepared standard cost card.

1. Direct material X and Y are used in the quantities of 12kg and 8 kg respectively. Current price of material X is Rs. 40 per kg while material Y is Rs. 32 per kg.
2. It takes 20 hours of direct labour to produce one unit with standard direct labour rate of Rs. 10 per hour.
3. Annual sales/ production budget is 2,400 units evenly spread throughout the year. The standard selling price is based on current price of Rs. 1,250 per unit.
4. The budgeted production overhead, all fixed, is Rs. 288,000 and expenditure is expected to occur evenly over the year. Company's policy is to absorb production overheads on direct labour hours.

The senior management has gathered information and takes decisions for handling current situation.

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a. Due to increase in competition, it is expected that sales price will decline by 6%. In order to increase the production and sales volume, specific marketing campaign will be launched. It is expected that volume of production and sales will increase by 10%.

b. The prices of material X is expected to increase by 3%. However, an agreement has been made recently whereby 4% discount will be availed on purchase of material Y.

c. An agreement with trade union revealed that 8% increase in rate per hour will ensure 10% savings in time for production in one unit.

d. Fixed production overhead, are expected to increase by 5% due to inflation.

Current and revised standard cost card, showing standard cost and profit per unit, is given below.

Current standard cost card and profit per unit	Rs.
Direct materials:	
Material X: 12 kg at Rs. 40 per kg	480.00
Material Y: 8 kg at Rs. 32 per kg	256.00
	736.00
Direct labour: 20 hours at Rs. 10 per hour	200.00
Fixed production overhead: [288,000/(2,400 x 20)] = 20 hours at Rs. 6 per hour	120.00
Standard cost of production per unit	1,056.00
Selling price per unit	1,250.00
Standard gross profit per unit	**194.00**

Revised standard cost card and profit per unit	Rs.
Direct materials:	
Material X: 12 kg at Rs. 40 x 1.03 = 41.20 per kg	494.40
Material Y: 8 kg at Rs. 32 x 0.96 = 30.72per kg	245.76
	740.16
Direct labour: 20 x 0.90= 18 hours at Rs. 10 x 1.08= 10.80 per hour	194.40
Fixed production overhead: 18 hours at Rs. 6.36 per hour W-1	114.48
Standard cost of production per unit	1,049.04
Selling price per unit (1,250 x 0.94)	1,175.00
Standard gross profit per unit	**125.96**

W-1 Fixed production overhead rate per hour	Rs.
Revised budgeted production overheads (288,000 x 1.05)	302,400
Revised production in units (2,400 x 1.10)	2,640
Revised direct labour hours (2,640 x 18)	47,520
Fixed production overhead rate per hour (302,400/ 47,520)	6.36

2. ALLOWING FOR WASTE AND IDLE TIME

2.1 Materials wastage in standard costing

Waste is an unavoidable feature of some production processes. The actual amount of materials wasted may vary from one period to another, but there may be a standard rate of wastage or a 'normal' rate of loss which is a measure of the average rate of wastage or loss.

An allowance for expected loss can be included in a standard cost. The standard cost can be based on the expected quantity of input materials required to produce one unit of output (which is the same principle as that used for normal loss in process costing).

► *Example 04:*

A company manufactures a product in a process production system. There is some wastage in production, and normal loss is 10% of the number of units input to the process. One unit of raw material is required to produce one unit of finished goods.

The standard price per unit of direct material is Rs.4.50 per unit.

a) If an ideal standard is used, and the standard does not provide for any loss in process, standard direct material cost per unit of output would be as follows

Ideal standard

No loss; therefore, standard cost =

1 unit of direct materials at Rs.4.50 per unit of material = Rs.4.50 per unit of output.

b) If the standard cost allows for a loss of 10% of input materials in producing each unit of output, then Standard Direct material cost per unit of output would be:

Attainable or current standard: allow for 10% loss

Standard input to produce one unit of = 1/0.9 units = 1.111 units.

Therefore, standard cost =

1.111 units of materials at Rs.4.50 per unit = Rs.5 per unit of output.

► *Example 05:*

A company produces sandwiches. Each sandwich requires two slices of bread and a loaf of bread contains 24 slices. Each loaf of bread costs Rs.6. It is estimated that currently 20% of bread is wasted. Management would like to reduce this wastage to 10%.

Calculation of a standard material cost for a sandwich based on various conditions are given below

a) Ideal conditions

Standard cost per slice of bread = Rs.6/24 slices = Rs.0.25 per slice

Ideal standard: 2 slices × Rs.0.25 = Rs.0.50

b) Current conditions

Current standard: 2/0.80 slices = 2.5 slices at Rs.0.25 = Rs.0.625

c) Attainable conditions

Attainable or target standard: 2/0.9 = 2.22 slices at Rs.0.25 = Rs.0.555.

Note that the current and attainable standard costs include an allowance for wastage, and a materials usage variance will occur only if the actual wastage rate differs from the standard wastage rate.

2.2 Idle time and standard costing

Idle time occur when the direct labour employees are being paid but have no work to do. Idle time is also known as non-productive time. The causes of idle time may be:

- A breakdown in production, for example a machine breakdown that halts the production process
- Time spent waiting for work due to a bottleneck or hold-up at an earlier stage in the production process or due to machine cleanup process.
- Running out of a vital direct material, and having to wait for a new delivery of the materials from a supplier.
- A lack of work to do due to a lack of customer orders.

A feature of idle time is that it is recorded, and the hours 'lost' due to idle time are measured.

Sometimes idle time may be an unavoidable feature of the production process, so that an allowance for idle time is included in the standard cost.

Methods of including idle time in standard costs

There are different ways of allowing for idle time in a standard cost.

- **Method 1**. Include idle time as a separate element of the standard cost, so that the standard cost of idle time is a part of the total standard cost per unit.
- **Method 2.** Allow for a standard amount of idle time in the standard hours per unit for each product. This is the same approach described above for materials wastage and standard costing. The standard hours per unit therefore include an allowance for expected idle time.

▶ *Example 06:*

A company manufactures Product X. Due to the nature of the production process, there is some idle time and it has been estimated that the 'normal' amount of idle time is 10% of hours worked.

Ignoring idle time, the standard time to make 1 unit of Product X is 0.36 hours. Labour is paid Rs.18 per hour.

This means that the labour time to make 1 unit of product X is 0.36/0.90 = 0.40 hours, of which 0.04 hours are idle time.

There are two ways of making an allowance for in the standard cost the expected idle time.

Method 1: Include idle time as a separate element of the standard cost. The standard cost per unit will include the following items:

	Rs.
Active hours worked: 0.36 hours × Rs.18 per hour	6.48
Idle time: 0.04 hours × Rs.18 per hour	0.72
	7.20

Method 2: Include an allowance for expected idle time in the standard hours per unit for each product.

Standard cost = 0.40 hours × Rs.18 per hour = Rs.7.20

3. COMPREHENSIVE EXAMPLES

- *Example 01:*

A company manufactures two products, X and Y. In Year 1 it budgets to make 2,000 units of Product X and 1,000 units of Product Y. Budgeted resources per unit and costs are as follows:

	Product X	Product Y
Direct materials per unit:		
Material A	2 units of material	1.5 units of material
Material B	1 unit of material	3 units of material
Direct labour hours per unit	0.75 hours	1 hour
Costs		
Direct material A	Rs.4 per unit	
Direct material B	Rs.3 per unit	
Direct labour	Rs.20 per hour	
Variable production overhead	Rs.4 per direct labour hour	

Fixed production overheads per unit are calculated by applying a direct labour hour absorption rate to the standard labour hours per unit, using the budgeted fixed production overhead costs of Rs.120,000 for the year.

The standard full production cost per unit of product X and Y are as follows

First calculate the budgeted overhead absorption rate.

Budgeted direct labour hours	hours
Product X: (2,000 units × 0.75 hours)	1,500
Product Y (1,000 units × 1 hour)	1,000
	2,500
Budgeted fixed production overheads	Rs.120,000
Fixed overhead absorption rate/hour	Rs.48

	Product X		Product Y	
		Rs.		Rs.
Direct materials				
Material A	(2 units × Rs.4)	8	(1.5 units × Rs.4)	6
Material B	(1 unit × Rs.3)	3	(3 units × Rs.3)	9
Direct labour	(0.75 hours × Rs.20)	15	(1 hour × Rs.20)	20
Variable production overhead	(0.75 hours × Rs.4)	3	(1 hour × Rs.4)	4
Standard variable prod'n cost		29		39
Fixed production overhead	(0.75 hours × Rs.48)	36	(1 hour × Rs.48)	48
Standard full production cost		65		87

▶ *Example 02:*

A company manufactures two products, Laurel and Hardy. In Year 1 it budgets to make 6,000 units of Product Laurel and 2,000 units of Product Hardy. Budgeted resources per unit and costs are as follows:

	Laurel	Hardy
Direct materials per unit:		
Material X	3 kg	1kg
Material Y	2 kg	6 kg
Direct labour hours per unit	1.6 hours	3 hours
Budgeted Costs		
Direct material X	Rs. 3 per unit	
Direct material Y	Rs. 4 per unit	
Direct labour	Rs. 25 per hour	
Variable production overhead	Rs. 5 per direct labour hour	

Fixed production overheads per unit are calculated by applying a direct labour hour absorption rate to the standard labour hours per unit, using the budgeted fixed production overhead costs of Rs.187,200 for the year.

The standard full production cost per unit of product Laurel and Hardy are as follows

First calculate the budgeted overhead absorption rate.

Budgeted direct labour hours	hours
Laurel: (6,000 units × 1.6 hours)	9,600
Hardy (2,000 units × 3 hours)	6,000
	15,600
Budgeted fixed production overheads	Rs. 187,200
Fixed overhead absorption rate/hour	Rs. 12 / hour

	Laurel		Hardy	
		Rs.		Rs.
Direct materials				
Material X	(3 kg × Rs. 3)	9.00	(1 kg × Rs. 3)	3.00
Material Y	(2 kg × Rs.4)	8.00	(6 kg × Rs. 4)	24.00
Direct labour	(1.6 hrs × Rs.25)	40.00	(3 hrs × Rs.25)	75.00
Variable production overhead	(1.6 hrs × Rs.5)	8.00	(3 hrs × Rs.5)	15.00
Standard variable prod'n cost		65.00		117.00
Fixed production overhead	(1.6 hrs × Rs.12)	19.20	(3 hrs × Rs.12)	36.00
Standard full production cost		84.20		153.00

▶ *Example 03:*

A company manufactures Product Y. Due to the nature of the production process, there is some idle time and it has been estimated that the 'normal' amount of idle time is 20% of hours worked.

Ignoring idle time, the standard time to make 1 unit of Product Y is 0.56 hours. Labour is paid Rs.30 per hour.

Calculate the standard cost of the expected idle time using each of the following two methods:

i. Include idle time as a separate element of the standard cost

ii. Include an allowance for expected idle time in the standard hours and standard cost

The labour time to make 1 unit of product X is 0.56/0.80 = 0.70 hours, of which 0.14 hours are idle time.

i. Include idle time as a separate element of the standard cost.

The standard cost per unit will include the following items:

	Rs.
Active hours worked: 0.56 hours × Rs.30 per hour	16.80
Idle time: 0.14 hours × Rs.30 per hour	4.20
	21.00

ii. Include an allowance for expected idle time in the standard hours and in standard cost.

Standard cost = 0.70 hours × Rs.30 per hour = Rs.21.00

▶ *Example 04:*

Omega Limited plans to sell its new skin care lotion, Lanosof, in 100ml bottle. Cost and production studies show these standard costs of materials and ingredients.

Container:	Description	Cost	Allowance for waste and breakage
Item 153	100ml bottle	Rs. 3,600 per gross	3%
Item 253	Label	Rs. 1,100 per pack of 500 labels	5%

Materials	Description	Cost	Quantity used for batch of 1 liter
Item C3A	Compound 3A	Rs. 200 per 250 lbs.	550 lbs.
Item AG	Alcohol	Rs. 500 per 800 lbs.	750 lbs.
Item PO	Perfume oil	Rs. 5,000 per 100 lbs.	10 lbs.

Labour	Time for batch of 1 liter	Rate	Idle time
Skilled	12 hours	Rs. 60 per hour	2%
Unskilled	30 hours	Rs. 25 per hour	5%

A standard prime cost card for one bottle of 100ml of new skin care lotion, Lanosof, is given below.

Standard cost card of 100ml bottle of Lanosof	Rs.
Container:	
Item 153 (3,600/144 = 25 / 0.97)	25.77
Item 253 (1,100/500 = 2.20/ 0.95)	2.32
	28.09
Materials:	
Item C3A (550 x 100/1,000= 55 lbs) x (200/250 = 0.80 per lb.)	44.00
Item AG (750 x 100/1,000= 75 lbs) x (500/800 = 0.625 per lb.)	16.88
Item PO (10 x 100/1,000= 1 lb) x (5,000/100 = 50 per lb.)	50.00
	110.88
Direct labour:	
Skilled (12 x 100/1,000= 1.20/ 0.98= 1.22 hours) at rate of Rs. 60 per hour	73.20
Skilled (30 x 100/1,000= 3.00/ 0.95= 3.16 hours) at rate of Rs. 25 per hour	79.00
	152.20
Standard prime cost of 100ml bottle	**291.17**

STICKY NOTES

A standard is a pre-determined unit of cost for stock valuation, budgeting and control

A standard cost card shows full details of the standard cost of each product

The standard for each type of cost (material, labour and Overhead) is made up of a standard resource price and a standard resource usage

The difference between standard and actual is known as a variance. The process by which the total difference between standard and actual results is analyzed in known as variance analysis.

Performance standards are used to set efficiency targets. There are four types: Ideal, Current, Basic and Attainable

There may be a standard rate of wastage or a 'normal' rate of loss which is a measure of the average rate of wastage or loss. An allowance for expected loss can be included in a standard cost.

CHAPTER 12

VARIANCE ANALYSIS

IN THIS CHAPTER

AT A GLANCE

A budget is a standard, set to coordinate between different departments and managers.

We prepare budgets to motivate managers and to evaluate their performance.

The original budget prepared at the beginning of a budget period is known as the fixed budget. When we shift our fixed budget to actual activity for control purposes, it is called flexed budget.

Difference between flexed budget and actual result is called variances.

Total Cost variances are to be calculated by comparing total standard cost with total actual cost.

Total material, labour and overhead variances can be calculated by comparing total standard cost with total Actual cost respectively.

Material variance can be divided into material Price and usage variance.

Labour variance can be divided into labour rate and efficiency variance.

Variable overhead can vary with number of units or with number of hours.

Fixed overhead variances are Expenditure and volume variances.

For all cost variances if actual cost is greater than standard it is an adverse variance.

Variances can be interrelated for example an adverse material usage variance may be due to favourable material price variance.

Mix variances are to be calculated where there is more than one type of material or labour involved.

Sales variances can be identified by comparing budgeted sales and actual sales.

Sales variances include sales price and volume variance. If actual sales exceed budget, the variance is favourable.

1. VARIANCE ANALYSIS

Variance analysis is quantitative result of difference between standard and actual results. This analysis is used to put control over business activities through investigation of areas where performance was unexpectedly poor. For example, the standard cost of raw material for 600 units was set at Rs. 30,000 but actual cost was Rs. 36,000; thus creating adverse variance of Rs. 6,000. It showed adverse performance in this area, the reasons are most important to see whether this variance was caused by controllable or uncontrollable factors. **(Tools, 2021)**

When we set standard cost, we have to determine the budgeted level as well. The standard cost at budgeted level is known as fixed budget. The actual results cannot be compared with fixed budget because the actual activity exceeds budgeted activity, thus creating useless variance. In order to calculate realistic variances, it is important to compare the standard cost at actual activity, which is termed as flexed budget approach. This approach is explained with example in following section.

1.1. Budgets and actual results for a period:

1.1.1. Fixed budget

The original budget prepared at the beginning of a budget period is known as the fixed budget. A fixed budget is a budget for a specific volume of output and sales activity, and it is the 'master plan' for the financial year that the company tries to achieve.

▶ *Example 01:*

Mardan Manufacturing Limited has budgeted to make 1,200 units and sell 1,000 units in January.

The selling price per unit is budgeted at Rs. 15,000.

The standard costs of production are as given below.

Standard cost card (Mardan Manufacturing Limited)

		Rs.
Direct materials	5 kg @ Rs.1,000 per kg	5,000
Direct labour	4 hours @ Rs. 500 per hour	2,000
Variable overhead	4 hours @ Rs. 200 per hour	800
Marginal production cost		**7,800**
Fixed production overhead	4 hours @ Rs. 600 per hour	2,400
Total absorption cost		**10,200**

The budget prepared for January is as follows:

Unit sales		1,000
Unit production		1,200
Budget		**Rs. '000**
Sales	(1,000 units ×15,000)	15,000
Cost of sales:		
Materials	(1,200 units ×Rs. 5,000 per unit)	6,000
Labour	(1,200 units ×Rs. 2,000 per unit)	2,400
Variable overhead	(1,200 units ×Rs. 800 per unit)	960
Fixed overhead	(1,200 units ×Rs. 2,400 per unit)	2,880
		12,240
Closing inventory	(200 units ×Rs. 10,200 per unit)	(2,040)
Cost of sales	**(1,000 units ×Rs. 10,200 per unit)**	**(10,200)**
Gross Profit		**4,800**

Note: Budgeted profit = 1,000 units × (Rs. 15,000 –Rs. 10,200 per unit) = Rs. 4,800,000

One of the main purposes of budgeting is budgetary control and the control of costs. Costs can be controlled by comparing budgets with the results actually achieved.

Differences between expected results and actual results are known as variances. Variances can be either favourable (F) or adverse (A) depending on whether the results achieved are better or worse than expected.

Consider the following:

- *Example 02:*

At the end of January Mardan Manufacturing Limited recorded its actual results as follows.

	Budget	Actual
Unit sales	1,000	900
Unit production	1,200	1,000
Budget	**Rs. '000**	**Rs. '000**
Sales	15,000	12,600

Cost of sales:	Budget	Actual
Materials	6,000	4,608
Labour	2,400	2,121
Variable overhead	960	945
Fixed overhead	2,880	2,500
	12,240	10,174
Closing inventory	(2,040)	(1,020)
Cost of sales	(10,200)	(9,154)
Profit	4,800	3,446

Note: The actual closing inventory of 100 units is measured at the standard cost of Rs. 10,200 per unit. This is what happens in standard costing systems. (in exam if question is silent about inventory measurement then actual closing inventory shall be measured at actual absorption cost.

What does this tell us?

The actual results (profit) was less than budgeted profit which indicates adverse situation. The profit was declined by Rs. 1,354,000 when compared with budget. In order to see why it was happened, we have to see each item separately. It looked obvious that major impact was caused by decline in sales by Rs. 2,400,000. However, each item of cost showed different results. The actual cost of material, labour and production overheads was less than budgeted cost which showed favourable results.

When we look into the units sold it was clear that actual sales in units was less than budgeted sales in units. Similarly, budgeted cost was calculated on basis of production of 1,200 units whereas actual units produced were less than budget i.e. 1,000. Is it realistic to compare the results of 1,200 units with cost of 1,000 units? Absolutely not, in order to make realistic comparison, we have to revised the budget at actual level of activity. The revised budget should be compared with actual results, to get realistic variances. This approach is further explained in following section.

1.1.2. Flexed budget

Variances are not calculated by comparing actual results to the fixed budget directly because the figures relate to different levels of activity and the comparison would not be realistic. For the purpose of realistic comparison, it is important to prepare another budget which is termed as Flexed Budget. This budget is prepared at actual level of activity, however, basis used in preparation of budget are same as in fixed budget.

Following example explain the concept of flexed budget

- *Example 03:*

Continuing the example 02, the flexed budget prepared by Mardan Manufacturing Limited at the end of January (based on actual levels of activity and standard revenue per unit and standard cost per unit) is as follows:

Unit sales		900
Unit production		1,000
Budget at 900 units		**Rs. '000**
Sales	(900 units ×15,000)	13,500

Cost of sales:		**Rs. '000**
Materials	(1,000 units ×Rs. 5,000 per unit)	5,000
Labour	(1,000 units ×Rs. 2,000 per unit)	2,000
Variable overhead	(1,000 units ×Rs. 800 per unit)	800
Fixed overhead	(1,000 units ×Rs. 2,400 per unit)	2,400
		10,200
Closing inventory	(100 units ×Rs. 10,200 per unit)	(1,020)
Cost of sales	(900 units ×Rs. 10,200 per unit)	(9,180)
Profit		4,320

This shows the amount that the company would have received for the actual number of units sold if they had been sold at the budgeted revenue per item.

It shows what the actual number of units produced (1,000 units) would have cost if they had been made at the standard cost.

The flexed budget is a vital concept as variance analysis concept is purely based on it.

1.1.3. Comparison of actual results to the flexed budget.

After preparation of flexed budget, the actual results are compared with it to calculate variances. This practice is also known as control statement, because reasons on the basis of variances were highlighted.

- *Example 04:*

At the end of January, Mardan Manufacturing Limited has recorded its actual results as follows (together with the original fixed budget and the flexed budget for the month).

	Fixed budget	Flexed budget	Actual
Unit sales	1,000	900	900
Unit production	1,200	1,000	1,000

	Budget	Actual	Actual
Budget	Rs. '000	Rs. '000	Rs. '000
Sales	15,000	13,500	12,600
Cost of sales:			
Materials	6,000	5,000	4,608
Labour	2,400	2,000	2,121
Variable overhead	960	800	945
Fixed overhead	2,880	2,400	2,500
	12,240	10,200	10,174
Closing inventory	(2,040)	(1,020)	(1,020)
Cost of sales	(10,200)	(9,180)	(9,154)
Profit	4,800	4,320	3,446

Note: The actual closing inventory of 100 units is measured at the standard total absorption cost of Rs. 10,200 per unit. This is what happens in standard costing systems. (in exam if question is silent about inventory measurement then actual closing inventory shall be measured at actual absorption cost

1.2. Variance Analysis

Variance analysis explains the difference between the fixed budget profit and the actual profit in detail. This paragraph provides an initial commentary for variances which will be explained in detail later.

The variance may cause due to change in volume or change in base (price, rate etc.). For example, difference between material cost in flexed budget and actual results may cause due to usage of material or price of variance. In order to interpret the variance in detail, it is important to know about variance relating to usage and price separately. This technique is used not only for material, rather it is applied on all other cost and revenue items.

1.3. Cost variances

Adverse and favourable cost variances

In a standard costing system, all units of output are valued at their standard cost. Cost of production and cost of sales are therefore valued at standard cost.

Actual costs will differ from standard costs. A cost variance is the difference between an actual cost and a standard cost.

- When actual cost is higher than standard cost, the cost variance is adverse (A) or unfavourable (U).
- When actual cost is less than standard cost, the cost variance is favourable (F).

Similarly, standard revenue and actual revenue might differ, and it is known as sales variance.

- When actual revenue is higher than standard revenue, the variance is Favourable (F).
- When actual revenue is less than standard revenue, the variance is adverse (A) or unfavourable (U).

In a cost accounting system, variances are adjusted to the profit in an accounting period.

- Favourable variances increase the reported profit.
- Adverse variances reduce the reported profit.

1.4. Variances and performance reporting

Variance reports are produced at the end of each control period (say, at the end of each month).

- Large adverse variances indicate poor performance, provided they are due to factors controllable by management, and the need for control action by management.
- Large favourable variances indicate unexpected good performance. Management might wish to consider how this good performance can be maintained in the future.

Variances might be reported in a statement for the accounting period that reconciles the budgeted profit with the actual profit for the period. This statement is known as an **operating statement**.

2. DIRECT MATERIALS VARIANCES

2.1 Direct materials: total cost variance

This section has three variances, the total direct material cost variance, direct material price variance and direct material usage variance. Total direct material variance is the difference between the actual material cost in producing units in the period and the standard material cost of producing those units.

- *Calculation of direct material total cost variance:*

	Rs.
Standard material cost of actual production:	
Actual units produced × Standard kgs per unit × Standard price per kg	X
Actual material cost of actual production:	
Actual units produced × Actual kgs per unit × Actual price per kg	(X)
Favourable (Adverse)	X or (X)

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.

- *Example 05:*

Following data is relevant to Jamal Limited for the month of January 2021.

Standard material cost per unit: (10 kgs @Rs. 100 per kg) = Rs. 1,000 per unit

Actual production in period = 600 units.

Materials purchased and used: 5,850 kgs at a cost of Rs. 5,740,000

Direct materials total cost variance is calculated as follows:

	Rs. '000
Standard: 600 units should cost (@ Rs. 1.000 per unit)	6,000
Actual: 600 units did cost	(5,740)
Total cost variance (F)	260

The direct materials total cost variance can be analyzed into a price variance and a usage variance.

2.2 Direct materials price variance

A price variance measures the difference between the actual price paid for materials and the price that should have been paid (the standard price).

The price variance may be calculated for the materials purchased or materials used. Usually it is calculated at the point of purchase as this allows the material inventory to be carried at standard cost.

- *Calculation of direct material price variance:*

	Rs.
Standard material cost of actual production:	
Actual kgs purchased × Standard price per kg	X
Actual material cost of actual purchases	
Actual kgs purchased × Actual price per kg	(X)
Favourable (Adverse)	X or (X)

- *Formula to calculate direct material price variance:*

	Result
(SP – AP) x AQ	F or (A)
Where:	
SP = Standard price	
AP = Actual price	
AQ = Actual quantity purchased or used	

Normally, actual quantity is quantity purchased in accordance to concept of standard costing principle, however, it can be calculated on quantity used, if asked by examiner.

- *Example 06:*

Standard material cost extracted from cost card of product A101, is given below.

	Rupees
Standard cost of materials (20 liters at Rs. 8 per liter)	160

During the month of February 2021, 5,000 units were produced. Material of 99,300 liters was purchased at cost of Rs. 814,260. There was no opening or closing material inventory.

Direct materials price variance is calculated as follows:

	Rupees
Standard: 99,300 liters should cost (@ Rs. 8 per kg)	794,400
Actual: 4,850 kgs did cost	(814,260)
Materials price variance (A)	(19,860)
Formula Method:	**Rupees**
(SP – AP) x AQ	
(8 – [814,260/99,300 = 8.20]) x 99,300	(19,860) A

- *Example 07:*

A unit of Product P123 has a standard cost of 5 liters of Material A at Rs.3 per liter. The standard direct material cost per unit of Product 123 is therefore Rs.15. In a particular month, 2,000 units of Product 123 were manufactured. 11,000 liters of Material A was purchase at total cost of Rs. 33,550 whereas 10,400 liters of Material A were actually used.

Management intends to record the material price variance at the time of usage of material.

The material price variance is calculated as follows:

	Rs.	
10,400 litres of materials should cost (× Rs.3)	31,200	
They did cost (10,400 x 3.05)	31,720	
Material price variance	(520)	A
Formula Method:	**Rupees**	
(SP – AP) x AQ		
(3 – [33,550/11,000 = 3.05]) x 10,400	(520) A	

2.3 Direct materials usage variance

A usage variance measures the difference between the materials that were used in production and the materials that should have been used (the standard usage).

The usage variance is calculated by comparing the actual quantity of material used to make the actual production to the standard quantity that should have been used to produce those units. In other words, the actual usage of materials is compared with the standard usage for the actual number of units produced,

The difference is the usage variance, measured as a quantity of materials. This is converted into a money value at the standard price for the material.

- *Calculation of direct material usage variance:*

Material usage variance	
Standard quantity of material used to make the actual production	X
Actual quantity of material used to make the actual production	(X)
Usage variance (kgs)	X (X)
Standard cost per kg (multiply by)	X
Usage variance (Rs.) Favourable (Adverse)	X (X)

- *Formula for material usage variance:*

Formula	Rs.
(SQ x AQ) x SP	
Whereas:	
SQ = Standard Quantity at actual units produced	
AQ = Actual quantity used	
SP = Standard price	

- *Example 08:*

Rana Enterprises makes a single product with the following standard material costs per unit:

	Rupees
Standard cost of materials (2 kg at Rs. 10 per kg)	20

Actual production in period = 1,000 units.

Materials purchased and used: 2,200 kg

Material cost Rs. 20,900

Direct materials usage variance is calculated as follows:

	kgs
Standard: Making 1,000 units should have used (@ 2 kg per unit)	2,000
Actual: Making 1,000 units did use	(2,200)
Usage variance in kg (A)	(200)
Standard price per kg in Rs.	10
Usage variance (Rs.) (A)	(2,000)

Formula Method:	Rupees
(SQ – AQ) x SP	
([1,000 x 2] – 2,200 x 10	(2,000) A

- *Example 09:*

Mansoori Limited makes and sells a single product. Each unit of the product requires 9kg of material at Rs. 14 per kg.

The actual details for last period were that 1,200 units of finished goods were produced; 11,000 kg of material was purchased for Rs. 148,500 and 10,700 kg was used.

Mansoori limited maintains its raw materials inventory at standard cost

Material price and usage variances, are calculated as under.

Material price variance	Rs.	
11,000 litres of materials should cost (× Rs. 14)	154,000	
They did cost	(148,500)	
Material price variance	5,500	F

Formula Method:	Rupees
(SP – AP) x AQ	
(14 – [148,500/11,000 = 13.50]) x 11,000	5,500 F

Material usage variance	kgs
Standard: Making 1,200 units should have used (@ 9 kg per unit)	10,800
Actual: Making 1,200 units did use	10,700
Usage variance in kg (F)	100
Standard price per kg in Rs.	14
Usage variance (Rs.) (F)	1,400

Formula Method:	Rupees
(SQ – AQ) x SP	
([1,200 x 9] – 10,700 x 14)	1,400 F

2.4 Direct materials: possible causes of variances

When variances occur and they appear to be significant, management should investigate the reason for the variance. If the cause of the variance is something within the control of management, control action should be taken. Some of the possible causes of materials variances are listed below.

Materials price variance: causes

Possible causes of favourable materials price variances include:

- Different suppliers were used and these charged a lower price than the usual supplier.
- Materials were purchased in sufficient quantities to obtain a bulk purchase discount.
- Materials were bought that were of lower quality than standard and so cheaper than expected.

Possible causes of adverse materials price variances include:

- Different suppliers were used and these charged a higher price than the usual supplier.
- Suppliers increased their prices by more than expected. (Higher prices might be caused by an unexpected increase in the rate of inflation.)
- There was a severe shortage of the materials, so that prices in the market were much higher than expected.
- Materials were bought that were better quality than standard and more expensive than expected.

Materials usage variance: causes

Possible causes of favourable materials usage variances include:

- Wastage rates were lower than expected.
- Improvements in production methods resulted in more efficient usage of materials.
- Higher quality material was used resulting less wastage.

Possible causes of adverse materials usage variances include:

- Wastage rates were higher than expected.
- Poor materials handling resulted in a large amount of breakages. Breakages mean that a quantity of materials input to the production process are wasted.
- Materials used were of cheaper quality than standard, with the result that more materials had to be thrown away as waste.

2.5 Journal entries-direct materials in standard costing

Description	Debit	Credit
	-------- Rupees --------	
Material price variance is recognised at the time of purchase		
Materials Inventory (AQP x SP)	X	
Material price variance (If adverse)	X	
Material price variance (If favourable)		X
Accounts payable		X
(Record purchase of raw materials)		
Material is issued to production		
Work in progress control (SQ x SP)	X	
Material usage variance (If adverse)	X	
Material usage variance (If favourable)		X
Material Inventory (AQU x SP)		X
Material price variance is recognised at the time of usage		
Materials Inventory (AQP x AP)	X	
Accounts payable		X
(Record purchase of raw materials)		
Material is issued to production		
Work in progress control (SQ x SP)	X	
Material usage variance (If adverse)	X	
Material price variance (If adverse)		
Material usage variance (If favourable)		X
Material price variance (If favourable)		
Material Inventory (AQU x SP)		X

It can be explained with the help of following example.

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- *Example 10:*

The Shawn Furniture House uses 12 meters of pipe at cost of Rs. 8 per meter as standard for the production of one of its chairs Model No. CHRA12. During one month's operations, 50,000 meters of pipe were purchased at Rs. 7.80 a meter and 3,600 chairs were produced using 43,800 meters of pipe.

a) Assuming that material price variance is recognized at the time of purchases. Calculation of material price and usage variance along with journal entries are given below.

Material price variance	Rupees
(SP – AP) x AQP	
(8 – 7.80) x 50,000	10,000 F
Material usage variance	**Rupees**
(SQ – AQ) x SP	
(3,600 x 12 – 43,800) x 8	4,800 A

Description	Debit	Credit
	-------- Rupees	--------
Materials Inventory (50,000 x 8)	400,000	
Material price variance		10,000
Accounts payable (50,000 x 7.80)		390,000
(Record purchase of raw materials)		
Work in progress control (3,600 x 12 x 8)	345,600	
Material usage variance	4,800	
Material Inventory (43,800 x 8)		350,400
(Record issue of material to production)		

b) Assuming that material price variance is recognized at the time of issue of materials. Calculation of material price and usage variance along with journal entries are given below.

Material price variance	Rupees
(SP – AP) x AQU	
(8 – 7.80) x 43,800	8,760 F
Material usage variance	**Rupees**
(SQ – AQ) x SP	
(3,600 x 12 – 43,800) x 8	4,800 A

Description	Debit	Credit
	-------- Rupees	--------
Materials Inventory (50,000 x 7.80)	390,000	
Accounts payable (50,000 x 7.80)		390,000
(Record purchase of raw materials)		
Work in progress control (3,600 x 12 x 8)	345,600	
Material usage variance	4,800	
Material price variance		8,760
Material Inventory (43,800 x 7.80)		361,640
(Record issue of material to production)		

3. DIRECT LABOUR VARIANCES

3.1 Direct labour: total cost variance

In this section, we will discuss four variances related to labour i.e. total direct labour variance, labour rate variance, labour efficiency variance and idle time variance.

The total direct labour cost variance is the difference between the actual labour cost in producing units in the period and the standard labour cost of producing those units.

- *Calculation of total direct labour variance:*

	Rs.
Standard labour cost of actual production:	
Actual units produced × Standard hrs per unit × Standard rate per hr	X
Actual labour cost of actual production:	
Actual units produced × Actual hours per unit × Actual rate per hour	(X)
	X

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.

- *Example 11:*

Following standard labour cost per unit is related to Lahore Trading Company:

Standard labour cost per unit: (3 hours @Rs. 50 per hour) = Rs. 150 per unit

Actual production in period = 800 units.

Labour hours paid for: 2,500 hours at a cost of Rs. 128,500

Direct labour total cost variance is calculated as follows:

	Rs.
Standard: 800 units should cost (@ Rs.150 per unit)	120,000
Actual: 800 units did cost	(128,500)
Total cost variance (A)	(8,500)

The direct labour total cost variance can be analyzed into a rate variance and an efficiency variance. These are calculated in a similar way to the direct materials price and usage variances.

- A rate variance measures the difference between the actual wage rate paid to labour per hour and the rate that should have been paid (the standard rate of pay).
- An efficiency variance (or productivity variance) measures the difference between the time taken to make the production output and the time that should have been taken (the standard time).

3.2 Direct labour rate variance

The actual labour cost of the actual hours paid for is compared with the standard cost for those hours. The difference is the labour rate variance. The direct labour rate variance is calculated for the actual number of hours paid for.

- *Calculation of direct labour rate variance:*

	Rs.
Standard labour cost of actual production:	
Actual hours paid for × Standard rate per hour	X
Actual labour cost of actual purchases	
Actual hours paid for × Actual rate per hour	(X)
Favourable (Adverse)	X (X)

Formula	Rs.
(SR x AR) x SH	
Whereas:	
SR = Standard Rate per hour	
AR = Actual rate per hour	
SH = Standard hours at actual units produced	

► *Example 12:*

Standard cost of labour per unit is Rs. 30 (30 minutes at Rs. 60 per hour)

Actual production in period = 6,000 units.

Labour hours paid for: 3,100 hours at a cost of Rs. 179,800

Direct labour rate variance is calculated as follows:

Labour rate variance	Rs.
Standard: 3,100 hours should cost (@ Rs. 60 per hour)	186,000
Actual: 3,100 hours did cost	(179,800)
Labour rate variance (F)	6,200
Formula method	**Rupees**
(SR – AR) x AH	
(60 – [179,800/3,100= 58]) x 3,100	6,200 F

3.3 Direct labour efficiency variance

The direct labour efficiency variance is calculated for the hours used on the units produced.

For the actual number of standard units produced, the actual hours worked is compared with the standard number of hours that should have been worked to produce the actual output. The difference is the efficiency variance, measured in hours. This is converted into a money value at the standard direct labour rate per hour.

► *Calculation of direct labour efficiency variance:*

	Hours
Standard labour hours used to make the actual production	X
Actual labour hours used to make the actual production	(X)
Efficiency variance (hours)	X (X)
Standard cost per hour (multiply by)	X
Efficiency variance (Rs.) Favourable (Adverse)	X (X)
Formula	**Rs.**
(SH x AH) x SR	
Whereas:	
SH = Standard hours to produce actual units	
AH = Actual hours	
SR = Standard rate per hour	

- *Example 13:*

For Modern Manufacturing Limited, standard labour cost per unit: (4 hours @Rs. 50 per hour) = Rs. 200 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,050 hours at a cost of Rs. 194,400

Direct labour efficiency variance is calculated as follows:

	Hours
Standard: Making 1,000 units should have used (@ 4 hours per unit)	4,000
Actual: Making 1,000 units did use	(4,050)
Efficiency variance (hours) (A)	50
Standard cost per hour	Rs. 50
Efficiency variance (Rs.) (A)	Rs. 2,500
Formula method	**Rupees**
(SH – AH) x SR	
(1,000 x 4 – 4,050) x 50	(2,500) A

- *Example 14:*

Product P234 has a standard direct labour cost per unit of:

0.5 hours × Rs.12 per direct labour hour = Rs.6 per unit.

During a particular month, 3,000 units of Product 234 were manufactured. These took 1,400 hours to make and the direct labour cost was Rs. 16,200.

The total direct labour cost variance, the direct labour rate variance and the direct labour efficiency variance for the month, would be calculated as follows

Total direct labour cost variance	Rs.	
3,000 units of output should cost (×Rs.6)	18,000	
They did cost	16,200	
Direct labour total cost variance	1,800	(F)

The variance is favourable, because actual costs were less than the standard cost.

The direct labour rate variance is calculated by taking the actual number of hours worked (and paid for).

Direct labour rate variance	Rs.	
1,400 hours should cost (×Rs.12)	16,800	
They did cost	16,200	
Direct labour rate variance	600	(F)

The rate variance is favourable because the labour hours worked cost less than they should have done.

The labour efficiency variance, like a materials usage variance, is calculated for the actual number of units produced. The variance in hours is converted into a money value at the standard rate of pay per hour.

Direct labour efficiency variance	hours	
3,000 units of Product P234 should take (× 0.5 hours)	1,500	
They did take	1,400	
Efficiency variance in hours	100	(F)
Standard direct labour rate per hour	Rs.12	
Direct labour efficiency variance in Rs.	Rs.1,200	(F)

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

Labour cost variances: summary	Rs.	
Labour rate variance	600	(F)
Labour efficiency variance	1,200	(F)
Total direct labour cost variance	1,800	(F)

Alternate way of calculating the direct labour rate and efficiency variance, is using the formulas, which are given as under.

Labour rate variance	Rupees
(SR – AR) x AH	
(12 – [16,200/1,400= 11.57143) x 1,400	600 F

Labour efficiency variance	Rupees
(SH – AH) x SR	
(3,000 x 0.50 – 1,400) x 12	1,200 F

3.4 Idle time variance

Idle time occurs when the direct labour employees are being paid but have no work to do. The causes of idle time may be:

- A breakdown in production, for example a machine breakdown that halts the production process
- Time spent waiting for work due to a bottleneck or hold-up at an earlier stage in the production process
- Time spent rearranging the production line for a new batch
- Running out of a vital direct material, and having to wait for a new delivery of the materials from a supplier.
- A lack of work to do due to a lack of customer orders.

A feature of idle time is that it is recorded, and the hours 'lost' due to idle time are measured. Idle time variance is part of the efficiency variance.

Sometimes idle time might be a feature of a production process for example where there may be bottlenecks in a process that might lead to idle time on a regular basis. In this case the expected idle time might be built into the standard cost.

- If idle time is not built into the standard cost the idle time variance is always adverse.
- If it is built into the standard cost the idle time variance might be favourable or adverse depending on whether the actual idle time is more or less than the standard idle time for that level of production.

Idle time not part of standard cost

As stated above if the idle time is not included in the standard cost, any idle time is unexpected and leads to an adverse variance. It is calculated simply by multiplying the idle time by standard rate per hour.

It is important that when idle time is calculated, direct labour efficiency is based on hours worked only, not the paid hours because non-productive time is used in idle time variance.

- *Calculation of idle time variance:*

	Hours
Actual hours paid for	X
Actual hours worked	(X)
Idle time (hours)	X
Standard cost per hour (multiply by)	X
Idle time (Rs.) Adverse	X

- *Example 15:*

ABC company has provided the following standard labour cost per unit.

Direct labour (2.5 hours at Rs. 40 per hour) = Rs. 100

During the month of September, 1,500 units were produced. Total 3,820 hours were paid at rate of Rs. 41.50 per hour, including 90 idle hours.

Calculation of labour rate variance, labour efficiency variance and idle time variance, is given as under.

Labour rate variance	Rupees
(SR – AR) x AH	
(40 – 41.50) x 3,820	(5,730) A

Labour efficiency variance	Rupees
(SH – AH) x SR	
[(1,500 x 2.50) – (3,820- 90)] x 40	800 F

Labour idle time variance	Rupees
Idle hours x SR	
90 x 40	(3,600) A

3.5 Idle time variance where idle time is included in standard cost

Methods of including idle time in standard costs

There are different ways of allowing for idle time in a standard cost.

- **Method 1.** Include idle time as a separate element of the standard cost, so that the standard cost of idle time is a part of the total standard cost per unit.
- **Method 2.** Allow for a standard amount of idle time in the standard hours per unit for each product. The standard hours per unit therefore include an allowance for expected idle time. This is feasible when the idle time is a necessary feature of the production process such as in batch processing.

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- *Example 16:*

For Marden Manufacturing Limited, standard labour rate = Rs. 500 per hour

A unit of production should take 3.6 hours to produce.

Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.

4 hours must be paid for (3.6/90%) to make 1 unit).

Expected idle time is 0.4 hours (10% of 4 hours).

Idle time can be built into the standard as follows:

Method 1		**Rs.**
Labour	3.6 hours ×Rs. 500 per hour	1,800
Idle time	0.4 hours ×Rs. 500 per hour	200
		2,000
Method 2		
Labour	4 hours ×Rs. 500 per hour	2,000

The two methods will result in the identification of the same overall variance for idle time plus labour efficiency but the split of the number may differ.

For Marden Manufacturing, standard labour rate = Rs. 500 per hour

A unit of production should take 3.6 hours to produce.

Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.
4 hours must be paid for (3.6/90%) to make 1 unit).
Expected idle time is 0.4 hours (10% of 4 hours).

Method 1

Idle time can be built into the standard as follows:

		Rs.
Labour	3.6 hours ×Rs. 500 per hour	1,800
Idle time	0.4 hours ×Rs. 500 per hour	200
		2,000

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of Rs. 2,121,000
Labour hours worked: 4,100 hours
Direct labour idle time variance is calculated as follows:

	Hours	
Expected idle time (1,000 units × 0.4 hours per unit)	400	
Actual idle time (4,200 hours – 4,100 hours)	(100)	
Idle time (hours)	300	F
Standard cost per hour (multiply by)	Rs. 500	
Idle time (Rs.)	Rs. 150,000	F

Direct labour efficiency variance is calculated as follows:

	Hours	
Standard: Making 1,000 units should have used (@ 3.6 hours per unit)	3,600	
Actual: Making 1,000 units did use	(4,100)	
Efficiency variance (hours)	(500)	A
Standard cost per hour	Rs. 500	
Efficiency variance (Rs.)	Rs. 250,000	A

Method 2

Idle time can be built into the standard as follows:

		Rs.
Labour	4 hours ×Rs. 500 per hour	2,000
Actual production in period = 1,000 units.		
Labour hours paid for: 4,200 hours at a cost of Rs. 2,121,000		
Labour hours worked: 4,100 hours		

Direct labour idle time variance is calculated as follows:	Hours	
Expected idle time (10% of 4,200 hours paid for)	420	
Actual idle time (4,200 hours – 4,100 hours)	(100)	
Idle time (hours)	320	F
Standard cost per hour (multiply by)	Rs. 500	
Idle time (Rs.)	Rs. 160,000	F

Direct labour efficiency variance is calculated as follows:	Hours	
Standard: Making 1,000 units should have used (4 hours per unit less 10% of the hours paid for = 4,000 – (10% of 4,200))	3,580	
Actual: Making 1,000 units did use	(4,100)	
Efficiency variance (hours)	(520)	**A**
Standard cost per hour	Rs. 500	
Efficiency variance (Rs.)	Rs. 260,000	**A**

In summary the idle time variance is part of the efficiency variance. Different methods result in a different split of the idle time variance and efficiency variance but the figures always sum to the same total.

Revisiting the previous examples:

Sum of idle time and efficiency variances (Marden Manufacturing Limited)

	Idle time variance	Efficiency variance	Total
Idle time not recorded	–	100 (A)	100 (A)
Idle time recorded:			
not part of standard cost	50 (A)	50 (A)	100 (A)
part of standard cost (method 1)	150 (F)	250 (A)	100 (A)
part of standard cost (method 2)	160 (F)	260 (A)	100 (A)

3.6 Direct labour: possible causes of variances

When labour variances appear significant, management should investigate the reason why they occurred, and take control measures where appropriate to improve the situation in the future. Possible causes of labour variances include the following.

Possible causes of favourable labour rate variances include:

- Using direct labour employees who were relatively inexperienced and new to the job.
- Change in method of production, where unskilled labour time enhanced while skilled labour time reduced.
- Actual pay increase turning out to be less than expected.

Possible causes of adverse labour rate variances include:

- An increase in pay for employees.
- Working overtime hours paid at a premium above the basic rate.
- Using direct labour employees who were more skilled and experienced than the 'normal' and who are paid more than the standard rate per hour.

Possible causes of favourable labour efficiency variances include:

- More efficient methods of working.
- Good morale amongst the workforce and good management with the result that the work force is more productive.
- If incentive schemes are introduced to the workforce, this may encourage employees to work more quickly and therefore give rise to a favourable efficiency variance.
- Previously unaccounted for learning and experience curves
- Using employees who are more experienced than 'standard', resulting in favourable efficiency variances as they are able to complete their work more quickly than less-experienced colleagues.

Possible causes of adverse labour efficiency variances include:

- Using employees who are less experienced than 'standard', resulting in adverse efficiency variances.
- An event causing poor morale.

3.7 Journal Entries related to direct labour in standard costing

Description	Debit	Credit
	-------- Rupees --------	
Work in progress control (SH x SR)	X	
Adverse variances	X	
Favourable variances		X
Payroll (Actual)		X
(Record charging direct labour cost to production)		

▶ *Example 17:*

The standard cost card of Rashid Food Manufacturing Limited shows that the processing of a product FDL560 requires 1 hour at a standard wage rate of Rs. 60 per hour.

The 2,000 units actually taken 1,975 hours at a cost of Rs. 122,450, including 25 idle hours.

Calculation of direct labour rate, efficiency and idle time variances and journal entry to charge direct labour to production, is given below.

Labour rate variance	**Rupees**
(SR – AR) x AH	
(60 – [122,450/ 1,975 = 62) x 1,975	(3,950) A

Labour efficiency variance	**Rupees**
(SH – AH) x SR	
[(2,000 x 1) – (1,975- 25)] x 60	3,000 F

Labour idle time variance	**Rupees**
Idle hours x SR	
25 x 60	(1,500) A

Journal entry to charge direct labour cost to production in standard costing is given below.

Description	**Debit**	**Credit**
	-------- Rupees --------	
Work in progress control (2,000 x 60)	120,000	
Labour rate variance	3,950	
Labour idle time variance	1,500	
Labour efficiency variance		3,000
Payroll		122,450
(Record charging direct labour cost to production)		

4. VARIABLE PRODUCTION OVERHEAD VARIANCES

4.1 Variable production overhead: total cost variance

Three variances will be discussed in this section which includes total variable production overhead variance, variable overhead expenditure variance and variable overhead efficiency variance.

The total variable production overhead cost variance is the difference between the actual variable production overhead cost in producing units in the period and the standard variable production overhead cost of producing those units.

- *Calculation of total variable production overhead variance:*

	Rs.
Standard variable production overhead cost of actual production:	
Actual units produced × Standard hours per unit × Standard rate per hour	X
Actual variable production overhead cost of actual production:	
Actual units produced × Actual hours per unit × Actual rate per hour	(X)
Favourable (Adverse)	X (X)

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.

- *Example 18:*

Irha Limited has provided extract of standard cost, which showed that standard variable cost of one unit is Rs. 64 (4 hours at Rs. 16 per hour).

In the month of September, 2020; 5,200 units were produced

Total direct labour hours were 21,100 and actual variable production overhead was Rs. 331,700.

Total variable production overhead total cost variance is calculated as follows:

	Rs.
Standard: 5,200 units should cost (@ Rs. 64 per unit)	332,800
Actual: 5,200 units did cost	(331,700)
Total cost variance (F)	1,100

The variable production overhead total cost variance can be analyzed into an expenditure variance (spending rate per hour variance) and an efficiency variance.

- The expenditure variance is similar to a materials price variance or a labour rate variance. It is the difference between actual variable overhead spending in the hours worked and what the spending should have been (the standard rate).
- The variable overhead efficiency variance in hours is the same as the labour efficiency variance in hours (excluding any idle time variance), and is calculated in a very similar way. It is the variable overhead cost or benefit from adverse or favourable direct labour efficiency variances.

4.2 Variable production overhead expenditure variance

It is normally assumed that variable production overheads are incurred during hours actively worked, but not during any hours of idle time.

- The variable production overhead expenditure variance is calculated by taking the actual number of hours worked.
- The actual variable production overhead cost of the actual hours worked is compared with the standard cost for those hours. The difference is the variable production overhead expenditure variance.

▶ *Calculation of variable production overhead expenditure variance:*

	Rs.
Standard variable production overhead cost of actual production:	
Actual hours worked × Standard rate per hour	X
Actual variable production overhead cost of actual purchases	
Actual hours worked × Actual rate per hour	(X)
Favourable (Adverse)	X (X)
Formula method	**Rupees**
(AH x VOAR/hour) – Actual variable production overhead	
Where	
AH = Actual hours worked	
VOAR/hour = Standard variable overhead absorption rate per hour	

▶ *Example 19:*

Irha Limited has provided extract of standard cost, which showed that standard variable cost of one unit is Rs. 64 (4 hours at Rs. 16 per hour).

In the month of September, 2020; 5,200 units were produced

Total direct labour hours were 21,100 and actual variable production overhead was Rs. 331,700.

Variable production overhead expenditure variance is calculated as follows:

	Rupees
Standard: 21,100 hours should cost (@ Rs. 16 per hour)	337,600
Actual: 21,100 hours did cost	(331,700)
Variable production overhead expenditure variance (F)	5,900
Formula method	**Rupees**
(AH x VOAR/hour) – Actual variable production overhead	
(21,100 x 16) – 331,700	5,900 F

4.3 Variable production overhead efficiency variance

The variable production overhead efficiency variance in hours is exactly the same as the direct labour efficiency variance in hours.

It is converted into a money value at the standard variable production overhead rate per hour.

▶ *Calculation of variable production overhead efficiency variance:*

Variable overhead efficiency variance	Hours
Standard hours used to make the actual production	X
Actual hours used to make the actual production	(X)
Efficiency variance (hours)	X
Standard rate per hour (multiply by)	X
Efficiency variance (Rs.) Favourable (Adverse)	X (X)

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Formula method	Rupees
(SH x AH) – VOAR/hour	
Where	
SH = Standard hours to produce actual units	
AH = Actual hours worked	
VOAR/hour = Standard variable overhead absorption rate per hour	

► *Example 20:*

Irha Limited has provided extract of standard cost, which showed that standard variable cost of one unit is Rs. 64 (4 hours at Rs. 16 per hour).

In the month of September, 2020; 5,200 units were produced

Total direct labour hours were 21,100 and actual variable production overhead was Rs. 331,700.

Variable production overhead efficiency variance is calculated as follows:

Variable production overhead efficiency variance	Hours
Standard: Making 5,200 units should have used (@ 4 hours per unit)	20,800
Actual: Making 5,200 units did use	(21,100)
Efficiency variance (hours) (A)	(300)
Standard variable overhead rate per hour	Rs. 16
Efficiency variance (Rs.) (A)	Rs. (4,800)

Formula method	Rupees
(SH x AH) – VOAR/hour	
(5,200 x 4- 21,100) x 16	(4,800) A

► *Example 21:*

Product P123 has a standard variable production overhead cost per unit of: 1.5 hours × Rs.2 per direct labour hour = Rs.3 per unit.

During a particular month, 2,000 units of Product 123 were manufactured. These took 2,780 hours to make and the variable production overhead cost was Rs. 6,550.

The total variable production overhead cost variance, the variable production overhead expenditure variance and the variable production overhead efficiency variance for the month would be calculated as follows:

Total variable production overhead cost variance	Rs.	
2,000 units of output should cost (×Rs.3)	6,000	
They did cost	(6,550)	
Total variable production overhead cost variance	(550)	(A)
Variable production overhead expenditure variance	**Rs.**	
2,780 hours should cost (×Rs.2)	5,560	
They did cost	(6,550)	
Variable production overhead expenditure variance	(990)	(A)

The expenditure variance is adverse because the expenditure on variable overhead in the hours worked was more than it should have been.

Variable production overhead efficiency variance	hours	
2,000 units of Product P123 should take (× 1.5 hours)	3,000	
They did take	2,780	
Efficiency variance in hours	220	(F)
Standard variable production overhead rate per hour	Rs.2	
Variable production overhead efficiency variance in	Rs.440	(F)

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

Variable production overhead cost variances: summary	Rs.	
Variable production overhead expenditure variance	990	(A)
Variable production overhead efficiency variance	440	(F)
Total variable production overhead cost variance	550	(A)

Alternatively, variable production overhead efficiency and expenditure variances can be solved with the help of following formulas.

Variable production overhead expenditure variance	Rupees
(AH x VOAR/hour) – Actual variable production overhead	
(2,780 x 2) – 6,550	(990) A

Variable production overhead efficiency variance	Rupees
(SH x AH) – VOAR/hour	
(2,000 x 1.5 x 2,780) x 2	440 F

4.4 Variable production overhead: possible causes of variances

Possible causes of favourable variable production overhead expenditure variances include:

- Variable production overheads include various items of cost like indirect material, indirect labour, electricity etc. The decline in cost of these items may cause favourable variable production overhead expenditure variance.
- Individual items of overheads are used in more effective manner.

Possible causes of adverse variable production overhead variances include:

- Unexpected increases in prices of variable overhead items like increase in electricity rates, increase in rate per hour of indirect labour.
- The activities which drive the variable overheads are not efficiently controlled like lack of supervision on workers, due to which slow production process carried out and as a result, more resources are utilized.

Anything that causes labour efficiency variance will have an impact on variable production overhead efficiency variances as variable production overhead is incurred as the labour force carries out production.

Possible causes of favourable variable production overhead efficiency variances include:

- More efficient methods of working.
- Good morale amongst the workforce and good management with the result that the work force is more productive.

- If incentive schemes are introduced to the workforce, this may encourage employees to work more quickly and therefore give rise to a favourable efficiency variance.
- Using employees who are more experienced than 'standard', resulting in favourable efficiency variances as they are able to complete their work more quickly than less-experienced colleagues.

Possible causes of adverse variable production overhead efficiency variances include:

- Using employees who are less experienced than 'standard', resulting in adverse efficiency variances.
- An event causing poor morale.

4.5 Journal Entries of variable production overhead cost charged to production in standard costing

Description	Debit	Credit
	-------- Rupees --------	
Work in progress control (SH x VOAR)	X	
Adverse variances	X	
Favourable variances		X
Production overhead control		X
(Record charging variable production overheads to production)		

► *Example 22:*

The normal capacity of Rizwan manufacturing limited is 20,000 direct labour hours per month. The standard cost card shows that 2 hours are required to produce one unit of product ABT. At normal capacity the budgeted variable production overhead rate is Rs. 1.50 per direct labour hour.

During July, the plant operated 18,000 direct labour hours, with variable production overhead of Rs. 26,800. Actual production for the month of July is 9,200 units.

The expenditure variance is adverse because the expenditure on variable overhead in the hours worked was more than it should have been.

Variable production overhead expenditure variance	Rupees
(AH x VOAR/hour) – Actual variable production overhead	
(18,000 x 1.50) – 26,800	200 F

Variable production overhead efficiency variance	Rupees
(SH x AH) – VOAR/hour	
(9,200 x 2 - 18,000) x 1.50	600 F

Journal entry to applied variable production overheads to product cost in standard costing is given as under:

Description	Debit	Credit
	-------- Rupees --------	
Work in progress control (9,200 x 2 x 1.50)	27,600	
Variable production overhead expenditure variance		200
Variable production overhead efficiency variance		600
Production overhead control		26,800
(Record charging variable production overheads to production)		

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5. FIXED PRODUCTION OVERHEAD COST VARIANCES: ABSORPTION COSTING

5.1 Total Fixed production overhead variance

In standard absorption costing, the total fixed production overhead variance is the amount of over or under absorbed overheads. The amount of fixed overhead absorbed for each unit of output is the standard fixed overhead cost per unit. The total fixed overhead cost variance is the amount of:

- under-absorbed fixed production overhead is adverse variance or
- over-absorbed fixed production overhead is favourable variance.

Under or over absorption of production overheads has already been discussed in detail in Chapter 3.

▶ *Calculation of total fixed production overhead variance:*

Fixed production overhead total variance	Rs.
Actual units produced × Fixed production overhead per unit	X
Actual fixed production overhead incurred in the period	(X)
Total fixed production overhead variance Favourable (Adverse)	X/(x)

The total fixed production overhead cost variance can be analyzed into an expenditure variance and a volume variance. Together, these variances explain the reasons for the under- or over-absorption.

▶ *Example 23:*

Following is the fixed overheads standard cost of Shakeel Limited.

1.8 hours at Rs. 25 per hour = Rs. 45

The above standard cost is calculated at budgeted level of 7,500 units per month. In the month of March 2021, 7,800 units were produced and actual fixed production overheads were Rs. 340,000.

The total cost variance for fixed production overhead (over/under absorption) is calculated as follows:

	Rs.
Fixed production overhead absorbed in the period: = Actual units produced × Fixed production overhead per unit = 7,800 units ×Rs. 45 per unit	351,000
Actual fixed production overhead incurred in the period	(340,000)
Fixed production overhead variance total (A)	11,000 F

The amount of fixed production overhead absorption rate is a function of the budgeted fixed production overhead expenditure and the budgeted production volume.

The total variance can be explained in these terms.

5.2 Fixed production overhead expenditure variance

A fixed production overhead expenditure variance is very easy to calculate. It is simply the difference between the budgeted fixed production overhead expenditure and actual fixed production overhead expenditure.

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▶ *Calculation of fixed production overhead expenditure variance:*

	Rs.
Budgeted fixed production overhead	X
Actual fixed production overhead incurred	(X)
Fixed production overhead expenditure variance Favourable (Adverse)	X (X)

An adverse expenditure variance occurs when actual fixed overhead expenditure exceeds the budgeted fixed overhead expenditure.

A favourable expenditure variance occurs when actual fixed overhead expenditure is less than budget.

▶ *Example 24:*

Following is the fixed overheads standard cost of Shakeel Limited.

1.8 hours at Rs. 25 per hour = Rs. 45

The above standard cost is calculated at budgeted level of 7,500 units per month. In the month of March 2021, 7,800 units were produced and actual fixed production overheads were Rs. 340,000.

The fixed production overhead expenditure variance is calculated as follows:

	Rs.
Budgeted fixed production overheads (7,500 x 45)	337,500
Actual fixed production overhead incurred in the period	(340,000)
Fixed production overhead variance total (A)	(2,500) A

5.3 Fixed production overhead volume variance

The fixed production overhead volume variance measures the amount of fixed overheads under- or over-absorbed because of the fact that actual production volume differs from the budgeted production volume.

The volume variance is measured first of all in either unit of output or standard hours of the output units.

The volume variance in units (or standard hours of those units) is converted into a money value, as appropriate, at the standard fixed overhead cost per unit (or the standard fixed overhead rate

▶ *Calculation of Fixed production overhead volume variance:*

	Units
Actual production volume (the number of units produced)	X
Budgeted production volume	(X)
Fixed production overhead volume variance (units)	X
Standard absorption rate per unit	X
Fixed production overhead volume variance(Rs.) Favourable (Adverse)	X (X)

Formula method	Rupees
(AU – BU) x FOAR/unit	
Where	
AU = Actual units produced	
BU = Budgeted units (production)	
FOAR/unit = Standard fixed overhead absorption rate per unit	

When actual activity volume exceeds the budget, there will be over-absorption of fixed overheads, which is a 'favourable' variance. When actual activity volume is less than budget, there will be under-absorption of fixed overhead, which is an 'adverse' variance.

When overheads are absorbed on the basis of direct labour hours or machine hours, the actual hours worked might be higher or lower than budgeted. The reasons for a favourable or an adverse volume variance might therefore be any of the following.

- Working more hours than budgeted might be caused by working overtime, or taking on additional direct labour employees.
- Working fewer hours than budgeted might be caused by staff shortages (due to employees leaving or absence from work), hold-ups in production or lack of customer orders.

▶ *Example 25:*

Following is the fixed overheads standard cost of Shakeel Limited.

1.8 hours at Rs. 25 per hour = Rs. 45

The above standard cost is calculated at budgeted level of 7,500 units per month. In the month of March 2021, 7,800 units were produced and actual fixed production overheads were Rs. 340,000.

The volume variance is calculated as follows:

	Units
Actual number of units produced	7,800
Budgeted production	7,500
Fixed production overhead volume variance(units) (F)	300
Fixed production overhead per unit	Rs. 45
Fixed production overhead volume variance(Rs.) (A)	Rs. 13,500

Alternate way of calculating the fixed production overhead volume variance is as under.

Fixed production overhead volume variance	Rupees
(AU – BU) x FOAR/Unit	
(7,800 – 7,500) x 45	13,500 F

Analysis of Total fixed production overhead variance, calculated in example 23-24 and 25 is given below.

Summary of fixed production overhead variances	Rs.	
Expenditure variance	(2,500)	Adverse
Volume variance	13,500	Favourable
Total variance	11,000	Favourable

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► *Example 26:*

A company budgeted to make 5,000 units of a single standard product in Year 1.

Budgeted direct labour hours are 10,000 hours.

Budgeted fixed production overhead is Rs. 40,000.

Actual production in Year 1 was 5,200 units, and fixed production overhead was Rs. 40,500.

The total fixed production overhead cost variance, the fixed overhead expenditure variance and the fixed overhead volume variance for the year, would be as follows

Standard fixed overhead cost per unit = Rs.8 (Rs. 40,000/Rs.5,000 units)

Fixed production overhead total cost variance	Rs.	
5,200 units: standard fixed cost (×Rs.8) = fixed overhead absorbed	41,600	
Actual fixed overhead cost expenditure	(40,500)	
Fixed production overhead total cost variance	1,100	(F)

The variance is favourable, because fixed overhead costs have been over absorbed.

Fixed overhead expenditure variance	Rs.	
Budgeted fixed production overhead expenditure	40,000	
Actual fixed production overhead expenditure	(40,500)	
Fixed overhead expenditure variance	(500)	(A)

This variance is adverse because actual expenditure exceeds the budgeted expenditure.

Fixed overhead volume variance	units of production	
Actual production volume in units	5,200	
Budgeted production volume in units	(5,000)	
Fixed overhead volume variance in units	200	(F)
Standard fixed production overhead cost per unit	Rs.8	
Fixed overhead volume variance in Rs.	Rs.1,600	(F)

This variance is favourable because actual production volume exceeded the budgeted volume

Summary	Rs.	
Fixed overhead expenditure variance	(500)	(A)
Fixed overhead volume variance	1,600	(F)
Fixed overhead total cost variance	1,100	(F)

5.4 Fixed production overhead efficiency and capacity variances

Volume variance can be further analysed into two variances, termed as capacity variance and efficiency variance.

- The company has worked a different number of hours than budgeted for a variety of reasons. They have operated at a different capacity.
- During the hours worked the company has operated at a different level of efficiency to that budgeted.

Fixed production overhead efficiency variance

This is exactly the same, in hours, as the direct labour efficiency variance and the variable production overhead efficiency variance.

It is converted into a money value at the standard fixed overhead rate per hour.

- *Calculation of fixed production overhead efficiency variance:*

	Hours
Standard hours used to make the actual production	X
Actual hours used to make the actual production	(X)
Efficiency variance (hours)	X (X)
Standard Fixed production overhead rate per hour (multiply by)	X
Efficiency variance (Rs.) Favourable (Adverse)	X (X)

Formula method	Rupees
(SH – AH) x FOAR/hour	
Where	
SH = Standard hours to produce actual units	
AH = Actual hours	
FOAR/hour = Standard fixed overhead absorption rate per hour	

- *Example 27:*

Following is the fixed overheads standard cost of Shakeel Limited.

1.8 hours at Rs. 25 per hour = Rs. 45

The above standard cost is calculated at budgeted level of 7,500 units per month. In the month of March 2021, 7,800 units were produced and actual fixed production overheads were Rs. 340,000. Actual labour hours worked were 14,000.

Fixed production overhead efficiency variance is calculated as follows:

	Hours
Standard: Making 7,800 units should have used (@ 1.8 hours per unit)	14,040
Actual: Making 1,000 units did use	(14,000)
Efficiency variance (hours) (F)	40
Standard FOAR/ hour	Rs. 25
Efficiency variance (Rs.) (F)	Rs. 1,000

Fixed production overhead efficiency variance	Rupees
(SH – AH) x FOAR/hour	
(7,800 x 1.8 – 14,000) x 25	1,000 F

Fixed production overhead capacity variance

This is the difference between the budgeted and actual hours worked (excluding any idle time hours). It is converted into a money value at the standard fixed overhead rate per hour.

- *Calculation of fixed production overhead capacity variance:*

Fixed production overhead capacity variance	Hours
Actual number of hours worked	X
Budgeted hours to be worked	(X)
Capacity variance (hours)	X (X)
Standard cost per hour (multiply by)	X
Capacity variance (Rs.) Favourable (Adverse)	X (X)

Formula method	Rupees
(AH – BH) x FOAR/hour	
Where	
BH = Budgeted hours to produce budgeted units	
AH = Actual hours	
FOAR/hour = Standard fixed overhead absorption rate per hour	

- *Example 28:*

Following is the fixed overheads standard cost of Shakeel Limited. 1.8 hours at Rs. 25 per hour = Rs. 45

The above standard cost is calculated at budgeted level of 7,500 units per month. In the month of March 2021, 7,800 units were produced and actual fixed production overheads were Rs. 340,000. Actual labour hours worked were 14,000.

The fixed production overhead capacity variance is calculated as follows:

Fixed overhead capacity variance	Hours
Actual number of hours worked	14,000
Budgeted hours to be worked (7,500 x 1.8)	(13,500)
Capacity variance (hours) (F)	500
Standard FOAR per hour (multiply by)	Rs. 25
Capacity variance y variance (Rs.) (F)	Rs. 12,500

Alternate way of solving the fixed production capacity variance with the help of formula, is given below.

Fixed production overhead capacity variance	Rupees
(AH – BH) x FOAR/hour	
(14,000 – 7,500 x 1.8) x 25	12,500 F

Summary of fixed production overhead volume variance, as calculated in example 25, is given below.

Summary	Rs.	
Fixed overhead efficiency variance	1,000	F
Fixed overhead capacity variance	12,500	(F)
Fixed overhead volume variance	13,500	(F)

▶ *Example 29:*

The budgeted capacity of Manju Company for product A and B were 9,000 and 12,000 units respectively. At this level fixed production overhead rate was Rs. 10 and Rs. 15 per unit for product A and B respectively. Fixed overhead absorption rate is Rs. 5 per labour hour.

During the month of January, actual data is given as under:

	Product A	**Product B**
Sales	10,000 units	12,000 units
Production	8,000 units	14,000 units

Actual fixed production overhead for January was Rs. 260,000 and actual labour hours were recorded at 59,500 hours.

Calculation of total fixed production overhead variance and split it into fixed production overhead expenditure and efficiency variances. Also prepare analysis table for calculated variances, is given below.

Fixed production overhead total cost variance	**Rs.**	
Produce A: 8,000 units: standard fixed cost (×Rs.10)	80,000	
Produce B: 14,000 units: standard fixed cost (×Rs.15)	210,000	
Total fixed production overhead absorbed	290,000	
Actual fixed production overheads	(260,000)	
Fixed production overhead total variance (F)	30,000	(F)

Fixed overhead expenditure variance	**Rs.**	
Budgeted fixed production overheads:		
Product A: 9,000 x 10	90,000	
Product B: 12,000 x 15	180,000	
	270,000	
Actual fixed production overheads	(260,000)	
Fixed overhead expenditure variance	10,000	(F)

Fixed overhead volume variance	**Rupees**	
(AU – BU) x FOAR/unit		
Product A:		
(8,000 – 9,000) x 10	10,000	(A)
Product B:		
(14,000 – 12,000) x 15	30,000	(F)
Fixed overhead volume variance	**20,000**	**(F)**

Summary	**Rs.**	
Fixed overhead expenditure variance	10,000	F
Fixed overhead volume variance	20,000	(F)
Fixed overhead total cost variance	**30,000**	**(F)**

Calculation of fixed production overhead capacity and efficiency variances, and analysis of volume variance in summary statement, is given below.

Fixed overhead capacity variance	Rupees	
(AH –s BH) x FOAR/hour		
(59,500 – 54,000) x 5	27,500	(F)
W-1 Calculation of budgeted hours		
Product A (9,000 x 10/5)	18,000	
Product B (12,000 x 15/5)	36,000	
Budgeted hours	54,000	
Fixed overhead efficiency variance	**Rupees**	
(SH – AH) x FOAR/hour		
(58,000 – 59,500) x 5	7,500	(A)
W-1 Calculation of standard hours		
Product A (8,000 x 10/5)	16,000	
Product B (14,000 x 15/5)	42,000	
Budgeted hours	58,000	

Summary	Rs.	
Fixed overhead capacity variance	27,500	F
Fixed overhead efficiency variance	(7,500)	(A)
Fixed overhead volume variance	**20,000**	**(F)**

5.5 Fixed production overheads: possible causes of variances

Some of the possible causes of fixed production overhead variances include the following.

Fixed overhead expenditure variance

- Poor control over overhead spending (adverse variance) or good control over spending (favourable variance).
- Poor budgeting for overhead spending. If the budget for overhead expenditure is unrealistic, there will be an expenditure variance due to poor planning rather than poor expenditure control.
- Unplanned increases or decreases in items of expenditure for fixed production overheads, for example, an unexpected increase in factory rent.

Fixed overhead volume variance

A fixed overhead volume variance can be explained by anything that made actual output volume different from the budgeted volume. The reasons could be:

- Efficient working by direct labour: a favourable labour efficiency variance results in a favourable fixed overhead efficiency variance.
- Working more hours or less hours than budgeted (capacity variance).
- An unexpected increase or decrease in demand for a product, with the result that shorter/longer hours were worked (adverse/favourable capacity variance)
- Strike action by the workforce, resulting in a fall in output below (adverse capacity variance).
- Extensive breakdowns in machinery, resulting in lost production (adverse capacity variance).

5.6 Journal Entries to absorb fixed production overhead to product cost in standard costing

Description	Debit	Credit
	-------- Rupees --------	
Work in progress control (SH x FOAR)	X	
Adverse variances	X	
Favourable variances		X
Production overhead control		X
(Record charging fixed production overheads to production)		

- *Example 29:*

ST Company operates a standard costing system for its only product. The standard cost card relating to fixed production overhead showed as 2 hours at Rs. 10 per hour.

Fixed production overhead are absorbed on the basis of labour hours. Fixed overhead costs are budgeted at Rs. 12,000 per annum, arising at a constant rate during the year.

Actual production during this period was 60 units, with actual fixed production overhead costs being Rs. 980.

Calculation of fixed production overhead expenditure and volume variance, along with entry to absorb fixed production overhead in standard costing, is given below.

Fixed production overhead expenditure variance	Rupees
Budgeted fixed cost – actual fixed cost	
(12,000/12) – 980	20 F
Fixed production overhead volume variance	**Rupees**
(AU- BU) x FOAR/ Unit	
(60- [12,000/20= 600/12= 50) x 20	200 F

Description	Debit	Credit
	-------- Rupees --------	
Work in progress control (60 x 2 x10)	1,200	
Fixed production overhead expenditure variance		20
Fixed production overhead volume variance		200
Production overhead control		980
(Record charging fixed production overheads to production)		

6. SALES VARIANCES

Sales variances are calculated to analyse the performance of the sales function or revenue center on broadly similar terms to those for manufacturing costs as discussed in above ratios. The most significant feature of sales variance calculation is that they are calculated in terms of profit or contribution margin (depending upon method of costing whether absorption or marginal), instead of its sales value.

This section of sales variances is divided into two categories. The sales variances in both sections are same but calculation is different in both because of different costing techniques. These are given as under.

6.1 Sales variances in marginal costing

As we have already discussed in previous chapters that in marginal costing only variable costs are accounted for in order to calculate the contribution margin. Fixed cost is treated as period cost.

In this section, two variances are calculated, first is known as sales price variance and sales contribution volume variance. These are described in below sections.

6.1.1 Sales price variance

Sales price variance is the difference between actual and standard price. If actual price is greater than standard price, then variance is favourable, otherwise it is treated as adverse. In order to calculate sales price variance for the period, the result of above difference is multiplied with actual units sold.

- *Calculation of sales price variance:*

Sales price variance	Rupees
Actual price per unit sold	X
Standard price per unit to be sold	(X)
Sales price variance per unit	X (X)
Actual units sold (multiply by)	X
Sales price variance (Rs.) Favourable (Adverse)	X (X)

Formula method	Rupees
(AP – SP) x AU	
Where	
AP = Actual price per unit	
SP = Standard price per unit	
AU = Actual units sold	

- *Example 30:*

J Limited operates a standard costing accounting system. The following information has been extracted from its standard cost card and budgets:

Budgeted sales volume in units	5,000
Budgeted selling price per unit in Rs.	100
Standard variable cost per unit in Rs.	56
Standard total cost per unit in Rs.	75

J Limited is using marginal cost accounting system and its actual sales were 4,500 units at a selling price of Rs. 120 per unit.

Calculation of sales price variance, is calculated as under.

Sales price variance	Rupees
Actual price per unit sold	120
Standard price per unit to be sold	100
Sales price variance per unit (F)	20
Actual units sold	4,500
Sales price variance (Rs.) Favourable	90,000

Formula method	Rupees
(AP – SP) x AU	
(120-100) x 4,500	90,000 F

6.1.2 Sales contribution volume variance

To ascertain the changes in sales volume, we have to measure the difference between actual units sold and budgeted sales in units. To convert it into monetary value, the result is multiplied by contribution per unit. Contribution margin is derived after deducting the variable costs from sales.

- *Calculation of sales contribution volume variance:*

Sales contribution volume variance	Rupees
Standard contribution generated from actual units sold	X
Standard contribution to be generated from budgeted units sold	(X)
Sales price variance (Rs.) Favourable (Adverse)	X (X)

Formula method	Rupees
(AU – BU) x SC/U	
Where	
AU = Actual units sold	
BU = Budgeted units	
SC/U = Standard contribution per unit	

- *Example 31:*

J Limited operates a standard costing accounting system. The following information has been extracted from its standard cost card and budgets:

Budgeted sales volume in units	5,000
Budgeted selling price per unit in Rs.	100
Standard variable cost per unit in Rs.	56
Standard total cost per unit in Rs.	75

J Limited is using marginal cost accounting system and its actual sales were 4,500 units at a selling price of Rs. 120 per unit.

Calculation of sales contribution volume variance, is calculated as under.

Sales contribution volume variance	Rupees
Standard contribution generated from actual units sold (4,500 x 44)	198,000
Standard contribution to be generated from budgeted units sold (5,000 x 44)	(220,000)
Sales contribution volume variance (Rs.) (Adverse)	(22,000)

Formula method	Rupees
(AU – BU) x SC/U	
(4,500 – 5,000) x 44	(22,000) A

6.2 Sales variances in absorption costing

Absorption costing is technique in which fixed production cost is part of product cost.

In this section, two variances are calculated, first is known as sales price variance and sales profit volume variance. The only difference is that standard profit per unit is used, instead of standard contribution per unit. These are described in below sections.

6.2.1 Sales price variance

Sales price variance in absorption costing is same as discussed in marginal costing. There is no difference in sales price variance whether marginal costing or absorption costing is in use.

6.2.2 Sales contribution volume variance

To ascertain the changes in sales volume, we have to measure the difference between actual units sold and budgeted sales in units. To convert it into monetary value, the result is multiplied by profit per unit. Profit is derived after deducting the variable cost and fixed production cost from sales.

- *Calculation of sales profit volume variance:*

Sales profit volume variance	Rupees
Standard profit generated from actual units sold	X
Standard profit to be generated from budgeted units sold	(X)
Sales volume variance (Rs.) Favourable (Adverse)	X (X)

Formula method	Rupees
(AU – BU) x SP/U	
Where	
AU = Actual units sold	
BU = Budgeted units	
SP/U = Standard profit per unit	

- *Example 32:*

J Limited operates a standard costing accounting system. The following information has been extracted from its standard cost card and budgets:

Budgeted sales volume in units	5,000
Budgeted selling price per unit in Rs.	100
Standard variable cost per unit in Rs.	56
Standard total cost per unit in Rs.	75

J Limited is using marginal cost accounting system and its actual sales were 4,500 units at a selling price of Rs. 120 per unit.

Calculation of sales contribution volume variance, is calculated as under.

Sales contribution volume variance	Rupees
Standard contribution generated from actual units sold (4,500 x 25)	112,500
Standard contribution to be generated from budgeted units sold (5,000 x 25)	(125,000)
Sales contribution volume variance (Rs.) (Adverse)	(12,500)

Formula method	Rupees
(AU – BU) x SC/U	
(4,500 – 5,000) x 25	(12,500) A

- *Example 33:*

Jolt Limited operates a standard costing system. The following information has been extracted from its standard cost card and budgets:

Budgeted sales volume in units	150,000
Budgeted selling price per unit in Rs.	5
Standard variable cost per unit in Rs.	2.80
Standard total cost per unit in Rs.	3.75

The actual production during a period was 140,000 units and total revenue generated was Rs. 840,000.

Calculation of sales price variance and sales volume variance under both costing techniques, is given below.

Sales price variance	Rupees
(AP – SP) x AU	
(6-5) x 140,000	140,000 F
Actual price (AP) = 270,000/140,000 = Rs. 6	

Sales contribution volume variance	Rupees
(AU – BU) x Standard contribution per unit	
(140,000-150,000) x 2.20	(22,000) A

Sales profit volume variance	Rupees
(AU – BU) x Standard profit per unit	
(140,000-150,000) x 1.25	(12,500) A

7. INTERRELATIONSHIPS BETWEEN VARIANCES

7.1 The nature of interrelationships between variances

The reasons for variances might also be connected, and two or more variances might arise from the same cause. This is known as an interrelationship between two variances. In simple words, a single reason might put impact on two or more variances. For example, use of high quality material put adverse impact on material price variance because of high price paid, but on other side, the material usage variance might be favourable because of decline in wastage.

In this situation, the management should not analyse variance separately, rather the interrelated variances should be analysed in combination. When this happens, management should look at the two variances together, in order to assess their significance and decide whether control action is needed.

Few interrelationships between variances examples are given below.

7.2 Materials price and usage

A materials price variance and usage variance might be interrelated. For example, if a company decides to use a material for production that is more expensive than the normal or standard material, but easier to use and better in quality, there will be an adverse price variance. However, a consequence of using better materials might be lower wastage. If there is less wastage, there will be a favourable material usage variance. Therefore, using a different quality of material can result in an adverse price variance and a favourable usage variance.

7.3 Labour rate and efficiency

If there is a change in the grade of workers used to do some work, both the rate and efficiency variances may be affected.

For example, if a lower grade of labour is used instead of the normal higher grade:

- there should be a favourable rate variance because the workers will be paid less than the standard rate
- however, the lower grade of labour may work less efficiently and take longer to produce goods than the normal higher grade of labour would usually take. If the lower grade of labour takes longer, then this will give rise to an adverse efficiency variance.

Therefore, the change in the grade of labour used results in two 'opposite' variances, an adverse efficiency variance and a favourable rate variance.

When inexperienced employees are used, they might also waste more materials than more experienced employees would, due to mistakes that they make in their work. The result might be not only adverse labour efficiency, but also adverse materials usage.

7.4 Labour rate and variable overhead efficiency

When a production process operates at a different level of efficiency the true cost of that difference is the sum of any costs associated with labour hours. Therefore, the issues described above also affect the variable overhead efficiency variance.

7.5 Capacity and efficiency

If a production process operates at a higher level of efficiency that might mean that it does not have to operate for as long to produce the budgeted production volume. The favourable fixed production overhead efficiency variance would cause an adverse fixed production overhead capacity variance.

The reverse is also true. If a production process operates at a lower level of efficiency that might mean that it has to operate for longer than was budgeted. The adverse efficiency fixed production overhead variance would cause a favourable fixed production overhead capacity variance.

7.6 Footnote: the importance of reliable standard costs

It is important to remember that the value of variances as control information for management depends on the reliability and accuracy of the standard costs. If the standard costs are inaccurate, comparisons between actual cost and standard cost will have no meaning. Adverse or favourable variances might be caused by inaccurate standard costs rather than by inefficient or efficient working.

8. OPERATING STATEMENT

8.1 Standard marginal costing

Operating statement is control statement which represents all possible variances in order to reconcile the budgeted profit with actual profit.

Under standard marginal costing, all variances related to sales, direct material, direct labour, variable production overheads are added in the operating statement.

An operating statement starts off with the expected figure of budgeted contribution and ends up with the actual contribution and then fixed production overhead actual is deducted to calculate the actual profit. Any favourable variance is added in budgeted contribution and adverse variance is deducted.

Format of operating statement is given below.

Operating statement – Marginal costing			Rupees
Budgeted contribution (Budgeted sales in units x standard cont. per unit)			X
Sales price variance (Add: Favourable and Less: Adverse)			X (X)
Sales contribution volume variance			X (X)
			X
Cost variances:	Fav.	Adv.	
Material price variance			
Material usage variance			
Labour rate variance			
Labour efficiency variance			
Labour idle time variance			
Variable production overhead expenditure variance			
Variable production overhead efficiency variance			X (X)
Actual contribution			X
Less: Actual fixed production overhead			(X)
Actual profit			X

The following comprehensive explains the concept of operating statement under marginal costing.

► *Example 34:*

MJ Limited manufactures one standard product and operates a system of variance accounting using a fixed budget. As assistant management accountant, you are responsible for preparing the monthly operating statements. Data from the budget, the standard product cost and actual data for the month of October are given below.

Budgeted and standard cost data:	Units
Budgeted sales and production	6,000
Standard cost for each unit of product:	**Rupees**
Material MM (15 kg at Rs. 2 per kg)	30.00
Material NN (10 kg at Rs. 2.50 per kg)	25.00
Direct wages (7.5 hours at Rs. 10 per hour)	75.00
Variable production overhead (7.5 hours at Rs. 6 per hour)	45.00

Budgeted and standard cost data:	Units
Fixed production overhead (80% of direct wages)	60.00
	235.00
Budgeted profit (20% of sales price)	58.75
Budgeted sales price	293.75

Actual data for the month of October:	Rs.
Production and sales 5,800 units at a price of Rs. 280 per unit.	1,624,000
Direct materials MM consumed 90,000 kg at Rs. 1.90 per kg	171,000
Direct materials NN consumed 55,000 kg at Rs. 2.70 per kg	148,500
Direct wages incurred 45,000 hours at Rs. 10.80 per hour	486,000
Variable production overhead incurred	268,000
Fixed production overhead incurred	352,000

Operating statement along with all possible variances for the month of October under marginal costing is given below.

Operating statement – Marginal costing			Rs.
Budgeted contribution (6,000 x 118.75)			712,500
Sales price variance			(79,750)
Sales contribution volume variance			(23,750)
			609,000
Cost variances:	**Fav.**	**Adv.**	
Material price variance-MM	9,000		
Material price variance-NN		11,000	
Material usage variance-MM		6,000	
Material usage variance-NN	7,500		
Labour rate variance		36,000	
Labour efficiency variance		15,000	
Variable production overhead expenditure variance	2,000		
Variable production overhead efficiency variance		9,000	
Actual contribution	18,500	77,000	(58,500)
			550,500
Less: Actual fixed production overhead			(352,000)
Actual profit			198,500

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Calculation of all variances are given below.

Material price variance	Rupees
(SP – AP) x AQ	
MM- (2.00-1.90) x 90,000	9,000 F
NN- (2.50-2.70) x 55,000	(11,000) A
Material usage variance	**Rupees**
(SQ – AQ) x SP	
MM- (87,000-90,000) x 2	(6,000) A
NN- (58,000-55,000) x 2.50	7,500 F
Labour rate variance	**Rupees**
(SR – AR) x AH	
(10.00-10.80) x 45,000	(36,000) A
Labour efficiency variance	**Rupees**
(SH – AH) x SR	
(43,500-45,000) x 10	(15,000) A
Variable production overhead expenditure variance	**Rupees**
(AH x VOAR/H) – Actual Variable production overhead	
(45,000 x 6) -268,000	2,000 F
Variable production overhead efficiency variance	**Rupees**
(SH – AH) x VOAR/H	
(43,500 – 45,000) x 6	(9,000) A
Sales price variance	**Rupees**
(AP – SP) x AUS	
(280-293.75) x 5,800	(79,750) A
Sales contribution volume variance	**Rupees**
(AUS – BUS) x Standard contribution per unit	
(5,800 – 6,000) x 118.75	(23,750) A

8.2 Standard absorption costing

Under standard absorption costing, all variances related to sales, direct material, direct labour, variable production overheads and fixed production overheads are included in the operating statement.

An operating statement starts off with the expected figure of budgeted profit and ends up with the actual profit. Only difference between statements under marginal and absorption is that in absorption costing, few additional variances are included in operating statement which are fixed production overhead expenditure and volume. In addition, sales profit volume variance is replaced to sales contribution volume variance.

Format of operating statement is given below.

Operating statement – Absorption costing			Rs.
Budgeted profit (Budgeted sales in units x standard profit per unit)			X
Sales price variance (Add: Favourable and Less: Adverse)			X (X)
Sales profit volume variance			X (X)
			X

Cost variances:	Fav.	Adv.	
Material price variance			
Material usage variance			
Labour rate variance			
Labour efficiency variance			
Labour idle time variance			
Variable production overhead expenditure variance			
Variable production overhead efficiency variance			
Fixed production overhead expenditure variance			
Fixed production overhead volume variance			
	X	X	X (X)
Actual profit			X

- *Example 35:*

MJ Limited manufactures one standard product and operates a system of variance accounting using a fixed budget. As assistant management accountant, you are responsible for preparing the monthly operating statements. Data from the budget, the standard product cost and actual data for the month of October are given below.

Budgeted and standard cost data:	**Units**
Budgeted sales and production	6,000
Standard cost for each unit of product:	**Rupees**
Material MM (15 kg at Rs. 2 per kg)	30.00
Material NN (10 kg at Rs. 2.50 per kg)	25.00
Direct wages (7.5 hours at Rs. 10 per hour)	75.00
Variable production overhead (7.5 hours at Rs. 6 per hour)	45.00
Fixed production overhead (80% of direct wages)	60.00
	235.00
Budgeted profit (20% of sales price)	58.75
Budgeted sales price	293.75

Actual data for the month of October:	**Rs.**
Production and sales 5,800 units at a price of Rs. 280 per unit.	1,624,000
Direct materials MM consumed 90,000 kg at Rs. 1.90 per kg	171,000
Direct materials NN consumed 55,000 kg at Rs. 2.70 per kg	148,500
Direct wages incurred 45,000 hours at Rs. 10.80 per hour	486,000
Variable production overhead incurred	268,000
Fixed production overhead incurred	352,000

Operating statement along with all possible variances for the month of October under absorption costing is given below.

Operating statement – Absorption costing			Rs.
Budgeted profit (6,000 x 58.75)			352,500
Sales price variance			(79,750)
Sales profit volume variance			(11,750)
			261,000
Cost variances:	**Fav.**	**Adv.**	
Material price variance-MM	9,000		
Material price variance-NN		11,000	
Material usage variance-MM		6,000	
Material usage variance-NN	7,500		
Labour rate variance		36,000	
Labour efficiency variance		15,000	
Variable production overhead expenditure variance	2,000		
Variable production overhead efficiency variance		9,000	
Fixed production overhead expenditure variance	8,000		
Fixed production overhead volume variance		12,000	
	26,500	89,000	(62,500)
Actual profit			198,500

The Calculation of all variances are given below.

Material price variance	Rupees
(SP – AP) x AQ	
MM- (2.00-1.90) x 90,000	9,000 F
NN- (2.50-2.70) x 55,000	(11,000) A

Material usage variance	Rupees
(SQ – AQ) x SP	
MM- (87,000-90,000) x 2	(6,000) A
NN- (58,000-55,000) x 2.50	7,500 F

Labour rate variance	Rupees
(SR – AR) x AH	
(10.00-10.80) x 45,000	(36,000) A

Labour efficiency variance	Rupees
(SH – AH) x SR	
(43,500-45,000) x 10	(15,000) A

Variable production overhead expenditure variance	Rupees
(AH x VOAR/H) – Actual Variable production overhead	
(45,000 x 6) -268,000	2,000 F

Variable production overhead efficiency variance	Rupees
(SH – AH) x VOAR/H	
(43,500 – 45,000) x 6	(9,000) A

Fixed production overhead Expenditure variance	Rupees
Budgeted cost – Actual cost	
(6,000 x 60 – 352,000)	8,000 F

Fixed production overhead volume variance	Rupees
(AU – BU) x FOAR/U	
(5,800 – 6,000) x 60	(12,000) A

Sales price variance	Rupees
(AP – SP) x AUS	
(280-293.75) x 5,800	(79,750) A

Sales profit volume variance	Rupees
(AUS – BUS) x Standard profit per unit	
(5,800 – 6,000) x 58.75	(11,750) A

9. MATERIALS MIX AND YIELD VARIANCES

9.1 Total material Usage Variance

When standard costing is used for products which contain two or more items of direct material, the total materials usage variance can be calculated by calculating the individual usage variances in the usual way and adding them up (netting them off).

► *Example 36:*

Product X is produced from three direct materials, A, B and C, that are mixed together in a process. The following information relates to the budget and output for the month of January

Standard cost:				Actual:
Material	Quantity	Standard price per kilo	Standard cost	Quantity used
	kg	Rs.	Rs.	kg
A	1	20	20	160
B	1	22	22	180
C	8	6	48	1,760
	10		90	2,100
Output	1 unit			200 units

Usage variances can be calculated in the usual way:

Making 200 units should have used:	A (kgs)	B (kgs)	C (kgs)
200 × 1 kg of A	200		
200 × 1 kg of B		200	
200 × 8 kgs of C			1,600
Making 200 units did use:	(160)	(180)	(1,760)
Usage variance in kgs	40 (F)	20 (F)	(160) (A)
Standard cost per kg	20	22	6
Usage variance in Rs.	800 (F)	440 (F)	(960) (A)
Total usage variance = Rs. 280 (F) (800 + 440 -960)			

Substitutable materials

If the materials are substitutable (i.e. less of one type of material can be compensated for by more of another) the direct materials usage variance can be analyzed into:

- a materials mix variance; and
- a materials yield variance

The total of these two variances is the total material usage variance.

It is vital to understand that this further analysis should only be performed if the materials can be substituted for each other. Mix and yield variances have a useful meaning only when the proportions (or 'mix') of the different raw materials in the final product can be varied and so are subject to management control.

- In the above example fewer kilograms of A but more kilograms of B and C than expected were used to make 200 units. The mix changed and this had an effect on the yield.
- In contrast, if a company manufactured a car, no number of extra tyres could compensate for one less engine! Mix and yield variances are irrelevant in this case.

9.2 Direct materials mix variance

The materials mix variance measures how much of the total usage variance is attributable to the fact that the actual combination or mixture of materials that was used was more expensive or less expensive than the standard mixture for the materials.

The mix component of the usage variance therefore indicates the effect on costs of changing the combination (or mix or proportions) of material inputs in the production process.

The materials mix variance is calculated as follows (making reference to the example above):

► *Example 37:*

Material	Actual mix (kgs)	Standard mix	Mix variance (kgs)	Std. cost per kg	Mix variance (Rs.)
A	160	(10% × 2,100) 210	50 (F)	20	1,000 (F)
B	180	(10% × 2,100) 210	30 (F)	22	660 (F)
C	1,760	(80% × 2,100) 1,680	(80) (A)	6	(480) (A)
	2,100	2,100	0		1,180 (F)

For each individual item of material, the mix variance is favourable when the actual mix is less than the standard mix, and the mix variance is adverse when actual usage exceeds the standard mix.

The total mix variance is favourable in this example because the actual mix of materials used is cheaper than the standard mix.

9.3 Direct materials yield variance

The materials yield variance is the difference between the actual yield from a given input and the yield that the actual input should have given in standard terms. It indicates the effect on costs of the total materials inputs yielding more or less output than expected.

The yield variance can be calculated in several ways. No one method is better than any other (use the one that makes most sense to you).

Working

Based on the above example note that:

- The standard cost of each unit (kg) of input = Rs. 90/10kg = Rs. 9 per kg
- The standard cost of each unit of output = Rs. 90 per unit

Method 1: Based on output

This compares the actual yield to the expected yield from the material used. The difference is then valued at the standard cost of output.

In the above example 10 kg of material in should result in 1 unit of output.

Therefore, 2,100 kg of material in should result in 210 units of output.

The difference between this figure and the actual output is the yield variance as a number of units. This is then multiplied by the expected cost of a unit of output.

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▶ *Example 38:*

	Units	
2,100 kgs of input should yield (@10 kg per unit)	210	
2,100 kgs of input did yield	200	
Yield variance (units)	10	(A)
Standard cost of output	Rs. 90	
Materials yield variance (Rs.)	Rs. 900	(A)

Method 2: Based on inputs

This compares the actual usage to achieve the yield to the expected usage to achieve the actual yield. The difference is then valued at the standard cost of input.

In the above example 1 unit should use 10 kg of input.

Therefore, 200 units should use 2,000 kg of input.

The difference between this figure and the actual input is the yield variance as a number of units. This is then multiplied by the expected cost of a unit of output.

▶ *Example 39 (Contd. From previous example 38):*

	Units	
200 units of product X should use (× 10 kgs)	2,000	
did use	2,100	
Yield variance in quantities	100	(A)
Standard cost of input	Rs. 9/kg	
Yield variance in money value	Rs. 900	(A)

Summary

Mix variance + yield variance = usage variance

	Rs.	
Mix variance	1,180	(F)
Yield variance	(900)	(A)
Usage variance (= mix + yield variances)	280	(F)

9.4 Factors to consider when changing the mix

Identification of the optimum mix involves consideration of several factors:

- Cost. The cheapest mix may not be the most cost effective. Often a favourable mix variance is offset by an adverse yield variance and the total cost per unit may increase.
- Quality. Using a cheaper mix may result in a lower quality product and the customer may not be prepared to pay the same price. A cheaper product may also result in higher sales returns and loss of repeat business.
- The fall in quality would make the company vulnerable to reputational risk.

10. WORKING BACKWARDS

10.1 Calculating actual cost from variances and standard cost

In your examination, you might be given a question where you are required to:

- calculate actual costs, given information about variances and standard costs, or
- calculate standard cost, given information about variances and actual costs.

This type of problem does not occur in practice, but it is a useful way of testing knowledge of variances.

Following examples will be used to illustrate the technique.

▶ *Example 40:*

The standard direct materials cost of making Product B is Rs.20, consisting of 4 kilos of material at Rs.5 per kilo.

During one period, 1,250 kilos of the material were purchased and the direct materials price variance was Rs.250 (A).

The actual costs of direct materials purchased and used in the period, would be calculated as follows

A table should be prepared showing how the total materials cost variance is calculated, and the figures that are available should be entered in the table.

		Rs.
(SP – AP) x AQ	=	(250)
(5.00 – AP) x 1,250	=	(250)
Hence, Actual price is		5.20

Actual purchase costs were higher than standard cost because the price variance is adverse. Actual purchase costs were therefore Rs.6,250 + Rs.250 = Rs.6,500.

▶ *Example 41:*

The standard direct material cost of Product C is Rs.21 (6 kilos of material at Rs.3.50 per kilo). During a period when 400 units of Product C were made, the direct material usage variance was Rs.630 (F).

The actual quantity of direct materials used in the period, would be calculated as follows:

A table should be prepared showing how the materials usage variance is calculated, and the figures that are available should be entered in the table.

Materials usage variance		Rs.
(SQ – AQ) x SP	=	630
(400x 6 – AQ) x 3.50	=	630
Hence, actual quantity	=	2,220

▶ *Example 42:*

In the standard cost of Product D, the cost of Grade A labour is Rs.24 per unit (= 1.5 hours per unit at Rs.16 per hour). During a month when 500 units of Product D were made and 780 hours were worked, the labour rate variance for Grade A labour was Rs.1,560 (F).

The actual cost of Grade A labour in the month, would be calculated as follows

Easy way is to calculate it by putting the given values in direct labour rate variance and then calculate the equation to get the desired answer.

Direct labour rate variance
(SR – AR) x AH = 1,560
(16.00- AR) x 780 = 1,560
Hence, AR = 14.00
Actual labour cost (780 x 14) = Rs. 10,920

- *Example 43:*

In a standard absorption costing system, the standard fixed production overhead cost per unit of Product E is Rs.36. This represents 3 direct hours at Rs.12 per hour.

The budgeted production volume in the period was 6,000 units of Product E. The fixed production overhead volume variance was Rs.12,600 (F).

The actual quantity of Product E that was produced, would be calculated as follows

A table should be prepared showing how the production overhead volume variance is calculated, and the figures that are available should be entered in the table.

Fixed overhead volume variance	units of production	
Budgeted production volume in units	6,000	
Actual production volume in units	?	
Fixed overhead volume variance in units	?	(F)
Standard fixed production overhead cost per unit	Rs.36	
Fixed overhead volume variance in Rs.	Rs.12,600	(F)

We know the volume variance in Rs. The volume variance is valued at the standard fixed overhead cost per unit. The volume variance in Rs. can therefore be converted into a volume variance in units as follows:

Rs. 12,600(F)/Rs.36 per unit = 350 units (F).

Actual production volume is higher than the budgeted volume, because the volume variance is favourable. The budgeted production volume was 6,000 units.

Actual production volume = 6,000 units + 350 units = 6,350 units.

10.2 Calculating standard cost from variances and actual cost

The same approach can be used to calculate a standard cost or budget amount if you are given a variance and data about actual costs (or sales revenues). Some further examples will illustrate the technique.

- *Example 44:*

Product F uses a direct material, material M. The standard price of material M is Rs.4 per kilo. During one month, 2,500 units of Product F were manufactured. These required 12,000 kilos of material M and the material usage variance was Rs.2,000 (A).

We know the standard price of material M, but we need to calculate the standard material usage. This can be obtained from the data provided. A table should be prepared showing how the material usage variance is calculated, and the figures that are available should be entered in the table.

Materials usage variance	kilos	
2,500 units of Product F should use	?	
They did use	12,000	
Material usage variance in kilos	?	
Standard price per kilo	Rs.4	
Material usage variance in Rs.	2,000	(A)

We know the material usage variance in Rs.. The variance is valued at the standard price per unit of material. From the information provided we can therefore calculate the material usage variance in kilos:

Usage variance = Rs.2,000(A)/Rs.4 per kilo = 500 kilos (A).

The variance is adverse, which means that actual usage was more than the standard (expected) usage. The standard material usage is therefore:

12,000 kilos – 500 kilos = 11,500 kilos.

This is the standard usage for 2,500 units of Product F, so the standard usage per unit is 11,500/2,500 = 4.60 kilos per unit.

The standard material cost for Product F is therefore:

4.6 kilos of material M at Rs.4 per kilo = Rs.18.40.

- *Example 45:*

The standard time required to make one unit of Product G is 1.25 hours of direct labour. During one month, total direct labour costs were Rs.119,000. The company made 6,800 units of Product G. These took 9,100 direct labour hours and the direct labour rate variance was Rs.8,400 (F).

The standard direct labour cost per unit of Product G, would be calculated as follows

We know the standard direct labour time, which is 1.25 hours per unit, but we need to calculate the standard direct labour rate per hour. This can be obtained from the data provided. A table should be prepared showing how the labour rate variance is calculated, and the figures that are available should be entered in the table.

Direct labour rate variance	Rs.	
9,100 hours should cost	?	
They did cost	119,000	
Direct labour rate variance	8,400	(F)

The rate variance is favourable, which means that actual costs were lower than standard costs. The actual labour cost for the 9,100 hours was Rs.119,000. Expected costs are higher.

The 9,100 hours should therefore cost Rs.119,000 + Rs.8,400 = Rs.127,400.

The standard rate per hour is Rs.127,400/9,100 hours = Rs.14 per hour.

The standard direct labour cost of Product G is:

1.25 hours at Rs.14 per hour = Rs.17.50

Tutorial note: It is easy to get confused about whether variances should be added or subtracted in this type of calculation. You need to think carefully and logically, to avoid making a mistake.

11. COMPREHENSIVE EXAMPLES

- *Example 01:*

A company makes a single product and uses standard absorption costing. The standard cost per unit is as follows:

	Rs. per unit
Direct materials	8
Direct labour	6
Fixed production overheads	12
	26

Budgeted production is 14,000 units per month. Last month, actual production was 14,800 units, and actual costs were as follows:

Total costs	Rs.
Direct materials	125,000
Direct labour	92,000
Fixed production overheads	170,000
	387,000

A statement for the month that reconciles budgeted costs, standard costs and actual costs would be prepared as follows

Reconciliation statement	Rs.	
Budgeted costs for the month (14,000 units × Rs.26)	364,000	
Extra standard costs of additional production (800 units × Rs.26)	20,800	
Standard costs of actual production (14,800 units × Rs.26)	384,800	
Cost variances		
Direct materials total cost variance	6,600	(A)
Direct labour total cost variance	3,200	(A)
Fixed overheads expenditure variance	2,000	(A)
Fixed overheads volume variance	9,600	(F)
Actual total costs in the month	387,000	

Workings: Direct materials total cost variance	Rs.	
14,800 units should cost (× Rs.8)	118,400	
They did cost	125,000	
Direct materials total cost variance	6,600	(A)

Direct labour total cost variance	Rs.	
14,800 units should cost (× Rs.6)	88,800	
They did cost	92,000	
Direct labour total cost variance	3,200	(A)

Fixed production overheads total cost variance	Rs.	
14,800 units: standard fixed overhead cost (× Rs.12)	177,600	
Actual fixed overhead cost	170,000	
Fixed production overheads total cost variance	7,600	(F)

Note: The fixed overhead total cost variance can be divided into:

a) an expenditure variance

b) a volume variance

Fixed production overheads expenditure variance	Rs.	
Budgeted fixed overhead expenditure (14,000 × Rs.12)	168,000	
Actual fixed overhead expenditure	170,000	
Fixed production overheads expenditure variance	2,000	(A)

Fixed production overheads volume variance	units	
Budgeted units of production	14,000	
Actual units produced	14,800	
Fixed production overheads volume variance in units	800	(F)
Standard fixed overheads per unit	Rs.12	
Fixed production overheads volume variance in Rs.	Rs.9,600	(F)

▶ *Example 02:*

a) Z Company uses a standard costing system and has the following labour cost standard in relation to one of its products:

4 hours of skilled labour at Rs.6.00 per hour: Rs.24.00

During October, 3,350 units of this products were made, which was 150 units less than budgeted. The labour cost incurred was Rs.79,893 and the number of direct labour hours worked was 13,450.

The direct labour rate and efficiency variances for the month, would be as follows:

Direct labour rate variance	Rs.	
13,450 hours should cost (× Rs.6)	80,700	
They did cost	79,893	
Labour rate variance	807	(F)

Direct labour efficiency variance	hours	
3,350 units should take (× 4 hours)	13,400	
They did take	13,450	
Efficiency variance in hours	50	(A)
Standard rate per hour	Rs.6	
Direct labour efficiency variance in Rs.	Rs.300	(A)

b) Company J uses a standard costing system and has the following data relating to one of its products:

	Rs. per unit	Rs. per unit
Selling price		9.00
Variable cost	4.00	
Fixed cost	3.00	
		7.00
Profit		2.00

The budgeted sales for October Year 5 were 800 units, but the actual sales were 850 units. The revenue earned from these sales was Rs. 7,480.

The sales price and sales volume variances for October using standard absorption costing and standard marginal costing, would be as follows:

Sales price variance	Rs.	
850 units should sell for (× Rs.9)	7,650	
They did sell for	7,480	
Sales price variance	170	(A)

Sales volume variance, absorption costing	units	
Actual sales volume (units)	850	
Budgeted sales volume (units)	800	
Sales volume variance in units	50(F)	
Standard profit per unit	Rs.2	
Sales volume variance (profit variance) in Rs.	Rs.100	(F)

Sales volume contribution variance, marginal costing		
Sales volume variance in units	50 (F)	
Standard contribution per unit (Rs.9 - Rs.4)	Rs.5	
Sales volume variance (contribution variance)	Rs.250	(F)

c) The budget was to produce 15,000 units. The standard fixed production cost of a product is Rs.20, which is 4 hours at a rate of Rs.5 per direct labour hour. Actual production was 14,600 units and actual fixed production overhead expenditure was Rs. 325,000. The production output was manufactured in 58,000 hours of work.

Calculations for the following variances are given below:

i. the fixed production overhead total cost variance

ii. the fixed production overhead expenditure variance and volume variance

iii. the fixed production overhead efficiency variance and capacity variance

Fixed production overhead total cost variance	Rs.	
Standard fixed overhead cost of 14,600 units (× Rs.20)	292,000	
Actual fixed overhead expenditure	325,000	
Fixed overhead total cost variance (under-absorption)	33,000	(A)

Fixed production overhead expenditure variance	Rs.	
Budgeted fixed overhead expenditure (15,000 × Rs.20)	300,000	
Actual fixed overhead expenditure	325,000	
Fixed overhead expenditure variance	25,000	(A)

Fixed production overhead volume variance	units	
Budgeted production volume	15,000	
Actual production volume	14,600	
Volume variance in units	400	(A)
Standard fixed overhead rate per unit	Rs.20	
Fixed production overhead volume variance in Rs.	Rs.8,000	(A)

Fixed production overhead efficiency variance	hours	
14,600 units should take × 4 hours)	58,400	
They did take	58,000	
Efficiency variance in hours	400	(F)
Standard fixed overhead rate per hour	Rs.5	
Fixed production overhead efficiency variance in Rs.	Rs.2,000	(F)

Fixed production overhead capacity variance	hours	
Budgeted hours of work (15,000 × 4 hours)	60,000	
Actual hours of work	58,000	
Capacity variance in hours	2,000	(A)
Standard fixed overhead rate per hour	Rs.5	
Fixed production overhead capacity variance in Rs.	10,000	(A)

► *Example 03:*

A company operates a standard overhead absorption costing system. The standard fixed overhead rate per hour is Rs.25. The following data relate to last month:

Actual hours worked	8,250
Budgeted hours	9,000
Standard hours of actual production	7,800
Actual fixed overhead expenditure	Rs. 211,000

For the month, calculations of the following variances are given below

- the fixed overhead capacity variance
- the fixed overhead efficiency variance
- the fixed overhead expenditure variance.

Fixed production overhead capacity variance	**hours**	
Budgeted production hours of work	9,000	
Actual production hours of work	8,250	
Capacity variance inhours	750	(A)
Standard fixed overhead rate per hour	Rs.25	
Fixed production overhead capacity variance in Rs.	Rs.18,750	(A)
Fixed production overhead efficiency variance	**hours**	
Standard hours produced	7,800	
Actual hours worked	8,250	
Efficiency variance in hours	450	(A)
Standard fixed overhead rate per hour	Rs.25	
Fixed production overhead efficiency variance in Rs.	Rs.11,250	(A)
Fixed production overhead expenditure variance	**Rs.**	
Budgeted fixed overhead expenditure (9,000 hours × Rs.25)	225,000	
Actual fixed overhead expenditure	211,000	
Fixed overhead expenditure variance	14,000	(F)

► *Example 04:*

A manufacturing company uses a standard absorption costing system in accounting for its production costs.

The standard cost of a unit of product is as follows:

	Standard quantity	**Standard price/rate**	**Standard cost**
		Rs.	**Rs.**
Direct materials	5 kilos	6.00	30.00
Direct labour	20 hours	4.00	80.00
Variable production overhead	20 hours	0.20	4.00
Fixed production overhead	20 hours	5.00	100.00

The following data relates to Period 1:

Budgeted output	25,000 units
Actual output - produced	20,000 units
Units sold	15,000 units
Materials put into production	120,000 kilos
Materials purchased	200,000 kilos
Direct labour hours paid	500,000 hrs

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Due to a power failure 10,000 hours were lost.

Cost of materials used	Rs.825,000
Rate per direct labour hour	Rs.5
Variable production overhead	Rs.70,000
Fixed production overhead	Rs.2,100,000

For Period 1, calculations for the following variances are given below:

- the material price variance
- the material usage variance
- the direct labour rate variance
- the direct labour idle time variance
- the direct labour efficiency variance
- the variable overhead total cost variance
- the fixed overhead expenditure variance
- the fixed overhead volume variance
- the total manufacturing cost variance.

Material price variance	**Rs.**	
120,000 kilos of materials should cost (× Rs.6)	720,000	
They did cost	825,000	
Material price variance	105,000	(A)
Material usage variance	**kilos**	
20,000 units should use (× 5 kilos)	100,000	
They did use	120,000	
Material usage variance in kilos	20,000	(A)
Standard price per kilo of material	Rs.6	
Material usage variance in Rs.	Rs.120,000	(A)
Direct labour rate variance	**Rs.**	
500,000 hours should cost (× Rs.4)	2,000,000	
They did cost (× Rs.5)	2,500,000	
Labour rate variance	500,000	(A)
Direct labour idle time variance = 10,000 hours (A) × Rs.4 per hour = Rs.40,000 (A)		
Direct labour efficiency variance	**hours**	
20,000 units should take (× 20 hours)	400,000	
They did take (500,000 – 10,000)	490,000	
Efficiency variance in hours	90,000	(A)
Standard rate per hour	Rs.4	
Direct labour efficiency variance in Rs.	Rs.360,000	(A)

Variable overhead total cost variance	Rs.	
20,000 units should cost (× Rs.4)	80,000	
They did cost	70,000	
Variable overhead total cost variance	10,000	(F)
Fixed production overhead expenditure variance	**Rs.**	
Budgeted fixed overhead expenditure (25,000 units × Rs.100)	2,500,000	
Actual fixed overhead expenditure	2,100,000	
Fixed overhead expenditure variance	400,000	(F)
Fixed production overhead volume variance	**units**	
Budgeted production volume	25,000	
Actual production volume	20,000	
Volume variance in units	5,000	(A)
Standard fixed overhead rate per unit	Rs.100	
Fixed production overhead volume variance in Rs.	Rs.500,000	(A)

Summary	Favourable	Adverse		
Variance	**Rs.**	**Rs.**		
Material price		105,000		
Material usage		120,000		
Direct labour rate		500,000		
Direct labour idle time		40,000		
Direct labour efficiency		360,000		
Variable overhead cost	10,000			
Fixed overhead expenditure	400,000			
Fixed overhead volume		500,000		
	410,000	1,625,000		
Manufacturing cost total variance			Rs.1,215,000	(A)

- *Example 05:*

A production manager is studying the cost report for the six-month period that has just ended. The production department incurred overhead costs of Rs. 680,000 and had under-absorbed overheads of Rs. 46,400. The actual direct labour hours worked in the department were 48,000 hours, which was 2,000 hours less than budgeted. Actual hours and standard hours are same,

For the given example, the budgeted absorption rate per direct labour hour, would be:

	Rs.
Actual overhead expenditure	680,000
Under-absorbed overhead	(46,400)
Absorbed overhead	633,600
Hours worked	48,000
Therefore budgeted absorption rate per hour (Rs.633,600/48,000)	Rs.13.20

The budgeted overhead expenditure, would be calculated as follows:

	hours
Actual hours worked	48,000
This was less than budget by	2,000
Budgeted hours	50,000
Absorption rate per hour	Rs.13.20
Budgeted overhead expenditure	
(50,000 hours × Rs.13.20)	Rs.660,000

The overhead expenditure and overhead volume variances in the period, would be,

Volume variance in hours	2,000 hours	Adverse
Absorption rate per hour	Rs.13.20	
Volume variance in Rs.	Rs.26,400	Adverse

	Rs.	
Actual overhead expenditure	680,000	
Budgeted overhead expenditure	660,000	
Expenditure variance	20,000	Adverse

- *Example 06:*

Lettuce makes a product – the vegetable guard. It is the organic alternative to slug pellets and chemical sprays.

For the forthcoming period budgeted fixed costs were Rs. 6,000 and budgeted production and sales were 1,300 units.

The vegetable guard has the following standard cost:

	Rs.
Selling price	50
Materials 5kg × Rs.4/kg	20
Labour 3hours × Rs.4/hour	12
Variable overheads 3hours × Rs.3/hour	9

Actual results for the period were as follows:

1,100 units were made and sold, earning revenue of Rs. 57,200.

6,600kg of materials were bought at a cost of Rs. 29,700 but only 6,300 kg were used

3,600 hours of labour were paid for at a cost of Rs.14,220. The total cost for variable overheads was Rs. 11,700 and fixed costs were Rs.4,000.

The company uses marginal costing and values all inventory at standard cost.

a) Assuming now that the company uses absorption costing, recalculating the fixed production overhead variances, would be as follows:

Tutorial note: If the company uses absorption costing with a direct labour hour absorption rate, we can calculate an expenditure, capacity and efficiency variance for fixed production overheads.

The first step is to calculate a budgeted absorption rate per hour

Budgeted labour hours: 1,300 × 3 = 3,900 hours

Budgeted fixed cost Rs. 6,000

Budgeted absorption rate: Rs. 6,000 /3,900 = Rs.1.54

Fixed overhead expenditure variance

Same as in (a): Rs. 2,000 (F).

Fixed overhead capacity variance

	hours	
Budgeted hours of work	3,900	
Actual hours worked	3,600	
Capacity variance in hours	300	(A)
Standard fixed overhead rate per hour	Rs.1.54	
Fixed overhead capacity variance in Rs.	Rs.462	(A)

Fixed overhead efficiency variance

Efficiency variance in hours = 300 hours (A) – see answer to (a).

Fixed overhead efficiency variance = 300 hours (A) × Rs.1.54 = Rs.462 (A).

b) Possible causes for the labour variances that have been calculated are discussed below:

Labour rate

The labour rate variance is favourable indicating a lower rate per hour was paid than expected. This is perhaps because more junior or less experienced staff were used during production. Though less likely, it is possible that staff had a pay cut imposed upon them. Finally, an incorrect or outdated standard could have been used.

Labour efficiency

This is significantly adverse, indicating staff took much longer than expected to complete the output. This may relate to the favourable labour rate variance, reflecting employment of less skilled or experienced staff. Staff demotivated by a pay cut are also less likely to work efficiently.

It may also relate to the reliability of machinery as staff may have been prevented from reaching full efficiency by unreliable equipment

- *Example 07:*

Carat plc, a premium food manufacturer, is reviewing operations for a three-month period. The company operates a standard marginal costing system and manufactures one product, ZP, for which the following standard revenue and cost data per unit of product is available:

Selling price	Rs. 12.00
Direct material	A 2.5 kg at Rs. 1.70 per kg
Direct material	B 1.5 kg at Rs. 1.20 per kg
Direct labour	0.45 hours at Rs. 6.00 per hour

Fixed production overheads for the three-month period were expected to be Rs. 62,500.

Actual data for the three-month period was as follows:

Sales and production	48,000 units of ZP were produced and sold for Rs. 580,800
Direct material A	121,951 kg were used at a cost of Rs. 200,000
Direct material B	67,200 kg were used at a cost of Rs. 84,000
Direct labour	Employees worked for 18,900 hours, but 19,200 hours were paid at a cost of Rs. 117,120
Fixed production overheads	Rs. 64,000

Budgeted sales for the three-month period were 50,000 units of Product ZP.

a) The following variances are required to be calculated for the given example:

   i. price, mix and yield variances for each material;

   ii. labour rate, labour efficiency and idle time variances.

Sales volume contribution per unit

	Rs. /unit	Rs. /unit
Standard sales price		12·00
Material A (Rs. 1·70 × 2·50)	4·25	
Material B (Rs. 1·20 × 1·50)	1·80	
Labour (Rs. 6·00 × 0·45)	2·70	
	8·75	
Standard contribution		3·25

Direct material price variances

Material A price variance	Rs.	
Actual quantity × actual price	200,000	
Actual quantity × standard price (Rs. 1·70 × 121,951)	207,317	
Price variance	7,317	(F)
Material B price variance	**Rs.**	
Actual quantity × actual price	84,000	
Actual quantity × standard price (Rs. 1·20 × 67,200)	80,640	
Price variance	3,360	(A)

Materials mix and yield variances

Standard cost of input and output

	kg	Rs. /kg	Standard cost
Material A = Rs. 1·70 × 2·5 =	2.5	Rs. 1.70	4·25
Material B = Rs. 1·20 × 1·5 =	1.5	Rs. 1.20	1·80
	4.0		6·05

Standard cost of input = Rs. 6.05/4kg

Standard cost of output = Rs. 6.05/unit

Material mix

	Actual mix	Standard ratio	Standard mix	Mix variance (kg)	Standard cost per kg	Mix variance (Rs.)
A	121,951	2.5	118,220	(3,731)	1.7	(6,343) (A)
B	67,200	1.5	70,931	3,731	1.2	4,477 (F)
	189,151		189,151			(1,866) (A)

Material yield variance

	Units	
189,151 did yield	48,000	
189,151 should have yielded (÷ 4kg)	47,288	
Extra yield	712	
Standard cost of a unit	Rs. 6.05	
Yield variance	Rs. 4,309	(F)

Labour variances

Labour rate variance	Rs.	
Actual hours × actual rate	117,120	
Actual hours × standard rate (19,200 × Rs. 6)	115,200	
	1,920	(A)
Labour efficiency variance	**Rs.**	
Actual hours worked × standard rate		
18,900 hours × Rs. 6	113,400	
Standard hours × standard rate		
48,000 units × 0.45 hours × Rs. 6	129,600	
	16,200	(F)
Labour idle time variance	**Hours**	
Actual hours paid for	19,200	
Actual hours worked	18,900	
Idle time (hours)	300	
Standard rate	Rs. 6	
Idle time (Rs.)	1,800	(A)

b) Possible explanations for the following variances are also discussed below:

i. material price, mix and yield variances for material A;

ii. labour rate, labour efficiency and idle time variances.

The favourable material A price variance indicates that the actual price per kilogram was less than standard. Possible explanations include buying lower quality material, buying larger quantities of material A and thereby gaining bulk purchase discounts, a change of supplier, and using an out-of-date standard.

The adverse material A mix variance indicates that more of this material was used in the actual input than indicated by the standard mix. The favourable material price variance suggests this may be due to the use of poorer quality material (hence more was needed than in the standard mix), or it might be that more material A was used because it was cheaper than expected.

The favourable material A yield variance indicates that more output was produced from the quantity of material used than expected by the standard. This increase in yield is unlikely to be due to the use of poorer quality material: it is more likely to be the result of employing more skilled labour, or introducing more efficient working practices.

It is only appropriate to calculate and interpret material mix and yield variances if quantities in the standard mix can be varied. It has also been argued that calculating yield variances for each material is not useful, as yield is related to output overall rather than to particular materials in the input mix. A further complication is that mix variances for individual materials are inter-related and so an explanation of the increased use of one material cannot be separated from an explanation of the decreased use of another.

The unfavourable labour rate variance indicates that the actual hourly rate paid was higher than standard. Possible explanations for this include hiring staff with more experience and paying them more (this is consistent with the favourable overall direct material variance), or implementing an unexpected pay increase. The favourable labour efficiency variance shows that fewer hours were worked than standard. Possible explanations include the effect of staff training, the use of better quality material (possibly on Material B rather than on Material A), employees gaining experience of the production process, and introducing more efficient production methods. The adverse idle time variance may be due to machine breakdowns; or a higher rate of production arising from more efficient working (assuming employees are paid a fixed number of hours per week).

▶ *Example 08:*

Hexa Limited uses a standard costing system. The following profit statement summarizes the performance of the company for August 20X3:

		Rupees
Budgeted profit		3,500
Favourable variance:		
Material price	16,000	
Labour efficiency	11,040	27,040
Adverse variance:		
Fixed overheads expenditure	(16,000)	
Material usage	((6,000)	
Labour rate	(7,520)	(29,520)
Actual profit		1,020

The following information is also available:

Standard material price per unit (Rs.)	4.00
Actual material price per unit (Rs.)	3.90
Standard wage rate per hour (Rs.)	6.00
Standard wage hours per unit	10
Actual wages (Rs.)	308,480
Actual fixed overheads (Rs.)	316,000
Fixed overheads absorption rate	100% of direct wages

a) Budgeted output in units, actual number of units purchased, actual units produced, actual hours worked and actual wage rate per hour would be calculated as follows:

(i)	Budgeted output in units		
	Actual Fixed Overhead	Rs. 316,000	
	Less: Adverse Fixed Overhead Variance	Rs. 16,000	
	Budgeted Fixed Overhead	Rs. 300,000	
	Direct wages per unit (Rs. 6 x 10 hours)	Rs. 60	
	Budgeted output in units (Rs. 300,000/60)	5,000	units

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(ii)	**Actual number of units purchased**		
	Material Price Variance – Total	Rs. 16,000	
	Price Variance per unit (Rs. 4.00 – Rs. 3.90)	Re. 0.10	
	Units purchased (Rs. 16,000 / 0.10)	160,000	
(iii)	**Actual units produced**		
	Standard Wages (308,480 – 7,520 + 11,040)	Rs. 312,000	
	Standard Labour Cost (Rs. 6 x 10 hours)	Rs. 60	
	Units produced (Rs. 312,000 / Rs. 60)	5,200	
(iv)	**Actual hours worked**		
	Actual Labour Costs	Rs. 308,480	
	Less: Labour Rate Variance	7,520	
	Actual Labour Costs at Standard Rate	300,960	
	Standard Rate per hour	Rs. 6.00	
	Actual hours worked (300,960 / 6)	50,160	
(v)	**Actual Wages / Actual Hours = Rs. 308,480 / 50,160 = Rs. 6.15**		

b)

Possible causes of favourable material price variance
Fortunate buy
Inferior quality materials
Unusual discount due to bulk quantity purchase
Drop in market price
Less costly method of transportation

Possible causes of unfavourable material quantity variance
Carelessness
Poorly adjusted machines
Unskilled workers
New equipment
Inferior quality materials

Possible causes of favourable labour efficiency variance
Use of better skilled workers
High quality material
New equipment
Possible causes of unfavourable labour rate variance
Use of workers with better skills
Change in pay scales
Overtime

- *Example 09:*

Excellent Limited makes and sells a single product. The standard cost card for the product, based on normal capacity of 45,000 units per month is as under:

	Rupees
Material 60 kg at Rs. 0.60 per kg	36.00
Labour ½ hour at Rs. 50.00 per hour	25.00
Variable factory overheads, 30% of direct labour cost	7.50
Fixed factory overheads	6.50
Total	**75.00**

Actual data for the month of August 20X3 is as under:

Work in process on August 1, 20X3 (60% converted)	Units	10,000
Started during the month	Units	50,000
Transferred to finished goods	Units	48,000
Work in process on August 31, 20X3 (50% converted)	Units	10,000
Material purchased at Rs. 0.50 per kg	Rs.	1,750,000
Material issued to production	Kg	3,100,000
Direct labour at Rs. 52 per hour	Rs.	1,300,000
Factory overheads (including fixed costs of Rs. 290,000)	Rs.	600,000

The company uses FIFO method for inventory valuation.

All materials are added at the beginning of the process. Conversion costs are incurred evenly throughout the process. Inspection takes place when the units are 80% complete. Under normal conditions, no spoilage should occur.

a) A quantity and equivalent production schedules for material and conversion costs would be prepared as follows:

Preliminary working	Rs.
Units in process at beginning	10,000
Units started during the month	50,000
Total possible units	60,000
Normal loss	–
Expected good output:	60,000
Actual good output:	
Started in the previous period but finished in this period	10,000
Started and finished in this period (balance)	38,000
Finished in this period (given)	(48,000)
Closing WIP	(10,000)
Loss of units (Balance quantity)	2,000

Equivalent Units	Total units	Percentage complete	Materials	Conversion cost
Started last period				
Opening WIP	10,000			
Materials		0%		
Conversion		40%		4,000
Started and finished in period	38,000	100%	38,000	38,000
Good output	48,000			
Started but not finished				
Closing WIP	10,000			
Materials		100%	10,000	
Conversion		50%		5,000
Abnormal loss	2,000			
Materials		100%	2,000	
Conversion		80%		1,600
Units made in period			50,000	48,600

b) Material, labour and variable overhead variances are calculated below. (Assuming that the material price variance is calculated as materials are used rather than as they are purchased).

Material, labour and variable overhead variances		
1)	**Material price variance**	**Rs.**
	3,100,000 kg should cost (@ 0.60 per kg)	1,860,000
	3,100,000 kgs did cost (@ 0.50 per kg)	1,550,000
	Material price variance (F)	310,000
2)	**Material quantity variance**	**Kgs.**
	Making 50,000 units should use (@60 kg per unit)	3,000,000
	Making 50,000 units did use	3,100,000
	Material quantity variance in kg (A)	(100,000)
	Standard cost per kg (Rs.)	0.60
	Material quantity variance in Rs. (A)	(60,000)
3)	**Labour rate variance**	**Rs.**
	25,000 hours should cost (@ 50 per hr)	1,250,000
	25,000 hours did cost (@ 52 per hr)	1,300,000
	Labour rate variance (A)	(50,000)
	W: Labour hours worked = Rs.1,300,000 ÷ Rs. 52 = 25,000 hours	
4)	**Labour efficiency variance**	**hrs.**
	Making 48,600 units should use (@ 0.50 hrs per unit)	24,300
	Making 48,600 units did use	25,000
	Labour efficiency variance in hours (A)	(700)
	Standard rate per hour (Rs.)	50
	Labour efficiency variance in Rs. (A)	(35,000)

5)	Variable overhead expenditure variance	Rs.
	25,000 hrs should cost (@ 15 per hr)	375,000
	25,000 hrs did cost (Rs.600,000 - Rs.290,000)	310,000
	Variable overhead rate variance (F)	65,000
6)	**Variable overhead efficiency variance**	**hrs.**
	Making 48,600 units should use (@ 0.50 hrs per unit)	24,300
	Making 48,600 units did use	25,000
	Variable overhead efficiency variance in hours (A) **(as above)**	(700)
	Standard rate per hour (Rs.)	15
	Variable overhead efficiency variance in Rs. (A)	(10,500)

c) The over (under) absorption of fixed production overhead and analyze it into expenditure variance and volume variance would be calculated below:

	Over(under) absorption of fixed production overhead	
	Note: Fixed overhead absorption rate is Rs.6.50 per unit. Each unit takes 0.50 hrs. Therefore, the fixed overhead absorption rate is Rs. 13 per hour.	
1)	**Over(under) absorption**	**Rs.**
	Amount absorbed (48,600 units at Rs. 6.50 per unit)	315,900
	Actual expenditure	290,000
	Over absorption (F)	25,900
2)	**Fixed production overhead expenditure variance**	**Kg**
	Budgeted expenditure (45,000 units @ Rs. 6.50 per unit)	292,500
	Actual expenditure	290,000
	Expenditure variance in Rs. (F)	2,500
3)	**Fixed production overhead volume variance**	**Rs.**
	Budgeted volume	45,000
	Actual volume	48,600
	Volume variance in units (F)	3,600
	Standard rate per unit (Rs.)	6.50
	Labour efficiency variance in Rs. (F)	23,400

d) Analyze the fixed production overhead volume variance into efficiency and capacity variances.

1)	Fixed overhead efficiency variance	hrs.
	Making 48,600 units should use (@ 0.50 hours per unit)	24,300
	Making 48,600 units did use	25,000
	Fixed overhead efficiency variance in hours (A) **(as above)**	(700)
	Standard rate per hour (Rs.)	13
	Fixed overhead efficiency variance in Rs. (A)	(9,100)

2)	Fixed overhead capacity variance	Rs.
	Budgeted hours (45,000 hours at 0.50 hour per unit)	22,500
	Actual hours worked	25,000
	Capacity variance in hours (F)	2,500
	Standard rate per hour (Rs.)	13
	Capacity variance in Rs. (F)	32,500

▶ *Example 10:*

You have recently been appointed as the Financial Controller of Watool Limited. Your immediate task is to prepare a presentation on the company's performance for the recently concluded year. You have noticed that the records related to cost of production have not been maintained properly. However, while scrutinizing the files you have come across certain details prepared by your predecessor which are as follows:

i. Annual production was 50,000 units which is equal to the designed capacity of the plant.

ii. The standard cost per unit of finished product is as follows:

Raw material X	6 kg at Rs. 50 per kg
Raw material Y	3 kg at Rs. 30 per kg
Labour- skilled	1.5 hours at Rs. 150 per hour
Labour- unskilled	2 hours at Rs. 100 per hour
Factory overheads	Variable overheads per hour are Rs. 100 for skilled labour and Rs. 80 for unskilled labour. Fixed overheads are Rs. 4,000,000.

iii. Data related to variation in cost of materials is as under:

Material X price variance	Rs. 95,000 (Adverse)
Material Y actual price	6% below the standard price
Material X quantity variance	Nil
Material Y quantity variance	Rs. 150,000 (Adverse)

iv. Opening raw material inventories comprised of 25 days of standard consumption whereas closing inventories comprised of 20 days of standard consumption.

v. Actual labour rate for skilled and unskilled workers was 10% and 5% higher respectively.

vi. Actual hours worked by the workers were 168,000 and the ratio of skilled and unskilled labour hours was 3:4 respectively.

vii. Actual variable overheads during the year amounted to Rs. 16,680,000. Fixed overheads were 6% more than the budgeted amount.

a) Actual purchases of each type of raw materials is calculated as follows:

Actual quantity purchased: Material X	
Standard consumption quantities (50,000 units × 6kg per unit)	300,000
Usage variance	0
Actual usage	300,000
Opening inventory (300,000 kg × 25/365)	(20,548)
Closing inventory (300,000 kg × 20/365)	16,438
Inventory movement	(4,110)
Actual purchase quantity (kg)	295,890

Actual cost of purchase:	
Standard rate (Rs. per kg)	50
Actual quantity purchased at standard rate (Rs.)	14,794,500
Price paid above / (below) the standard rate	
{adverse / (favourable) price variance}	95,000
Actual cost of purchase	14,889,500

Actual quantity purchased: Material Y	
Standard consumption quantities (50,000 units × 3kg per unit)	150,000
Usage variance (Rs.150,000 @Rs.30 per kg)	5,000
Actual usage	155,000
Opening inventory (150,000 kg × 25/365)	(10,274)
Closing inventory (150,000 kg × 20/365)	8,219
Inventory movement	(2,055)
Actual purchase quantity (kg)	152,945

Actual cost of purchase:	
Standard rate (Rs. per kg)	30
Actual quantity purchased at standard rate (Rs.)	4,588,350
Price paid above / (below) the standard rate (6%)	(275,301)
Actual cost of purchase	4,313,049

b) Labour rate and efficiency variances, variable overhead rate and efficiency variances and fixed overhead expenditure variance, would be calculated as follows:

Labour and overhead variances:		
Labour rate variances:	**Skilled labour**	**Unskilled labour**
Actual hours at standard rate		
168,000×3/7	72,000	
168,000×4/7		96,000
Standard rates per hour	150	100
Actual hours at standard rate	10,800,000	9,600,000
Price variances		
10% (A)	**(1,080,000)**	
5% (A)		**(480,000)**

Labour efficiency variance:		
50,000 units should use		
@1.5 hours	75,000	
@2 hours		100,000
50,000 units did use	72,000	96,000
Labour efficiency variance (hours) (F)	3,000	4,000
Standard rate per hour (Rs.)	150	100
Labour efficiency variance (Rs.) (F)	**450,000**	**400,000**

Variable overhead rate variances:		
168,000 hours should cost		**Rs.**
168,000 × 3/7 × Rs.100		7,200,000
168,000 × 4/7 × Rs.80		7,680,000
		14,880,000
168,000 hours did cost		16,680,000
Variable overhead rate variance (A)		**1,800,000**
Variable overhead efficiency variance:	**Skilled**	**Unskilled**
50,000 units should use	**Hrs**	**Hrs**
@1.5 hours	75,000	
@2 hours		100,000
50,000 units did use	72,000	96,000
Labour efficiency variance (hours) **(as before)**	3,000	4,000
Standard rate per hour (Rs.)	100	80
Variable overhead efficiency variance (Rs.) (F)	**300,000**	**320,000**
Total (Rs.) (F)		**620,000**
Fixed overhead expenditure variance		**Rs.**
Budgeted fixed overhead		4,000,000
Variance (6%)		240,000

- *Example 11:*

The following data relates to actual output, actual costs and variances for the four-weekly accounting period number 4 of a company which makes only one product.

The value of work-in-progress at the end of period 4 was the same as the value of work-in-progress at the beginning of the month.

Actual production of Product XY	18,000 units
Actual costs incurred:	**Rs.000**
Direct materials purchased and used (150,000 kg)	210
Direct labour costs (32,000 hours)	136
Variable production overhead	38

Variances:	Rs.000	
Direct materials price	15	Favourable
Direct materials usage	9	Adverse
Direct labour rate	8	Adverse
Direct labour efficiency	16	Favourable
Variable production overhead expenditure	6	Adverse
Variable production overhead efficiency	4	Favourable

Variable production overhead varies with labour hours worked.

A standard marginal costing system is operated.

A standard product cost sheet for one unit of Product XY, showing how the standard marginal production cost of the product is made up is presented below:

Standard marginal production cost – Product XY		Rs.
Direct materials	(8 kilos at Rs.1.50 per kilo)	12.0
Direct labour	(2 hours at Rs.4 per hour)	8.0
Variable production overhead	(2 hours at Rs.1 per hour)	2.0
Standard marginal production cost		22.0

Tutorial note: This problem tests your understanding of the formulae for calculating variances. Here, you are given the actual costs and the variances, and have to work back to calculate the standard cost. The answer can be found by filling in the balancing figures for each variance calculation.

Workings

Materials price variance	Rs.	
150,000 kilos of materials did cost	210,000	
Material price variance	15,000	(F)
150,000 kilos of materials should cost	225,000	

(The variance is favourable, so the materials did cost less to buy than they should have cost.)

Therefore, the standard price for materials is Rs. 225,000/150,000 kilograms = Rs.1.50 per kilo.

Materials usage variance		
Materials usage variance in Rs. = Rs.9,000 (A)		
Standard price for materials = Rs.1.50		
Materials usage variance in kilograms = 9,000/1.50 = 6,000 kilos (A)		
	kilos	
18,000 units of the product did use	150,000	
Material usage variance in kilos	6,000	(A)
18,000 units of the product should use	144,000	

Therefore, the standard material usage per unit of product = 144,000 kilos/18,000 units = 8 kilos per unit.

Direct labour rate variance	Rs.	
32,000 hours of labour did cost	136,000	
Direct labour rate variance	8,000	(A)
32,000 hours of labour should cost	128,000	

Therefore, the standard direct labour rate per hour = Rs. 128,000/32,000 hours = Rs.4 per hour.

Direct labour efficiency variance

Labour efficiency variance in Rs. = Rs.16,000 (F)

Standard rate per hour = Rs.4

Labour efficiency variance in hours = 16,000/4 = 4,000 hours (F)

	hours	
18,000 units of the product did take	32,000	
Labour efficiency variance in hours	4,000	(F)
18,000 units of the product should take	36,000	

Therefore, the standard time per unit of product = 36,000 hours/18,000 units = 2 hours per unit.

This number of hours per unit also applies to variable production overheads.

Variable overhead expenditure variance	Rs.	
32,000 hours did cost	38,000	
Variable overhead expenditure variance	6,000	(A)
32,000 hours should cost	32,000	

Therefore, the variable production overhead rate per hour = Rs. 32,000/32,000 hours = Rs.1 per hour.

- *Example 12:*

MZ Limited (MZL) manufactures a single product X and uses standard marginal costing system. The standard cost card of product X is as follows:

	Rupees
Raw material (13 kg @ Rs. 135 per kg)	1,755
Labour (14 hours @ Rs. 100 per hour)	1,400
Variable production overheads (Rs. 75 per labour hour)	1,050

Following data is available in respect of operations for the month of February 2018:

i. 55,000 units were put into process. 1,500 units were lost in process which were considered to be normal loss. Process losses occur at the end of the process.

ii. 698,000 kg of material was purchased at Rs. 145 per kg. Material is added at the start of the process and conversion costs are incurred evenly throughout the process.

iii. 755,000 labour hours were worked during the month. However, due to certain labour related issues, wages were paid at Rs. 115 per hour.

iv. Fixed production overheads are budgeted at Rs. 40 million for the month of February 2018. Total actual production overheads amounted to Rs. 95 million.

v. Actual fixed production overheads exceeded budgeted fixed overheads by Rs. 1.1 million.

vi. Inventory balances were as under:

	01 February 2018	28 February 2018
Raw material (kg)	15,000	17,000
Work in process (units)	5,000 (60% converted)	6,000 (80% converted)
Finished goods (units)	10,000	12,000

vii. MZL uses FIFO method for valuing the inventories.

Material, labour and overhead variances are computed as follows

Material, labour, overhead variances		Rs. in '000
Cost variances under marginal costing		
Material price variance [(135–145)×696,000]	Adv.	(6,960.00)
Material usage variance {(53,500**(W.3)**×13)– 696,000**(W.1)**}×135	Adv.	(67.50)
Labour rate variance (100–115)×755,000	Adv.	(11,325.00)
Labour efficiency variance {(14×54,300)**(W.3)–**755,000}×100	Fav.	520.00
Variable overheads expenditure variance (755,000×75)–Rs. 53,900,000**(W.4)**	Fav.	2,725.00
Variable overheads efficiency variance {(54,300**(W.3)**×14)–755,000}×75	Fav.	390.00
Fixed overhead expenditure variance (40,000–41,100) **(W.4)**)	Adv.	(1,100.00)

W-1:		
Actual material usage (kg)	(698,000+15,000–17,000)	696,000.00

W-2: Quantity schedule	**Units**
WIP (opening)	5,000.00
Units started	55,000.00
Total units in production	60,000.00
Normal loss	(1,500.00)
WIP (End)	(6,000.00)
Finished goods/Transferred out	**52,500.00**

W-3: Equivalent production units		**Material**	**Conversion cost**
		---------- Units ----------	
Finished goods/Transferred out **(W-2)**		52,500.00	52,500.00
Less: WIP (Opening)		(5,000.00)	(5,000.00)
Started and finished in this period		47,500.00	47,500.00
Add: WIP (Opening)	(5,000×40%)		2,000.00
Add: WIP (Closing)	(6,000×80%)	6,000.00	4,800.00
Equivalent production units		**53,500.00**	**54,300.00**

W-4: Actual variable and fixed overheads		Rs. in '000
Budgeted fixed overheads	***Given***	40,000.00
Actual fixed overheads exceeded applied overheads	***Given***	1,100.00
Actual fixed overheads		41,100.00
Less: Total actual variable and fixed overheads	***Given***	95,000.00
Actual variable overheads		**53,900.00**

▶ *Example 13:*

Jack and Jill (JJ) manufactures various products. The following information pertains to one of its main products:

i. Standard cost card per unit

	Rupees
Direct material (5 kg at Rs. 40 per kg)	200
Direct labour (1.5 hours at Rs. 80 per hour)	120
Factory overheads	130% of direct labour

ii. Fixed overheads are budgeted at Rs. 3 million based on normal capacity of 75,000 direct labour hours per month.

iii. Actual data for the month of June 2015

	Units
Opening work in process (80% converted)	8,000
Started during the month	50,000
Transferred to finished goods	48,000
Closing work in process (60% converted)	7,000

	Rupees
Material issued to production at: Rs. 38 per kg	1,900,000
Rs. 42 per kg	8,400,000
Direct labour at Rs. 84 per hour	6,048,000
Variable factory overheads	6,350,000
Fixed factory overheads	2,850,000

iv. Materials are added at the beginning of the process. Conversion costs are incurred evenly throughout the process. Losses up to 3% of the input are considered as normal. However, losses are determined at the time of inspection which takes place when units are 90% complete.

v. JJ uses FIFO method for inventory valuation.

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a) "Equivalent production units" is calculated as follows

Equivalent units using FIFO:	Quantity schedule (Units)	Equivalent production units	
		Material (Units)	Conversion (Units)
Opening WIP **(80% conversion)**	8,000	(8,000)	(6,400)
Units started during the month	50,000		
	58,000		
Units transferred to finished goods	48,000	48,000	48,000
Closing WIP **(60% conversion)**	7,000	7,000	4,200
Normal loss 3% of input (58,000-7,000) × 3%	1,530	-	-
Abnormal loss (90% conversion) **Bal.**	1,470	1,470	1,323
	58,000	**48,470**	**47,123**
	A	**B**	**(A×B)**

b) Computation for the following variances for the month of June 2015 are given below

- Material rate and usage
- Labour rate and efficiency
- Variable factory overhead expenditure and efficiency
- Fixed factory overhead expenditure and volume

Variances:		kg/Hrs. /Rs.	(Standard-Actual)	Fav./ (adv.)
				Rupees
Material price variance:				
Actual material usage	**W.2**	50,000	40 - 38 = Rs. 2.00	100,000
Actual material usage	**W.2**	200,000	40 - 42 = (Rs. 2.00)	(400,000)
				(300,000)
Material usage variance:				
Standard material rate per kg		40.00	242,350 - 250,000 = (7,650 kg)	**(306,000)**
Labour rate variance:				
Actual labour hours	**W.2**	72,000	80 - 84 = (Rs. 4.00)	**(288,000)**
Labour efficiency variance:				
Standard labour rate per hour		80.00	70,685 - 72,000 = (1,315 Hours)	**(105,200)**

Variable overhead expenditure variance:				
Actual labour hours at standard rate		72,000	**(W.1)** 64.00	4,608,000
Actual variable overheads				(6,350,000)
				(1,742,000)
Variable overhead efficiency variance:				
Standard variable overhead rate per hour	**W.1**	64.00	70,685 - 72,000 = (1,315 Hours)	**(84,160)**
Fixed overhead expenditure variance:				
Budgeted fixed production overhead				3,000,000
Actual fixed production overhead				(2,850,000)
				150,000
Fixed overhead volume variance:				
Standard fixed overhead rate per hour	**W.1**	40.00	70,685 - 75,000 = (4,315 Hours)	**(172,600)**

W.1: Statement of standard factory overhead rate per hour:		**Rs.**
Standard factory overhead rate per hour	(120×130%)÷1.5	104.00
Standard fixed factory overhead rate per hour	3,000,000÷75,000	40.00
Standard variable factory overhead rate per hour	104-40	64.00

W.2:	**Standard usage of material/labour**			**Actual usage of material /labour/overheads**		
	Eq. units	**Per unit**	**Kg/ hrs.**	**Amount**	**Per kg/ hrs. (Rs.)**	**Kg /hrs.**
Material	48,470	5.0 kg	242,350	1,900,000	38.00	50,000
				8,400,000	42.00	200,000
				10,300,000		**250,000**
D. labour	47,123	1.5 hours	70,685	6,048,000	84.00	**72,000**
V. overheads				6,350,000	88.1944	**72,000**

- *Example 14:*

Hexal Limited is a manufacturer of various machine parts. Following information has been extracted from the cost records of one of its products AXE for the month of June 2014:

i. Standard cost per unit:

	Rupees
Raw material	170.00
Direct labour (1.25 hours)	150.00
Overheads	137.50

ii. Based on normal capacity of 128,000 direct labour hours, fixed overheads are estimated at Rs. 2,560,000.

iii. Following information pertains to production of 100,000 units of product AXE:

Actual direct labour hours worked		130,000
Unfavourable material usage variance	Rs.	820,000
Unfavourable material price variance	Rs.	600,000
Actual direct labour cost	Rs.	16,250,000
Actual fixed and variable overheads	Rs.	15,500,000

For the month of June 2014, actual material cost and labour variances are computed as follows

Actual direct material cost		Rupees
Standard material cost	100,000x170	17,000,000
Un-favourable material usage variance		820,000
Un-favourable material price variance		600,000
		18,420,000

Direct labour variances		Favourable/ (Adverse)
1	**Direct labour rate variance**	
	(SR – AR) x AH	
	[(150/1.25)-(16,250,000/130,000)] x 130,000	(650,000)
2	**Direct labour efficiency variance**	
	(SH – AH) x SR	
	[(100,000 x 1.25)-130,000)] x 120	(600,000)

W-1		
Standard total overheads rate per labour hour	137.5/1.25	110.00
Standard fixed overhead rate per labour hour	2,560,000/128,000	(20.00)
Standard variable overhead rate per labour hour	**Rs.**	90.00

► *Example 15:*

Zamil Industries (ZI) produces and markets an industrial product Zeta. ZI uses standard absorption costing system. The break-up of Zeta's standard cost per unit is as under:

		Rupees
Materials:	Axe – 1 kg	160
	Zee – 2 kg	210
Direct labour – 0.8 hours		200
Overheads – 0.8 hours		180

Production of Zeta for the month of August 2016 was budgeted at 15,000 units. Information pertaining to production of Zeta for August 2016 is as under:

i. Raw material inventory is valued at lower of cost and net realizable value. Cost is determined under FIFO method. Stock cards of materials Axe and Zee are reproduced below:

Date	Description	Axe		Zee	
		kg	Cost per kg (Rs.)	kg	Cost per kg (Rs.)
1-Aug	Opening balance	9,000	150	4,000	120
				8,000	122
3-Aug	Purchase returns	-	-	(2,000)	122
4-Aug	Purchases	17,000	148	35,000	125
6-Aug	Issues to production	(16,000)	-	(29,000)	-

ii. Actual direct wages for the month were Rs. 3,298,400 consisting of 11,780 direct labour hours.

iii. Fixed overheads were estimated at Rs. 540,000 based on budgeted direct labour hours.

iv. The actual fixed overheads for the month were 583,000.

Actual sales of Zeta for the month of August 2016 was 12,000 units. Opening and closing finished goods inventory of Zeta was 5,000 and 8,500 units respectively.

a) Following variances are calculated as follows:

i. Material price, mix and yield variances

ii. Labour rate and efficiency variances

Material price variance:						
Actual material usage at actual price using FIFO						
Axe			**Zee**			**Net adverse variance Rs.**
Issues (kg)	**Actual rate**	**Rs.**	**Issues (kg)**	**Actual rate**	**Rs.**	
9,000	150	1,350,000	4,000	120	480,000	
7,000	148	1,036,000	6,000	122	732,000	
-	-	-	19,000	125	2,375,000	
16,000		2,386,000	**29,000**		3,587,000	
Actual material usage at standard price:						
16,000	160	2,560,000	**29,000**	(210÷2) **105**	3,045,000	
Fav./(Adverse) variance		**174,000**			**(542,000)**	**(368,000)**

Material mix variance					
	Actual mix (kg)	Actual usage at std. mix ratio (kg)	Mix quantity variance (Adv.)/Fav.	Std. cost per (kg)	Rs.
Axe	16,000	15,000	(1,000)	160	(160,000)
Zee	29,000	30,000	1,000	105	105,000
	45,000	**45,000**			
Material mix variance – **adverse**					**(55,000)**

Material yield variance				
	Yield (no. of units)		Per unit Std. raw material usage at Std. price	Rs.
Standard yield	(45,000÷3)	15,000	(160+210) 370	5,550,000
Actual yield	(12,000+8,500–5,000)	15,500	370	5,735,000
Yield variance – **favourable**				**185,000**

Labour variance		Rs.
Labour rate variance		
Actual hours at standard rate	11,780×(200÷0.8)	2,945,000
Actual hours at actual		(3,298,400)
Labour rate variance – **adverse**		**(353,400)**
Labour efficiency variance		
Allowable hours at standard rate	(15,500×0.8)×(200÷0.8)	3,100,000
Actual hours at standard rate	11,780×(200÷0.8)	(2,945,000)
Labour efficiency variance – **favourable**		**155,000**

a) Computation of applied fixed overheads and analysis 'under/over applied fixed factory overheads' into expenditure, efficiency and capacity variances are as follows:

Analyses of under/over applied fixed overheads		Rs.
Standard fixed overhead rate per hour	(540,000÷15,000×0.8)	**45**
Applied fixed overheads	(15,500×0.8×45)	558,000
Actual fixed overheads		(583,000)
Under applied overheads		**(25,000)**
Fixed overhead expenditure variance		
Budgeted fixed overheads		540,000
Actual fixed overheads		(583,000)
Fixed overhead expenditure variance – **adverse**	**(A)**	**(43,000)**
Fixed overhead efficiency variance		**Rs.**
Allowable hours for actual production at standard cost	15,500×0.8×45	558,000
Actual hours worked at standard rate	11,780×45	(530,100)
Fixed overhead efficiency variance – **favourable**	**(B)**	**27,900**

Fixed overhead capacity variance		
Actual hours worked at standard rate	11,780×45	530,100
BU hours at standard rate	12,000×45	(540,000)
Fixed overhead capacity variance – **adverse**	**(C)**	**(9,900)**
Under applied fixed overheads	**(A)+(B)+(C)**	**(25,000)**

Example 16:

Hexo Limited is using a standard absorption costing system to monitor its costs. The management is considering to adopt a marginal costing system. In this respect, following information has been extracted from the records for the month of December 2016:

i. Actual as well as budgeted sale was 10,500 units at Rs. 2,000 per unit.

ii. Standard cost per unit is as follows:

		Rupees
Direct material	5 kg @ Rs. 158	790
Direct labour	3 hours @ Rs. 150	450
Production overheads (fixed & variable)	Rs. 120 per labour hour	360
		1,600

iii. Budgeted fixed overheads were Rs. 1,650,000.

iv. Production and actual costs were as under:

	Units
Production: Budgeted	11,000
Actual	12,000
Actual variable costs:	**Rupees**
Direct material (58,000 kg @ Rs. 160)	9,280,000
Direct labour (35,000 hours @ Rs. 155)	5,425,000
Variable overheads	2,975,000

v. Applied fixed overheads exceeded actual overheads by Rs. 200,000.

vi. There was no opening finished goods inventory. Closing finished goods inventory was 1,500 units.

a) The profit for the month of December 2016, using standard marginal costing, would be computed as follows:

Profit for the month of December 2016 - Standard marginal costing		
		Rupees
Sales	10,500×2,000	21,000,000
Production cost	12,000×(790+450+(**W.1**) 210)	(17,400,000)
Closing stock	1,500×(790+450+(**W.1**) 210)	2,175,000
Variable cost of sales at standard rate		(15,225,000)
Contribution margin		5,775,000
Budgeted fixed overheads		(1,650,000)
Profit at standard rate		**4,125,000**

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W-1: Production overhead rate:	Per unit	Per hour
	------------ Rupees ------------	
Standard overhead rate (fixed & variable)	360	(360÷3) 120
Less: Standard fixed overhead rate (1,650,000÷11,000)	150	(150÷3) 50
Standard variable overhead rate per hour	**210**	**70**

b) Reconciliation for the profit computed above with actual profit under marginal costing, by incorporating the related variances is given below:

Reconciliation of standard and actual profit under marginal costing:		Rupees
Standard profit as above	**(A)**	4,125,000
(Adverse)/favourable cost variances:		
Direct material price (SR–AR)×AQ=(158–160)×58,000		(116,000)
Direct material usage (SQ–AQ)×SR=[(5×12,000)–58,000]×158		316,000
Direct labour rate (SR–AR)×AH= (150–155)×35,000		(175,000)
Direct labour efficiency (SH –AH)×SR= [(3×12,000)–35,000]×150		150,000
Variable overheads expenditure Actual cost – (VOAR/H×AH)=2,975,000-(70×35,000)		(525,000)
Variable overheads efficiency (SH–AH)×VOAR/H=(36,000–35,000)×70		70,000
Fixed overheads expenditure variance (BU overheads – Actual overheads) [1,650,000–(12,000 ×150–200,000)]		50,000
Net adverse variance	**(B)**	**(230,000)**
Closing stock (Difference of standard and actual variable costs)		
[(9,280,000+5,425,000+2,975,000)÷12,000×1,500]-[(1,600-150)×1,500]**(C)**		35,000
Actual profit under marginal costing	**A+B+C**	**3,930,000**

c) Reconciliation for the actual profit under marginal and absorption costing, is given below:

Actual profit under absorption costing:	Rupees
Actual profit under marginal costing – as above	3,930,000
Fixed cost carried forward to the next year with closing inventory under absorption costing whereas under marginal costing fixed costs are charged in the year of incurrence (1,800,000-200,000)÷12,000)×1,500	200,000
Actual profit under absorption costing	**4,130,000**

▶ *Example 17:*

Sigma Limited (SL) is a manufacturer of Product A. SL operates at a normal capacity of 90% against its available annual capacity of 50,000 machine hours and uses absorption costing. The following summarized profit statements were extracted from SL's budget for the year ending 31 December 2015.

	Actual - 2014		Budget - 2015	
	Units	**Rs. In '000**	**Units**	**Rs. In '000**
Sales	4,125	49,500	4,600	56,580
Opening inventory	400	(3,400)	600	(5,400)
Cost of production	4,325	(38,925)	4,500	(44,325)
Closing inventory	600	5,400	500	4,925
Under absorbed production overheads		(100)	-	
Selling and administration cost (30% fixed)		(3,000)		(5,250)
Net profit		9,475		6,530

Other relevant information is as under:

	2014	Budget - 2015
Standard machine hours per unit	**10 hours**	**10 hours**
Standard production overhead rate per unit	Rs. 2,000	Rs. 2,250
Estimated fixed production overheads at normal capacity	Rs. 3,600,000	Rs. 4,050,000
Actual production overheads (Actual machine hours 44,000)	Rs. 8,750,000	-

a) Under/over absorbed production overheads can be understood as:

Production overhead rate is predetermined at beginning of the year based on budgeted annual overheads and budgeted annual production. Overhead are applied to actual hours/units using predetermined overhead rate. However, actual overheads and actual production may differ from the budgeted overheads and production, therefore, it would result in under/over absorption of production overheads.

b) Analysis for the under absorbed production overheads of SL for the year ended 31 December 2014, into spending and volume variances. Give two probable reasons for each variance, would be as follows

(i) Spending variance		
Hours allowed for actual production of 4,325 units	4,325×10	43,250
		Rs. in '000
Budgeted variable overheads for hours allowed	43,250×0.12*1	5,190
Standard fixed overheads		3,600
		8,790
Actual overheads		8,750
Favourable spending variance	**A**	**40**

(ii) Volume variance		
Estimated fixed overheads at normal capacity	45,000×0.08*2	3,600
Fixed overheads for hours allowed for actual production	43,250×0.08*2	3,460
Adverse volume variance	**B**	**(140)**
Under absorbed production overheads	**(A+B)**	**(100)**
***1Variable cost per hour [(2,000÷10)–(3,600,000÷(50,000×90%)]=120**		
***2Fixed cost per hour [(2,000÷10) –120]=80**		

Reasons for favourable spending variance:

(i)	Lesser spending/decrease in price of overhead items as compared to budget.
(ii)	Over-estimating overhead expenditure while preparing the budget.

Reasons for adverse volume variance:

(i)	Under-utilization of available capacity
(ii)	In-efficient use of machine hours

c) A budgeted Profit and Loss Statement for the year ending 31 December 2015, using marginal costing would be prepared as follows:

For the year ending 31 December 2015		**Rs. in '000**
Sales		56,580
Variable cost of sales:		
Opening inventory	5,400-(600×0.8*3)	(4,920)
Cost of production	(44,325–4,050)	(40,275)
Closing inventory	4,925-(500×0.9*4)	4,475
		(40,720)
Gross contribution margin		15,860
Variable selling and administration cost	5,250×70%	(3,675)
Net contribution margin		12,185
Fixed production overheads		(4,050)
Fixed selling and distribution overheads	5,250×30%	(1,575)
Net profit		**6,560**
***3 Fixed cost per unit – 2014 [3,600,000÷(50,000×90%÷10)=800**		
***4 Fixed cost per unit – 2015 [4,050,000÷(50,000×90%÷10)=900**		

d) Analysis of the difference between budgeted profit determined under absorption and marginal costing, for the year ending 31 December 2015, is given below.

		Rs. in '000
Net profit under marginal costing		6,560
Under absorption costing:		
▪ fixed overheads brought from the last year as included in the opening inventory	(600×0.8) *3	(480)
▪ fixed overheads carried forward to the next year as included in the closing inventory	(500×0.9) *4	450
Net profit under absorption costing		**6,530**

▶ *Example 18:*

Daisy Limited (DL) manufactures and markets product Zee. DL uses standard absorption costing.

Following information pertains to product Zee for the month of February 2019.

i. Data extracted from the budget for the month of February 2019:

Production Units		27,000
Cost of production:		**Rs. In '000**
Direct material	X: 16,000 kg @ Rs. 400 per kg	6,400
	Y: 14,000 kg @ Rs. 300 per kg	4,200
Direct Labour	10,000 hours @ Rs. 220 per hour	2,200
Factory overheads (including fixed overheads of Rs. 900,000) Rs. 250 per labour hour		2,500

ii. Actual input ratio of X and Y was 55:45 respectively.

iii. Direct materials are added at the beginning of the process. Actual process losses were 6% of the output. There is no change in the direct material prices during the month.

iv. DL increased wages by 12% as against the budgeted increase of 8% which improved labour efficiency by 5%.

v. Due to higher than expected inflation, actual factory overhead rate was 6% higher than the budgeted rate.

vi. Conversion costs were incurred evenly throughout the process.

vii. 27,400 units of Zee were transferred to finished goods. There was no opening or closing work in process. Finished goods inventory at the beginning and closing of the month was 1,000 units and 1,500 units respectively.

Computation for the following variances is given below

- Material price, mix and yield variances
- Labour rate and efficiency variances
- Over/under applied overheads and analyze it into:
  - variable overhead expenditure and efficiency variances
  - fixed overhead expenditure and volume variances

Variances for the month of February 2019			**Units**
Budgeted production		A	27,000
Actual production		B	27,400
Allowable production from actual input	A÷D×E	C	26,140
			kg
Total budget input quantity	X 16,000+Y 14,000	D	30,000
Total actual input quantity	B×1.06	E	29,044
			Rs.
Standard material cost per finished unit	(6,400,000+4,200,000)÷A	F	392.59
			Hours
Allowable hours for actual production	10,000÷A×B	G	10,148
Actual hours	G×0.95	H	9,641
			Rs.
Standard Fixed overhead rate per hour	900,000÷10,000	J	90
Standard variable overhead rate per hour	250–90	K	160

Material mix variance

Description	Actual input in standard mix ratio (kg)		Actual input in 55:45 ratio (kg)		Rate per kg (Rs.)	Fav/ (Adverse) variance (Rs. in '000)
X	16,000÷D×E	15,490.13	E×0.55	15,974.20	400.00	(193.63)
Y	14,000÷D×E	13,553.87	E×0.45	13,069.80	300.00	145.22
Total	E	29,044.00	E	29,044.00		(A) (48.41)

Material yield variance:			
(Actual yield - Allowable yield from actual input)×Standard material cost per unit			
		[(B–C)×F]	**(F)** 494.66
Material price variance:			
No variance as there is no change in prices of material.			-
Labour rate variance:			
(Standard rate - Actual rate) × Actual hours [220–(220÷1.08×1.12)]×H			**(A)** (78.56)
Labour efficiency variance:			
(Allowable hours - Actual hours) × Standard rate		[G–H×220]	**(F)** 111.54
Overheads over/(under) applied			
Applied overheads		G×250	2,537.00
Actual overheads:			
-	Variable overheads	H×K×1.06	1,635.11
-	Fixed overheads	900×1.06	954.00
			2,589.11
Overheads under applied			**(A)** (52.11)
Analysis of under applied overheads:			
(i)	**Variable overhead expenditure variance:**		
	(Standard variable overheads rate – Actual variable overhead rate) × Actual hours		
		[K–(K×1.06)×H]	**(A)** (92.55)
	Variable overhead efficiency variance		
	(Allowable hours – Actual hours) × Standard variable overhead rate per hour		
		(G–H)×K	**(F)** 81.12
(ii)	**Fixed overhead expenditure variance**	900,000×6%	**(A)** (54.00)
	Fixed overhead volume variance:		
	(Allowable hours – Budgeted hours)×Standard fixed overhead rate per hour		
		(G–10,000)×J	**(F)** 13.32

▶ *Example 19:*

Seema Enterprises (SE) produces various leather goods. It operates a standard marginal costing system. For one of its products Bela, following information was extracted for the month of December 2015 from SE's budget document for the year 2015.

	Rs. In million
Sales 9,800 units	25.00
Cost of production of 10,000 units	
Direct material 5,000 kg.	9.00
Direct Labour 24,000 hours	3.60
Variable overheads 2,000 machine hours	4.40
Fixed overheads	3.80

Actual production for the month of December 2015 was 12,000 units whereas SE earned revenue of Rs. 30 million by selling 11,000 units of Bela. Following information pertains to actual cost of production for the month:

i. 5,700 kg material was issued to production. Raw materials are valued using FIFO method. Other details relating to the raw material used for Bela are as follows:

		Kg	Rs. In million
1-Dec-2015	Opening balance	3,000	5.70
10-Dec-2015	Purchases	15,000	26.25

ii. To minimize labour turnover, SE increased production wages by 10% above the standard rate, effective 1 December 2015. This improved labour efficiency by 5% as compared to budget.

iii. 2,100 machine hours were worked. Details of overheads are as under:

- Depreciation amounted to Rs. 1.6 million (same as budgeted)
- Factory building rent amounted to Rs. 1.20 million (same as budgeted)
- All other overheads were 4% in excess of the budget

iv. Variances are treated as period cost and charged to cost of sales.

v. There was no opening finished goods inventory of Bela. Actual closing inventory may be valued at standard marginal production costs.

a) Budgeted and actual profits of Bela for the month of December 2015 using marginal costing is computed below:

		Rs. in million
Budgeted profit:		
Sales **(9,800 units)**		25.00
Variable costs	(9+3.6+4.4)	(17.00)
Closing finished goods inventory at standard cost 17÷10,000×200		0.34
Contribution margin		8.34
Fixed cost		(3.80)
		4.54

Actual profit:		
Sales **(11,000 units)**		30.00
Variable costs	**(W-1)**	(19.74)
Closing finished goods inventory at standard cost	17×1,000÷10,000	1.70
Contribution margin		11.96
Fixed cost	1.6+1.2+(3.8-1.6-1.2)×1.04	(3.84)
		8.12

W-1: Actual variable cost				
Material cost using FIFO		3,000		5.70
		2,700	(2,700×26.25÷15,000)	4.73
	Kg	**5,700**		10.43
Labour cost; Actual labour hours		(24,000÷10,000×12,000×0.95)	**27,360**	
Actual hours at actual rate			27,360×(3.6÷24,000×1.1)	4.51
Variable overheads:				
Actual machine hours at actual rate			2,100×(4.4÷2,000×1.04)	4.80
				19.74

b) The budgeted profit with actual profit using relevant variances under marginal costing would be reconciled as follows

Reconciliation of budgeted profit with actual profit		Rs. in million
Budgeted profit	**(As computed in (a) above)**	**4.54**
Favourable/(adverse) variances:		
Sales volume (contribution margin) variance:		
Actual sale quantity at standard contribution margin	8.34÷9,800×11,000	9.36
BU sale quantity at standard contribution margin		8.34
		1.02
Sales price variance		**Rs. in million**
Actual sale quantity at actual price		30.00
Actual sale quantity at standard price	25÷9,800×11,000	28.06
		1.94
Material price variance:		
Actual usage at actual price	**(W-1)**	10.43
Actual usage at standard price	5,700×(9÷5,000)	10.26
		(0.17)
Material usage variance		
Actual usage at standard rate		10.26
Allowable usage at standard rate	(5,000÷10,000×12,000)×(9÷5,000)	10.80
		0.54

Labour rate variance		
Actual hours at actual rate	**(W-1)**	4.51
Actual hours at standard rate	27,360**(W-1)**×(3.6÷24,000)	4.10
		(0.41)
Labour efficiency variance		
Actual hours at standard rate		4.10
Allowable hours at standard rate	24,000÷10,000×12,000×(3.6÷24,000)	4.32
		0.22
Variable overhead expenditure variance		
Actual machine hours at actual rate	**(W-1)**	4.80
Actual machine hours at standard rate	2,100**(W-1)**×(4.4÷2,000)	4.62
		(0.18)
Variable overhead efficiency variance		
Actual machine hours at standard rate		4.62
Allowable machine hours at standard rate	2,000÷10,000×12,000×(4.4÷2,000)	5.28
		0.66
Fixed overhead expenditure variance		
Actual fixed overheads	**(As computed in (a) above)**	3.84
Standard fixed overheads		3.80
		(0.04)
Fixed overhead volume variance		
Under marginal costing, **there is no fixed overhead volume variance** as fixed costs are treated as period cost and not allocated to products.		-
Actual profit		**8.12**

- *Example 20:*

Following information has been extracted from the records of Silver Industries Limited (SIL) for the month of June 2017:

	Production units	Direct labour hours	Variable & fixed overheads (Rs.)
Available capacity	10,000	30,000	-
Budget	8,000	24,000	3,600,000
Actual	8,600	25,000	3,900,000

Fixed overheads were budgeted at Rs. 1,200,000. Applied fixed overheads exceeded actual fixed overheads by Rs. 20,000.

SIL uses standard absorption costing. Over/under applied factory overheads are charged to profit and loss account.

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i. Accounting entries to record the factory overheads would be prepared as follow:

Date	Description	Debit	Credit
		-------- Rupees --------	
30-Jun-17	Work in process/Finished goods [8,600×(24,000÷8,000)×150(W-1)	3,870,000	
	PL account (Under absorbed overheads) **(Bal.)**	30,000	
	Overhead control account		3,900,000
	(Under-absorbed overheads charged to profit & loss account)		

ii. Analysis for under/over applied overheads into expenditure, efficiency and capacity variances, would be as follows.

		Rupees
Variable overhead expenditure variance		
Actual hours at standard variable rate	25,000×100	2,500,000
Actual variable overheads	**(W-2)**	2,630,000
Adverse variance	**A**	**(130,000)**
Variable overhead efficiency variance		
Allowable hours at standard rate	8,600×3×100	2,580,000
Actual hours at standard variable rate	25,000×100	2,500,000
Favourable variance	**B**	**80,000**
Fixed overhead expenditure variance		
Budgeted fixed overheads		1,200,000
Actual fixed overheads	**(W.2)**	1,270,000
Adverse variance	**C**	**(70,000)**
Fixed overhead efficiency variance		
Allowable hours at standard rate	8,600×3×50	1,290,000
Actual hours at standard rate	25,000×50	1,250,000
Favourable variance	**D**	**40,000**
Fixed overhead capacity variance		
Budgeted hours at standard rate	24,000×50	1,200,000
Actual hours at standard rate	25,000×50	1,250,000
Favourable variance	**E**	**50,000**
	(A+B+C+D+E)	**(30,000)**
W-1: Standard fixed and variable overhead rate per hour		**Rupees**
Standard fixed and variable overhead rate per hour	3,600,000÷24,000	150
Less: Standard fixed overhead rate per hour	1,200,000÷24,000	50
Standard variable overhead rate per hour		**100**
W-2: Actual fixed overheads		
Applied fixed overheads	8,600×(24,000÷8,000)×50	1,290,000
Applied overheads exceeded actual overheads		(20,000)
Actual fixed overheads		1,270,000
Actual variable overheads (Balancing)		2,630,000
Total variable overheads		**3,900,000**

iii. Comments on the difference between overhead variances under marginal and absorption costing are given below:

All variable and fixed overhead variances under marginal and absorption costing are same, except for the fixed overhead volume (efficiency and capacity) variances which can be calculated only under absorption costing.
In **absorption costing**, fixed overheads are allocated to the products and these are included in the inventory valuations. Therefore, fixed overhead volume variances can be computed under absorption costing only.
In **marginal costing**, only variable overheads are assigned to the product; fixed overheads are regarded as period costs and written off as a lump sum to the profit and loss account. Therefore, fixed overhead volume variances cannot be computed under marginal costing.

▶ *Example 21:*

Siyara Pakistan Limited (SPL) manufactures and sells a single product Zeta. The product passes through two processes before transferring to warehouse for sale. Following data pertains to Process I for the month of August 2020:

Standard cost information:

i. Direct material per unit – 1 kg at Rs. 75.

ii. Direct labour per unit – 1.2 hours at Rs. 40 per hour.

iii. Factory overheads per unit – 150% of direct labour. Factory overheads are budgeted on the basis of 250,000 direct labour hours. 40% of factory overheads are variable

Actual data for the month of August 2020:

	Rs. In 000
Direct material issued: Rs. 75 per kg	6,750
Rs. 85 per kg	11,475
Direct labour paid for 235,000 hours	9,870
Variable factory overheads	6,345
Fixed factory overheads	11,250

i. Direct material is added at the beginning of the process. Conversion costs are incurred evenly throughout the process. Losses up to 7% of the input are considered as normal. However, losses are determined at the time of inspection which takes place when product is 75% complete.

ii. During the month, 225,000 kg of direct material was issued to Process I and 200,000 units were transferred to Process II.

iii. Opening and closing work in processes were 25,000 units (80% completed) and 35,000 units (60% completed) respectively.

iv. 10% of direct labour hours were idle due to machine break-down but fully paid.

v. SL uses FIFO method for inventory valuation.

(a) Computation of following variances for the month of August 2020 are given below.

- Material price and usage
- Labour rate, efficiency and idle time
- Variable factory overhead expenditure and efficiency
- Fixed factory overhead expenditure and volume

Material price and usage variance:		Rupees	
Price variance = (SP-AP) x AQ	(75-81)x225,000	(1,350,000)	A
Usage variance= (SQ-AQ) x SP	(211,700-225,000)x75	(997,500)	A

Labour rate, efficiency and idle time variances		Rupees	
Rate variance = (SR-AR) x AH	(40-42)x235,000	(470,000)	A
Efficiency variance= (SH-AH) x SR	(242,730-211,500)x40	1,249,200	F
Idle time variance= Idle hours x SR	23,500x40	(940,000)	A

Variable factory overhead expenditure and efficiency variances		Rupees	
Expenditure variance =(SR-AR)xAH	(24-30)x211,500	(1,269,000)	A
Efficiency variance= (SH-AH) x SR	(211,700-225,000)x24	(749,520)	A

Fixed factory overhead expenditure and volume variances		Rupees	
Expenditure variance = (BC-AC)	9,000,000-11,250,000	(2,250,000)	A
Volume variance= (AH-BH) x SR	(242,730-250,000)x36	(261,720)	A

W-1 Equivalent production units	Quantity Schedule	Equivalent Production Units	
		Material	**Conversion**
Opening WIP (80% conversion)	25,000	(25,000)	(25,000)
Material added	225,000		
	250,000		
Units transferred to warehouse	200,000	200,000	200,000
Closing WIP (60% conversion)	35,000	35,000	21,000
Normal loss [(225,000–35,000)×7%]	13,300	-	-
Abnormal loss - balancing figure	1,700	1,700	1,275
	250,000	**211,700**	**202,275**

W-2 Material	
Actual quantity (AQ) purchased and consumed	225,000
Standard quantity (SQ) allowed (211,700(W-1)×1)	211,700
Standard rate (SR)	75
Actual rate (AR) [(6,750+11,475)/225]	81

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W-3 Labour	
Actual hours (AH) paid	235,000
AH worked (235,000×0.9)	211,500
Idle hours (235,000–211,500)	23,500
Standard hours (SH) allowed (202,275 (W-1)×1.2)	242,730
AR (9,870/235)	42
SR	40

W-4 Variable factory overheads	
AR (6,345/211.5)	30
SR (40×1.5×0.4)	24
AH worked (235,000-0.9)	211,500
SH allowed (202,275×1.2)	242,730

W-5 Fixed factory overheads	
SR (40×1.5×0.6)	36
Budgeted expenditure (36×250,000)	9,000,000
Actual expenditure	11,250,000
Budgeted hours	250,000
SH allowed (202,275×1.2)	242,730

(b) Reconcile the budgeted expenditure with actual expenditure for the month of August 2020 by using relevant variances calculated in part (a).

Reconciliation:	Rupees
Direct material (211,700×75)	15,877,500
Direct labour (202,275×1.2×40)	9,709,200
Variable overheads (202,275×1.2×24)	5,825,520
Fixed overheads (202,275×1.2×36)	8,738,280
Budgeted expenditure	**40,150,500**
	Rupees
Add: Adverse material price variance	1,350,000
Add: Adverse material usage variance	997,500
Add: Adverse labour rate variance	470,000
Less: Favourable labour efficiency variance	(1,249,200)
Add: Adverse labour idle time variance	940,000
Add: Adverse variable overhead expenditure variance	1,269,000
Less: Favourable variable overhead efficiency variance	(749,520)
Add: Adverse fixed overhead expenditure variance	2,250,000
Add: Adverse fixed overhead volume variance	261,720
	5,539,500
Actual expenditure	**45,690,000**

AT A GLANCE SPOTLIGHT STICKY NOTES

▶ *Example 22:*

Hulk Limited (HL) produces and markets a single product. The company uses standard costing system. Following is the standard cost card per unit of the finished product:

Direct material	2.8 kg at Rs. 6.75 per kg
Direct labour	Rs. 150 per hour
Variable production overheads	Rs. 12 per direct labour hour
Fixed production overheads	Rs. 18 per direct labour hour

The standard labour hours required for producing one unit of finished product is 30 minutes whereas HL's standard operating capacity per month is 15,000 hours.

Actual results for the month of February 2013 were as under:

	Rupees
Direct material @ Rs. 6.25 per kg	504,000
Direct labour	Rs. 160 per hour
Variable production overheads	175,000
Fixed production overheads	Rs. 17 per direct labour hour

Actual labour hours consumed by HL for producing 27,000 units was 33 minutes per unit of finished product.

a) Computation of direct material, labour and overhead variances, are given below.

Material price variance	Rupees
(SP- AP) x AQ	
(6.75- 6.25) x [504,000/6.25= 80,640]	40,320 F

Material usage variance	Rupees
(SQ- AQ) x SP	
(27,000 x 2.8 – 80,640) x 6.75	(34,020) A

Labour rate variance	Rupees
(SR- AR) x AH	
(150- 160) x [27,000 x33/60= 14,850]	(148,500) A

Labour efficiency variance	Rupees
(SH- AH) x SR	
[(27,000 x 30/60= 13,500)- 14,850] x 150	(202,500) A

Variable production overhead expenditure variance	Rupees
(AH x VOAR/H) –Actual Variable Production OH	
(14,850 x 12) – 175,000	3,200 F

Variable production overhead efficiency variance	Rupees
(SH- AH) x VOAR/H	
[(27,000 x 30/60= 13,500)- 14,850] x 12	(16,200) A

Fixed production overhead expenditure variance	Rupees
Budgeted cost – Actual cost	
(15,000 x 18) – (14,850 x 17)	17,550 F

Fixed production overhead volume variance	Rupees
(AU- BU) x FOAR/H	
[27,000 - (15,000 x 60/30= 30,000)] x 36	(108,000) A

b) At least FOUR reasons for adverse price variances are given below.
   i. inaccurate standard prices
   ii. inflationary cost increases
   iii. scarcity in raw material supplies resulting in higher prices
   iv. Purchasing department inefficiencies
   v. Purchase of better quality products

▶ *Example 23:*

Pelican Limited produces and markets a single product Zeta. The company uses a standard costing system. Following is the standard material mix for the production of 400 units of Zeta.

Material	Weight Kg	Standard rate per kg
Material A	30	240
Material B	25	320

Actual costs on the production of 192 units of Zeta for the month of August 2011 were as follows:

Material	Weight Kg	Actual rate per kg
Material A	16	230
Material B	13	308

Calculation of price variance, usage variance, Mix variance and yield variance, are given below.

Material price variance	Rupees
(SP- AP) x AQ	
Material A= (240- 230) x 16	160 F
Material B= (320- 308) x 13	156 F
Material price variance	**316 F**

Material usage variance	Rupees
(SQ- AQ) x SP	
Material A (30 x 192/400= 14.4 – 16) x 240	(384) A
Material B (25 x 192/400= 12 – 13) x 320	(320) A
Material usage variance	**(704) A**

Material Mix Variance	Actual Mix Kg	Standard Mix Kg	Mix Var. in kg	Standard price/ kg	Mix var. in Rs.
Material A	16	29x 30/55= 15.82	(0.18) A	240	(43.20) A
Material B	13	29 x 25/55= 13.18	0.18 F	320	57.60 F
	29	29			14.40 F

Material Yield variance	
Actual output in units	192
Expected output (55 /400= 0.1375), (29/0.1375)	210.91
Yield in units (A)	18.91
Weighted average cost per unit W-1	38
Material Yield variance (A)	**(718.60) A**

W-1	Rupees
Material A (30 x 240)	7,200
Material B (25 x 320)	8,000
Total cost of 400 units	15,200
Standard cost per unit (15,200/400)	**38**

▶ *Example 24:*

ABC Limited produces and markets a single product. The company operates a standard costing system. The standard cost card for the product is as under:

Sales price	Rs. 600 per unit
Direct material	2.5 kg per unit at Rs. 50 per kg
Direct labour	2.0 hours per unit at Rs. 100 per hour
Variable overheads	Rs. 25 per direct labour hour
Fixed overheads	Rs. 10 per unit
Budgeted production	500,000 units per month

The company maintains finished goods inventory at 25,000 units throughout the year. Actual results for the month of August 2010 were as under:

		Rs. In 000
Sales price	480,000 units	295,000
Direct material	950,000 kg	55,000
Direct labour	990,000 hours	105,000
Variable overheads		26,000
Fixed overheads		5,100

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Reconciliation of budgeted profit and actual profit using the all possible variances, is given below.

Material price variance	Rs. In 000
(SP- AP) x AQ	
(50 - [55,000/950]) x 950,000	(7,500) A

Material usage variance	Rs. In 000
(SQ- AQ) x SP	
(480,000 x 2.5 – 950,000) x 50	12,500 F

Labour rate variance	Rs. In 000
(SR- AR) x AH	
(100- [105,000 /990]) x 100	(6,000) A

Labour efficiency variance	Rs. In 000
(SH- AH) x SR	
(480,000 x 2- 990,000) x 100	(3,000) A

Variable production overhead expenditure variance	Rs. In 000
(AH x VOAR/H) –Actual Variable Production OH	
(990,000 x 25) – 26,000,000	(1,250) A

Variable production overhead efficiency variance	Rs. In 000
(SH- AH) x VOAR/H	
(480,000 x 2- 990,000) x 25	(750) A

Fixed production overhead expenditure variance	Rs. In 000
Budgeted cost – Actual cost	
(500,000 x 10) – 5,100,000	(100) A

Fixed production overhead volume variance	Rs. In 000
(AU- BU) x FOAR/H	
(480,000 – 500,000) x 10	(200) A

Sales price variance	Rs. In 000
(AP- SP) x AQ	
([295,000/480]- 600) x 480,000	7,000 F

Sales profit volume variance	Rs. In 000
(AU- BU) x Standard profit per unit W-1	
(480,000- 500,000) x 215	(4,300) A

W-1 Standard profit per unit	Rupees
Sales price	600.00
Direct material (2.5 x 50)	(125.00)
Direct labour (2 x 100)	(200.00)
Variable overheads (2 x 25)	(50.00)
Fixed overheads	(10.00)
	215.00

Operating statement – Absorption costing			Rs. 000
Budgeted profit (500,000 x 215)			107,500
Sales price variance			7,000
Sales profit volume variance			(4,300)
			110,200
Cost variances:	**Fav.**	**Adv.**	
Material price variance		7,500	
Material usage variance	12,500		
Labour rate variance		6,000	
Labour efficiency variance		3,000	
Variable production overhead expenditure variance		1,250	
Variable production overhead efficiency variance		750	
Fixed production overhead expenditure variance		100	
Fixed production overhead volume variance		200	
	12,500	18,800	(6,300)
Actual profit			103,900

STICKY NOTES

A budget is a plan expressed in money. It is prepared and approved prior to the budget period.

In a flexible budget the aim is to decide what total cost should be at different levels of output and sales. Fixed cost normally remain fixed, only variable costs and revenues vary with increase or decrease in the level of activity.

A Variance is the difference between planned or standard cost and actual cost. The process by which the total difference between standard and actual results is analyzed is known as variance analysis.

The direct material total cost variance is the difference between what the output actually cost and what it should have cost in terms of materials. It can be further divided in to material Price and Usage Variance.

The direct labour total cost variance is the difference between what the output actually cost and what it should have cost in terms of labour. It can be further divided in to labour rate and efficiency Variance.

The variable production overhead total variance can be subdivided in to the variable production overhead expenditure variance and the variable production overhead efficiency variance.

The fixed production overhead total variance can be subdivided in to an expenditure variance and a volume variance.

Mix variance can be divided in to price, mix and yield variances.

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CHAPTER 13

TARGET COSTING

IN THIS CHAPTER

AT A GLANCE

Target costing involves setting a target cost by subtracting a desired profit margin from a Competitive Selling / market Price.

The target cost may be less than the planned initial product cost but it is a target to be achieved by the time the product reaches the maturity stage of the product life cycle.

A cost gap is to be calculated by comparing current cost and the target cost. This cost gap is to be reduced over time by applying effective cost reduction techniques, improving technologies and processes.

1. TARGET COSTING

1.1 Target Costing – Defined

Target costing involves setting a target cost, after identification of target selling price and required profit margin. Desired profit is subtracted from competitive sales price, to get value of target cost.

1.2 Target Costing – Explained

Target costing is used mainly for new product development. This is because whenever a new product is designed and developed for a competitive market. In this situation, it is difficult to set price on tradition basis like cost plus profit approach. In simple words, target costing is market price less desired profit approach.

A company might decide the price that it would like to charge for a new product under development, in order to win a target share of the market. The company then decides on the level of profitability that it wants to achieve for the product, in order to make the required return on investment. Having identified a target price and a target profit, the company then establishes a target cost for the product. This is the cost at which the product must be manufactured and sold in order to achieve the target profits and return at the strategic market price. For instance, after market study, it is evident that market price of product should be Rs. 80 per unit. Company intends to earn 15% profit on selling price which equals to Rs. 12 (80 x 15%) per unit. Target cost can be calculated by deducting the desired profit from selling price i.e. Rs. 68 (Rs. 80- Rs. 12)

1.3 Target cost - Defined

Target cost is an estimate of a product cost which is determined by subtracting a desired profit margin from a competitive selling / market price. This target cost may be less than the planned initial product cost but it is expected to be achieved by the time the product reaches the maturity stage of the product life cycle.

1.4 Cost gap - Defined

Cost gap is the difference between the expected cost and the target cost. It can only be arising when expected cost to produce one unit exceeds the target cost. It can be calculated as:

Cost gap = Expected cost – Target cost

1.5 Origins of target costing

Target costing was originated in Japan in the era of 1960s, though it remained secret for years. However, in 1980s target costing was broadly recognised as major factor for the superior position of Japanese companies. Numerous large entities adopted target costing in Japan and North America for enhancement of its cost management and also increase their competitiveness. As a result, many variations in target costing have been developed and implemented in many countries globally. **(Patrick Feil, Spring 2004)**

Companies then became aware that a large proportion of the costs of making a product are committed at the design stage, before the product goes into manufacture. The design stage was therefore critical for ensuring that new products could be manufactured at a cost that would enable the product to make a profit for the company. It is not just a cost control exercise but rather holistically redesigning the entire production process to eliminate unnecessary costs, without reducing the value created by the product.

2. IMPLEMENTING & DETERMINING TARGET COSTING

2.1 Implementing target costing

Steps involved in the implementation of target costing process are as follows:

Step 1 Determine a product specification of which an adequate sales volume is estimated.

Step 2 Determine a selling price at which the organization will be able to achieve a desired market share.

Step 3 Estimate the required profit based on return on sales or return on investment.

Step 4 Calculate Target cost, by deducting the target profit from competitive sales price.

Step 5 Compile an estimated cost for the product on the anticipated design specification and current cost levels.

Step 6 Calculate target cost gap, by deducting the target cost from estimated cost.

Step 7 Make efforts to close the gap by applying effective cost reduction techniques, improving technologies and processes. **(Newsletter, 1999)**

2.2 Determining a Target cost

- *Illustration:*

New product design and development	Rs.
Decide: The target sales price	X
Deduct: The target profit margin	(X)
Equals: The target cost (maximum cost in order to meet or exceed the target profit)	X

- *Example 01:*

A construction company wants to calculate a target cost for a new flat, the expected market price is Rs. 5,000,000.

The company require a desired Profit Margin of 14%.

calculation of the target cost to achieve the desired Profit would be as follows:

Profit Required = Rs. 5,000,000 x 14% = Rs. 700,000

Target Cost = Rs. (5,000,000 – 700,000) = Rs. 4,300,000

- *Example 02:*

RL Limited intends to launch new product as market is extensively competitive, therefore, survey reveals that market price should be Rs. 400; at this level, estimated demand will be 500,000 units. Company intends to earn 15% return on investment on this product. Total capital investment on this product was Rs. 250 million.

The target cost per unit is calculated as under:

Return on investment = Rs. 250 million x 15% = Rs. 37.5 million

Desired profit per unit = Rs. 37,500,000/500,000 = Rs. 75

Target cost per unit = Rs. 400 – Rs. 75 = Rs. 325

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3. TARGET COSTING AND COST GAP

3.1 Target costing and the target cost gap

Target cost gap is calculated by deducted the target cost from estimated cost. It is important that target cost gap can be calculated only where estimated cost exceeds the target cost.

▶ *Example 03:*

Atlas Gaming Company, a manufacturer of computer games, is in the process of introducing a new game to the market and has undertaken market research to find out about customer's view on the value of the product. The results of this research have been used to establish a target selling price of Rs. 6,000. This is the price that the company thinks it will have to sell the product at to achieve the required sales volume.

Cost estimates have been prepared based on the proposed product specification.

Manufacturing cost per unit	Rupees
Direct material	321
Direct labour	2,403
Direct machinery cost	112
Ordering and receiving	23
Quality assurance	460
Non-manufacturing cost per unit	
Marketing	815
Distribution	325
After sales service	130

The target profit margin for the game is 30% of target selling price.

The target cost gap is calculated as under:

Target cost gap	Rupees
Target selling price	6,000
Target profit (6,000 x 30%)	(1,800)
Target cost	4,200
Estimated cost (Given in question)	4,589
Target cost gap	**389**

The estimated cost exceeds the target cost by Rs. 389 and it is the target cost gap.

▶ *Example 04:*

A company has designed a new product. NP8. It currently estimates that in the current market, the product could be sold for Rs.70 per unit. A gross profit margin of at least 30% on the selling price would be required, to cover administration and marketing overheads and to make an acceptable level of profit.

A cost estimation study has produced the following estimate of production cost for NP8.

Cost item	
Direct material M1	Rs.9 per unit
Direct material M2	Each unit of product NP8 will require three metres of material M2, but there will be loss in production of 10% of the material used. Material M2 costs Rs.1.80 per metre.
Direct labour	Each unit of product NP8 will require 0.50 hours of direct labour time. However it is expected that there will be unavoidable idle time equal to 5% of the total labour time paid for. Labour is paid Rs.19 per hour.
Production overheads	It is expected that production overheads will be absorbed into product costs at the rate of Rs. 60 per direct labour hour, for each active hour worked. (Overheads are not absorbed into the cost of idle time.)

a) The expected cost of Product NP8

	Rs.
Direct material M1	9.0
Direct material M2: 3 meters × 100/90 × Rs.1.80	6.0
Direct labour: 0.5 hours × 100/95 × Rs.19	10.0
Production overheads: 0.5 hours × Rs.60	30.0
Expected full cost per unit	**55.0**

b) Target cost for NP8

		Rs.
	Sales price	70.0
	Minimum gross profit margin (30%)	21.0
	Target cost	**49.0**

c) The size of the cost gap

		Rs.
	Expected cost per unit (a above)	55.0
	Target cost per unit (b above)	(49.0)
	Target cost gap	**6.0**

The company needs to identify ways of closing this cost gap.

3.2 Closing the target cost gap

Target costs are rarely achievable when the product is first manufactured, target cost may be much lower than the current cost determined by current technology and processes.

Target costing should involve a multi-disciplinary approach to close the cost gap. The management accountant should be involved in measuring estimated costs. Ways of reducing costs might be in product design and engineering, manufacturing processes used, selling methods and raw materials purchasing. Ideas for reducing costs can therefore come from the sales, manufacturing, engineering or purchasing departments.

Common methods of closing the target cost gap are:

- To re-design products to make use of common processes and components that are already used in the manufacture of other products by the company.
- To discuss with key supplier's methods of reducing materials costs. Target costing involves the entire 'value chain' from original suppliers of raw materials to the customer for the end-product, and negotiations and collaborations with suppliers might be an appropriate method of finding important reductions in cost.
- To eliminate non-value added activities or non-value added features of the product design. Something is 'non-value added' if it fails to add anything in value for the customer. The cost of non-value added product features or activities can therefore be saved without any loss of value for the customer. Value analysis may be used to systematically examine all aspects of a product cost to provide the product at the required quality at the lowest possible cost. This is the crux of target costing.
- Using standardized components will reduce the cost but it might impact the innovation element for the product
- To train staff in more efficient techniques and working methods. Improvements in efficiency will reduce costs.

▶ *Example 05:*

Scriba Company (SC) is trying to launch a new product into a competitive market in North America. Test marketing has revealed the following demand curve for the product:

P = 600 – 0.005Q

The estimated market for the product is 500,000 units per year. The company would like to capture 10% of this market.

The company has established a cost card, based on 50,000 units of sales each year:

	Rs.
Direct materials	100
Direct labour	30
Fixed overhead	70
Total cost	200

The company wishes to achieve a target profit of Rs. 10,000,000 for sales of this product per year.

a) What price will the company have to charge to capture its required market share and what is the target unit cost to achieve its target profit?

Tutorial note: The company will need to sell 50,000 units to gain 10% of the market.

The first step is to calculate the price that the item has to be sold at to achieve this market share. This can be calculated by using the demand curve:

P = 600 – 0.005Q

P = 600 – (0.005 × 50,000)

P = 600 – 250

P = Rs.350

Since the company wishes to generate Rs. 10,000,000 profit in total, this equates to a unit profit of:

Rs. 10,000,000 / 50,000 = Rs.200 per unit.

Once target price and target profit are available it is possible to calculate target cost:

Target price – target profit = target cost

Rs.350 – Rs.200 = Rs.150 per unit

b) What is the size of the target cost gap and how might Scriba Company seek to close this gap?

The target cost gap is calculated as:

	Rs.
Target unit cost	150
Current unit cost	200
Target cost gap	**50**

Currently actual cost is one third higher than it should be to reach the target profit.

The company can undertake various strategies to bring costs down to target:

Product redesign

This is the most effective way of reducing costs. Once the design of a product has been finalized it is difficult to reduce significantly the majority of a product's cost. If PC has not yet finalized the design and production of the product, it would be very worthwhile them revisiting the design and production planning stages of the product lifecycle.

Outsourcing

PC could seek a deal with a third party manufacturer to make the product. Complete outsourcing would not only remove the variable cost element of production but could also lead to huge fixed cost savings. This is a course of action worth exploring by the company. Suitable controls over any patents and quality would need to be in place, together with guarantees of delivery times and the ability to be flexible with production volumes.

Cost reduction

PC has to be careful with cost cutting. If applied badly the company could damage the value of the product, leading to a fall in market price. Cost reduction, however, seeks ways of lowering cost without reducing the value of the product. PC would seek to preserve those features of the product key to its customer value whilst seeking to reduce the cost of other areas. This, for instance, could involve cutting down on the quality of packaging.

4. IMPLICATIONS AND ADVANTAGES

4.1 Advantages of target costing

There are several possible advantages from the use of target costing.

- It helps to improve the understanding within a company of product costs.
- It recognizes that the most effective way of reducing costs is to plan and control costs from the product design stage onwards.
- It helps to create a focus on the final customer for the product or service, because the concept of 'value' is important: target costs should be achieved without loss of value for the customer.
- It is a multi-disciplinary approach, and considers the entire supply chain. It could therefore help to promote co-operation, both between departments within a company and also between a company and its suppliers and customers.
- Target costing can be used together with recognized methods for reducing costs, such as value analysis, value engineering, just in time purchasing and production, Total Quality Management and continuous improvement i.e. Kaizen costing.
- Target costing recognizes that process improvement and cost cutting is not a top down process but rather one where workers who actually work on the product could come up with valuable suggestions

4.2 The implications of using target costing

The use of a target costing system has implications for pricing, cost control and performance measurement.

Target costing can be used with pricing policy for a company's products or services. A company might decide on a target selling price for either a new or an existing product, which it considers necessary in order to win market share or achieve a target volume of sales. Having identified the selling price that it wants for the product, the company can then work out a target cost.

Cost control and performance measurement has a different emphasis when target costing is used.

- Cost savings are actively sought and made continuously over the life of the product
- There is joint responsibility for achieving benchmark savings. If one department fails to deliver the cost savings expected, other departments may find ways to achieve the savings
- Staff are trained and empowered to find new ways to reduce costs while maintaining the required quality.

Target costing is more likely to succeed in a company where a culture of 'continuous improvement' exists.

4.3 Target costing and services

Target costing can be used for services as well as products. Services vary widely in nature, and it is impossible to make general statements that apply to all types of services. However, features of some service industries that make them different from manufacturing are as follows.

- Some service industries are labour-intensive, and direct materials costs are only a small part of total cost. Opportunities for achieving reductions in materials costs may therefore be small.
- Overhead costs in many services are very high. Effective target costing will therefore require a focus on how to reduce overhead costs.

A service company might deliver a number of different services through the same delivery system, using the same employees and assets. Introducing new services or amendments to existing services therefore means adding to the work burden of employees and the diversity or complexity of the work they do.

- A system of target costing therefore needs to focus on quality of service and value for the customer. Introducing a new service might involve a loss of value in the delivery of existing services to customers. For example, adding a new service to a telephone call center could result in longer waiting times for callers.

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- New services might be introduced without proper consideration being given to whether the service is actually profitable. For example, a restaurant might add additional items to its menu, in the belief that the only additional cost is the cost of the food. In practice there would be implications for the purchasing and preparation of the food and possibly also for the delivery of food from the kitchen to the restaurant dining area. New items added to the menu might therefore make losses unless all aspects of cost are properly considered.
- When a single delivery system is used for services, the cost of services will consist largely of allocated and apportioned overheads. For target costing to be successful, there must be a consistent and 'fair' method of attributing overhead costs to services (both existing services and new services).
- Services might be provided by not-for-profit entities. For example, health services might be provided free of charge by the government. When services are provided free of charge, target costing can be used for new services. However, it is doubtful whether concepts of 'target price' and 'target profit' can be used by a not-for-profit entity. This raises questions about how to decide what the target cost should be and will probably be some arbitrary figure.

▶ *Example 06:*

A company wishes to introduce a new product to the market.

The company estimates the market for the product to be 50,000 units.

The company uses target costing.

Current projected costs are as follows:

	Rs. '000
Manufacturing cost	
Bought in parts (100 components)	50,000
Direct labour (assembly of components) 10 hours × Rs. 500 per hour	5,000
Machine costs (750,000,000 ÷ 50,000)	15,000
Ordering and receiving (500 orders × 100 components ×Rs. 500 per order) ÷ 50,000 units	500
Quality assurance (10 hours × Rs. 800 per hour)	8,000
Rework costs 10% (probability of failure) × Rs. 10,000 (cost of rework)	1,000
Non-manufacturing costs	
Distribution	10,000
Warranty costs 10% (probability of recall) × Rs. 15,000 (cost to correct)	1,500
	91,000
Target selling price (Rs.)	100,000
Target margin	20%
Target profit (Rs.)	20,000
Target cost (Rs.)	80,000

The company has undertaken market research which found that several proposed features of the new product were not valued by customers. Redesign to remove the features leads to a reduction in the number of components down to 80 components and a direct material cost reduction of 12%.

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The reduction in complexity has other impacts:

Assembly time will be reduced by 20%.

Quality assurance will only require 6 hours.

The probability of a failure at the inspection stage will fall to 5%.

The probability of an after-sales failure will also fall to 5%.

Cost of warranty corrections will fall by Rs. 2,000.

Reduced weight of the product will reduce shipping costs by Rs. 1,000 per unit.

The revised projected costs are as follows:

	Before	After
	Rs. '000	Rs. '000
Manufacturing cost		
Bought in parts (100 components)	50,000	
Bought in parts (80 components with 12% reduction)		44,000
Direct labour (assembly of components)		
10 hours × Rs. 500 per hour	5,000	
8 hours (20% reduction) × Rs. 500 per hour		4,000
Machine costs (750,000,000 ÷ 50,000)	15,000	15,000
Ordering and receiving		
500 orders × 100 components × Rs. 500 per order/50,000 units	500	
500 orders × 80 components × Rs. 500 per order/50,000 units		400
Quality assurance		
10 hours × Rs. 800 per hour	8,000	
6 hours × Rs. 800 per hour		4,800
Rework costs		
10% × Rs. 10,000	1,000	
5% × Rs. 10,000		500
Non-manufacturing costs		
Distribution	10,000	9,000
Warranty costs		
10% × Rs. 15,000	1,500	
5% × Rs. 13,000		650
	91,000	78,350
The target cost is achieved as it covers the target cost gap of Rs. 11,000,000.		

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5. COMPREHENSIVE EXAMPLES

- *Example 01*

Pollar Co assembles and sells a range of components for motor vehicles and it is considering a proposal to add a new component to its product range. This is a component for electric motor cars, which has been given the code number NP19. The company sees an opportunity to gain market share in a market that is expected to grow considerably over time, but already competition from rival producers is strong.

Component NP19 would be produced by assembling a number of parts bought in from external suppliers, and would then be sold on to manufacturers of electric cars. Pollar Co would use its current work force of assembly workers to make the component. Production overheads are currently absorbed into production costs on an assembly hour basis.

Pollar Co is considering the use of target costing for the new component.

a) Brief description for how target costing might be used in the development and production of a new product, is as follows

When a company identifies a product that it wishes to make and sell, it must design the product in a way that will appeal to customers. A product design and specification must be prepared, based on a combination of technical considerations and market research.

The component will also consider the price at which the product will be sold. The price that can be obtained will often depend on the price of similar rival products in the market, or on market research into customer attitudes to price. This may be called the target price.

The company should decide on the profit margin it would like to make from the product. The desired margin is subtracted from the target price to obtain a target cost.

A cost estimate is then produced for the product if it is made to the planned design and specification and this cost estimate is compared with the target cost. If the cost estimate is higher than the target cost, the difference is called a cost gap.

When a cost gap exists, the company should re-consider the planned product design and look for ways of reducing the estimated cost to the level of the target cost – in other words, the aim should be to eliminate the cost gap before actual production of the new product item begins.

b) The benefits of adopting a target costing approach at an early stage in the development of a new product would be

Target costing should begin at an early stage in the product design and development process because the opportunity for reducing production costs is greatest at the design stage. If there is a cost gap, the product design can be amended. Because the measures to reduce costs are made at an early stage, it is easier to find ways of reducing costs that do not take away significant value for the customer. (If costs are reduced in a way that reduces value for the customer, the target sales price will probably not be achievable.)

If target costing is introduced at a later stage in the product development, for example after the material components, product design features and production methods have been finally agreed, there are fewer opportunities for cost reduction.

Early adoption of target costing also helps to create a general awareness of the need for cost control, and it increases the probability that new products will be developed at a cost that allows the company to sell them at a competitive price whilst making an acceptable level of profit. It can therefore be argued that target costing improves the probability of commercial success (profitability) for new products.

c) If a target costing approach is used and a cost gap is identified for component NP19, possible measures that Pollar Co might take to reduce the gap are suggested below

If a cost gap is identified early in the product design process, the team responsible for the product development (which should include marketing staff as well as production and R&D staff) should consider every aspect of the product design and planned production method to consider ways of reducing the costs.

The aim should be to make changes in a way that does not remove significant value for the customer. For example, some aspects of the product, such as the materials or parts used, could be changed and parts that are less expensive used instead. Some features of the product design might be removed without loss of significant value.

As an alternative (or in addition to) looking for cheaper or fewer parts to the product, cost savings might be achieved by identifying suppliers who are willing to provide parts at a lower cost. Prices from suppliers might be re-negotiated, such as the fixed costs of buying part 1922 in batches.

It might be possible to change the production process in some ways to reduce the assembly time required per unit, or different assembly workers might be hired at a lower rate of pay per hour.

Finding ways of reducing overhead costs can be difficult because indirect costs cannot be identified directly with specific products. However, if Pollar Co uses target costing for new products, it would be surprising if it did not also employ methods of looking for savings in overhead costs (such as total quality management and continuous improvement).

Now if Cost information for the new component NP19 is as follows:

1. Part 1922: Each unit of component NP19 requires one unit of part 1922. These bought-in parts are purchased in batches of 5,000 units, and the purchase cost is Rs.5.30 each plus delivery costs of Rs. 2,750 per batch.
2. Part 1940: Each unit of component NP19 requires 20 cm of part 1940, which costs Rs.2.40 per meter to purchase. However, it is expected that there will be some waste due to cutting and that 5% of the purchased part will be lost in the assembly process.
3. Other parts for component NP19 will also be bought in and will cost Rs.7.20 per unit of the component.
4. Assembly labour. It is estimated that each unit of component NP19 will take 25 minutes to assemble. Assembly labour, which is not in short supply, is paid Rs.24 per hour. It is also estimated that 10% of paid labour time will be idle time.
5. Production overheads. Analysis of recent historical costs for production overheads shows the following costs:

	Total production overhead	Total assembly labour hours worked
	Rs.	
Month 1	912,000	18,000
Month 2	948,000	22,000

Fixed production overheads are absorbed at a rate per assembly hour based on normal activity levels. In a normal year, Pollar Co works 250,000 assembly hours.

Pollar Co estimates that it needs to sell component NP19 at a price of no more than Rs.56 per unit to be competitive, and it is considered that an acceptable gross profit margin on components sold by the company is 25%. Gross margin is defined as the sales price minus the full production cost of sales.

d) The expected cost per unit of component NP19 and any cost gap that exists, would be calculated as follows.

Workings: production overhead costs

Production overhead costs can be estimated using the high-low method.

Production overheads	hours	Rs.
Month 1: Total cost	18,000	912,000
Month 2: Total cost	22,000	948,000
Therefore variable cost	4,000	36,000

Variable production overhead cost per hour = Rs. 36,000/4,000 = Rs.9

Production overheads	Rs.
Month 1: Total cost of 18,000 hours	912,000
Variable cost (18,000 × Rs.9)	(162,000)
Therefore fixed costs per month	750,000

Annual fixed production overhead costs = Rs.750,000 × 12 = Rs.9,000,000.

Fixed production overhead absorption rate = Rs. 9,000,000 / 250,000 = Rs.36

Cost estimate and cost gap estimate	
Cost per unit of NP19	**Rs.**
Part 1922: Rs.5.30 + (Rs.2,750/5,000)	5.850
Part 1940: 0.20 × Rs.2.40 × 100/95	0.505
Other parts	7.200
Assembly labour cost: 25/60 × Rs.24 × 100/90	11.111
Variable overheads: 25/60 × Rs.9	3.750
Fixed overheads: 25/60 × Rs.36	15.000
Total estimated production cost	43.416
Target cost (75% of Rs.56)	42.000
Cost gap	(1.416)

► *Example 02:*

Hi-tech Limited (HL) assembles and sells various components of heavy construction equipment. HL is working on a proposal of assembling a new component EXV-99. Based on study of the product and market survey, the following information has been worked out:

Projected lifetime sale of the component EXV-99	Units	500,000
Selling price per unit	Rs.	11,000
Target gross profit percentage		40%

Information about cost of production of the new component is as follows:

i. One unit of EXV-99 would require:

Parts no.	Net quantity	Cost per unit/kg (Rs.)
XX	1 unit	2,350
YY	1.5 kg	1,400
ZZ	1 unit	1,200

The above parts would be imported in a lot, for production of 1,000 units of EXV-99. Custom duty and other import charges would be 15% of cost price. HL is negotiating with the vendor who has agreed to offer further discount.

ii. On average, assembling of one unit of EXV-99 would require 1.8 skilled labour hours at Rs. 200 per hour. The production would be carried out in a single shift of 8 hours. At the start of each shift, set-up of machines would require 30 minutes. 6% of the input quantity of YY and ZZ would be lost during assembly process.

iii. HL works at a normal annual capacity of 4,000,000 skilled hours. Actual production overheads and skilled labour hours for the last two quarters are as under:

Quarter ended	Total assembly hours	Production overheads (Rs)
30-Sep-2014	950,000	65,600,000
31-Dec-2014	1,050,000	68,000,000

iv. A special machine that would be used exclusively for the production of EXV-99 would be purchased at a cost of Rs. 1,500,000.

From the above information, determination of the discount that HL should obtain in order to achieve the target gross profit, would involve following:

Discount required from vendors to achieve target gross profit from sale of EXV-99		Rs. in million
Total cost estimated	W.1	3,624.27
Target cost	[11,000×60%×500,000]	3,300.00
Cost gap		324.27
Discount amount to be obtained from the vendor	[324.27÷1.15]	**281.97**
Required discount %	[(281.97÷2,931(W.1)×100	9.62%

W.1: Cost estimate for 500,000 units of EXV-99:		
Material XX (2,350×500,000)		1,175.00
Material YY (incl. process loss at 6%)(1.5÷0.94×1,400×500,000)		1,120.00
Material ZZ (incl. process loss at 6%)(1.0÷0.94×1,200×500,000)		636.00
		2,931.00
Custom duty and other import charges	[2,931×15%]	439.65
Direct labour:		
Labour cost	(1.8×200×500,000)	180.00
Labour set up cost	(1.8÷7.5×0.5×200×500,000)	12.00
Production overheads:		
Variable	[1.80×24.00**(W.2)**×500,000]	21.60
Fixed	[1.80×42.80**(W.3)**×500,000]	38.52
Fixed – cost of machine		1.50
Total cost		**3,624.27**

W.2: Variable overhead rate per hour:	Hours	Rupees
Quarter ended 31 December 2014	1,050,000	68,000,000
Quarter ended 30 September 2014	(950,000)	(65,600,000)
	100,000	2,400,000
Variable overhead rate per hour ***(using high-low method)*** (2,400,000÷100,000		**24.00**

W.3: Fixed overhead rate per hour:		
Cost for the quarter ended 30 September 2014		65,600,000
Less: Variable cost	[950,000×24**(W.3)**]	(22,800,000)
Fixed overheads per quarter		42,800,000
Fixed overheads per annum	[42,800,000×4]	171,200,000
Fixed overhead rate per hour at normal capacity of 4,000,000 hrs. [171,200,000÷4,000,000]		**42.80**

- *Example 03:*

Fintech company assembles and sells many types of radios. It is considering to apply target costing for one of its new product which includes technology advancement. Following data is provided for calculation of estimated cost of production.

i. Selling price of Rs. 2,500 has been set in order to compete with the similar radio on the market that has comparable features to Fintech Company's intended product. The board have agreed that the acceptable margin (after allowing for all production costs) should be 20%.

ii. Component 1- Circuit board: These are bought in and cost Rs. 410 each. They are bought in batches of 4,000 and additional delivery costs are Rs. 240,000.

iii. Component 2- Wiring: In an ideal situation 25cm of wiring is needed for each completed radio. However, there is some waste involved in the process as wire is occasionally cut to the wrong length or is damaged in the assembly process. Fintech company estimates that 2% of the purchase wire is lost in the assembly process. Wire costs Rs. 50 per meter to buy.

iv. Other material: Other material cost Rs. 810 per radio.

v. Assembly Labour: these are skilled people who are difficult to recruit and retain. Fintech company has more staff of this type than needed but is prepared to carry this extra cost in return for the security it gives the business. It takes 30 minutes to assemble a radio and the assembly workers are paid Rs. 1,260 per hour. It is estimated that 10% of hours paid to assembly workers is for idle time.

vi. Production overheads: Recent historic cost analysis has revealed the following production overhead data:

Month	Total Production overheads Rs.	Total assembly labour hours
Month 1	62,000,000	190,000
Month 2	70,000,000	230,000

Fixed production overheads are absorbed on an assembly hour basis based on normally annual activity levels. In a typical year 2,400,000 assembly hours will be worked by Fintech Company.

The expected cost per Radio and any cost gap that exists, would be calculated as follows.

Workings: production overhead costs

Production overhead costs can be estimated using the high-low method.

Production overheads	Hours	Rs.
Month 1: Total cost	190,000	62,000,000
Month 2: Total cost	230,000	70,000,000
Therefore variable cost	40,000	8,000,000

Variable production overhead cost per hour = Rs. 8,000,000/40,000 = Rs. 200

Production overheads	Rs.
Month 1: Total cost of 190,000 hours	62,000,000
Variable cost (190,000 × Rs.200)	(38,000,000)
Therefore fixed costs per month	24,000,000

Annual fixed production overhead costs = Rs.24,000,000 × 12 = Rs.288,000,000.

Fixed production overhead absorption rate = Rs. 288,000,000 / 2,400,000 = Rs.120

Cost estimate and cost gap estimate	
Cost per unit of NP19	**Rs.**
Circuit board: Rs. 410 + (Rs.240,000/4,000)	470.00
Wiring: 0.25 × Rs. 50 × 100/98	12.76
Other parts	810.00
Assembly labour cost: 30/60 × Rs. 1,260 × 100/90	700.00
Variable overheads: 30/60 × Rs. 200	100.00
Fixed overheads: 30/60 × Rs.120	60.00
Total estimated production cost	2,152.76
Target cost (80% of Rs. 2,500)	2,000.00
Cost gap	(152.76)

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Target costing involves setting a target cost by subtracting a desired profit margin from a Competitive Selling / market Price.

Target cost = Market Price – Desired Profit Margin

Target cost gap = Expected Cost – Target cost

Cost gap can be bridged by effective cost reduction techniques, better technology and Improved Processes

Advantages of target costing are proactive approach towards cost reduction, achievement of desired profit and Quality product in accordance with customer requirements

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CHAPTER 14

COST-VOLUME-PROFIT (CVP) ANALYSIS

IN THIS CHAPTER

AT A GLANCE

Cost-volume-profit analysis is used to show how costs and profits change with changes in the volume of activity.

Contribution margin facilitates analysis of cost-volume-profit. It is equal to sales minus variable expenses. It also allows approximation of profit for decision making. The same can also be used in planning and evaluating profit resulting from change in volume or cost. Hence aids in selection of optimize product mix and sales target.

Break-even point is often required to calculate the volume of sales required in a period (such as the financial year) to 'break even' and make neither a profit nor a loss. The break-even point can therefore be calculated by dividing the total contribution required (total fixed costs) by the contribution per unit.

Margin of safety is normally maintained to overcome problems of adverse impact of variables. It is calculated by taking difference between budgeted sales and break-even sales. When converted in percentage, it shows margin of safety ratio.

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1. THE NATURE OF CVP ANALYSIS

1.1 Introduction to CVP analysis

CVP analysis stands for ***cost-volume-profit analysis***'. It is used to show how costs and profits change with changes in the volume of activity. CVP analysis is an application of marginal costing concepts. It is a study of interrelationships between cost, volume and profit at different levels of activity.

1.2 Assumptions in CVP analysis

- Costs are either fixed or variable. The variable cost per unit is the same at all levels of activity (output and sales). Whereas total fixed costs are a constant amount in each period. Fixed costs are normally assumed to remain unchanged at all levels of output at least in the short term.
- The contribution per unit is constant for each unit sold (of the same product).
- The sales price per unit is constant for every unit of product sold; therefore, the contribution to sales ratio is also a constant value at all levels of sales.
- Production volume is equal to sales volume.

1.3 Contribution

Contribution is a key concept. Contribution is measured as sales revenue less variable costs.

Profit is measured as contribution minus fixed costs.

► *Illustration:*

	Rs.
Sales (Units sold × sales price per unit)	X
Variable costs (Units sold × variable cost price per unit)	(X)
Contribution	X
Fixed costs	(X)
Profit	X
Total contribution = Contribution per unit × Number of units sold.	

Many problems solved using CVP analysis use either contribution per unit (CPU) or the CS (Contribution/Sales) ratio.

Contribution per unit

It is assumed that contribution per unit (sales price minus variable cost) is a constant amount over all sales volumes.

► *Example 01:*

A company makes and sells a single product. The product has a variable production cost of Rs.8 per unit and a variable selling cost of Rs.1 per unit.

Total fixed costs (production, administration and sales and distribution fixed costs) are expected to be Rs. 500,000.

The selling price of the product is Rs.16.

The profit at sales volumes of 70,000, 80,000 and 90,000 units can be calculated as follows.

	70,000 units	80,000 units	90,000 units
	Rs.	Rs.	Rs.
Sales revenue (Rs.16/unit)	1,120,000	1,280,000	1,440,000
Variable cost (Rs.9/unit)	(630,000)	(720,000)	(810,000)
Contribution (Rs.7/unit)	490,000	560,000	630,000
Fixed costs	(500,000)	(500,000)	(500,000)
Profit/(loss)	(10,000)	60,000	130,000

Notes

A loss is incurred at 70,000 units of sales because total contribution is not large enough to cover fixed costs. Profit increases as sales volume increases, and the increase in profit is due to the increase in total contribution as sales volume increases.

Somewhere between 70,000 and 80,000 there is a number of units which if sold would result in neither a profit nor a loss. This is known as the breakeven position.

The contribution line could have been completed without calculating the sales and variable costs by simply multiplying the quantity sold by the CPU.

Considering facts as before, calculating total contribution as the number of units × contribution per unit, would be as follows:

Contribution per unit	Rs.
Sales price per unit	16
Variable production cost per unit	(8)
Variable selling cost per unit	(1)
Contribution per unit	7

	70,000 units	80,000 units	90,000 units
	Rs.	Rs.	Rs.
70,000 × Rs. 7 per unit	490,000		
80,000 × Rs. 7 per unit		560,000	
90,000 × Rs. 7 per unit			630,000
Fixed costs	(500,000)	(500,000)	(500,000)
Profit/(loss)	(10,000)	60,000	130,000

Contribution to sales ratio

Contribution to sales ratio, also known as C/S ratio or C/M ratio, represents proportionate relationship between contribution and sales. This ratio can be shown in term of percentage by multiplying the relationship of contribution and sales.

▶

Formula:

$$\text{CS ratio (contribution to sales ratio)} \quad \frac{\text{Contribution per unit}}{\text{Selling price per unit}}$$

- *Example 02:*

Jimco makes and sells a single product, Product P. It is currently producing 112,000 units per month, and is operating at 80% of full capacity. Total monthly costs at the current level of capacity are Rs. 611,000. At 100% capacity, total monthly costs would be Rs. 695,000. Fixed costs would be the same per month at all levels of capacity between 80% and 100%.

At the normal selling price for Product P, the contribution/sales ratio is 60%.

The variable cost per unit of Product P and total fixed costs per month would be calculated as:

100% capacity each month = 112,000 units/0.80 = 140,000 units.

Using high/low analysis:

	units	Rs.
High: Total cost of	140,000	695,000
Low: Total cost of	112,000	611,000
Difference: Variable cost of	28,000	84,000

Therefore, variable cost per unit = Rs. 84,000/28,000 units = Rs.3.

Substitute in high equation	Cost (Rs)
Total cost of 140,000 units	695,000
Variable cost of 140,000 units (× Rs.3)	420,000
Therefore fixed costs per month	275,000

In addition, if it is required to calculate the current normal sales price per unit, and the contribution per unit at the price, the same would require following calculations:

Contribution/sales ratio = 60%

Therefore, variable cost/sales ratio = 40%

The normal sales price per unit = Rs.3/0.40 = Rs.7.50

The contribution per unit at the normal selling price is Rs.7.50 – Rs.3 = Rs.4.50 per unit.

Using data of Example 01:

The contribution to sales ratio is calculated as under.

Contribution to sales ratio:
Contribution per unit / Selling price per unit = 7/16 = 0.4375

	70,000 units	80,000 units	90,000 units
	Rs.	Rs.	Rs.
Contribution (Rs.7/unit)	490,000	560,000	630,000
CS ratio	÷0.4375	÷0.4375	÷0.4375
Sales revenue	1,120,000	1,280,000	1,440,000

2. BREAK-EVEN ANALYSIS

2.1 Break-even analysis

CVP analysis can be used to calculate a break-even point for sales.

Break-even point is the volume of sales required in a period (such as the financial year) to 'break even' and make neither a profit nor a loss. At this level, company would able to recover its fixed cost from its contribution.

Management might want to know what the break-even point is in order to:

- identify the minimum volume of sales that must be achieved in order to avoid a loss, or
- assess the amount of risk in the budget, by comparing the budgeted volume of sales with the break-even volume.
- estimate the inflow of cash required by the business before it starts generating its own funds.

2.2 Calculating the break-even point

The break-even point can be calculated using simple CVP analysis.

At the break-even point, the profit is Rs.0. If the profit is Rs.0, total contribution is exactly equal to total fixed costs.

We therefore need to establish the volume of sales at which fixed costs and total contribution are the same amount.

There are a number of methods of calculating the break-even point when the total fixed costs for the period are known:

Method 1: Breakeven point expressed as a number of units.

The first method is to calculate the break-even point using the contribution per unit. This method can be used where a company makes and sells just one product.

▶ *Formula:*

Breakeven point expressed as a number of units

$$\text{Break-even point in sales units} = \frac{\text{Total fixed costs}}{\text{Contribution per unit}}$$

Total fixed costs are the same as the total contribution required to break even, and the break-even point can therefore be calculated by dividing the total contribution required (total fixed costs) by the contribution per unit.

It is important that in calculating the break-even point, we should take total variable cost for generating contribution per unit. Contribution per unit is sales price less variable production cost and variable non-production costs. Likely, total fixed cost used in above formula includes both production and non-production fixed costs.

Once the breakeven point is calculated as a number of units it is easy to express it in terms of revenue by multiplying the number of units by the selling price per item.

▶ *Example 03:*

A company makes a single product that has a variable cost of sales of Rs.12 and a selling price of Rs.20 per unit. Budgeted fixed costs are Rs. 600,000.

What volume of sales is required to break even?

Method 1

$$\text{Break-even point in sales units} \quad \frac{\text{Total fixed costs}}{\text{Contribution per unit}}$$

Contribution per unit = Rs.20 – Rs.12 = Rs.8.

Therefore, break-even point:

In units: Rs. 600,000 / Rs.8 per unit = 75,000 units of sales.

In sales revenue: 75,000 units × Rs.20 per unit = Rs. 1,500,000 of sales.

Method 2: Breakeven point expressed in sales revenue

If we intend to calculate breakeven point in sales revenue, then fixed cost is divided by CS ratio. It gives value of sales value to breakeven.

- *Formula:*

Breakeven point expressed in sales revenue

$$\text{Break-even point in revenue} = \frac{\text{Fixed costs}}{\text{Contribution to sales ratio}}$$

Once the breakeven point is calculated as an amount of revenue it is easy to express it as a number of units by dividing the revenue by the selling price per item.

- *Example 04:*

A company makes a single product that has a variable cost of sales of Rs.12 and a selling price of Rs.20 per unit. Budgeted fixed costs are Rs .600,000.

What volume of sales is required to break even?

Method 2

$$\text{Break-even point in revenue} = \frac{\text{Total fixed costs}}{\text{C/S ratio}}$$

C/S ratio = Rs.8/Rs.20 = 40%

Therefore, break-even point:

In sales revenue = Rs. 600,000/0.40 = Rs. 1,500,000 in sales revenue.

In units = Rs. 1,500,000 ÷ Rs.20 (sales price per unit) = 75,000 units.

- *Example 05:*

A soft drink company is planning to produce mineral water. It is contemplating the purchase of plant with a capacity of 100,000 bottles a month. For the first year of operation the company expects to sell between 60,000 to 80,000 bottles. The budgeted costs at each of the two levels are as follows:

	Rupees	
Particulars	**60,000 bottles**	**80,000 bottles**
Material	360,000	480,000
Labour	200,000	260,000
Factory overheads	120,000	150,000
Administration expenses	100,000	110,000

The production would be sold through retailers who will receive a commission of 8% of sale price.

In order to calculate, the break-even point in rupees and units, if the company decides to fix the sale price at Rs. 16 per bottle, please see below working

Calculation of variable and fixed cost

	Total costs		Variable cost			Fixed cost (A – E)
	60,000 bottles	80,000 bottles	20,000 bottles	Per bottle C/20,000	60,000 bottles D×60,000	
	A	B	C	D	E	F
Material	360,000	480,000	120,000	6.00	360,000	-
Labour	200,000	260,000	60,000	3.00	180,000	20,000
Factory overheads	120,000	150,000	30,000	1.50	90,000	30,000
Administration expenses	100,000	110,000	10,000	0.50	660,000	70,000
	780,000	1,000,000	220,000	11.00	660,000	120,000

	Rupees
Variable cost per bottle as above	11.00
Commission to retailers (8% of Rs. 16.00)	1.28
Variable cost per bottle	12.28
Contribution per bottle (16.00 – 12.28)	Rs. 3.72
CS ratio (contribution to sales ratio 3.72/16.00)	23.25%

$$\text{Break-even point (bottles)} = \frac{\text{Fixed cost}}{\text{Contribution per bottle}} = \frac{120{,}000}{3.72} = 32{,}258 \text{ bottles}$$

Break-even point in Rupees = 32,258 × 16.00 = Rs. 516,128

In addition, computation of the break-even point in units if the company offers a discount of 10% on purchase of 20 bottles or more, assuming that 20% of the sales will be to buyers who will avail the discount, would be as follows:

Average sales price (before discount)	Rs.16.00
Average discount per unit @ 10% on 20% of sales = 0.02 of Rs. 16.00	(0.32)
New average sales price	15.68
Variable cost per bottle as above	11.00
Commission to retailers (8% of Rs. 15.68)	1.25
Variable cost per bottle	12.25

Contribution per bottle (15.68 – 12.25) Rs. 3.43

$$\text{Break-even point (bottles)} = \frac{\text{Fixed cost}}{\text{Contribution per bottle}} = \frac{120{,}000}{3.43} = 34{,}985 \text{ bottles}$$

2.3 Margin of safety

The margin of safety is the difference between:

- the budgeted sales (in units or Rs.) and
- the break-even amount of sales (in units or Rs.).

It is usually expressed as a **percentage of the budgeted sales**. However, it may also be measured as:

- a quantity of units (= the difference between the budgeted sales volume in units and the breakeven sales volume), or
- an amount of sales revenue (= the difference between the budgeted sales revenue and the total sales revenue required to break even).

It is called the margin of safety because it is the maximum amount by which actual sales can be lower than budgeted sales without incurring a loss for the period. A high margin of safety therefore indicates a low risk of making a loss.

The margin of safety is often expressed as a percentage of budgeted sales.

▶ *Formula:*

$$\text{Margin of safety} = \frac{\text{Margin of safety (units)}}{\text{Budgeted sales (units)}} \times 100$$

$$\text{Margin of safety} = \frac{\text{Margin of safety (revenue)}}{\text{Budgeted revenue}} \times 100$$

▶ *Example 06:*

Saadat sons has recently prepared budget for next year, and following data is extracted:

Particulars	
Budgeted sales	80,000 units
Selling price	Rs. 8 per unit
Variable cost	Rs. 4 per unit
Fixed cost (annual)	Rs. 200,000

The breakeven point and margin of safety is calculated below.

The break-even point = Rs. 200,000/(Rs.8 – 4) = 50,000 units.

The budgeted sales are 80,000 units.

Margin of safety = Budgeted sales – break-even sales
= 80,000 – 50,000 = 30,000 units

Margin of safety ratio = 30,000 units/80,000 units =37.5% of budgeted sales

This means that sales volume could be up to 37.5% below budget, and the company should still expect to make a profit.

▶ *Example 07:*

Auto Industries Limited (AIL) manufactures auto spare parts. Currently, it is operating at 70% capacity. At this level, the following information is available:

Break-even sales	Rs. 125 million
Margin of safety	Rs. 25 million
Contribution margin to sales	20%

AIL is planning to increase capacity utilization through the following measures:

Selling price would be reduced by 5% which is expected to increase sales volume by 30%.

Increase in sales would require additional investment of Rs. 40 million in distribution vehicles and working capital. The additional funds would be arranged through a long-term loan at a cost of 15% per annum. Depreciation on distribution vehicles would be Rs. 5 million.

As a result of increased production, economies of scale would reduce variable cost per unit by 10%.

a) Preparing for profit statements under current and proposed scenarios would involve following calculations:

Auto Industries Limited	Current	Proposed
Profit statement	Rs. in million	
Sales (125+25), 150*1.30*.95	150.00	185.25
Variable cost of sales (150*80%), 120*90%*1.3)	(120.00)	(140.40)
Contribution margin	30.00	44.85
Fixed cost (125×20%), 25+5+ (40*15%)	(25.00)	(36.00)
Net profit	5.00	8.85

b) In addition, computing break-even sales and margin of safety after taking the above measures would have following results.

Break-even sales (36÷[44.85/185.25])		148.70
Margin of safety	(185.25-148.70)	36.55

2.4 Target profit

CVP analysis is helpful tool for determining the sales level where target profit is achieved. Target profit is a profit which a company intend to earn. For calculation of target profit, the assumption given in CVP analysis shall continue.

The volume of sales required must be sufficient to earn a total contribution that covers the fixed costs and makes the target amount of profit. In other words, the contribution needed to earn the target profit is the target profit plus the fixed costs.

The sales volume that is necessary to achieve this, is calculated by dividing the target profit plus fixed costs by the contribution per unit in the usual way.

- *Formula:*

Volume target expressed in units

$$\text{Volume target (units)} = \frac{\text{Total fixed costs + target profit}}{\text{Contribution per unit}}$$

Once the volume target is calculated as a number of units it is easy to express it in terms of revenue by multiplying the number of units by the selling price per item.

Similarly, the sales revenue that would achieve the target profit is calculated by dividing the target profit plus fixed costs by the C/S ratio.

- *Formula:*

target expressed in sales revenue

$$\text{target in revenue(Rs.)} = \frac{\text{Total fixed costs + target profit}}{\text{Contribution to sales ratio}}$$

Once the volume target is calculated as an amount of revenue it is easy to express it as a number of units by dividing the revenue by the selling price per item.

- *Example 08:*

A company makes and sells a product that has a variable cost of Rs.5 per unit and sells for Rs.9 per unit.

Budgeted fixed costs are Rs. 600,000 for the year, and the company wishes to make a profit of at least Rs. 100,000.

The sales volume required to achieve the target profit can be found as follows:

The total contribution must cover fixed costs and make the target profit.

	Rs.
Fixed costs	600,000
Target profit	100,000
Total contribution required	700,000

Contribution per unit = Rs.9 – Rs.5 = Rs.4.

Sales volume required to make a profit of Rs. 100,000:

= Rs. 700,000 / Rs.4 per unit = 175,000 units.

Therefore, the sales revenue required to achieve target profit

175,000 units × Rs.9 = Rs. 1,575,000

Alternatively:

C/S ratio = 4/9

Sales revenue required to make a profit of Rs. 100,000

= Rs.700,000 ÷ (4/9) = Rs.1,575,000.

Therefore, the number of units required to achieve target profit

Rs. 1,575,000 ÷ Rs. 9 = 175,000 units

- *Example 09:*

A company makes a single product that it sells at Rs. 80 per unit. The total fixed costs are Rs. 360,000 for the period and the contribution/sales ratio is 60%. Company intends to earn profit of Rs. 240,000 in coming period.

The break-even point and sales level to earn target profit, would be calculated as follows

Contribution per unit = 60% × Rs.80 = Rs.48

Fixed costs = Rs. 360,000

Break-even point = Rs. 360,000/Rs.48 per unit = 7,500 units

Budgeted sales = 8,000 units

Target profit + Fixed costs = Rs. 240,000 + Rs. 360,000 = Rs. 600,000

Desired sales level = Rs. 600,000 / 48 = 12,500 units.

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- *Example 10:*

A company makes and sells a single product. The following data relates to the current year's budget.

Sales and production (units):	**8,000**
Variable cost per unit:	Rs. 20
Fixed cost per unit:	Rs. 25
Contribution/sales ratio:	60%

The selling price next year will be 6% higher than the price in the current year budget and the variable cost per unit will be 5% higher than in the current year budget. Budgeted fixed costs next year will be 10% higher than budgeted fixed costs in the current year.

If required to calculate (i) the budgeted contribution per unit and (ii) the budgeted total profit for the current year following working is required

i.

Contribution/sales ratio	60%
Therefore, variable cost/sales ratio	40%
Variable cost per unit Rs.	20
Sales price Rs. (20/0.40)	50
Contribution per unit Rs. (50-20)	30
Budgeted contribution (8,000 x 30)	Rs. 240,000
Budgeted fixed cost (8,000 x 25)	Rs. 200,000
Budgeted profit, current year	Rs. 40,000

However, for the next year, in order to calculate the number of units that will have to be sold in order to achieve a total profit that is equal to the budgeted profit in the current year please see below.

ii.

Sales price next year (50 x 1.06)	53
Next year variable cost (20 x 1.05)	21
Therefore, contribution per unit (53-21)	32
	Rupees
Target profit next year	40,000
Fixed cost next year (200,000 x 1.10)	220,000
Target contribution required	260,000
Hence, target sales (260,000 / 32) units	8,125

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- *Example 11:*

From the books and records of the CDE Company, the cost analyst determined that sales were Rs. 1,000,000 and costs were as follows:

Description	Variable cost Rs.	Fixed cost Rs.	Total cost Rs.
Direct material	300,000	-	300,000
Direct labour	300,000	-	300,000
Factory overhead	80,000	50,000	130,000
Marketing expenses	70,000	30,000	100,000
Administrative expenses	50,000	20,000	70,000

The company is considering two alternative proposals that would change certain cost items. Proposal 1 would increase fixed cost by Rs. 10,000, with sales and variable costs remaining the same. Proposal 2 would modernize present equipment at an annual increase of fixed costs of Rs. 25,000, with the expectation of saving the same amount in each of the direct materials and direct labour costs.

Calculation of (i) current contribution to sales ratio; (ii) current break-even point; (iii) the break-even point and profit, if proposal 1 is adopted and (iv) contribution to sales ratio, the breakeven point and profit, if proposal 2 is adopted, are given below.

i. Current contribution to sales ratio

	Rupees
Current sales	1,000,000
Less: Variable cost:	
Direct material	(300,000)
Direct labour	(300,000)
Variable factory overhead	(80,000)
Variable marketing expenses	(70,000)
Variable administrative expenses	(50,000)
	(800,000)
Contribution margin	200,000
CS ratio (200,000/1,000,000) x 100	**20%**

ii. Current breakeven point, is calculated below.

	Rupees
Fixed cost	
Factory overhead	50,000
Marketing expenses	30,000
Administrative expenses	20,000
	100,000
CS ratio	20%
Breakeven point in Rs. (100,000/0.20)	**500,000**

iii. Breakeven point and profit, if proposal 1 is adopted.

	Rupees
CS ratio (see-i)	20%
Fixed cost as given in ii	100,000
Incremental fixed cost	10,000
Fixed cost under proposal 1	110,000
Hence breakeven point (110,000/20%)	**550,000**
Profit under proposal 1	
Contribution (see-i)	200,000
Less: Fixed cost	(110,000)
Profit	**90,000**

iv. CS ratio, breakeven point and profit, if proposal 2 is adopted.

	Rupees
Sales	1,000,000
Less: Variable costs:	
Direct material (300,000-25,000)	(275,000)
Direct labour (300,000-25,000)	(275,000)
Variable factory overhead	(80,000)
Variable marketing expenses	(70,000)
Variable administrative expenses	(50,000)
	(750,000)
Contribution margin	250,000
CS ratio (250,000/1,000,000)	**25%**
Fixed cost as given in ii	100,000
Incremental fixed cost	25,000
Fixed cost under proposal 1	**125,000**
Hence breakeven point (125,000/25%)	**500,000**
Profit under proposal 1	
Contribution	250,000
Less: Fixed cost	(125,000)
Profit	**125,000**

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- *Example 12:*

Entity E has monthly sales of Rs. 128,000, but at this level of sales, its monthly profit is only Rs. 2,000 and its margin of safety is 6.25%.

From the above information we can calculate (i) fixed costs as well as (ii) the level of monthly sales needed to increase the monthly profit to Rs.5000 as follows:

i. The margin of safety is 6.25%. Therefore, the break-even volume of sales = 93.75% of budgeted sales = 0.9375 × Rs. 128,000 = Rs. 120,000

	Budget (Rs.)	Break-even (Rs.)
Sales	128,000	120,000
Profit	2,000	0
Total costs	126,000	120,000

This gives us the information to calculate fixed and variable costs, using high/low analysis.

	Rs. Revenue	Rs. Cost
High: Total cost at	128,000	126,000
Low: Total cost at	120,000	120,000
Difference: Variable cost of	8,000	6,000

Therefore, variable costs = Rs. 6,000/Rs. 8,000 = 0.75 or 75% of sales revenue.

Substitute in high or low equation	Cost (Rs.)
Total cost at Rs.128,000 revenue	126,000
Variable cost at Rs.128,000 revenue (× 0.75)	(96,000)
Therefore fixed costs	30,000

Alternate approach

i. At sales of Rs. 128,000, profit is Rs .2,000.
The contribution/sales ratio = 100% – 75% = 25% or 0.25.
To increase profit by Rs. 3,000 to Rs. 5,000 each month, the increase in sales must be:
(Increase in profit and contribution) ÷ C/S ratio
= Rs. 3,000/0.25 = Rs. 12,000.
Sales must increase from Rs. 128,000 (by Rs. 12,000) to Rs. 140,000 each month.

Alternative approach to the answer

	Rs.
Target profit	5,000
Fixed costs	30,000
Target contribution	35,000
C/S ratio	0.25
Therefore sales required (Rs.35,000/0.25)	Rs.140,000

▶ *Example 13:*

Octa Electronics produces and markets a single product. Presently, the product is manufactured in a plant that relies heavily on direct labour force. Last year, the company sold 5,000 units with the following results:

	Rupees
Sales	22,500,000
Less: Variable expenses	(13,500,000)
Contribution margin	9,000,000
Less: Fixed expenses	(6,300,000)
Net income	2,700,000

a) Break-even point in rupees and the margin of safety would be:

Break-even point in Rupees

$$\text{Break even point in Rupees} = \frac{\text{Fixed Expense}}{\text{Contribution margin\%}}$$

$$= \frac{6{,}300{,}000}{40\%\ (\text{W-1})} = \text{Rs. } 15{,}750{,}000$$

W-1:	Rupees	
Selling price	22,500,000	
Less: variable expense	13,500,000	
Contribution margin	9,000,000	
Contribution margin %	40%	(9,000,000 / 22,500,000)

$$\text{Margin of safety} = \frac{\text{Current sales - Break even sales}}{\text{Current sales}}$$

$$= \frac{22{,}500{,}000 - 15{,}750{,}000}{22{,}500{,}000} = 30\%$$

b) For the contribution margin ratio and the break-even point in number of units if variable cost increases by Rs. 600 per unit can be calculated. The selling price per unit if the company wishes to maintain the contribution margin ratio achieved during the previous year involves following working.

New CM Ratio	Rupees	
Selling price	22,500,000	
Less: variable expense	(16,500,000)	(Rs. 13,500,000 + 5,000 x Rs. 600)
Contribution margin	6,000,000	
Contribution margin %	26.67%	(Rs. 6,000,000 / Rs. 22,500,000)
Break-even point in units		
Break-even point in units =	Fixed Expense / Contribution margin per unit	
=	6,300,000 / Rs. 6,000,000 ÷ 5,000	= 5,250 units

New Selling Price	
Let S = new selling price per unit	
S =	Variable Costs per unit + S x 0.4
S =	(Rs. 16,500,000 ÷ 5,000) + 0.4S
0.6 S =	Rs. 3,300
S =	Rs. 5,500

c) The company is also considering the acquisition of a new automated plant. This would result in the reduction of variable costs by 50% of the amount computed in (b) above whereas the fixed expenses will increase by 100%. If the new plant is acquired, units that will have to be sold next year to earn net income of Rs. 3,150,000 would be

No. of units to be sold next year to earn a profit of Rs. 3,150,000

New contribution per unit		
Selling price	Rs. 4,500	
Less: variable expenses	Rs. 1,650	(Rs. 16,500,000 / 5,000 x 50%)
Contribution margin	Rs. 2,850	

New breakeven point in units to achieve net income of Rs. 3,150,000t

$$\text{Break even point in units} = \frac{\text{Fixed Expense} + \text{Target Profit}}{\text{Contribution margin per unit}}$$

$$= \frac{(\text{Rs. } 6{,}300{,}000 \text{ x } 2) + \text{Rs. } 3{,}150{,}000}{\text{Rs. } 2{,}850} = 5{,}526 \text{ units}$$

▶ *Example 14:*

The following information pertains to Hope Limited for the latest financial year:

	Rupees
Sales price per unit	1,600
Direct labour per unit	240
Variable cost (other than direct labour) per unit	960
Fixed cost (no labour cost included)	850,000

Volume of sales and production was 6,000 units which represent 80% of normal capacity. The management of the company is planning to increase wages of direct labour by 15% with effect from next financial year.

i. In order to calculate the number of units to be sold to maintain the current profit if the sales price remains at Rs. 1,600 and the 15% wage increase goes into effect, please see below:

Units to be sold to maintain the current profit:		Rs.
Sales	(6,000 units × 1,600)	9,600,000
Variable cost	[6,000 × (960+240)]	(7,200,000)
Contribution margin	**A**	2,400,000
Revised contribution margin per unit [1,600–960–(240×1.15)]	**B**	364
Units to be sold	**A÷B**	**6,593 Units**

ii. The management believes that an additional investment of Rs. 760,000 in machinery (to be depreciated at 10% annually) will increase normal capacity by 25%. Determine the selling price in order to earn a profit of Rs. 2 million assuming that all units produced at increased capacity can be sold and that the wage increase goes into effect.

Selling price per unit to earn a profit of Rs. 2 million:			
Revised capacity	(6,000 ÷ 0.8 × 1.25)	Units	9,375
Revised fixed cost	850,000 + (760,000 × 10%)	Rs.	926,000
New selling price $= \frac{926{,}000+2{,}000{,}000}{9{,}375} + (240\times1.15) + 960$		Rs.	1,548

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3. BREAK-EVEN CHARTS AND PROFIT-VOLUME CHARTS

3.1 Break-even chart

A break-even chart is a chart or graph showing, for all volumes of output and sales:

- total costs, analyzed between variable costs and fixed costs
- sales
- profit (= the difference between total sales and total costs)
- the break-even point (where total costs = total sales revenue, and profit = 0).

The concept of a break-even chart is similar to a cost behaviour chart, but with sales revenue shown as well.

If the chart also indicates the budgeted volume of sales, the margin of safety can be shown as the difference between the budgeted volume and the break-even volume of sales.

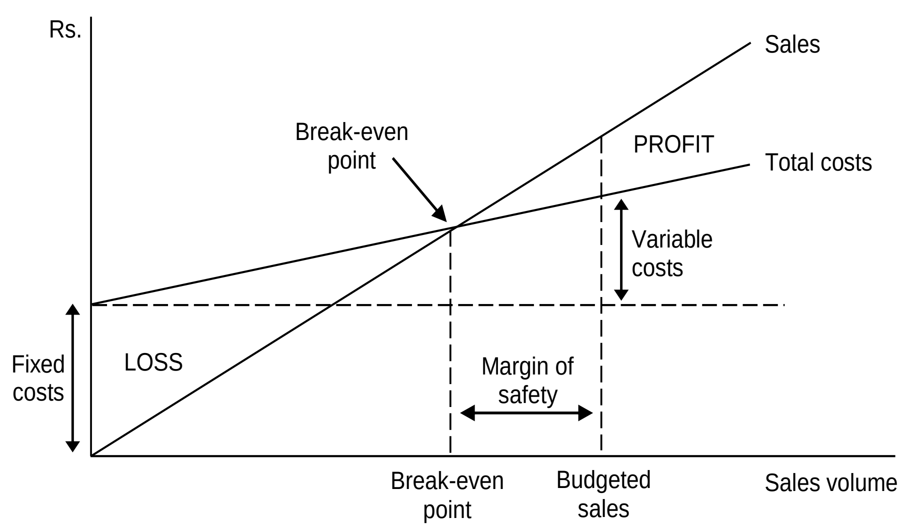
The break-even chart can be prepared in two ways, first is conventional break-even chart and second is contribution break-even chart.

- In the conventional break-even chart, breakeven point is calculated with intersection of total cost and total revenue curves. The fixed costs are represented by the horizontal line of dashes as it remains same amount at all volumes of sales. Variable costs are shown on top of fixed costs, by taking difference between total cost curve and fixed cost curve. At point 0, the variable cost is also 0. But as volume increased the total variable cost shows tendency of being increased. The gap between breakeven point and budgeted sales indicates the margin of safety.
- In contribution break-even chart, breakeven point is calculated in similar way as discussed in conventional breakeven chart. However, fixed cost horizontal line is not shown in it, rather total variable cost curve is calculated. The difference between the total cost curve and variable cost curve indicates the fixed cost. We can measure the fixed cost at any level of activity, as it shows equal. The margin of safety can be calculated in same way as indicated in conventional break-even chart.

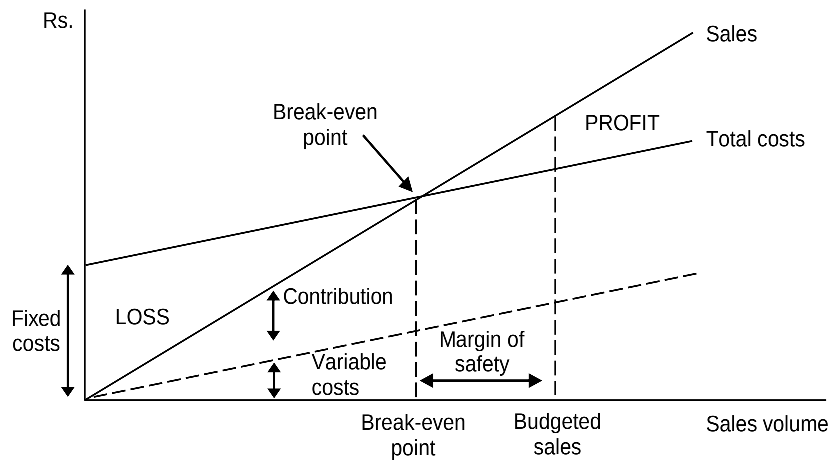
Because the sales price per unit is constant, the total sales revenue line rises in a straight line from the origin of the graph (i.e. from x = 0, y = 0).

Conventional break-even chart:

▶ *Illustration 01:*



▶ *Illustration 02:*



Points to note

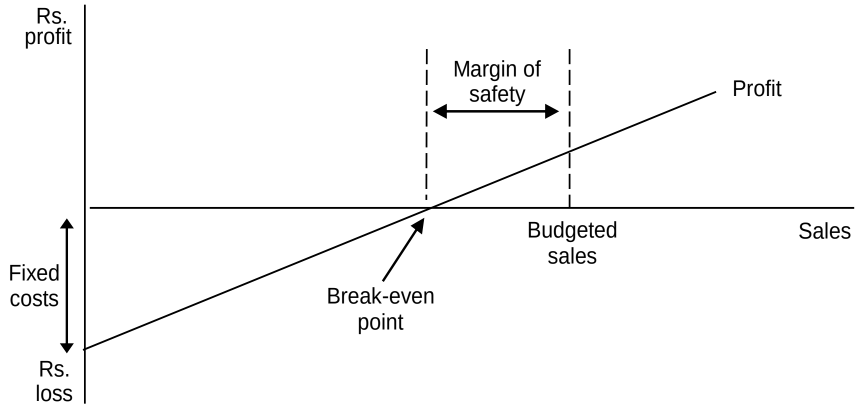
You should be able to identify the following points on these charts.

- The break-even point is shown on both charts as the volume of sales at which total revenue equals total costs.
- In the second chart, total contribution at the break-even point is shown as exactly equal to fixed costs.
- If budgeted sales are shown on the chart, the margin of safety can also be extracted, as the difference between budgeted sales and the break-even point.

3.2 Profit/volume chart (P/V chart)

A profit volume chart (or P/V chart) is an alternative to a break-even chart for presenting CVP information. It is a chart that shows the profit or loss at all levels of output and sales.

▶ *Illustration:*



At Rs.0 sales, there is a loss equal to the total amount of fixed costs. The loss becomes smaller as sales volume increases, due to the higher contribution as sales volume increases. Break-even point is then reached and profits are made at sales volumes above the break-even point.

We could draw a line on the graph to show fixed costs. This line should be drawn parallel to the x axis, starting at the loss (= total fixed costs) at Rs.0 sales. By drawing this line for fixed costs, total contribution would be shown as the difference between the line showing the profit (or loss) and the line for the fixed costs.

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▶ *Example 15:*

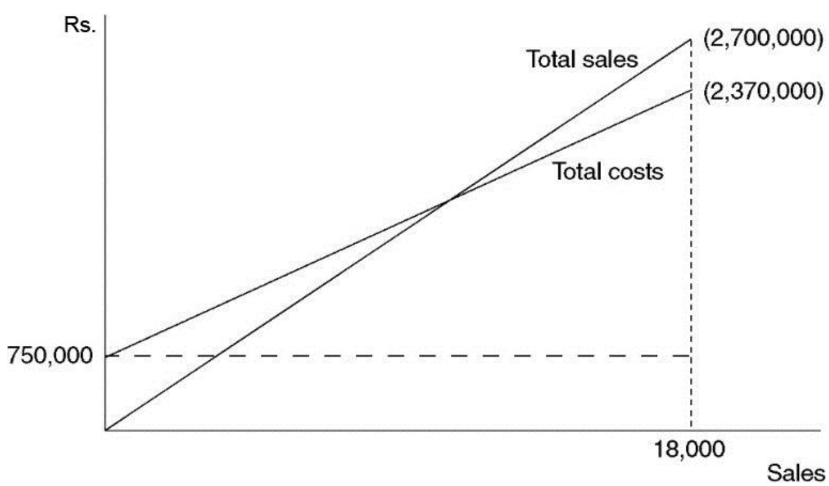
You are a management accountant for a business that develops specialist computers. You are consulted to investigate the viability of marketing a new type of hand-held computer.

With the help of the manager of research and development, the production manager, the buyer and the sales manager, you have made the following estimates of annual sales and profitability:

Sales	Profit/(loss)
units	**Rs.**
12,000	(30,000)
15,000	150,000
18,000	330,000

The selling price will be Rs.150.

A traditional break-even chart using the information given above will be prepared as follows:



Workings			
	Sales	**Sales (at Rs.150)**	**Profit**
	units	**Rs.**	**Rs.**
	18,000	2,700,000	330,000
	12,000	1,800,000	(30,000)
Difference	6,000	900,000	360,000

An increase in sales from 12,000 units to 18,000 units results in an increase of Rs. 900,000 in revenue and Rs. 360,000 in contribution and profit.

From this, we can calculate that the contribution is Rs.60 per unit (Rs. 360,000/6,000) and the C/S ratio is 0.40 (Rs. 360,000/Rs. 900,000). Variable costs are therefore 0.6 or 60% of sales.

To draw a break-even chart, we need to know the fixed costs.

Substitute in high or low equation

When sales are 18,000 units:	Rs.
Sales (at Rs.150 each)	2,700,000
Variable cost (sales × 60%)	1,620,000
Contribution (sales × 40%)	1,080,000
Profit	330,000
Therefore fixed costs	750,000
When sales are 18,000 units:	**Rs.**
Fixed costs	750,000
Variable cost (see above)	1,620,000
Total costs	2,370,000

In addition, the margin of safety if annual sales are expected to be 15,000 units can be calculated as

Break-even point = Fixed costs ÷ C/S ratio

= Rs. 750,000/0.40 = Rs. 1,875,000

Break-even point in units = Rs. 1,875,000/Rs.150 per unit = 12,500 units.

If budgeted sales are 15,000 units, the margin of safety is 2,500 units (15,000 – 12,500).

This is 1/6 or 16.7% of the budgeted sales volume.

4. MULTI PRODUCT CVP ANALYSIS

4.1 Breakeven analysis – Contribution per batch or per unit

The techniques for contribution margin can be extended to multi-product analysis. This approach is applied in situation when more than one products are produced generating different CS ratios. However, fixed cost relating to these products is common. In order to cater the complexity, one more assumption is added which is "There shall be constant sales mix". In simple words, the ratio of sales during specific period shall be same.

This assumption is that products are sold in a set ratio which does not change with volume. This assumption allows us to calculate a weighted average contribution per unit or batch and/or CS ratio which can be used to solve breakeven, margin of safety and target profit problems.

Formula: Breakeven point for batches

$$\text{Break-even point in batches} = \frac{\text{Total fixed costs}}{\text{Contribution per batch}}$$

$$\text{Break-even point in revenue} = \frac{\text{Total fixed costs}}{\text{CS ratio for the batch}}$$

Example 16:

The following budget information refers to the two products of a company.

	X	Y	
Sales price per unit	100	120	
Variable cost per unit	(75)	(111)	
Contribution per unit	25	9	
Sales volume	15,000	5,000	
Sales mix	3	1	
CS ratio	0.25	0.075	
Fixed costs			315,000

In calculating the number of units at which the company will breakeven using the average contribution per batch and the average contribution per unit and the revenue, please see below

Average contribution per batch

X and Y are sold in the ratio of 3:1 (15,000:5,000) therefore the average contribution per batch is: (3× 25) + (1×9) = Rs.84

Breakeven as a number of batches is given by:

Fixed costs/Contribution per batch = Rs. 315,000/Rs.84 = 3,750 batches

		Units		
	Batches	X (3 per batch)	Y (1 per batch)	
Breakeven	3,750	11,250	3,750	
Revenue per unit		Rs.100	Rs.120	
Revenue		1,125,000	450,000	= 1,575,000

4.2 Breakeven analysis – C/S ratio

► *Example 16 (Contd.):*

The following budget information refers to the two products of a company.

	X	Y	
Sales price per unit	100	120	
Variable cost per unit	(75)	(111)	
Contribution per unit	25	9	
Sales volume	15,000	5,000	
Sales mix	3	1	
CS ratio	0.25	0.075	
Fixed costs			315,000

For breakeven revenue using the average C/S ratio and the unit sales first average contribution and revenue per batch (as before) would be calculated that is

Average contribution per batch (as before): (3× 25) + (1×9) = Rs.84

Average revenue per batch: (3× 100) + (1×120) = 300 + 120 = Rs.420

Note that 300 out of every 420 will be revenue from selling X and 120 from selling Y.

Weighted average CS ratio: Rs.84/Rs.420 = 0.20

Breakeven in revenue is given by

Fixed costs/CS ratio = Rs. 315,000/0.20 = Rs. 1,575,000

		Units		
	Revenue	X ($^{300}/_{420}$)	Y ($^{120}/_{420}$)	
Breakeven	1,575,000	Rs.1,125,000	Rs.450,000	
Revenue per unit		÷ Rs.100	÷ Rs.120	
Units		11,250	3,750	= 15,000 units

4.3 Margin of safety – Multi product

The margin of safety is calculated in the same way as for single products by comparing the budgeted activity level to the breakeven. The breakeven point can be compared to the budgeted activity level using batches, units or revenue.

This will be illustrated using the previous example.

► *Example 16 (Contd.):*

Margin of safety

	Batches	Units	Revenue
Budgeted activity	5,000	20,000	2,100,000[1]
Breakeven point	3,750	15,000	1,575,000
Margin of safety	1,250	5,000	525,000
Margin of safety as percentage of sales	25%	25%	25%

[1] Budgeted revenue = (Rs.100 × 15,000) + (Rs.120 × 5,000) = Rs.2,100,000

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4.4 Target profit

The target profit is calculated in the same way as for single products. The necessary contribution to earn the target profit is the target profit plus the fixed costs. The activity level required to achieve the necessary contribution may be found using contribution per unit, contribution per batch or the CS ratio.

- *Example 16 (Contd.):*

The company wishes to make a profit of Rs. 189,000 on a fixed cost base of Rs. 315,000

Average contribution per batch = Rs.84

Average contribution per unit = Rs.21

Weighted average CS ratio = 0.20

Target profit

	Batches	Units	Revenue
Target profit (Rs.189,000 + Rs.315,000)	Rs.504,000	Rs.504,000	Rs.504,000
Contribution per batch	Rs.84		
Contribution per unit		Rs.21	
C/S ratio			0.20
	6,000	24,000	Rs.2,520,000
Sales of X (×3 and × ¾)	18,000	18,000	
Sales of Y (×1 and × ¼)	1,000	6,000	

Proof of revenue

	X	Y	
Units to be sold	18,000	6,000	
Selling price per unit	100	120	
Revenue	1,800,000	720,000	Rs.2,520,000

5. COMPREHENSIVE EXAMPLES

► *Example 01:*

Sword Leather Limited (SLL) produces and sells shoes. The following information pertains to its latest financial year:

	Rs. in million
Sales (62,500 pairs)	187.5
Fixed production overheads	35.0
Fixed selling and distribution overheads	10.0

Variable production cost (in proportion of 40:35:25 for material, labour and overheads respectively)	60% of sale
Variable selling and distribution cost	15% of sale

To increase profitability, SLL has decided to introduce new design shoes and discontinue the existing deigns. In this regard it has carried out a study whose recommendations are as follows:

i. Replace the existing fully depreciated plant with a new plant at an estimated cost of Rs. 50 million. The new plant would:
   - reduce material wastage from 10% to 5%;
   - decrease direct wages by 5%; and
   - increase variable overheads by 6% and fixed overheads by Rs. 15 million (including depreciation on the new plant).

ii. Improve efficiency of the staff by paying 1% commission to marketing staff and annual bonus amounting to Rs. 1.5 million to other staff.

iii. Introduction of new designs would require an increase in variable selling and distribution cost by 2%.

iv. Sell the newly designed shoes at 10% higher price.

v. Maintain finished goods inventory equal to one month's sale.

Required: Compute the budgeted production for the first year if the budgeted sale has been determined with the objective of maintaining 25% margin of safety on sale.

► *Solution*

Budgeted production of the new design shoes for the first year			Rs. per unit
Sales		187,500,000÷62,500×1.1 (A)	3,300.00
Variable costs:			
	Direct material	(3,000×0.6×0.4)÷1.1×1.05	(687.27)
	Direct wages	3,000×0.6×0.35×0.95	(598.50)
	Production overheads	3,000×0.6×0.25×1.06	(477.00)
	Selling and distribution	3,000×0.15×1.02	(459.00)
	Sales commission to marketing staff	3,300×1%	(33.00)
		(B)	(2,254.77)
Contribution margin		(C)	1,045.23
Total fixed cost (Rs.)		(35+10+15+1.5) (D)	61,500,000

Budgeted production:		No. of pairs
Break-even sales	D÷C (E)	58,839
Margin of safety on sales at 25%	E÷0.75×0.25	19,613
Budgeted sales	(F)	78,452
Inventory - average one month's sales	F ÷12	6,538
Budgeted production		84,990

- *Example 02:*

The manager of a small printing business has received enquires about printing of three different types of advertising leaflet, type A, type B and type C. Selling price and cost information for these leaflets is shown below:

Leaflet type:	Type A	Type B	Type C
	Rs.	Rs.	Rs.
Selling price, per 1,000 leaflets	300	660	1,350
Estimate printing costs:			
Variable costs, per 1,000 leaflets	120	210	390
Specific fixed costs per month	7,200	12,000	28,500

In addition to the specific fixed costs, Rs. 12,000 per month will be incurred in general fixed costs.

Required

Assuming that fixed orders have been received to print 50,000 of Leaflet A and 50,000 of Leaflet B each month, calculate the quantity of Leaflet C that must be sold to produce an overall profit, for all three leaflets combined, of Rs. 5,400 per month.

Solution

Tutorial note: The volume of sales required to achieve a target profit is an application of CVP analysis.

	Rs.	Rs.
Target profit		5,400
General fixed costs		12,000
Specific fixed costs:		
Leaflet Type A		7,200
Leaflet Type B		12,000
Leaflet Type C		28,500
Total contribution required		65,100
Contribution from:		
50,000 Leaflets Type A: (50 × (300 – 120))	9,000	
50,000 Leaflets Type B: (50 × (660 – 210))	22,500	
		31,500
Contribution required from Leaflets Type C		33,600

The contribution from Leaflets Type C is Rs. (1,350 – 390) = Rs.960 per 1,000 leaflets.

The sales quantity of Leaflets Type C required to achieve a target profit of Rs. 5,400 each month is therefore Rs. 33,600/Rs.960 per 1,000 = 35,000 leaflets.

- *Example 03:*

Himalayan Rivers (HR) is planning to install a new plant. Planned production from the plant for the next year is 150,000 units. Cost of production is estimated as under:

	Rs. In million
Direct material	6.00
Direct Labour	5.00
Production overheads	10.29

Production overheads include the following:

i. Factory premises would be acquired on rent at a cost of Rs. 1.8 million per annum.

ii. Indirect labour has been budgeted at 30% of direct labour cost, 50% of which would be fixed.

iii. Depreciation of the plant would be Rs. 0.5 million.

iv. Total power and fuel cost has been budgeted at Rs. 3 million. 80% of power and fuel cost would vary in accordance with the production.

v. All remaining production overheads are variable.

The sales and marketing budget includes the following:

i. Employment of two sales representatives at a monthly salary of Rs. 25,000 each and a sales commission of 2% on sales achieved.

ii. Hiring of a delivery van at Rs. 70,000 per month.

iii. (iii) Launching an advertisement campaign at a cost of Rs. 1.5 million

Required

Calculate the breakeven sales revenue and quantity for the next year if HR expects to earn a contribution margin of 40% on sales, net of 2% sales commission.

- *Solution*

Break-even sales revenue and quantity		Rs. in million
Break even sales revenue	6.59**(W-2)**÷[(100–2)×40%]	16.81
Break even sales quantity	[16,810,000÷200**(W.1)**] **Units**	84,050

W-1: Sales price per unit		Rs. in million
Variable overheads (excluding 2% sales commission):		
Direct material		6.00
Direct labour		5.00
Variable overheads	10.29-3.65 **(W-2)**	6.64
		17.64
Variable overheads % to sales	[100-(100-2)×40%]–2%	58.80%
Sales price per unit	(17.64÷58.8%)÷150,000 **Rs.**	200.00

W-2: Fixed cost		Rs. in million
Production overheads:		
Rent - factory premises		1.80
Indirect labour	5×30%×50%	0.75
Depreciation of plant		0.50
Power and fuel	3×20%	0.60
		3.65
Sales and marketing expenses:		
Employees' salaries	25,000×2×12	0.60
Delivery van	70,000×12	0.84
Advertisement campaign		1.50
Total fixed overheads		6.59

- *Example 04:*

Following information has been extracted from the projected results of Saffron Limited (SL) for the year ending 31 March 2019:

Sales	Rs. 160 million
Contribution margin	30%
Margin of safety	25%

Information for the next year ending 31 March 2020:

i. SL is planning to increase its sales by reducing sales prices by 5% and launching a sales campaign at a cost of Rs. 5 million.

ii. Cost efficiency measures planned for the next year are expected to reduce variable cost per unit by 10%.

iii. Inflation impact on all costs would be 8%, except depreciation. At present, depreciation is 40% of the total fixed cost.

iv. Margin of safety would be maintained at 25%.

Required

a) Prepare a budgeted statement of profit or loss for the year ending 31 March 2020 based on the above projections.

b) The percentage increase in sales volume.

- *Solution*

a)

Budgeted statement of profit or loss for the year ending 31 March 2020		
		Rs. in million
Sales	152**(W-2)**÷43.14×56.97	200.73
Variable cost	Balancing	(143.76)
Contribution margin (CM) (at a safety margin of 25% and fixed cost of Rs. 42.73 million) [42.73**(W-1)**÷0.75]		**56.97**
Fixed cost	**(W-1)**	(42.73)
Net profit		**14.24**

W-1: Fixed Cost		
- For 2019	(160×0.3×0.75)	36.00
- For 2020:		
Depreciation	(36×0.4)	14.40
Other fixed cost	(36-14.40)×1.08+5	28.33
		42.73

W-2: CM on revision of sales price and variable cost		Rs. in million
Sales	(160×0.95)	152.00
Variable cost	(160×0.7)×1.08×0.9	(108.86)
Contribution margin		**43.14**

b) The percentage increase in sales volume would be:

Increase in sales volume %:		
Budgeted sales of 2019-20 at 2018-19 prices	(200.73÷0.95)	211.29
Increase in sales volume (%)	(211.29–160)÷160	**32.06%**

▶ *Example 05:*

Digital Industries Limited (DIL) incurred a loss for the year ended 30 June 2017 as it could achieve sales amounting to Rs. 89.6 million which was 80% of the break-even sales. Contribution margin on the sales was 25%. Variable costs comprised of 45% direct material, 35% direct labour and 20% overheads.

During a discussion on the situation, the Marketing Director was of the view that no increase in sales price was possible due to severe competition. However, sales volume can be increased by reducing prices. The Production Director was of the view that since the plant is quiet old, the production capacity cannot be increased beyond the current level of 70%.

Accordingly, the management has developed the following plan:

A new plant would be installed whose capacity would be 20% more than installed capacity of the existing plant. The cost and useful life of the plant is estimated at Rs. 30 million and 10 years respectively. The funds for the new plant would be arranged through a long-term bank loan at a cost of 10% per annum. Capacity utilization of 85% is planned for the first year of the operation.

The new plant would eliminate existing material wastage which is 5% of the input and reduce direct labour hours by 8%.

The existing plant was installed fifteen years ago at a cost of Rs. 27 million. It has a remaining useful life of three years and would be traded in for Rs. 2 million.

DIL depreciates its fixed assets on straight line basis over their estimated useful lives.

To sell the entire production, selling price would be reduced by 2%.

Material would be purchased in bulk quantity which would reduce direct material cost by 10%.

Direct wages would be increased by 8% which would increase production efficiency by 10%.

Impact of inflation on overheads would be 4%.

Required:

Compute the projected sales for the next year and the margin of safety percentage after incorporating the effect of the above measures.

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- *Solution*

Digital Industries Limited

Projected sales and margin of safety % for the next year

		Rs. in million
Projected sales for the next year	(89.6÷0.7)×1.2×0.85×0.98 **(A)**	127.95
Margin of safety % to projected sales	(A-B)÷A×100	8.66%
Break-even sales	**[A÷ (A-C) × D] (B)**	**116.87**
Variable cost:		
Variable cost – 2017 level of 75%	[127.95**(A)**÷0.98]×0.75	97.92
Variable cost on incorporating impact of changes:		
Direct material	(97.92×0.45)×0.95×0.9	37.67
Direct labour	(97.92×0.35)×0.92×0.9×1.08	30.65
Overheads	(97.92×0.20)×1.04	20.37
Variable cost – projected	**(C)**	**88.69**
Fixed cost - projected:		
Fixed cost – 2017 (equal to CM for break-even sales)	(89.6÷0.8) ×0.25	28.00
Depreciation - old plant	27÷(15+3)	(1.50)
		26.50
Impact of 4% inflation	26.5×4%	1.06
Depreciation - new plant	30÷10	3.00
Long-term loan interest at 10%	(30-2) ×10%	2.80
Loss on Disposal (4.5-2)		2.50
	(D)	**35.86**

- *Example 06:*

Washington Limited (WL) is a listed company having paid-up capital of Rs. 140 million. WL deals in the manufacturing of washing machines. Following are the extracts from the budgeted statement of profit or loss for the year ending 31 December 2018:

	Rs. in '000
Sales revenue (Rs. 10,000 per unit)	168,000
Cost of goods sold (including fixed cost of Rs. 21.2 million)	(127,000)
Gross profit	41,000
Operating expenses (including fixed cost of Rs. 4.5 million)	(16,000)
Profit before taxation	25,000
Taxation @ 30%	(7,500)
Profit after taxation	17,500

Additional information:

i. An analysis of actual results for the first two months of the year 2018 shows that:

- Due to change in import duty structure, imported products have become available in the market at much cheaper prices. Consequently, it was decided to reduce the selling price to Rs. 9,500 per unit with effect from 1 January 2018.
- 1,500 washing machines were sold during the period.
- Due to increase in raw material prices with effect from 1 January 2018, variable cost of sales has increased by 5%.

ii. To boost the sales, WL has decided to launch a promotion campaign at an estimated cost of Rs. 5 million.

iii. The directors of WL wish to pay 5% dividend to its ordinary shareholders. However, according to the agreement with the bank, WL cannot pay dividend exceeding 80% of its profit after taxation.

Required

Calculate the minimum number of units to be sold in remaining 10 months to enable WL to pay the desired dividend.

▶ *Solution*

Washington Limited		**Rupees**
Dividend needs to pay	140,000,000×5%	7,000,000
Profit after tax (required)	(7,000,000÷0.8)	8,750,000
Required contribution margin in remaining 10 months		
Profit before tax (required)	8,750,000 /70%	12,500,000
Add: Fixed cost (Jan - Dec)	(21,200,000+4,500,000)	25,700,000
Add: Promotion campaign	***Given***	5,000,000
Contribution margin required		43,200,000
Contribution margin recovered in 1st two months	**(W-1)**	(3,304,464)
Required contribution in remaining 10 months		39,895,536
		Rupees
Forecasted sales revenue to earn in next 10 months	39,895,536/23.19%**(W-1)**	172,037,670
Number of units to be sold	172,037,670/9,500	18,109
W-1: Actual results of first two months of 2018		
Sales	1,500×9,500	14,250,000.00
Variable manufacturing cost	(127,000,000–21,200,000)/ 16,800*×1.05×1,500	9,918,750.00
Variable operating cost	(16,000,000–4,500,000)/16,800×1,500	1,026,785.71
Contribution margin		**3,304,464.29**
Contribution margin %		**23.19%**
***Budgeted number of units to be sold**	168,000,000/10,000	16,800

AT A GLANCE SPOTLIGHT STICKY NOTES

▶ *Example 07:*

Basketball (Private) Limited (BPL) is in the process of planning for the next year. BPL is currently operating at 70% of the production capacity. The management wants to achieve an increase of Rs. 36 million in profit after tax of the latest year.

The summarized statement of profit or loss for the latest year is as follows:

	Rs. in million
Sales	567
Cost of sales (60% variable)	(400)
Gross profit	167
Operating expenses (40% variable)	(47)
Profit before tax	120
Tax (25%)	(30)
Profit after tax	90

Following are the major assumptions/projections for the next year's budget:

i. Selling price of all products would be increased by 8%. However, to avoid any adverse impact of price increase, 10% discount would be offered to the large customers who purchase about 30% of the total sales. Additionally, distributor commission would be increased from 2% to 3% of net selling price.

ii. Average variable costs other than distributor commission are projected to increase by 4% while fixed costs other than depreciation are projected to increase by 5%.

iii. Depreciation for the latest year was Rs. 90 million and would remain constant.

Required:

(a) Compute the amount of sales required to achieve the target profit.

(b) Determine the production capacity that would be utilized to achieve the sales as computed in (a) above.

▶ *Solution*

Basketball Private Limited		*Rs. in million*
Budgeted sales to achieve target profit [361.11m **(W-1)**/53.7%**(W-2)**]		**672.46**
W-1: Contribution margin required in next year		
Total existing fixed cost including depreciation (400m×40%)+(47m×60%)		188.20
Add: Increase in fixed costs in next year	(188.2m–90m)×5%	4.91
Add: Target profit for the next year	(90m+36m)÷75%	168.00
Total contribution margin required in next year		**361.11**

W-2: Budgeted Contribution margin (next year)		
Budgeted sales	[567m×1.08]	612.36
Less: Discount @ 10% on 30% of sales	[612.36m×10%×30%]	(18.37)
Net average sales		593.99
Less: Distributor commission on net average sales	[593.99m×3%]	(17.82)
Less: Variable cost	[247.46m **(W-3)**×1.04]	(257.36)
Budgeted contribution margin		**318.81**
Budgeted contribution margin ratio	(318.81m/593.99m)	**53.7%**
W-3: Variable cost (existing)		
Distributor commission	(567m×2%)	11.34
Variable cost	[{(400m×60%)+(47m×40%)} –11.34m]	247.46
Average increase in selling price (1.08×30%×90%)+(1.08×70%) **OR** [1.08–(1.08×10%×30%)]	**A**	1.0476
Capacity to be utilized during next year [(672.46m (part a)÷**A**) ÷ (567m÷70%)]		79.25%

► *Example 08:*

Solvent Limited has two divisions each of which makes a different product. The budgeted data for the next year is as under:

	Product A	**Product B**
	Rupees	
Sales	200,000,000	150,000,000
Direct material	45,000,000	30,000,000
Direct labour	60,000,000	45,000,000
Factory overheads	35,000,000	15,000,000
Price per unit	20	25

Details of factory overheads are as follows:

i. Product A is stored in a rented warehouse whose rent is Rs. 0.25 million per month. Product B is required to be stored under special conditions. It is stored in a third party warehouse and the company has to pay rent on the basis of space utilized (varies in accordance with the production in units). The rent has been budgeted at Rs. 0.12 million per month.

ii. Indirect labour has been budgeted at 20% of direct labour. 70% of the indirect labour is fixed.

iii. Depreciation for assets pertaining to product A and B is Rs. 6.0 million and Rs. 2.0 million respectively.

iv. 80% of the cost of electricity and fuel varies in accordance with the production in units and the total cost has been budgeted at Rs. 4.0 million.

v. All other overheads are fixed.

Required

Compute the break-even sales assuming that the ratio of quantities sold would remain the same, as has been budgeted above.

AT A GLANCE SPOTLIGHT STICKY NOTES

Solution

Solvent Limited	Product A	Product B	Total
Sale – units	10,000,000	6,000,000	16,000,000
Sales price per unit	20	25	
Sales in Rupees	200,000,000	150,000,000	350,000,000
Less: Variable costs	**Product A**	**Product B**	**Total**
Direct material	45,000,000	30,000,000	-
Direct labour	60,000,000	45,000,000	-
Variable overheads (Note 1)	5,600,000	5,340,000	-
	110,600,000	80,340,000	190,940,000
Contribution margin Rs.	89,400,000	69,660,000	159,060,000
Contribution margin % to sales			45.446%
Break even sales revenue:			
Total 39,060,000/0.45446			85,948,699

Budgeted sales ratio	Revenue (Rs.)	Ratio	
Product A revenue	200,000,000	4	
Product B revenue	150,000,000	3	
Total revenue	350,000,000	7	
Revenue from A at breakeven 85,948,699 × 4/7	49,113,542		
Revenue from B at breakeven 85,948,699 × 3/7		36,835,157	
Sales price per unit	÷20	÷25	
Quantity of A: 49,113,542/20	2,455,677		
Quantity of A: 36,835,157/25		1,473,406	
Note 1: Variable & fixed overheads:			
Total overheads as given	35,000,000	15,000,000	50,000,000
Variable overheads:			
- Rent based on space utilized			
120,000 x 12	-	(1,440,000)	-
- Indirect labour			
60,000,000 x 20% x 30%	(3,600,000)		
45,000,000 x 20% x 30%		(2,700,000)	-
- Electricity & fuel			
(4,000,000x80%)/16,000,000x10,000,000	(2,000,000)	-	-
(4,000,000x80%)/16,000,000x6,000,000	-	(1,200,000)	-
Variable overheads	(5,600,000)	(5,340,000)	(10,940,000)
Fixed costs (Total overheads-Variable overheads)	29,400,000	9,660,000	39,060,000

▶ *Example 09:*

KPK Dairies Limited (KDL) is planning to introduce three energies flavored milk from 1 July 2015. In this respect, following projections have been made:

		C-Plus	I-Plus	V-Plus
Planned production	(No. of packets)	540,000	275,000	185,000
Sales	(No. of packets)	425,000	255,000	170,000
Production cost per packet:		---------- Rupees ----------		
Direct material		100	98	97
Direct labour		15	13	12
Variable overheads		23	19	16
Fixed overheads		25	22	20
Selling and distribution cost per packet:				
Variable overheads		12	8	10
Fixed overheads		5	5	5
Total cost per packet		**180**	**165**	**160**

KDL will sell its products through a distributor at a commission of 5% of sale price and expects to earn a contribution margin of 40% of net sales i.e. sales minus distributor's commission.

Required:

Compute break even sales in packets and rupees, assuming that ratio of quantities sold would be as per projections.

▶ *Solution*

KPK Dairies Limited						
Break-even sales:			C-Plus	I-Plus	V-Plus	Total
- In total – No. of packets(H÷G)		A				287,660
- Product wise – No. of packets (A×C)		B	143,830	86,298	57,532	287,660
- Product wise – Rupees (B×D)			37,850,303	20,893,609	13,625,879	72,369,791
W.1: Sales quantity ratio			-------------------------Liters-------------------------			
Projected sales			425,000	255,000	170,000	850,000
Sales quantity ratio		C	0.5	0.3	0.2	1.0
W.2: Contribution margin per combination:			----------------------- Rupees -----------------------			
Gross sales price per unit	(E÷0.57*)	D	263.16	242.11	236.84	
Commission at 5% of sales			(13.16)	(12.11)	(11.84)	
Variable cost per unit		E	(150.00) (100+15 +23+12)	(138.00) (98+13+ 19+8)	(135.00) (97+12+ 16+10)	
Contribution margin (CM) per unit		F	100.00	92.00	90.00	
CM in sales quantity ratio(C×F)		G	50.00	27.60	18.00	**95.60**
VC% to sales: (100-5%) × 60% = 57%*						

W-3: Fixed overheads				
Production fixed overheads	13,500,000 (540,000×25)	6,050,000 (275,000×22)	3,700,000 (185,000×20)	23,250,000
Selling and distribution fixed overheads	2,125,000 (425,000×5)	1,275,000 (255,000×5)	850,000 (170,000×5)	4,250,000
H				**27,500,000**

Example 10:

Fine Limited (FL) is involved in manufacturing and distribution of various consumer products. Following information pertains to one of its products, FGH for the year ended 31 December 2020:

	Rs. In '000
Sales (500,000 units)	56,000
Material (Rs. 30 per kg)	(22,500)
Skilled labour (Rs. 125 per hour)	(10,000)
Semi-skilled labour (Rs. 100 per hour)	(5,000)
Production overheads (50% variable)	(4,500)
Gross profit	**14,000**

The management of FL has decided to take following measures with respect to production of FGH for the next year:

i. Increase production volume by 10% to take advantage of increase in demand. Currently the plant for FGH is operating at 80% of its capacity.

ii. Purchase 60% of the material from FL's associated company that has offered a bulk discount of 5%. Additional wastage from this material is expected to be 1%.

iii. Replace 40% of the skilled labour with semi-skilled labour. It is estimated that semi-skilled labour will take 30% more time to do the work of skilled labour. Impact of inflation on all costs would be 10%. FL's management also wants to maintain the same gross profit margin in 2021 as the previous year.

Required

Compute selling price per unit of FGH for the next year.

Solution

	Units
Revised sales volume (500,000 x 1.1)	550,000
	Rs. In '000
Material - from existing supplier (22,500×1.1×40%)	9,900
Material - from new supplier [22,500×1.1×60%×95%×(100/99)]	14,250
Skilled labour (10,000×1.1×0.6)	6,600
Semi-skilled labour [100,760(W-1)×100]	10,076
production overhead - variable (4,500×0.5×1.1)	2,475
production overhead - fixed (4,500×0.5)	2,250
Total costs	45,551

	Units
Add: Inflation @10%	4,555
Target cost	50,106
Add: Target gross profit @ 25% (50,106×25/75)	16,702
Target sales	66,808
	Rupees
Target selling price (66,808,000/550,000)	**121.47**
W-1	**Hours**
Semi-skilled labour hours required:	
- in replacement of skilled labour (10,000,000/125) ×1.1×40%×1. 3	45,760
- existing requirement (50,000/100)×1.1	55,000
	100,760

Example 11:

Macchiato (Private) Limited (MPL) is planning to launch a new business of manufacturing carpets and rugs. The extracts from the projected statement of profit or loss of the new business are given below:

	Rs. In '000
Sales	500,000
Cost of goods sold	(360,000)
Gross profit	140,000
Operating expenses	(90,000)
Profit before taxation	50,000
Taxation @ 35%	(17,500)
Profit after taxation	32,500

Selling prices of carpets and rugs would be Rs. 24,000 and Rs. 4,000 per unit with contribution margin of 25% and 20% respectively. Carpets and rugs would be sold in the ratio of 1:4.

a) Computation the sales revenue at break-even and the margin of safety in units, is shown below.

	Rs. In '000
Sales (given)	500,000
Less: Variable costs **(W-1)**	(385,000)
Contribution margin	115,000
Combined CM [Contribution/Sales]	23.0%
Fixed cost **(W-3)**	65,000
Break-even sales [Fixed costs/Combined CM]	**282,609**

	Sales at BE	Existing Sales	Safety units
Carpets Break-even sales/D×B **(W-2)**	7,065	12,500	5,435
Rugs Break-even sales/D×B **(W-2)**	28,261	50,000	21,739

a) Determination of number of carpets and rugs that must be sold if MPL wishes to maintain profit after taxation equivalent to 10% of sales, is given below.

Sales revenue to yield desired net margin [65,000 **(W-3)**/0.0762 **(W-4)**]	853,018,373
Carpets Sales/D×B	21,325
Rugs 21,325×4 OR Sales/D×B	85,300

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W-1 Variable costs	Carpets	Rugs	Total
Selling price per unit [given]	24,000	4,000	
Contribution [Selling price × CM%]	(6,000)	(800)	
Variable cost per unit	18,000	3,200	
Number of units sold **(W-2)**	12,500	50,000	
Total variable costs (Rs. in '000)	**225,000**	**160,000**	**385,000**

W-2 Number of units sold	Carpets	Rugs	Total
Sales (Rs.) **A**			500,000,000
Ratio **B**	1	4	
Sale price (Rs.) **C**	24,000	4,000	
Weighted average ratio **D=B×C**	24,000	16,000	40,000
No. of units sold **A/D×B**	**12,500**	**50,000**	

W-3 Fixed costs	Rs. In '000
Cost of goods sold [given]	360,000
Operating expenses [given]	90,000
Total costs	450,000
Less: Variable costs **(W-1)**	(385,000)
Fixed costs	**65,000**

W-4 Net margin	%
Contribution margin [From (a)]	23.00%
Desired retained profit [0.1/(1–0.35)]	(15.38%)
Net margin [CM– desired retained profit]	7.62%

► *Example 12:*

ABC Limited deals in manufacturing and marketing of perfumes. The company has three brands to cater for different classes of customers. The selling prices and contribution margins for the year 2013 were as follows:

	A	B	C
	----------Rs. Per u,nit---------		
Sales price	10,000	8,000	5,000
Contribution margin	5,000	3,000	2,000

Total sale for the year 2013 was Rs. 15,600 million and sales volume ratio for A, B and C was 2:3:5 respectively.

The following estimates pertain to the year ending 31 December 2014:

- The average sale prices and variable costs for the next year are expected to increase by 14% and 8% respectively.
- The normal market growth is estimated at 5% per annum. However, the company plans to launch an aggressive marketing campaign for which additional advertising budget of Rs. 250 million has been approved. With increased advertisement, increase in sales volume for A, B and C has been forecasted at 15%, 12% and 10% respectively.

Required

Compute projected contribution margin for the year 2014 and the impact of advertising on profit of the company.

▶ *Solution*

Projected CM for 2014	**A**	**B**	**C**	**Total**
Projected CM on sales for 2014 (after advertising) Rs. in million **C x K**	3,120	2,827	3,058	9,005
CM on normal sales growth rate of 5% Rs. in million **C x H**	2,850	2,649	2,920	8,419
Additional CM due to advertising				586
Advertising cost				(250)
Net increase in profit due to advertising Rs. in million				336
Working:				
Sale price per unit Rs. **(A)**	10,000	8,000	5,000	
CM per unit Rs.	(5,000)	(3,000)	(2,000)	
Variable cost per unit Rs. **(B)**	5,000	5,000	3,000	
Revised sales price with 14% increase Rs. **(A x 1.14)**	11,400	9,120	5,700	
Revised variable cost with 8% increase Rs. **(B x 1.08)**	(5,400)	(5,400)	(3,240)	
Projected CM per unit for 2014 Rs. **(C)**	6,000	3,720	2,460	
Sales quantities for 2013 and 2014:				
Sales volume ratio **(D)**	2	3	5	10
Sales ratio **(E x [A x D])**	20,000	24,000	25,000	69,000
Total sales Rs. in million **F(E÷69×15.6)**	4,522	5,426	5,652	15,600
Total sales quantities for 2013 Units in million **G (F÷A)**	0.452	0.678	1.130	
Sales quantities for 2014 at estimated normal growth of 5% Units in million **H (G×1.05)**	0.475	0.712	1.187	
Sales volume increase % for 2014 with advertising **(J)**	15%	12%	10%	
Sale quantities for 2014 having advertising effect Units in million **K= G×(1+J)]**	0.520	0.760	1.243	

AT A GLANCE SPOTLIGHT STICKY NOTES

▶ *Example 13:*

Altar Limited (AL) produces and markets a single product. Following information is available from AL's records for the month of February 2013:

Sales price	Rs. 26 per unit
Direct material (2 kg at Rs. 5 per kg)	Rs. 10 per unit
Direct labour	Rs. 2 per unit
Variable overheads	Rs. 4 per unit
Fixed overheads	Rs. 3.50 per unit
Selling expenses	Rs. 295,000
Administration expenses	Rs. 101,400
Production (Good units)	175,000 units
Closing inventory	30,000 units

Additional information:

(i) Inspection is performed at the end of production and defective units are estimated at 20% of the inspected units. The defective units are sold as scrap at Rs. 5 per unit.

(ii) Fixed overheads per unit are calculated on the basis of good units produced.

(iii) As compared to last month, selling expenses in February 2013 have decreased by Rs. 42,000.

(iv) In January 2013, AL produced and sold 180,000 units.

Required

Assuming there was no inventory at the beginning of February 2013, calculate break-even sales in quantity for the month of February 2013.

▶ *Solution*

Breakeven sales in units for February 2013	**Units**
Contribution margin per unit (26 – 18.75 **W-2** – 1.2 **W-2**)	6.05
Break even quantity (834,900 **W-3** ÷ 6.05) in units	138,000

W-1 Number of units sold	**Units**
Units produced [175,000 ÷ 0.80]	218,750
Less: Defective units [218,750 – 175,000] OR [218,750 × 20%]	(43,750)
Good units produced	175,000
Less: closing inventory	(30,000)
Number of units sold	**145,000**

W-2 Variable costs		Per unit	Rupees
Direct material (218,750 × 5 × 2)		10.00	2,187,500
Direct labour (218,750 × 2)		2.00	437,500
Variable overheads (218,750 × 4)		4.00	875,000
Less: Defective units sold (43,750 × 5)	5 × 20%	(1.00)	(218,750)
Total variable cost of production		**15.00**	**3,281,250**
Variable cost per good unit (3,281,250 ÷ 175,000)		**15 ÷ 0.8**	**18.75**
Calculation of variable selling expenses per unit [using high-low method]:			
= (42,000/[180,000-145,000)			1.20

W-3 Fixed costs	Units
Fixed overheads (175,000 × 3.5)	612,500
Selling expenses 295,000 – (145,000 × 1.2)	121,000
Administration expenses	101,400
Total fixed costs	**834,900**

▶ *Example 14:*

Zodiac Limited (ZL) produces a single product and has a maximum production capacity of 300,000 units per annum. Following information pertains to ZL's estimated cost of production:

(i) Direct material Rs. 12 per unit.

(ii) Direct labour Rs. 8 per unit. However, based on guaranteed wages, the minimum total cost of labour is Rs. 150,000 per month.

(iii) Variable overheads Rs. 6 per unit.

(iv) Semi-variable overheads Rs. 450,000 per annum up to 55% capacity. An additional amount of Rs. 180,000 per annum is estimated for every 20% increase in capacity or a part thereof.

(v) Fixed overheads Rs. 750,000 per annum.

During the first five-months of the year 2012, ZL utilized 70% of its production capacity. However, it is expected to utilize 92% capacity during the remaining seven-months. The actual selling price during the first five-months was Rs. 34 per unit.

Required

Compute selling price per unit which should be charged by ZL for the remaining seven-months to earn a total profit of Rs. 936,000 for the year 2012.

AT A GLANCE SPOTLIGHT STICKY NOTES

▶ *Solution*

Zodiac Limited (ZL)

Statement of cost and sales for the year 2012

Maximum production capacity = 300,000 units per annum

Particulars	**5 months**	**7 months**
Capacity utilized	70%	92%
Production (300,000 x 5 x 70%)/12; (300,000 x 7 x 92%)/12	87,500	161,000
	Rupees	**Rupees**
Sales @ Rs. 34 per unit	2,975,000	
Direct materials @ Rs. 12 per unit	(1,050,000)	(1,932,000)
Direct wages @ 8 per unit or Rs. 150,000 per month whichever is higher	(750,000)	(1,288,000)
Overheads:		
Fixed (5:7)	(312,500)	(437,500)
Variable @ Rs. 6 per unit	(525,000)	(966,000)
Semi variable **(W-1)**	(262,500)	(472,500)
Total Cost	(2,900,000)	(5,096,000)
Profit during first 5 months	75,000	
Desired profit during next 7 months (Rs. 936,000 – Rs. 75,000)		861,000
Sales required for next 7 months		5,957,000
Units to be produced in next 7 months		161,000
Required selling price for next 7 months (5,957,000/161,000)		**37.00**

▶ *Example 15:*

Emerald Limited (EL) is engaged in the manufacture and sale of a single product. Following statement summarizes the performance of EL for the first two quarters of the financial year 20X2:

	Quarter 1	**Quarter 2**
Sales volume in units	580,000	540,000
	Rs. In 000	
Sales revenue	493,000	464,400
Cost of Goods sold		
Material	(197,200)	(183,600)
Labour	(98,600)	(91,800)
Factory overheads	(84,660)	(80,580)
	(380,460)	(355,980)
Gross Profit	112,540	108,420
Selling and distribution expenses	(26,500)	(25,500)
Administrative expenses	(23,500)	(23,500)
	(50,000)	(49,000)
Net Profit	62,540	59,420

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In the second quarter of the year EL increased the sale price, as a result of which the sales volume and net profit declined. The management wants to recover the shortfall in profit in the third quarter. In order to achieve this target, the product manager has suggested a reduction in per unit price by Rs. 15.

The marketing director however, is of the opinion that if the price of the product is reduced further, the field force can sell 650,000 units in the third quarter. It is estimated that to produce more than 625,000 units the fixed factory overheads will have to be increased by Rs. 2.5 million.

Required

a) Compute the minimum number of units to be sold by EL at the reduced price, to recover the shortfall in the second quarter profits.

	Rupees
Revised(reduced) Selling price (Rs.464,400 / 540,000 ×1000) – 15	845
	Rs. in 000
Shortfall in profit of last quarter	3,120
Profit for the 1st quarter	62,540
Target profit for the third quarter	65,660
Add: Fixed cost	
Administration cost	23,500
Fixed factory overhead **(W–1)**	25,500
Fixed selling and distribution expense **(W–1)**	12,000
	61,000
Targeted contribution margin	126,660
Contribution margin per unit (845-637) **(W–2)** in Rs.	208
No. of units to be sold	608,942

W-1 Computation of Fixed cost	**Factory overheads**	**Selling and distribution expenses**
At 580,000 volume	84,660,000	26,500,000
At 540,000 volume **(A)**	80,580,000	25,500,000
Difference **(B)**	4,080,000	1,000,000
Variable cost per unit **(C)**	102	25
Fixed cost [A – (540,000 × C)]	25,500,000	12,000,000

W-2 Computation of variable cost per unit	**Rupees**
Material (183,600 / 540,000) × 1000	340
Labour (91,800 / 540,000) × 1000	170
Factory overheads	102
Selling and distribution expenses	25
	637

AT A GLANCE SPOTLIGHT STICKY NOTES

b) Determine the minimum price which could be charged to maintain the profitability calculated in (a) above, if EL wants to sell 650,000 units.

Minimum price that should be charged if EL wants to sell 650,000 units	Rs. In 000
Required contribution as above	126,660
Additional fixed cost	2,500
	129,160
Number of units sold	650,000
Required contribution margin per unit	198.71
Variable cost per unit	637.00
Minimum price	**835.71**

▶ *Example 16:*

Naseem (Private) Limited (NPL) is a manufacturer of industrial goods and is launching a new product. The production will be carried out using existing facilities. However, the capacity of a machine would have to be increased at a cost of Rs. 3.0 million.

The budgeted costs per unit are as under:

Imported material	1.3 kg at Rs. 750 per kg
Local material	0.5 kg at Rs. 150 per kg
Labour	2.0 hours at Rs. 300 per hour
Variable overheads	Rs. 200 per labour hour
Selling & administration cost – variable	Rs. 359

Other relevant details are as under:

(i) Net weight of each unit of finished product will be 1.6 kg.

(ii) During production, 5% of material input will evaporate. The remaining waste would be disposed off at a rate of Rs. 80 per kg.

(iii) The cost of existing plant is Rs. 10 million. The rate of depreciation is 10% per annum.

(iv) Administration and other fixed overheads amount to Rs. 150,000 per month. As a result of the introduction of the new product, these will increase to Rs. 170,000 per month. The management estimates that 20% of the facilities would be used for the new product.

(v) The company fixes its sale price at variable cost plus 25%. (vi) Applicable tax rate for the company is 35%.

Required

Compute sales quantity and value, required to achieve a targeted increase of Rs. 4.5 million in after tax profit.

Variable cost per unit	**Qty**	**Rate**	**Cost per unit**
	Kg	**Rupees**	
Imported raw material	1.30	750	975.00
Local material	0.50	150	75.00
Total input	1.80		1,050.00
Sale of wastage {1.8-1.6-(0.05 x 1.8)}	0.11	80	(8.80)
Cost of material per unit			1,041.20
Skilled labour (2 hours @ Rs.300)			600.00
Overheads (2 hours @ Rs. 200)			400.00
Selling and administration cost			359.20
			2,400.20

Required contribution margin	**Rupees**
Fixed overheads:	
- Depreciation on cost of additional capacity (3,000,000 x 10%)	300,000
- Incremental administration and other fixed overheads (170,000-150,000) x 12	240,000
Gross profit required before tax (4,500,000/0.65)	6,923,077
Total contribution margin	7,463,077
Sales price per unit at variable cost plus 25% (2,400.20 x 1.25)	3,000.25
Contribution margin per unit sale (3,000.25 – 2400.20)	600.05
Sales in units (7,463,077 / 600.05)	**12,437 Units**

STICKY NOTES

Cost-volume-profit analysis is used to how changes in costs and profits with the change in volume activity.

Contribution is measured as sales revenue less total variable costs. And profit is measured as contribution minus total fixed costs.

Breakeven point is the point where total contribution is exactly equal to total fixed cost. It is calculated by dividing total fixed costs with contribution per unit.

Margin of safety is the difference between budgeted sales and the break-even amount of sales. It is usually expressed as a percentage of the budgeted sales.

If the target profit is known, then the volume of sales desired to achieve the target profit can be calculated using the formula as below:
Volume target (units) = (Total fixed costs + target profit)/contribution per unit

Breakeven chart is a visual representation showing all volumes of output and sales with their total costs, sales, profits and break-even points.

CHAPTER 15

RELEVANT COSTS

IN THIS CHAPTER

AT A GLANCE

Relevant cost is future cost, cash-based cost and incremental cost. Any cost incurred in the past is not relevant cost.

Identifying relevant costs would involve cost of materials, labour and overheads. In this respect, Relevant costs of materials are the additional cash flows that will be incurred (or benefits that will be lost) by using the materials for the purpose that is under consideration.

Relevant cost of labour would involve some considerations. If labour is not in restricted supply, the relevant cost of the labour is its variable cost. However, if labour is a fixed cost and there is spare labour time available.

Only variable overhead costs are considered relevant for decision making. This is because it is an estimate of cash spending per hour for each additional hour. Although, fixed overhead absorption rates are irrelevant, the only overhead fixed costs that are relevant costs for a decision are extra cash spending that will be incurred, or cash spending that will be saved, as a direct consequence of making the decision.

1. THE CONCEPT OF RELEVANT COSTING

1.1 Definition and identification of relevant cost

A relevant cost is defined as future cash flow arising as a direct consequence of a decision. As per this definition, following points are important in measuring the relevant cost of specific decision.

- The cost shall be incurred in future as result of decision. It means that any cost that has already been incurred before initiation of decision is not relevant cost and considered as "Sunk Cost".
- The cost or benefit in relation to specific decision shall be in cash. There shall be cash inflows or outflows as direct consequence of decision. The non-cash costs like depreciation and apportioned overheads are treated as irrelevant cost.
- The cost shall be incremental means when decision is taken, the cost is incurred otherwise not. Any cost that will happen anyway, regardless of the decision, cannot be a relevant cost. For example, if committed to pay rent of machine for next six months is irrelevant cost because it will not affect the decision. This cost is termed as "Committed cost.

Relevant cost principle is used when a decision has to be made and the concern is whether the decision will increase profit or not. It is based on minimum cost principle. Examples of application of relevant cost to specific decisions are:

- Decision regarding acceptance of job or undertake some work at a stated price that customer is willing to pay.
- Whether to sell joint products arising as result of common process, at split off point or to sell it after processing further.
- Whether the products should be made in house or whether to subcontract or outsource the work to external supplier.

Relevant costs should be used for assessing the economic or financial consequences of any decision by management. Only relevant costs and benefits should be taken into consideration when evaluating the financial consequences of a decision.

As a relevant cost is a future cash flow that will occur as a direct consequence of making a particular decision, it is used for target profit analysis as well.

1.2 Concepts and terms used in relevant costing

The key concepts in this definition of relevant costs are as follows:

- Relevant costs are costs that will occur in the future. They cannot include any costs that have already occurred in the past.
- Relevant costs of a decision are costs that will occur as a direct consequence of making the decision. Costs that will occur anyway, no matter what decision is taken, cannot be relevant to the decision.
- Relevant costs are cash flows. Notional costs, such as depreciation charges, notional interest costs and absorbed fixed costs, cannot be relevant to a decision.

Several terms are used in relevant costing, to indicate how certain costs might be relevant or not relevant to a decision.

Incremental cost

An incremental cost is an additional cost that will occur if a particular decision is taken. Provided that this additional cost is a cash flow, an incremental cost is a relevant cost.

▶ *Example 01:*

A company has identified that each cost unit it produces has the following costs:

	Rs. in '000
Direct materials	50
Direct labour	20
	70
Fixed production overhead	30
Total absorption cost	100

The incremental cost of making one extra unit is Rs. 70,000. Making one extra unit would not affect the fixed cost base. The fixed cost of Rs. 30,000 is irrelevant cost as it would not affect the decision.

Differential cost

A differential cost is the amount by which future costs will vary, depending on which course of action is taken. A differential cost is therefore an amount by which future costs will be higher or lower, if a particular course of action is chosen. Provided that this additional cost is a cash flow, a differential cost is a relevant cost.

▶ *Example 02:*

A company needs to hire a photocopier for the next six months. It has to decide whether to continue using a particular type of photocopier, which it currently rents for Rs.2,000 each month, or whether to switch to using a larger photocopier that will cost Rs.3,600 each month. If it hires the larger photocopier, it will be able to terminate the rental agreement for the current copier immediately.

The decision is whether to continue with using the current photocopier, or to switch to the larger copier. One way of analyzing the comparative costs is to say that the larger copier will be more expensive to rent, by Rs.1,600 each month for six months. The differential cost of hiring the larger copier for six months would therefore be Rs.9,600.

Avoidable and unavoidable costs

An avoidable cost is a cost that could be saved (avoided), depending whether or not a particular decision is taken. An unavoidable cost is a cost that will be incurred anyway.

Avoidable costs are relevant costs.

Unavoidable costs are not relevant to a decision.

▶ *Example 03:*

A company has one year remaining on a short-term lease agreement on a warehouse. The rental cost is Rs.100,000 per year. The warehouse facilities are no longer required, because operations have been moved to another warehouse that has spare capacity.

If a decision is taken to close down the warehouse, the company would be committed to paying the rental cost up to the end of the term of the lease. However, it would save local taxes of Rs.16,000 for the year, and it would no longer need to hire the services of a security company to look after the empty building, which currently costs Rs.40,000 each year.

The decision about whether to close down the unwanted warehouse should be based on relevant costs only.

Local taxes and the costs of the security services (Rs.56,000 in total for the next year) could be avoided and so these are relevant costs.

The rental cost of the warehouse cannot be avoided, and so should be ignored in the economic assessment of the decision whether to close the warehouse or keep it open for another year.

Committed cost

Committed costs are a category of unavoidable costs. A committed cost is a cost that a company has already committed to or an obligation already made, that it cannot avoid by any means.

Committed costs are not relevant costs for decision making.

- *Example 04:*

A company bought a machine one year ago and entered into a maintenance contract for Rs. 20,000 for three years.

The machine is being used to make an item for sale. Sales of this item are disappointing and are only generating Rs, 15,000 per annum and will remain at this level for two years.

The company believes that it could sell the machine for Rs. 25,000.

The relevant costs in this decision are the selling price of the machine and the revenue from sales of the item.

If the company sold the machine it would receive Rs. 25,000 but lose Rs. 30,000 revenue over the next two years – an overall loss of Rs. 5,000

The maintenance contract is irrelevant as the company has to pay Rs. 20,000 per annum whether it keeps the machine or sells it.

Leases normally represent a committed cost for the full term of the lease, since it is extremely difficult to terminate a lease agreement.

Sunk costs

Sunk costs are costs that have already been incurred (historical costs) or costs that have already been committed by an earlier decision. Sunk costs must be ignored for the purpose of evaluating a decision, and cannot be relevant costs.

- *Example 05:*

A company must decide whether to launch a new product on to the market.

It has spent Rs.900,000 on developing the new product, and a further Rs.80,000 on market research.

A financial evaluation for a decision whether or not to launch the new product should ignore the development costs and the market research costs, because the Rs.980,000 has already been spent and would not be recovered regardless to go ahead with the launch or not. The costs are sunk costs.

1.3 Opportunity costs

Relevant costs can also be measured as an opportunity cost. An opportunity cost is a benefit that will be lost by taking one course of action instead of the next-most profitable course of action.

- *Example 06:*

A company has been asked by a customer to carry out a special job. The work would require 20 hours of skilled labour time. There is a limited availability of skilled labour, and if the special job is carried out for the customer, skilled employees would have to be moved from doing other work that earns a contribution of Rs.60 per labour hour.

A relevant cost of doing the job for the customer is the contribution that would be lost by switching employees from other work. This contribution forgone (20 hours × Rs.60 = Rs.1,200) would be an opportunity cost. This cost should be taken into consideration as a cost that would be incurred as a direct consequence of a decision to do the special job for the customer. In other words, the opportunity cost is a relevant cost in deciding how to respond to the customer's request.

2. IDENTIFYING RELEVANT COSTS

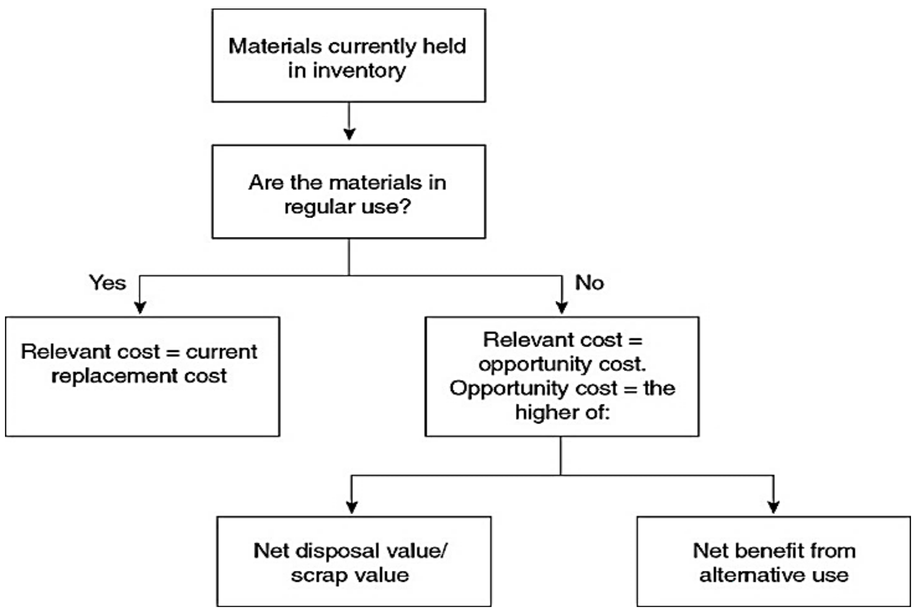
It is important to know about calculation of relevant cost of material, labour and overheads, which is explained in detail in following paragraphs.

2.1 Relevant cost of materials

The relevant cost of raw material is generally their current replacement cost, unless material has already been purchased and not available for use in regular terms or other contracts.

If **none of the required materials are currently held as inventory**, the relevant cost of the materials is simply their current replacement cost. In other words, the relevant cost is the cash that will have to be paid to acquire and use the materials.

If **the required materials are currently held as inventory**, the relevant costs are identified by applying the following rules:



Note that the historical cost of materials held in inventory cannot be the relevant cost of the materials, because their historical cost is a sunk cost.

The relevant costs of materials can be described as their 'deprival value'. The deprival value of materials is the benefit or value that would be lost if the company were deprived of the materials currently held in inventory.

- If the materials are regularly used, their deprival value is the cost of having to buy more units of the materials to replace them (their replacement cost).
- If the materials are not in regular use, their deprival value is either the net benefit that would be lost because they cannot be disposed of (their net disposal or scrap value) or the benefits obtainable from any alternative use. In an examination question, materials in inventory might not be in regular use, but could be used as a substitute material in some other work. Their deprival value might therefore be the purchase cost of another material that could be avoided by using the materials held in inventory as a substitute.

▶ *Example 07:*

A company has been asked to quote a price for a one-off contract.

The contract would require 5,000 kilograms of material X. Material X is used regularly by the company. The company has 4,000 kilograms of material X currently in inventory, which cost Rs.4 per kilogram. The price for material X has risen to Rs.4.20 per kilogram since last purchase.

The contract would also require 2,000 kilograms of material Y. There are 1,500 kilograms of material Y in inventory, but because of a decision taken several weeks ago, material Y is no longer in regular use by the company. The 1,500 kilograms originally cost Rs.14,400, and have a scrap value of Rs.3,600. New purchases of material Y would cost Rs.10 per kilogram.

For the relevant costs of the materials to assist management in identifying the minimum price to charge for the contract, please see below:

Material X

This is in regular use. Any units of the material that are held in inventory will have to be replaced for other work if they are used for the contract. The relevant cost is their replacement cost.

Relevant cost = replacement cost = 5,000 kilograms × Rs.4.20 = Rs.21,000.

Material Y

This is not in regular use. There are 1,500 kilograms in inventory, and an additional 500 kilograms would have to be purchased. The relevant cost of material Y for the contract would be:

	Rs.
Material held in inventory (scrap value)	3,600
New purchases (500 × Rs.10)	5,000
Total relevant cost of Material Y	**8,600**

▶ *Example 08:*

A company is considering whether to agree to do a job for a customer. It has sufficient spare capacity to take on this job.

To do the job, three different direct materials will be required, Material X, Material Y and Material Z. Data relating to these materials is as follows:

Material	Quantity needed for the job	Quantity currently held as inventory	Original cost of units currently held as inventory	Current purchase price	Current disposal value
	units	units	Rs. per unit	Rs. per unit	Rs. per unit
X	800	200	20	23	22
Y	600	400	15	19	12
Z	500	300	30	40	20

Material X is regularly used by the company for other work. Material Y is no longer in regular use, and the units currently held as inventory have no alternative use. Material Z is also no longer in regular use, but if the existing inventory of the material is not used for this job, they can be used as a substitute material on a different job, where the contribution would be Rs.25 per unit of Material Z used.

For calculation of the total relevant costs of the materials for this job for the customer, please see below:

Material X: This material is in regular use. Its relevant cost is therefore its current replacement cost, because any existing inventory will be replaced if it is used on the job.

Materials Y and Z: The relevant cost of the additional quantities that will have to be purchased is their current replacement cost.

Material Y: units already held in inventory. The relevant cost of these units is their opportunity cost, which is the cash that could be obtained by disposing of them.

Material Z: units already held in inventory. The relevant cost of these units is the higher value of their disposal value (Rs.20 per unit) and the contribution that they would earn if they are used as a substitute material on a different job (Rs.25 per unit)

Relevant costs	Rs.	Rs.
Material X: 800 units × Rs.23		18,400
Material Y:		
Opportunity cost of units in inventory = disposal value (400 units × Rs.12)	4,800	
Purchase cost of additional units (200 units × Rs.19)	3,800	
		8,600
Material Z:		
Opportunity cost of units in inventory = (300 units × Rs.25)	7,500	
Purchase cost of additional units (200 units × Rs.40)	8,000	
		15,500
Total relevant cost of materials		42,500

▶ *Example 09:*

R Ltd has been approached by a customer who would like a special job to be done for them. The job would require the following materials.

Material	Total required	Already in inventory	Book value of units in inventory	Realisable value	Replacement cost
	units	units	Rs. Per unit	Rs. per unit	Rs. per unit
A	1,000	0	-	-	6
B	1,000	600	2	2.50	5
C	1,000	700	3	2.50	4
D	200	200	4	6.00	9

a) Material B is used regularly by R Ltd and if units of B are required for this job, they would need to be replaced to meet other production demand.

b) Material C and D are in inventory as the result of previous overbuying, and they have a restricted use. No other use could be found for material C, but the units of material D could be used in another job as substitute for 300 units of material E, which currently costs Rs. 5 per unit (of which the company has no units in inventory at the moment).

The relevant costs of material, in deciding whether or not to accept the order, is calculated as under, along with reasons.

Relevant costs	Note	Rs.
Material A (1,000 x 6)		6,000
Material B (1,000 x 5)		5,000
Material C (300 x 4) + (700 x 2.50)		2,950
Material D		1,500
		15,450

Note-1:

Material A is not owned and would have to be bought in full at the replacement cost of Rs. 6 per unit.

Note-2:

Material B is used regularly by the company. There is existing inventory (600 units) but if these are used on the contract under review, a further 600 units would be bought to replace them. Relevant costs are therefore 1,000 units at the replacement cost of Rs. 5 per unit.

Note-3:

1,000 units of Material C are needed and 700 are already in inventory. If used for the contract, a further 300 units must be bought at Rs. 4 each. The existing inventory of 700 units will not be replaced, if they are used for the contract, they could not be sold at Rs. 2.50 each. The realizable value of these 700 units is an opportunity cost of sales revenue forgone.

Note-4:

Material D are already in inventory and will not be replaced. There is an opportunity cost of using D in the contract because there are alternative opportunities either to sell the existing inventory for Rs. 6 per unit (Rs. 1,200 in total) or avoid other purchases of material E, which would cost 300 x Rs. 5= Rs. 1,500. Since substitution for E is more beneficial, Rs. 1,500 is the opportunity cost and thus relevant cost.

2.2 Relevant cost of labour

The relevant cost of labour for any decision is the additional cash expenditure (or saving) that will arise as a direct consequence of the decision. However, if the labour force will be paid irrespective of the decision made, is not relevant cost because it is not incremental. Details of labour cost is given below.

- **If the cost of labour is a variable cost**, and labour can be hired from market, the relevant cost of the labour is its variable cost. For example, suppose that part-time employees are paid Rs.18 per hour, they are paid only for the hours that they work and part-time labour is not in short supply. If management is considering a decision that would require an additional 100 hours of part-time labour, the relevant cost of the labour would be Rs.18 per hour or Rs.1,800 in total.
- **If labour is a fixed cost and there is spare labour time available**, the relevant cost of using labour is 0. The spare time would otherwise be paid for idle time, and there is no additional cash cost of using the labour to do extra work. For example, suppose that a new contract would require 30 direct labour hours, direct labour is paid Rs.20 per hour, and the direct workforce is paid a fixed weekly wage for a 40-hour week. If there is currently spare capacity, so that the labour cost would be idle time if it is not used for the new contract, the relevant cost of using 30 hours on the new contract would be Rs.0. The 30 labour hours must be paid for whether or not the contract work is undertaken.
- **If labour is in limited supply**, the relevant cost of labour should include the opportunity cost of using the labour time for the purpose under consideration instead of using it in its next-most profitable way.

► *Example 10:*

Department 1. The contract would require 200 hours of work in department 1, where the workforce is paid Rs.16 per hour for a fixed 40-hour week. There is currently spare labour capacity in department 1 and there are no plans to reduce the size of the workforce in this department.

Department 2. The contract would require 100 hours of work in department 2 where the workforce is paid Rs.24 per hour. This department is currently working at full capacity. The company could ask the workforce to do overtime work, paid for at the normal rate per hour plus 50% overtime premium. Alternatively, the workforce could be diverted from other work that earns a contribution of Rs.8 per hour.

Department 3. The contract would require 300 hours of work in department 3 where the workforce is paid Rs.24 per hour. Labour in this department is in short supply and all the available time is currently spent making product Z, which earns the following contribution:

	Rs.	Rs.
Sales price		98
Labour (2 hours per unit)	48	
Other variable costs	30	
		78
Contribution per unit of product Z		20

In evaluating the relevant cost for the contract of labour in the three departments, following working may be helpful

Department 1. There is spare capacity in department 1 and no additional cash expenditure would be incurred on labour if the contract is undertaken.

Relevant cost = Rs.0.

Department 2. There is restricted labour capacity. If the contract is undertaken, there would be a choice between:

- overtime work at a cost of Rs.36 per hour (Rs.24 plus overtime premium of 50%) – this would be an additional cash expense, or
- diverting the labour from other work, and losing contribution of Rs.8 per hour – cost per hour = Rs.24 basic pay + contribution forgone Rs.8 = Rs.32 per hour.

It would be better to divert the workforce from other work, and the relevant cost of labour is therefore 100 hours × Rs.32 per hour = Rs.3,200.

Department 3. There is restricted labour capacity. If the contract is undertaken, labour would have to be diverted from making product Z which earns a contribution of Rs.20 per unit or Rs.10 per labour hour (Rs.20/2 hours). The relevant cost of the labour in department 3 is:

	Rs.
Labour cost per hour	24
Contribution forgone per hour	10
Relevant cost per hour	34

Relevant cost of 300 hours = 300 × Rs.34 = Rs.10,200.

Summary of relevant costs of labour:

	Rs.
Department 1	0
Department 2	3,200
Department 3	10,200
	13,400

Example 11:

A one-year contract has been offered to Maliaka Industries which required the following labour workforce.

Labour type	Fix six months	Subsequent six months	Fix six months	Subsequent six months
	Hours required		Normal wage rate per hour	
Skilled	1,350	1,276	25.00	28.75
Semi-skilled	1,400	1,225	17.00	19.00
Unskilled	1,225	1,400	15.00	16.00

It is expected that there will be shortage of skilled labour in the first six months only. Therefore, for the purposes of the contract skilled labour will have to be diverted from other work from which a contribution of Rs. 7.50 per hour is earned, net of wage costs. In subsequent six months, the sufficient skilled labour will be available. The skilled labour is paid, irrespective, of workload.

The firm currently has a surplus of semi-skilled labour paid at full rate but doing unskilled work. The labour concerned could be transferred to provide sufficient labour for the contract and would be replaced by unskilled labour.

The relevant cost of labour is calculated as under.

	Rs.
Skilled [(1,350 x 25.00+7.50)]	43,875
Semi-skilled	-
Unskilled [(1,225 x 15.00) + (1,400 x 16)]	40,775
Relevant cost of labour	**84,650**

Example 12:

A contract is under consideration which would require 1,400 hours of direct labour. There is spare capacity of 500 hours of direct labour, due to the cancellation of another order by a customer. The other time would have to be found by asking employees to work in the evenings and at weekends, which would be paid at 50% above the normal hourly rate of Rs.15.

Alternatively, the additional hours could be found by switching labour from other work which earns a contribution of Rs.5 per hour.

Relevant cost of direct labour if the contract is accepted and undertaken would require:

A total of 900 hours would have to be found by either working overtime at a cost of Rs.15 × 150% = Rs.22.50 per hour, or diverting labour from other work that earns a contribution of Rs.5 per hour after labour costs of Rs.15 per hour. The opportunity cost of diverting labour from other work is therefore Rs.20 per hour. This is less than the cost of working overtime. If the contract is undertaken, labour will therefore be diverted from the other work.

It is assumed that the 500 hours of free labour time (idle time) available would be paid for anyway, even if the contract is not undertaken. The relevant cost of these hours is therefore Rs.0

Relevant cost of labour	Rs.
500 hours	0
900 hours (× Rs.20)	18,000
Total relevant cost of labour	18,000

AT A GLANCE SPOTLIGHT STICKY NOTES

2.3 Relevant cost of overheads

Relevant costs of expenditures that might be classed as overhead costs should be identified by applying the normal rules of relevant costing. Relevant costs are future cash flows that will arise as a direct consequence of making a particular decision.

Fixed overhead absorption rates are therefore irrelevant, because fixed overhead absorption is not overhead expenditure and does not represent cash spending. Similarly, depreciation on machinery or factory asset is although overheads, but not relevant cost because it is not in cash.

However, it might be assumed that the overhead absorption rate for **variable** overheads is a measure of actual cash spending on variable overheads. It is therefore often appropriate to treat a variable overhead hourly rate as a relevant cost, because it is an estimate of cash spending per hour for each additional hour worked.

The only overhead fixed costs that are relevant costs for a decision are extra cash spending that will be incurred, or cash spending that will be saved, as a direct consequence of making the decision.

▶ *Example 12:*

A company bought a machine six years ago for Rs.125,000. Its written down value is now Rs.25,000. The machine is no longer used for normal production work, and it could be sold now for Rs.17,500. A project is being considered that would make use of this machine for six months. After this time the machine would be sold for Rs.10,000.

Calculating the relevant cost of the machine to the project would involve:

Relevant cost = Difference between sale value now and sale value if it is used. This is the relevant cost of using the machine for the project.

Relevant cost = Rs.17,500 - Rs.10,000 = Rs.7,500.

▶ *Example 13:*

Tychy Limited (TL) is engaged in the manufacture of Specialized motors. The company has been asked to provide a quotation for building a motor for a large textile industrial unit in Punjab. Following information has been obtained by TL's technical manager in a one-hour meeting with the potential customer. The manager is paid an annual salary equivalent to Rs. 2,500 per eight-hour day.

i. The motor would require 120 ft. of wire-C which is regularly used by TL in production. TL has 300 ft. of wire-C in inventory at the cost of Rs. 65 per ft. The resale value of wire-C is Rs. 63 and its current replacement cost is Rs. 68 per ft.

ii. 50 kg of another material viz. Wire-D and 30 other small components would also be required by TL for the motor. Wire-D would be purchased from a supplier at Rs. 10 per kg. The supplier sells a minimum quantity of 60 kg per order. However, the remaining quantity of wire-D will be of no use to TL after the completion of the contract. The other small components will be purchased from the market at Rs. 80 per component.

iii. The manufacturing process would require 250 hours of skilled labour and 30 machine hours.

The skilled workers are paid a guaranteed wage of Rs. 20 per hour and the current spare capacity available with TL for such class of workers is 100 direct labour hours. However, additional labour hours may be obtained by either:

- Paying overtime at Rs. 23 per hour; or
- Hiring temporary workers at Rs. 21 per hour. These workers would require 5 hours of supervision by AL's existing supervisor who would be paid overtime of Rs. 20 per hour.

The machine on which the motor would be manufactured was leased by TL last year at a monthly rent of Rs. 5,000 and it has a spare capacity of 110 hours per month. The variable running cost of the machine is Rs. 15 per hour.

iv. Fixed overheads are absorbed at the rate of Rs. 25 per direct labour hour.

The relevant cost of producing textile motor, together with reasons for the inclusion or exclusion of any cost from your computation would be as follows

Tychy Limited (TL)	Note	Rs.
Technical manager – meeting	1	NIL
Wire – C	2	8,160
Wire – D	3	600
Components	4	2,400
Direct labour	5	3,250
Machine running cost	6	450
Fixed overhead	7	NIL
Total relevant cost		14,860

Notes:

1. In case of technical manager's meeting with the potential client, the relevant cost is NIL because it is not only a past cost but also the manager is paid an annual salary and therefore TL has incurred no incremental cost on it.
2. Since wire-C is regularly used by TL, 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 since TL is not going to sell it.
3. Since wire-D is to be purchased for the contract therefore its purchase cost is relevant. TL only requires 50 kg of wire-D but due to the requirement of minimum order quantity TL will be purchasing 60 kg of the material and since TL has no other use for this material, the full cost of purchasing the 60 kg is the relevant cost.
4. Since the components are to be purchased from the market at a cost of Rs. 80 each. Therefore, the entire purchase price is a relevant cost.
5. The 100 hours of direct labour are presently idle and hence have zero relevant cost. The remaining 150 hours are relevant. TL has two choices: either use its existing employees and pay them overtime at Rs. 23 per hour which is a total cost of Rs. 3,450: or engage the temporary workers which would cost TL Rs. 3,250 including supervision cost of Rs. 100. The relevant cost is the cheaper of the two alternatives i.e. Rs. 3250.
6. The lease cost of machine will be incurred regardless of whether it is used for the manufacture of motors or remains idle. Hence, only the incremental running cost of Rs. 15 per hour is relevant.
7. Fixed overhead costs are incurred whether the work goes ahead or not so it is not a relevant cost.

▶ *Example 14:*

Fazal Industries Limited is currently negotiating a contract to supply its products to K-Mart, a large chain of departmental stores. K-Mart finally offered to sign a one-year contract at a lump sum price of Rs. 19,000,000.

The Cost Accountant of Fazal Industries Limited believes that the offered price is too low. However, the management has asked you to re-assess the situation. The cost accountant has provided you the following information:

Statement of Estimated Costs (Project: K-Mart)

	Notes	Rupees
Material:		
X (at historical cost)	(i)	1,500,000
Y (at historical cost)	(ii)	1,350,000
Z	(iii)	2,250,000
Labour:		
Skilled	(iv)	4,050,000
Supervisory	(v)	2,250,000
Overheads	(vii)	8,500,000
Total cost		**20,710,000**

You have analyzed the situation and gathered the following information:

i. Material X is available in stock. It has not been used for a long time because a substitute is currently available at 20% less than the cost of X.

ii. Material Y was ordered for another contract but is no longer required. Its net realizable value is Rs. 1,470,000.

iii. Material Z is not in stock.

iv. Skilled labour can work on other contracts which are presently operated by semi- skilled labour who have been hired on temporary basis at a cost of Rs. 325,000 per month. The company will need to give them a notice of 30 days before terminating their services.

v. Unskilled labour will have to be hired for this contract.

vi. Two new supervisors will be hired for this contract at Rs. 15,000 per month. The present supervisors will remain employed whether the contract is accepted or not.

vii. These include fixed overheads absorbed at the rate of 100% of skilled labour. Fixed production overheads of Rs. 875,000 which would only be incurred if the contract is accepted, have been included for determining the above fixed overhead absorption rate.

Preparation of a revised statement of estimated costs using the opportunity cost approach, for the management of Fazal Industries to state whether the contract should be accepted or not would involve following analysis

Revised Statement of Estimated Costs

Under the Opportunity Cost Approach

	Rupees
Materials	
X (1,500,000 x 80%)	1,200,000
Y (NRV)	1,470,000
Z (Purchase price)	2,250,000
Labour	
Skilled	4,050,000
Unskilled	2,250,000
Supervisory (Rs. 15,000 x 2 x 12)	360,000*
Overheads	
Avoidable fixed overhead	875,000
Variable overheads (Rs. 8,500,000 – Rs. 4,050,000)	4,450,000
	16,905,000

Conclusion:

The company should accept the order as it will give them incremental cash flows of Rs. 2,095,000 (Rs. 19,000,000-Rs. 16,905,000).

- *Example 15:*

The manager of a small printing business has received enquires about printing three different types of advertising leaflet, type A, type B and type C. Selling price and cost information for these leaflets is shown below:

Leaflet type:	Type A	Type B	Type C
	Rs.	Rs.	Rs.
Selling price, per 1,000 leaflets	300	660	1,350
Estimate printing costs:			
Variable costs, per 1,000 leaflets	120	210	390
Specific fixed costs per month	7,200	12,000	28,500

In addition to the specific fixed costs, Rs. 12,000 per month will be incurred in general fixed costs.

The printing business receives an enquiry from a customer about printing 30,000 of a different type of leaflet. The customer is willing to pay Rs .25,000. The variable labour and overhead costs of producing these leaflets would be Rs.80 per 1,000 leaflets.

The leaflets would be printed on a special type of paper. This costs Rs.500 per 1,000 leaflets. However, there are already sufficient quantities of the paper in inventory for 20,000 of the leaflets. This special paper was purchased three months ago for a customer who then cancelled his order. The material has a disposal value of Rs. 1,500, but it could also be used to produce 20,000 units of leaflet C. The cost of normal paper for leaflet C is Rs.300 per 1,000 leaflets.

For calculation of the relevant costs of making the leaflets for this special order and profit increase as a result of undertaking the order would require following workings

Relevant costs	Rs.
Materials	
To be purchased: 10,000 × Rs.500/1,000	5,000
Currently held in inventory	6,000
(Relevant cost = higher of [Rs.1,500 and (20,000 × Rs.300/1,000)]	
Variable costs of labour/overheads	2,400
(30,000 × Rs.80/1,000)	
Total relevant costs	(13,400)
Contract price	25,000
Incremental profit	11,600

3. COMPREHENSIVE EXAMPLES

- *Example 01:*

BB Company has received an enquiry from a customer for the supply of 500 units of a new product, product B22. Negotiations on the final price to charge the customer are in progress and the sales manager has asked you to supply relevant cost information.

The following information is available:

1) Each unit of product B22 requires the following raw materials:

   Raw material type

   X 4 kg

   Y 6 kg

2) The company has 5,000 kg of material X currently in stock. This was purchased last year at a cost of Rs.7 per kg. If not used to make product B22, this stock of X could either be sold for Rs.7.50 per kg or converted at a cost of Rs.1.50 per kg, so that it could be used as a substitute for another raw material, material Z, which the company requires for other production. The current purchase price per kilogram for materials is Rs.9.50 for material Z and Rs.8.25 per kg for material X.

3) There are 10,000 kilograms of raw material Y in inventory, valued on a FIFO basis at a total cost of Rs.142,750. Of this current inventory, 3,000 kilograms were purchased six months ago at a cost of Rs.13.75 per kg. The rest of the inventory was purchased last month. Material Y is used regularly in normal production work. Since the last purchase of material Y a month ago, the company has been advised by the supplier that the price per kilogram has been increased by 4%.

4) Each unit of product B22 requires the following number of labour hours in its manufacture:

   Type of labour:

   Skilled: 5 hours

   Unskilled: 3 hours

   Skilled labour is paid Rs.8 per hour and unskilled labour Rs.6 per hour.

5) There is a shortage of skilled labour, so that if production of B22 goes ahead it will be necessary to transfer skilled workers from other work to undertake it. The other work on which skilled workers are engaged at present is the manufacture of product B16. The selling price and variable cost information for B16 are as follows:

	Rs./unit	Rs./unit
Selling price		100
Less: variable costs of production		
Skilled labour (3 hours)	24	
Other variable costs	31	
		55
		45

6) The company has a surplus of unskilled workers who are paid a fixed wage for a 37-hour week. It is estimated that there are 900 hours of unused unskilled labour time available during the period of the contract. The balance of the unskilled labour requirements could be met by working overtime, which is paid at time and a half.

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7) The company absorbs production overheads by a machine hour rate. This absorption rate is Rs.22.50 per hour, of which Rs.8.75 is for variable overheads and the balance is for fixed overheads. If production of product B22 is undertaken, it is estimated that an extra Rs.4,000 will be spent on fixed costs. Spare machining capacity is available and each unit of B22 will require two hours of machining time in its manufacture using the existing equipment. In addition, special finishing machines will be required for two weeks to complete the B22. These machines will be hired at a cost of Rs.2,650 per week, and there will be no overhead costs associated with their use.

8) Cash spending of Rs.3,250 has been incurred already on development work for the production of B22. It is estimated that before production of the B22 begins, another Rs.1,750 will have to be spent on development, making a total development cost of Rs.5,000.

The minimum price that the company should be prepared to accept for the 500 units of product B22 would be calculated as follows together with brief explanation:

(Note: The minimum price is the price that equals the total relevant costs of producing the items. Any price in excess of the minimum price will add to total profit).

Workings for relevant costs

Material X

The company has enough kilograms of material X in inventory for the contract. When it is used, the inventory of material X will not be replaced. The relevant cost of the material is therefore its opportunity cost, not its replacement cost. The opportunity cost is the higher of its current sale value (Rs.7.50 per kg) or the net saving obtained if it is used as a substitute for material Z (Rs.9.50 – Rs.1.50 = Rs.8 per kg). The relevant cost of material X is therefore Rs.8 per kg.

Material Y

Material Y is in regular use, so its relevant cost is its current replacement cost.

	kg		Rs.
Total inventory	10,000		142,750
Purchased six months ago	3,000	(× Rs.13.75)	41,250
Purchased last month	7,000		101,500

Purchase price last month = Rs.101,500/7,000 kg = Rs.14.50 per kg.

Current purchase price = 4% higher = Rs.14.50 × 1.04 = Rs.15.08.

Skilled labour

Skilled labour is in short supply. If it is used to make product B22, workers will have to be taken off other work. The relevant cost of skilled labour is the wages for the skilled workers for the time spent on B22, plus the lost contribution (net of skilled labour cost) from not being able to make units of product B16.

Opportunity cost of skilled labour

Skilled labour cost per unit of Product B16 = Rs.24

Number of hours per unit = 3 hours

Contribution per unit of B16 = Rs.45

Contribution per skilled labour hour from B16 = Rs.15

Opportunity cost of skilled labour if it is used to make B22 = (500 × 5) × Rs.15 = Rs.37,500

Unskilled labour

900 unskilled labour will be available at no incremental cost to the company (as it is already being paid and is not fully employed). There is no relevant cost for these hours. The additional 600 hours required will involve extra wage payments, including overtime payments. The relevant cost of these 600 hours is Rs.6 per hour × 150% = Rs.9 per hour, including the overtime premium.

Overheads

Variable overheads are included as relevant costs because they will be additional costs if the units of B22 are made. The only incremental fixed costs, however, are the extra cash costs of Rs.4,000. The fixed overhead absorption rate is ignored. The additional costs of hiring special finishing machinery are also included as a relevant cost.

Development costs

Those costs already incurred are past costs (sunk costs) and are not relevant. The future development costs involve additional expenditure and are included as relevant costs.

Minimum price for making 500 units of B22

Materials:		**Rs.**
X	(500 units × 4kg) × Rs.8	16,000
Y	(500 units × 6kg) × Rs.15.08	45,240
Labour:		
Skilled wages	(500 units × 5 hours) × Rs.8	20,000
Opportunity cost	(500 units × 5 hours) × Rs.15	37,500
Unskilled	[(500 × 3) – 900] x 6 × 1.5	5,400
Overheads:		**Rs.**
Variable	(500 units × 2 hours) × Rs.8.75	8,750
Fixed	Incremental spending	4,000
Machine hire	(2 weeks × Rs.2,650)	5,300
Development costs		1,750
Minimum price		143,940

► *Example 02:*

Topaz Limited (TL) is the manufacturer of consumer durables. Pearl Limited, one of the major customers, has invited TL to bid for a special order of 150,000 units of product Beta.

Following information is available for the preparation of the bid.

i. Each unit of Beta requires 0.5 kilograms (kg) of material “C”. This material is produced internally in batches of 25,000 kg each, at a variable cost of Rs. 200 per kg. The setup cost per batch is Rs. 80,000. Material “C” could be sold in the market at a price of Rs. 225 per kg. TL has the capacity to produce 100,000 kg of material “C”; however, the current demand for material “C” in the market is 75,000 kg.

ii. Every 100 units of product Beta requires 150 labour hours. Workers are paid at the rate of Rs. 9,000 per month. Idle labour hours are paid at 60% of normal rate and TL currently has 20,000 idle labour hours. The standard working hours per month are fixed at 200 hours.

iii. The variable overhead application rate is Rs. 25 per labour hour. Fixed overheads are estimated at Rs. 22 million. It is estimated that the special order would occupy 30% of the total capacity. The production capacity of Beta can be increased up to 50% by incurring additional fixed overheads. The fixed overhead rate applicable to enhanced capacity would be 1.5 times the current rate. The utilized capacity at current level of production is 80%.

iv. The normal loss is estimated to be 4% of the input quantity and is determined at the time of inspection which is carried out when the unit is 60% complete. Material is added to the process at the beginning while labour and overheads are evenly distributed over the process.

v. TL has the policy to earn profit at the rate of 20% of the selling price.

In calculating the unit price that TL could bid for the special order to Pearl Limited would require following working:

Calculation of unit price to be quoted to Pearl Limited:		
Material (25,000 × 200)+(53,125 × 225) + 80,000	W-1	17,033,125
Labour (20,000 ×45 × 40%) + (210,625 × 45)	W-2	9,838,125
Variable overhead (230,625 × Rs. 25)		5,765,625
Incremental fixed cost (22m / 10 ×1.5)		3,300,000
		35,936,875
Profit margin (25% of cost)		8,984,219
Sale price		44,921,094
Sale price per unit (Rs. 44,921,094 / 150,000)		299
W-1: Material		
Input units of material C (150,000 / 96%) × 0.5		78,125
W-2: Labour		
Labour hours – completed units 150,000 x 1.50		225,000
– lost units {[(150,000 / 0.96) – 150,000] × 1.5 × 60%}		5,625
		230,625

► *Example 03:*

JD is a small specialist manufacturer of electronic components and much of its output is used by the makers of aircraft. One of the small number of aircraft manufacturers has offered a contract to Company JD for the supply of 400 identical components over the next twelve months.

The data relating to the production of **each component** is as follows:

a) Material requirements:

3 kilograms material M1: see note 1 below

2 kilograms material P2: see note 2 below

1 Part No. 678: see note 3 below

Note 1: Material M1 is in continuous use by the company. 1,000 kilograms are currently held in stock at a carrying amount of Rs.4.70 per kilogram but it is known that future purchases will cost Rs.5.50 per kilogram.

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Note 2: 1,200 kilograms of material P2 are held in inventory. The original cost of the material was Rs.4.30 per kilogram but as the material has not been required for the last two years it has been written down to Rs.1.50 per kilogram (scrap value). The only foreseeable alternative use is as a substitute for material P4 (in current use) but this would involve further processing costs of Rs.1.60 per kilogram. The current cost of material P4 is Rs.3.60 per kilogram.

Note 3: It is estimated that the Part No. 678 could be bought for Rs.50 each.

b) Labour requirements

Each component would require five hours of skilled labour and five hours of semi-skilled. An employee possessing the necessary skills is available and is currently paid Rs.5 per hour. A replacement would, however, have to be obtained at a rate of Rs.4 per hour for the work that would otherwise be done by the skilled employee. The current rate for semi-skilled work is Rs.3 per hour and an additional employee could be appointed for this work.

c) Overhead

JD absorbs overhead by a machine hour rate, currently Rs.20 per hour of which Rs.7 is for variable overhead and Rs.13 for fixed overhead. If this contract is undertaken it is estimated that fixed costs will increase for the duration of the contract by Rs. 3,200. Spare machine capacity is available and each component would require four machine hours.

A price of Rs.145 per component has been suggested by the large aircraft manufacturer.

In stating whether or not the contract should be accepted, please see below calculations with that supports conclusion with appropriate figures for presentation to management.

The contract should be accepted if the revenue from the contract will exceed the relevant costs of the contract.

Workings

Material M1. This material is in continuous/regular use. The relevant cost of the 1,000 kilograms is their replacement cost.

Relevant cost = 400 components × 3 kilos × Rs.5.50 per kilo = Rs.6,600.

Material P2. The material held in inventory has a relevant cost that is the higher of its scrap value (Rs.1.50) and the costs saved by putting it to an alternative use, which is Rs.2 (Rs.3.60 – Rs.1.60).

There are more units held in stock than are needed for the contract. The excess quantity should be ignored.

Relevant cost of material in stock = 400 components × 2 kilos × Rs.2 per kilo = Rs.1,600.

Part 678. Relevant cost = 400 components × Rs.50 = Rs.20,000.

Skilled labour. The relevant cost of skilled labour is the extra cash that would have to be spent to hire additional labour.

Relevant cost = 400 components × 5 hours per component × Rs.4 per hour = Rs.8,000.

Semi-skilled labour. Relevant cost = 400 components × 5 hours per component × Rs.3 per hour = Rs.6,000.

Variable overheads. It is assumed that the overhead absorption rate for variable overheads is the rate at which cash expenditure is incurred on variable overheads.

Relevant cost = 400 components × 4 machine hours per component × Rs.7 per machine hour = Rs.11,200.

Relevant cost statement	Rs.
Material M1	6,600
Material P2	1,600
Part 678	20,000
Skilled labour	8,000
Semi-skilled labour	6,000
Variable overheads	11,200
Incremental fixed costs	3,200
Total relevant costs	56,600
Contract sales value (400 × Rs.145)	58,000
Incremental profit	1,400

Undertaking the contract will add Rs.1,400 to total profit. On a purely financial basis, this means that the contract is worth undertaking. However, management might take the view that a higher profit margin is desirable, and the suggested price of Rs.145 per component might be negotiable.

▶ *Example 04:*

Rugby Limited (RL) is engaged in manufacturing of a product 'B1'. Presently, RL is considering to launch a new product B1–Extra which has a demand of 10,000 units per month. The estimated selling price of B1–Extra is Rs. 2,000 per unit. Other relevant information is as follows:

i. Each unit of B1-Extra would require 2 kg of material X and 1.5 labour hours. Material X is available in the market at Rs. 520 per kg. Alternatively, instead of material X, RL can use 2.5 kg of a substitute material Y which can be produced internally. Production of each kg of Y would require raw material costing Rs. 300 and 0.5 labour hour.

ii. Presently, about 14,000 labour hours remain idle each month and are paid at the rate of 50% of the normal wage rate of Rs. 250 per hour and such payments are charged to administration expenses.

iii. Any shortfall in required labour hours can be met through overtime at the rate of 40% above the normal wage rate.

iv. Records of last 4 months show the following factory overheads (variable and fixed) at different levels of direct labour hours:

	Month 1	Month 2	Month 3	Month 4
Direct labour (Hours)	174,000	172,000	170,000	168,000
Factory overheads (Rs. in '000)	58,280	57,840	57,400	56,960

The expected relevant cost per unit of B1-Extra and determine the cost gap (if any) if RL requires a margin of 30%, would be as follows:

Rugby Limited		
Cost gap per unit		Rs. per unit
Expected relevant cost per unit	(15,800,000/10,000)	1,580.00
Less: Target cost per unit	(2,000×70%)	1,400.00
Cost gap	(1,580–1,400)	180.00

Relevant costs of producing B1-Extra		
Material cost 10,000×1,040	(W-1)	10,400,000
Direct labour cost	(W-2)	2,100,000
Variable overheads 10,000×1.5×220	(W-4)	3,300,000
Total relevant cost		15,800,000

W-1: Decision to use X or Y		**Rs. per unit of B1-Extra**
<u>Cost of Y for each unit of B1-Extra</u>		
Material cost	(300×2.5)	750.00
Labour cost **(Without overtime)**	(250×50%)×(0.5×2.5)	156.25
Variable factory overheads	[(220**(W-4)**×0.5)×2.5]	275.00
Fixed (existing) **(Not relevant)**		-
Cost of Y for each unit of B1-Extra		1,181.25
Cost of material X for each unit of B1-Extra	(520×2.0)***(Given)***	1,040.00
Extra cost on producing Y internally (Not feasible)		**141.25**

W-2: Direct labour cost for B1-Extra		**Rupees**
Labour cost – hours	(14,000×250×50%)	1,750,000
Labour cost – overtime	(1,000(W-3)×1.4×250)	350,000
Total direct labour cost		2,100,000

W-3: Overtime hours required		**Labour hours**
Available labour hours		14,000
Labour hours required	(10,000×1.5)	15,000
Excess hours required - Overtime hours		(1,000)

W-4: Variable factory overhead rate by high-low method		**High**	**Low**	**Variable**
		(a)	**(b)**	**(a-b)**
Factory overheads (Rs.)	A	58,280,000	56,960,000	1,320,000
Labour hours	B	174,000	168,000	6,000
Variable factory overheads rate per hour (Rs.)	(A÷B)			220

- *Example 05:*

Ring Limited (RL) is engaged in the manufacture and sale of customized products. In January 2020, RL entered into an agreement with Gamma Limited (GL) for manufacture and supply of 3,500 units of a customized product 'Zing' at Rs. 4,000 per unit.

RL placed the order for raw material AA-2 and the supplier agreed to supply the material in second week of March 2020. RL had also hired skilled labour for the production of Zing. However, in February 2020, GL went bankrupt.

RL has recently been approached by Sigma Limited (SL) for supply of 3,500 units of D-Zing which is a modified version of Zing. RL can use the ordered raw material and the hired skilled labour for this product. The production of D-Zing will take three months. Following information has been provided in this regard:

Machinery

Specialized machinery will be needed to produce D-Zing. Following proposals are under consideration:

(i) Lease machinery for three months at monthly lease rentals of Rs. 250,000 and an upfront payment of refundable security deposit of Rs. 5,000,000. The upfront payment will be financed through running finance @ 20% per annum. As per the lease terms, monthly maintenance cost of Rs. 15,000 will be borne by the lessor.

(ii) Lease machinery at monthly lease rentals of Rs. 160,000 for a minimum period of six months. In this case, monthly maintenance of Rs. 20,000 will be borne by RL which will be incurred only in the months in which machinery is operative.

Direct material

Following raw materials will be required for manufacturing of each unit of D-Zing:

(i) 15 units of AA-2: RL had already ordered 50,000 units of AA-2 at Rs. 75 per unit under the original contract of Zing. The current market price for AA-2 is Rs. 80 per unit. If the contract is not fulfilled, a penalty at 20% of the contract value will be payable by RL.

(ii) 10 units of A-78: A-78 is available in market at Rs. 110 per unit. However, it can also be produced internally at a variable cost of Rs. 80 per unit. Fixed cost would be absorbed at Rs. 25 per unit. Internally produced A-78 would be subject to 20% normal loss.

(iii) 5 units of C-11: Market price of C-11 is Rs. 20 per unit. However, a substitute material D-50 can also be used after processing it at a cost of Rs. 15 per unit. Presently 5,000 units of D-50 is available in stock as a result of over purchasing for a previous order. D-50 was purchased at Rs. 5 per unit and can be sold back to the supplier at Rs. 3 per unit.

Direct labour

(i) RL had hired skilled labour from a third party at Rs. 1,000 per hour under the original contract of Zing. If order from SL is not accepted, 200 labour hours would become idle and RL will have to pay 50% of the contract rate.

(ii) If SL's offer is accepted, then D-Zing would be produced in batches of 350 units and the first batch would require 400 skilled labour hours. Learning curve effect is estimated at 80% but would remain effective for the first four batches only. The index of learning curve is – 0.322.

(iii) 1.5 hours of semi-skilled labour is required for every unit of D-Zing. Since there is a shortage of semi-skilled labour in the market, only 4,000 labour hours are available at Rs. 600 per hour. However, labour is willing to do overtime at a 50% higher rate up to maximum of 1,500 hours. Alternatively, unskilled labour can be hired at Rs. 200 per hour, however, unskilled labour would require 300% of the time taken by semi-skilled labour. This can be reduced to 250% if training is given to them at a cost of Rs. 300,000.

Variable overheads

Variable overheads would be charged at Rs. 125 per skilled labour hour.

By using the relevant cost approach, computation of minimum price per unit that RL may quote, is calculated below.

Relevant cost	--------Rupees-------	
Machinery:		
Lower of:		
Proposal 1		
- Lease rentals [250,000×3]	750,000	
- Finance cost [(5,000,000×20%)÷4]	250,000	
	1,000,000	
AND		
Proposal 2		
- Lease rentals (160,000×6)	960,000	
- Maintenance [20,000×3]	60,000	
	1,020,000	1,000,000
Direct material		
AA-2		
Contract price [50,000×75]	3,750,000	
Less: Savings from penalty amount [50,000×75×20%]	(750,000)	
Purchasing cost [{(3,500×15)–50,000}×80]	200,000	3,200,000
A-78		
Lower of:		
Purchasing cost [3,500×10×110	3,850,000	
AND		
Internal cost [(3,500×10×80)÷0.8]	3,500,000	3,500,000
C-11		
Opportunity cost of selling back [5,000×3]	15,000	
Further processing cost [5,000×15]	75,000	
Purchasing cost [(3,500×5)–5,000]×20	250,000	340,000
Direct labour		
Skilled		
Idle hours saved [200×1,000×50%]	(100,000)	
Labour for 10 batches [1,024**(W-1)**+1,092**(W-1)**]×1,000	2,116,000	2,016,000
Semi-skilled		
Lower of:		
Normal rate [4,000×600]	2,400,000	
Overtime [(3,500×1.5)–4,000]×600×1.5	1,125,000	
	3,525,000	
AND		
Unskilled without training- Labour cost	3,150,000	
AND		
Unskilled training- Labour cost	2,625,000	
Training cost	300,000	
	2,925,000	2,925,000
Variable overheads		
Cost [{1,024(W-1)+(182×6)}×125]		264,500
Total relevant costs		**13,245,500**
Minimum price to be quoted (13,245,500÷3,500)		3,784

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W-1 Learning curve effects

Year-wise relevant cost	Hours
For the first 4 batches [4×400×(4) −0.322]	1,024
For the first 3 batches [3×400×(3) −0.322]	842
For the 5th batch and onwards (1,024−842)	182
Total hours (182×6)	**1,092**

▶ *Example 06:*

Global (Pvt.) Limited (GPL) is in the process of preparing bid documents for a special order of 5,000 units of a new product Zeta. In this respect, GPL's technical department has worked-out the following projections/information:

(i) The order would be completed in 15 days.

(ii) GPL has sufficient stock of the required materials to produce Zeta. Some of the relevant information is as follows:

	Material A	Material B	Material C
Quantity required	5,000kg	3,000kg	2,000kg
Original purchase price	Rs. 180 per kg	Rs. 150 per kg	Rs. 50 per kg
Current purchase price	Rs. 200 per kg	Rs. 175 per kg	Rs. 160 per kg
Current disposal price	Rs. 100 per kg	Rs. 135 per kg	-

- Material A is used by GPL in many products and therefore sufficient stock is maintained.
- Material B has no use other than in the production of Zeta.
- The stock of material C was purchased several years ago for another project. It can only be used in the production of Zeta. Otherwise, it will have to be disposed of at a cost of Rs. 10 per kg to meet environmental legislation.

(iii) The production of Zeta would require:

- 800 skilled labour hours at Rs. 200 per hour. Presently, 1,440 labour hours remain idle during each month.
- 250 unskilled labour hours which can be hired at Rs. 120 per hour.
- 150 machine hours. If the machine is not used for Zeta, it may be leased out at Rs. 4,000 per day.

(iv) GPL absorbs overheads at Rs. 400 per skilled and unskilled labour hours. Based on normal capacity of 50,000 hours, fixed overheads are estimated at Rs. 6,000,000. If GPL decides to produce Zeta, fixed overheads would increase by Rs. 150,000.

(v) As a result of production of Zeta, general administration cost would increase by Rs. 100,000.

(vi) The planning department of GPL has incurred a cost of Rs. 20,000 on preparing feasibility for production of Zeta.

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Computation of bid price that GPL should quote, if it wants to earn profit (based on relevant cost) of 20% of selling price, is given below.

Computation of Bid Price	Rupees
Material A - at current purchase price 5,000×200	1,000,000
Material B - at current selling price 3,000×135	405,000
Material C - disposal cost saving 2,000×10	(20,000)
Skilled labour hours - after using idle hours [800-(1440÷2)]×200	16,000
Unskilled labour hours 250×120	30,000
Machine hours 15 days×4000	60,000
Variable overheads (800+250)×[(400×50,000-6,000,000)÷50,000)]OR(800+250)×[400 - (6,000,000÷50,000)]	294,000
Incremental fixed overheads	150,000
Increase in general administration costs	100,000
Feasibility cost incurred by planning department - sunk cost	-
Total production cost	2,035,000
Bid price - to earn 20% profit on selling price 2,035,000÷0.8	**2,543,750**

▶ *Example 07:*

The Telephone Co (T Co) is a company specialising in the provision of telephone systems for commercial clients. There are two parts to the business:

– Installing telephone systems in businesses, either first time installations or replacement installations;

– Supporting the telephone systems with annually renewable maintenance contracts.

T Co has been approached by a potential customer, Push Co, who wants to install a telephone system in new offices it is opening. Whilst the job is not a particularly large one, T Co is hopeful of future business in the form of replacement systems and support contracts for Push Co. T Co is therefore keen to quote a competitive price for the job. The following information should be considered:

1. One of the company's salesmen has already been to visit Push Co, to give them a demonstration of the new system, together with a complimentary lunch, the costs of which amounting to Rs. 4,000.

2. The installation is expected to take one week to complete and would require three engineers, each of whom is paid a monthly salary of Rs. 140, 000. The engineers have just had their annually renewable contract renewed with T Co. One of the three engineers has spare capacity to complete the work, but the other two would have to be moved from contract X in order to complete this one. Contract X generates a contribution of Rs. 50 per engineer hour. There are no other engineers available to continue with Contract X if these two engineers are taken off the job. It would mean that T Co would miss its contractual completion deadline on Contract X by one week. As a result, T Co would have to pay a one-off penalty of Rs. 5,000. Since there is no other work scheduled for their engineers in one week's time, it will not be a problem for them to complete Contract X at this point.

3. T Co's technical adviser would also need to dedicate eight hours of his time to the job. He is working at full capacity, so he would have to work overtime in order to do this. He is paid an hourly rate of Rs. 400 and is paid for all overtime at a premium of 50% above his usual hourly rate.

4. Two visits would need to be made by the site inspector to approve the completed work. He is an independent contractor who is not employed by T Co, and charges Push Co directly paid for the work. His cost is Rs. 20,000 for each visit made.

5. T Co's system trainer would need to spend one day at Push Co delivering training. He is paid a monthly salary of Rs. 150,000 but also receives commission of Rs. 1,250 for each day spent delivering training at a client's site.

6. 120 telephone handsets would need to be supplied to Push Co. The current cost of these is Rs. 182 each, although T Co already has 80 handsets in inventory. These were bought at a price of Rs. 168 each. The handsets are the most popular model on the market and frequently requested by T Co's customers.

7. Push Co would also need a computerised control system called 'Swipe 2'. The current market price of Swipe 2 is Rs. 10,800, although T Co has an older version of the system, 'Swipe 1', in inventory, which could be modified at a cost of Rs. 4,600. T Co paid Rs. 5,400 for Swipe 1 when it ordered it in error two months ago and has no other use for it. The current market price of Swipe 1 is Rs. 5,450, although if Push Co tried to sell the one they have, it would be deemed to be 'used' and therefore only worth Rs. 3,000.

8. 1,000 metres of cable would be required to wire up the system. The cable is used frequently by T Co and it has 200 metres in inventory, which cost Rs. 12 per metre. The current market price for the cable is Rs.13 per metre.

9. You should assume that there are four weeks in each month and that the standard working week is 40 hours long.

Preparation of cost statement, using relevant cost principles, showing the minimum cost that T Co. should charge for the contract, along with explanation of each cost item, is given below.

Computation of Minimum Cost	Note	Rupees
Demonstration and complimentary lunch	1	-
Engineers	2	5,000
Technical advisor	3	4,800
Site inspector visit	4	-
Training cost	5	1,250
Telephone handsets	6	21,840
Computerised control system	7	7,600
Cable cost	8	13,000
Minimum price		**53,490**

Notes:

1. Demonstration and complimentary lunch

The salesman has already been to visit Push Co to demonstrate the new system. The associated costs are sunk costs (they have already been incurred) and are therefore excluded from the cost statement.

Relevant cost = Rs.0

2. Engineers

One of the three engineers has spare capacity to complete the installation and his/her salary will be paid regardless of whether they work on the contract for Push Co. The relevant cost is therefore Rs. Nil.

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The other two engineers are currently fully utilised and earn a contribution of Rs.5 per hour each on Contract X. The engineers could be temporarily taken off of Contract X to work on the contract for Push Co. Work on Contract X would recommence in one week's time when there is no other scheduled work for the engineers.

Delaying the work on Contract X would result in T Co missing the contractual completion deadline and having to pay a one-off penalty of Rs. 5,000.

Relevant cost = Rs. 5,000

3. **Technical adviser**

The technical adviser is working at full capacity so would need to work 8 hours overtime on the contract for Push Co. All overtime is paid at a premium of 50% above his usual hourly rate of Rs. 400 (Rs.400 × 1.5 = Rs. 600).

Relevant cost = Rs. 600 × 8 hours = Rs. 4,800

4. **Site inspector visits**

The site inspector is an independent contractor who is not employed by T Co and charges Push Co directly for the work. Since the site engineer charges Push, the relevant cost for T Co is nil.

Relevant cost = Rs. Nil

5. **Training costs**

The system trainer is paid a monthly salary of Rs. 150,000. This is not a relevant cost, as it is not incremental. The trainer is also paid Rs. 1,250 commission for each day spent delivering training at a client's site. This cost will arise as a direct result of the decision and is therefore included.

Relevant cost = Rs. 1,250 per day × 1 day = Rs. 1,250

6. **Handsets**

120 handsets would need to be supplied to Push Co. Though 80 handsets are already in inventory, the handsets are frequently requested by T Co's customers and so would need to be replaced if supplied to Push Co. The current cost of a handset is Rs.182.

Relevant cost = Rs.182 × 120 handsets = Rs. 21,840

7. **Computerised control system**

The current market price of Swipe 2 is Rs. 10,800.

The original cost of Swipe 1 (Rs. 5,400) is a sunk cost and not relevant to the decision.

The current market price of Swipe 1 (Rs. 5,450) is also not relevant to the decision as T Co has no intention of replacing Swipe 1.

The company could sell Swipe 1 for Rs. 3,000 if it does not use it for this contract. This represents an opportunity cost.

In addition to the Rs. 3,000, Swipe 1 could be modified at a cost of Rs. 4,600, bringing the total cost of converting Swipe 1 to Rs. 7,600.

The total cost of converting Swipe 1 (Rs. 7,600) is significantly less than purchasing Swipe 2 (Rs. 10,800). It is assumed that the company would choose the cheaper option.

Relevant cost = Rs. 7,600

8. Cable costs

1,000 metres of cable is required. Although T Co has 200 metres of cable in inventory, it is used frequently and so would need to be replaced. All 1,000 metres should be valued at the current market rate (Rs. 13 per metre). The original purchase cost of Rs. 12 per metre is a sunk cost and is not relevant to the decision.

Relevant cost = 1,000 metres × Rs.13 per metre = Rs. 13,000

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Relevant costs are cash flows that will occur in the future as a direct consequence of making the decision

Relevant costs include incremental costs (additional cost that will occur if a particular decision is taken), differential costs (amount by which future costs will be different), avoidable costs (cost that can be saved) and opportunity costs (a benefit that will be lost by taking a course of action).

Relevant costs of materials, labour or overheads are the additional cash flows that will be incurred (or benefits that will be lost) by using the materials for the purpose that is under consideration or arise as a direct consequence of the decision.

CHAPTER 16

DECISION MAKING TECHNIQUES

IN THIS CHAPTER

AT A GLANCE

Management are often required to make decisions where company is at stake. These decisions are required to make where factors or sources are limited, Concepts of relevant costing and cost-volume-profit analysis are used for such decisions.

One-off contract decisions, special pricing decisions, make or buy decisions and many other short term decisions including join product, discontinuation of operations, replacement of equipment or plant and further processing decisions, are some of the decision making areas that may need management's attention.

1. INTRODUCTION TO DECISION MAKING

1.1 Types of decision

Decisions in the entity can be one-off decision, short-term decision and long-term decision and brief description of them is given below.

- Short-term decisions are decisions where the financial consequences occur soon after the decision is taken. For example, a short-term decision may result in an immediate increase in profit (additional net cash inflows), or an increase in annual profits and cash flows.
- A long-term decision is one where a capital investment may be required and the benefits of the investment will be obtained over a period of several years.

The concept of relevant costs (as discussed in chapter 14) is used for both short-term and long-term decisions, except that for long-term decisions the time value of money should also be taken into consideration.

Examples of management decisions where relevant costing is used are:

- Limiting factor decisions- Optimal product mix to earn maximum profit under given situation.
- One-off contract decisions: management might want to decide whether or not to undertake a contract for a specified fixed price. If it is a one-off contract, rather than regular production work, it would be worthwhile undertaking the contract if the extra revenue from the contract is higher than the relevant costs of doing the work (including any opportunity costs).
- Make-or-buy decisions- Should the company manufacture the products in-house or outsource them?
- Shutdown decisions- Whether specific product/s or segment/s be continued or discontinued?
- Joint product further processing decisions- Decision about selling the joint product at split-off point or after processing further.

1.2 Marginal costing and decision-making

It is often assumed that marginal costs are relevant costs for the purpose of decision-making.

- The marginal cost of a product is the extra cost that would be incurred by making and selling one extra unit of the product.
- Similarly, the marginal cost of an extra hour of direct labour work is the additional cost that would be incurred if a direct labour employee worked one extra hour. When direct labour is a variable cost, paid by the hour, the marginal cost is the variable cost of the direct labour wages plus any variable overhead cost related to direct labour hours.

This chapter focuses on short-term decision-making when there are limiting factors that restrict operational capabilities. Decision-making techniques for limiting factor situations are based on the following assumptions:

- The objective is to maximize profit and this is achieved by maximizing contribution;
- Marginal costs (variable costs) are the only relevant costs to consider in the model: and

Fixed costs will be the same whatever decision is taken; therefore, fixed costs are not relevant to the decision.

1.3 Incremental cost analysis

Incremental analysis helps companies to decide whether or not to accept a special order. This special order is typically lower than its normal selling price. Incremental analysis also assists with allocating limited resources to several product lines to ensure a scarce asset is used to maximum benefit.

- *Example 01:*

A company sells an item for Rs. 500,000. The company pays Rs. 200,000 for labour, Rs. 100,000 for materials and Rs. 50,000 for variable overhead selling expenses. The company allocates Rs. 50,000 per item for fixed overhead costs.

The company is not operating at capacity and will not be required to invest in equipment or overtime to accept a special order it receives. Then, a special order requests the purchase of 20 items for Rs. 400,000 each.

The sum of all variable costs and fixed costs per item is Rs. 400,000. However, the Rs. 50,000 of allocated fixed overhead costs are a sunk cost as already spent. The company has excess capacity and should only consider the relevant costs. Therefore, the cost to produce the special order is Rs. 350,000 per item (Rs. 200,000 + Rs. 100,000 + Rs. 50,000) and the profit per item is Rs. 50,000 (Rs. 400,000 – Rs. 350,000).

While the company is still able to make a profit on this special order, the company must consider the consequences of operating at full capacity. If no excess capacity is present, additional expenses to consider include investment in new fixed assets, overtime labour costs, and the opportunity cost of lost sales.

2. LIMITING FACTOR DECISIONS

2.1 Limiting factor: definition and the issue

Limiting factor is any factor which is in scarce supply and which stops the entity to produce more units. In other words, limiting factor limits the organisation's activities. Most commonly examples of limiting factors are:

- Materials when there may be insufficient material availability to produce units in order to meet market demand.
- Labour might be a limiting factor when insufficient labour available for specific skill.
- Every manufacturing plant has its own capacity and it cannot be enhanced in short-term. Sometimes, machine hours at full capacity produced insufficient units i.e. not able to meet the market demand.

In these circumstances, the factor setting a limit to the volume of sales and profit in a particular period is the availability of the scarce resource, because sales are restricted by the amount that the company can produce.

If the company makes just one product and a production resource is in limited supply, profit is maximized by making as many units of the product as possible with the limited resources available.

However, when a company makes and sells more than one products with the same scarce resource, a budgeting problem is to decide how many of each different product to make and sell in order to maximize profits.

2.3 Maximizing profit when there is a single limiting factor

When there is a limiting factor and company is producing more than one products, then the challenge is to earn maximum profit in this situation. In order to maximise the profit, decision of optimal production mix becomes more important. Following steps should be followed in order to earn maximum contribution or profit.

Step I: Identify the limiting factor

There can be more than one potential limiting factor, therefore, the identification of limiting factor is important. However, when single limiting factor is given in question, this step should not be applied in solution. When at maximum demand, the required level of limiting factor exceeds its availability, it is stated as limiting factor. This concept can be clarified from following example.

► *Example 02:*

A company manufactures and sells two products, Product X and Product Y which are both manufactured using two different machines.

The time taken to make each product together with the maximum machine time availability and contribution per unit and demands are as follows:

Machines	X	Y	Hours available
Machine type 1	10 minutes per unit (6 units per hour)	6 minutes per unit (10 units per hour)	3,000 hours
Machine type 2	5 minutes per unit (12 units per hour)	12 minutes per unit (5 units per hour)	4,200 hours
Sales demand in units	12,000	15,000	

Which machine is the limiting factor is identified by calculating the time needed to meet the total demands for both goods and comparing that to the machine time available:

	Machine type 1 (hours)	Machine type 2 (hours)
Product X: 12,000 ÷ 6 per hour	2,000	
Product X: 12,000 ÷ 12 per hour		1,000
Making 15,000 units of Y would use:		
Product Y: 15,000 ÷ 10 per hour	1,500	
Product Y: 15,000 ÷ 5 per hour		3,000
Total hours needed to meet maximum demand	3,500	4,000
Total hours available	3,000	4,200
Therefore, machine 1 time is the limiting factor		

Step II: Calculate contribution per unit of each product

Contribution per unit is calculated by deducting the variable production cost per unit from its sales price for each product.

Step III: Calculate contribution per limiting factor resource of each product.

For example, Product A has contribution of Rs. 50 per unit and product B Rs. 60. Machine hour is limiting factor (identified in step I). Product A and B required 4 and 5 machine hours respectively to product one unit.

Therefore, the contribution per machine hour is calculated as:

Product A (50/ 4)	Rs. 12.50
Product B (60 / 5)	Rs. 12.00

Step IV: Rank the products on the basis of step III.

Taking the values given in example in Step III, even contribution per unit of product B is higher than product A, but we should rank the products on the basis of contribution per machine hour. Hence, product A should be produced first and then product B should be produced.

Step V: Calculate optimal production mix

Optimal production mix is combination of products to be produced to get maximum profits under given constraints. For calculating optimal production mix, it is important to follow ranking calculated in Step IV.

▶ *Example 03:*

MS Limited makes two products, the M and S. Unit variable costs are as under.

	M	S
	Rs.	Rs.
Direct material	100	300
Direct labour (Rs. 50 per hour)	600	300
Variable production overheads	100	100

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The sales price per unit is Rs. 1,400 per M and Rs. 1,100 per S. During September, the available direct labour is limited to 60,000 hours and material of Rs. 2,500,000 Sales demand in September is expected to be as follows:

Product M	3,000 units
Product S	5,000 units

The optimal production mix, under limiting factor theory, is calculated as under.

Step I: Identify the limiting factor

	Labour hours
Product M (3,000 x 600/50)	36,000
Product S (5,000 x 300/50)	30,000
Required hours	66,000
Available hours	60,000
Labour is limiting factor as available hours are insufficient to produce all units of Product M and S.	
	Material Rs.
Product M (3,000 x 100)	300,000
Product S (5,000 x 300)	1,500,000
Required material	1,800,000
Available material	2,500,000
Material is not limiting factor, as sufficient material is available to product all units of both products.	

Step II to IV: The step II (calculation of contribution per unit), step III (calculation of contribution per limiting factor) and step IV (rank the products), is calculated in single table given below.

	Product M	Product S
Sales price per unit Rs.	1,400	1,100
Less: Variable cost per unit Rs.		
Direct materials	(100)	(300)
Direct labour	(600)	(300)
Variable production overheads	(100)	(100)
	(800)	(700)
Contribution per unit	600	400
Labour hours per unit	12	6
Contribution per labour hour	50	66.67
Ranking	II	I

Step V: Optimal production mix table

	Labour hours	Units
Available labour hours	60,000	
Product S (5,000 x 6)	(30,000)	5,000
	30,000	
Product M (30,000 / 12)	(30,000)	2,500

Hence 2,500 units of Product M and 5,000 units of Product S should be produced, in order to maximise the profits.

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- *Example 04:*

A company makes four products, A, B, C and D, using the same direct labour work force on all the products.

The company has no inventory of finished goods.

Direct labour is paid Rs. 12 per hour.

To meet the sales demand in full would require 12,000 hours of direct labour time.

Only 6,000 direct labour hours are available during the year.

Budgeted data for the company is as follows:

Product	A	B	C	D
Annual sales demand (units)	4,000	5,000	8,000	4,000
	Rs.	Rs.	Rs.	Rs.
Direct materials cost	3.0	6.0	5.0	6.0
Direct labour cost	6.0	12.0	3.0	9.0
Variable overhead	2.0	4.0	1.0	3.0
Fixed overhead	3.0	6.0	2.0	4.0
Full cost	14.0	28.0	11.0	22.0
Sales price	15.5	29.0	11.5	27.0
Profit per unit	1.5	1.0	0.5	5.0

The optimal production plan would be calculated as follows:

Calculation of contribution per unit, per limiting factor and ranking				
Product	**A**	**B**	**C**	**D**
Sales price	15.50	29.00	11.50	27.00
Direct materials cost	(3.00)	(6.00)	(5.00)	(6.00)
Direct labour cost	(6.00)	(12.00)	(3.00)	(9.00)
Variable overhead	(2.00)	(4.00)	(1.00)	(3.00)
Variable cost per unit	(11.00)	(22.00)	(9.00)	(18.00)
Contribution per unit	4.50	7.00	2.50	9.00
Labour hours per unit				
$\left(^{\text{total labour cost}}/_{\text{labour cost per hour}}\right)$	$^{6}/_{12}$	$^{12}/_{12}$	$^{3}/_{12}$	$^{9}/_{12}$
	0.5	1	0.25	0.75
Contribution per labour hour				
$\left(^{\text{contribution per unit}}/_{\text{labour hours per unit}}\right.$	$^{4.5}/_{0.5}$	$^{7}/_{1}$	$^{2.5}/_{0.25}$	$^{9}/_{0.75}$
Contribution per hour (Rs.)	9	7	10	12
Ranking	3rd	4th	2nd	1st

The products should be made and sold in the order D, C, A and then B, up to the total sales demand for each product and until all the available direct labour hours (limiting factor resources) are used up

Step 6: Construct a production plan to maximize contribution

Product	Sales units	Direct labour hours used	Contribution per unit	Total contribution
			Rs.	Rs.
D (1st)	4,000 (maximum)	3,000	9.00	36,000
C (2nd)	8,000 (maximum)	2,000	2.50	20,000
A (3rd)	2,000 (balance)	1,000	4.50	9,000
		6,000		65,000

Note: The plan is constructed as follows:

D is ranked first so the company needs to make as many of these as possible. The most it can sell is 4,000 units which would take 3,000 hours (0.75 hours per unit) to make. The company has 6,000 hours available so all of these can be made.

The company now has 3,000 hours left. C is ranked second and the most of C that can be sold is 8,000 units. This would use 2,000 hours (0.25 hours per unit).

The company now has 1,000 hours left. A is ranked third and the most of these that can be sold is 4,000 units. However, this would use 2,000 hours (0.5 hours per unit) so only half of these can be made.

- *Example 05:*

A company makes four products, W, X, Y and Z, using the same single item of direct material in the manufacture of all the products. Budgeted data for the company is as follows:

Product	W	X	Y	Z
Annual sales demand (units)	4,000	4,000	6,000	3,000
	Rs.	Rs.	Rs.	Rs.
Direct materials cost	5.00	4.00	8.00	6.00
Direct labour cost	4.00	6.00	3.00	5.00
Variable overhead	1.00	1.50	0.75	1.25
Fixed overhead	8.00	12.00	6.00	10.00
Full cost	18.00	23.50	17.75	22.25
Sales price	50.00	31.50	59.75	54.25
Profit per unit	32.00	8.00	42.00	32.00

Due to restricted supply, only Rs. 78,000 of direct materials will be available during the year. And it required to identify the quantities of production and sales of each product that would maximize annual profit, please see below

This question does not tell you the amount of material but it does give you its value. The analysis can proceed in the usual way using contribution per value of material rather than contribution per amount of material.

	W	X	Y	Z
	Rs.	Rs.	Rs.	Rs.
Sales price/unit	50.00	31.50	59.75	54.25
Variable cost/unit	(10.00)	(11.50)	(11.75)	(12.25)
Contribution per unit	40.00	20.00	48.00	42.00
Direct materials per unit (Rs.)	5	4	8	6
Rs. contribution per Rs.1 direct material	8.00	5.00	6.00	7.00
Priority for making and selling	1st	4th	3rd	2nd

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Profit-maximising budget				
Product	**Sales units**	**Direct materials (Rs.)**	**Contribution per unit (Rs.)**	**Total contribution (Rs.)**
W (1st)	4,000	20,000	40	160,000
Z (2nd)	3,000	18,000	42	126,000
Y (3rd) - balance	5,000	40,000	48	240,000
		78,000		526,000

- *Example 06:*

a) Company X manufactures four liquids: A, B, C and D. The selling price and unit cost details for these products are as follows:

	Liquid A	Liquid B	Liquid C	Liquid D
	Rs. per litre	**Rs. per litre**	**Rs. per litre**	**Rs. per litre**
Selling price	100	110	120	120
Costs:				
Direct materials	24	30	16	21
Direct labour (Rs.6/hour)	18	15	24	27
Direct expenses	0	0	3	0
Variable overhead	12	10	16	18
Fixed overhead (note 1)	24	20	32	36
Total cost per litre	78	75	91	102
Profit per litre	22	35	29	18

Note 1

Fixed overhead is absorbed on the basis of labour hours, based on a budget of 1,600 hours per quarter (three months).

During the next three months the number of direct labour hours is expected to be limited to 1,345 hours. The same labour is used for all products.

The marketing director has identified the maximum demand for each of the four products during the next three months as follows:

Liquid A	200 liters
Liquid B	150 liters
Liquid C	100 liters
Liquid D	120 liters

No inventories are held at the beginning of the period that could be used to satisfy demand in the period.

AT A GLANCE SPOTLIGHT STICKY NOTES

If the company requires to determine the number of liters of liquids A, B, C and D to be produced and sold in the next three months in order to maximize profits and calculate the profit that this would yield; working is given below:

	A	B	C	D
	Rs.	Rs.	Rs.	Rs.
Sales price	100	110	120	120
Variable cost per litre	(54)	(55)	(59)	(66)
Contribution per litre	46	55	61	54
Direct labour hours/unit	3	2.5	4	4.5
Contribution /direct labour hour (Rs.)	15.33	22.00	15.25	12.00
Priority for manufacture/sale	2nd	1st	3rd	4th

The fixed overhead absorption rate is Rs.8 per hour. This can be calculated from the overhead cost and direct labour hours for any of the four products.

The budgeted labour hours for calculating this absorption rate was 1,600 hours, therefore budgeted fixed costs are 1,600 hours × Rs.8 = Rs.12,800.

The output and sales that will maximize contribution and profit is as follows:

Product	Litres	Hours	Contribution /litre (Rs.)	Contribution /profit (Rs.)
B	150.0	375	55	8,250.0
A	200.0	600	46	9,200.0
C (balance)	92.5	370	61	5,642.5
		1,345		23,092.5
Fixed costs (see above)				12,800.0
Profit				10,292.5

b) Suppose that a contract has been made before the beginning of the period by Company X and one of its customers, Company Y. Company X has agreed to supply Company Y with supply of 20 liters of each A, B, C and D during the three-month period.

This sales demand from Company Y is included in the demand levels shown above in part (a) of the question.

For the above scenario please see below working for following requirements

Given the contract with Company Y, determine the number of liters of liquids A, B, C and D to be produced and sold in the next three months in order to maximize profits, if the maximum number of labour hours remain 1,345 hours for the period.

The profit that this would yield, would be calculated as follows:

In this situation, there is a minimum sales demand from Company Y that must be met:

Product	Litres	Hours	Contribution /litre (Rs.)	Contribution (Rs.)
A: (3 hours/litre)	20	60	46	920
B: (2.5 hours/litre)	20	50	55	1,100
C: (4 hours/litre)	20	80	61	1,220
D: (4.5 hours/litre)	20	90	54	1,080
		280		4,320
Total hours available		1,345		
Hours remaining		1,065		

The remaining 1,065 hours should be used to maximize contribution, using the same priorities as before. However, maximum sales demand should be reduced by 20 liters for each product, to allow for the sales to Company Y.

The output and sales that will maximize contribution and profit, allowing for the sales to Company Y, are as follows:

Product	Litres	Hours	Contribution/ litre	Contribution/ profit
			Rs.	Rs.
B	130	325	55	7,150
A	180	540	46	8,280
C (balance)	50	200	61	3,050
		1,065		18,480
Contribution from sales to Y				4,320
Total contribution				22,800
Fixed costs				12,800
Profit				10,000

► *Example 07:*

A company produces three products using the same raw material. The raw material is in short supply and only 3,000 kilograms shall be available in April 2009, at a cost of Rs. 1,500 per kilogram.

The budgeted costs and other data related to April 2009 are as follows:

	X	Y	Z
Maximum demand (units)	1,000	800	1,200
Selling price per unit (Rs.)	3,750	3,500	4,500
Material used per unit (kg)	1.6	1.2	1.8
Labour hours per unit (Rs. 75 per hour)	12	16	15

The number of units that should be produced by the company to earn maximum profit would be determined as follows:

		X	Y	Z
Selling price	A	3,750	3,500	4,500
Material cost per unit at Rs. 1,500 per kilogram	B	2,400	1,800	2,700
Labour cost per unit at Rs. 75 per hour	C	900	1,200	1,125
Profit per unit (A – B – C)	D	450	500	675
Material usage in kilograms per unit	E	1.6	1.2	1.8
Profit per kg of material used (D ÷ E)	F	281.25	416.67	375.00
Preferred order of manufacture		3	1	2
Maximum demand in units		1,000	800	1,200
Total raw material available – kgs				3,000
Less: consumption for 800 units of Y (800 x 1.2 kgs)				960
Balance available				2,040
Consumption for 1,200 units of Z = (1,200 x 1.8 kgs)			2,160	
Limited to 1,133 units @ 1.8 kg per unit				2,040
Balance				-
Therefore, the production should be as follows:				
Y = 800 units				
Z = 1,133 units				

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3. MAKE OR BUY DECISIONS

3.1 Make-or-buy decisions: outsourcing

A make-or-buy decision is a decision about:

- whether to make an item internally or to buy it from an external supplier, or
- whether to do some work with internal resources, or to contract it out to another organization such as a sub-contractor or an outsourcing organization.

The economic basis for the decision whether to make internally or whether to buy externally (outsource production) should be based on relevant costs. The preferred option **from a financial viewpoint** should be the one that has the lower relevant costs.

A financial assessment of a make-or-buy decision typically involves a comparison of:

- the costs that would be saved if the work is outsourced or sub-contracted, and
- the incremental costs that would be incurred by outsourcing the work.

► *Example 08:*

A company manufactures a component that is included in a final product that it also manufactures. Management have identified an external supplier who would be willing to supply the component.

The variable cost of manufacturing the component internally is Rs.10 and the external supplier would be prepared to supply the components for Rs.13 each. It has been estimated that cash savings on general overhead expenditure will be Rs. 48,000 each year if internal production is ended. The company needs 10,000 units of the component each year.

The decision regarding whether the company make or buy the component would require following evaluations

The annual relevant costs and benefits of a decision to buy the components externally can be presented as follows:

	Rs.
Extra costs of purchasing externally (10,000 units × (Rs.13 - Rs.10))	(30,000)
Cash savings in overhead expenditures	48,000
Net benefit from external purchasing (outsourcing) per year	18,000

Conclusion: The company would increase its profit by purchasing externally instead of making the items in-house. The recommendation on financial considerations is therefore to buy (outsource production), not make internally.

If the limiting factor situation exist, and current demand cannot be fulfilled by existing customers, then remaining demand can be fulfilled by purchasing the units from external supplier.

When there is limiting factor situation faced by entity, then following approach should be used to calculate the units to make in house and units to buy from external supplier.

Step I Identify the limiting factor.

Step II Calculate variable cost of production per unit of each product.

Step III Calculate extra cost per unit to buy of each product, after comparing it with cost of production per unit.

Step IV Calculate extra cost per limiting factor if bought for each product.

Step V Rank the products, if bought from external supplier (Lowest extra cost per unit to buy should be ranked first)

Step VI Rank the products from in house manufacturing point of view. (In reversal order as calculated in Step V)

Step VII Determination of units to be make and buy. (Optimal solution)

The above steps can be explained with the help of following example.

- *Example 09:*

Rizwan Manufacturing Company (RMC) is engaged in production of three products. Due to increase in demand of products, the RMC is facing difficulties in producing all units. The maximum machine hours available in the month of March 2021 are 50,000. The relevant data is given in following table.

		Product J	Product S	Product A
Maximum demand	Units	6,000	8,000	10,000
Machine hours per unit	Hr/U	4	3	2
Variable production cost per unit	Rs.	60	100	120
Cost to purchase per unit from external supplier	Rs.	90	120	140

The optimal solution relating to make or buy, is calculated as under.

As there is only one limiting factor given in question, no need to calculate and identify the limiting factor.

	Product J	Product S	Product A
Variable production cost per unit	60	100	120
Cost to purchase per unit from external supplier	(90)	(120)	(140)
Extra cost per unit, if bought	(30)	(20)	(20)
Machine hours per unit	4	3	2
Extra cost per machine hours, if bought	(7.50)	(6.67)	(10.00)
Ranking, if bought	II	I	III
Ranking, if make first	II	III	I

The product A should be produced first, but product S should be bought first. We should first make units in house, and remaining units should be bought from external supplier. The optimal table is given as under.

	Machine hours	Units to make	Units to buy
Available machine hours	50,000		
Product A (10,000 x 2)	(20,000)	10,000	
	30,000		
Product J (6,000 x 4)	(24,000)	6,000	
	6,000		
Product S (Note)	(6,000)	2,000	6,000

Note: After producing product A and J, only 6,000 machine hours are available. These hours can be utilized in the production of product S, which requires 3 hours to product one unit. Therefore, only 2,000 units of product S can be produced in house. The maximum demand of product S is 8,000 units, hence, remaining 6,000 units should be bought from external supplier.

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▶ *Example 10:*

Super clean Company is a contract cleaning company. It provides three services; daily office cleaning, intensive cleaning of office space and minor repairs. However, it has insufficient resources to do all the work available, and wishes to use a sub-contractor to take on some of the work.

Information relating to the different type of work is as follows:

	Average labour hours per job	Variable cost per job(Rs.)	Budgeted number of jobs	Sub-contractor quote per job (Rs.)
Daily office cleaning	4	60	1,500	80
Intensive cleaning	6	108	400	150
Minor repairs	3	56	640	100

There are 8,000 labour hours available. The service that should be sub-contracted would be analyzed using following workings.

The company can do all three types of job more cheaply with its own staff than by hiring the sub-contractor. However, provided that it earns more than Rs. 80 for a daily office cleaning job, Rs. 150 for an intensive cleaning job and Rs. 100 for a minor repairs job, it is profitable to use the sub-contractor to make up the shortfall in in-house resources.

The problem is to decide which work to outsource/sub-contract. The ranking should be established as follows:

	Daily office cleaning	Intensive cleaning	Minor repairs
	Rs.	Rs.	Rs.
Cost of doing the work in-house	60	108	56
Cost of sub-contractor	80	150	100
Extra cost of outsourcing, per job	20	42	44
Hours saved by sub-contracting	4	6	3
Extra cost per hour saved	Rs.5	Rs.7	Rs.14.
Priority for outsourcing	1st	2nd	3rd
Priority for doing work with own resources	3rd	2nd	1st

It is cheaper to sub-contract office cleaning than intensive cleaning. It is most expensive to sub-contract minor repairs and this is the first choice of job to be carried out in-house. The cost-minimizing plan should be to carry out the following work:

	Budgeted jobs	Total labour hours	Total variable cost
			Rs.
Minor repairs	640	1,920	35,840
Intensive cleaning	400	2,400	43,200
Office cleaning (balance)	920	3,680	55,200
Maximum labour hours available		8,000	
Sub-contract: Office cleaning	580		46,400
			180,640

▶ *Example 11:*

Wombat Company makes four products, W, X, Y and Z. All four products are made on the same machines, and the machine capacity for the year at Wombat's factory is 3,500 hours. However, it is able to obtain any of these products in unlimited quantities from a sub-contractor.

Budgeted data is as follows.

Product	W	X	Y	Z
Annual sales demand (units)	4,000	6,000	3,000	5,000
	Rs.	Rs.	Rs.	Rs.
Sales price per unit	15	20	18	17
Variable cost per unit, in-house manufacture	5	7	6	7
Cost of external purchase (outsourcing)	8.0	11.8	10.5	11.0
Machine hours per unit, in-house production	0.25	0.50	0.30	0.40

Which items should be produced in-house and which should be outsourced? The question would require following calculations to reach the conclusion

The selling price for each product is higher than the variable cost of purchasing each product externally; therefore, profit will be maximized by making the products in-house or purchasing them externally, up to the full amount of the annual sales demand.

Product	W	X	Y	Z
	Rs.	Rs.	Rs.	Rs.
Variable cost per unit, in-house manufacture	5.00	7.00	6.00	7.00
Cost of external purchase (outsourcing)	8.00	11.80	10.50	11.00
Extra cost of outsourcing, per unit	3.00	4.80	4.50	4.00
Machine hours per unit, in-house production	0.25	0.50	0.30	0.40
Extra cost of outsourcing, per machine hour saved	Rs.12	Rs.9.60	Rs.15	Rs.10
Priority for outsourcing	3rd	1st	4th	2nd
Priority for in-house production	2nd	4th	1st	3rd

The cost-minimizing and profit-maximizing budget is as follows.

Product	Units	Machine hours	Total variable cost
In-house production:			Rs.
Y	3,000	900	18,000
W	4,000	1,000	20,000
Z (balance)	4,000	1,600	28,000
		3,500	
Outsource:			
Z (1,000 x 11)	1,000		11,000
X (6,000 x 11.80)	6,000		70,800
Total variable cost			147,800

▶ *Example 12:*

An engineering company has been experiencing problems with restricted availability of resources. The company manufactures a variety of casings. It makes four types of casing. Each casing requires the same bought-in component and some high-grade steel. The standard costs for the four types of casing are as follows:

Casing	A	B	C	D
	Rs.	Rs.	Rs.	Rs.
Steel	250	500	190	390
Bought-in component	50	50	50	50
Direct labour	60	60	50	100
Variable production costs	40	50	40	50
Fixed production costs	180	240	150	270
Selling and administration costs	145	225	120	215
Profit	35	55	30	55
Selling price	760	1,180	630	1,130

All the selling and administration costs are fixed and the same single component is used for each of the four products. Direct labour is paid Rs.8 per standard hour and each member of the workforce is capable of producing any of the casings.

The company's main customer has ordered 30 units of Casing A, 20 units of B, 30 units of C and 20 units of D for production and delivery in the next month. Senior management have agreed that this order should be treated as a priority order and that these casings must be manufactured and delivered to the customer next month. This is necessary to maintain the goodwill of the customer. It is estimated that this order represents 10% of the total demand next month for each type of casing.

The company operates a just in time system, and has no inventories of steel, components or finished goods.

If the aim is to maximize profit for the month, establish the production and selling plan for the company next month in each of the following situations:

a) **Situation 1**. Supplies of steel are limited to Rs. 250,000.

b) **Situation 2**. Only 400 bought-in components are available from suppliers.

c) **Situation 3**. A labour dispute restricts available productive labour hours in the month to 2,125.

d) **Situation 4**. A labour dispute restricts available productive labour hours in the month to 2,125; but the manufacture of any quantities of the four casings could be sub-contracted to an outside supplier. The cost of buying the casings externally would Rs.475, Rs.705, Rs.380 and Rs.640 for Casing A, Casing B, Casing C and Casing D respectively. In addition, it should be assumed that the major customer insists that its order is completed by the company itself and the manufacture should not be sub-contracted.

Each of the restrictions on production should be treated independently, as four different situations.

Working: contribution per unit	A	B	C	D
	Rs./unit	Rs./unit	Rs./unit	Rs./unit
Profit	35	55	30	55
Fixed costs:				
Production	180	240	150	270
Selling	145	225	120	215
Contribution	360	520	300	540

Resources required for the priority order for the major customer

Casing	Units required	Steel		Direct labour	
		per unit	Total	per unit	Total
		Rs.	Rs.	hours	hours
A	30	250	7,500	7.5	225.0
B	20	500	10,000	7.5	150.0
C	30	190	5,700	6.25	187.5
D	20	390	7,800	12.5	250.0
Total			31,000		812.5

a) Steel in short supply and restricted to Rs. 250,000

Casing	A	B	C	D
	Rs.	Rs.	Rs.	Rs.
Contribution/unit	360	520	300	540
Steel costs/unit	250	500	190	390
Contribution/Rs.1 steel cost	1.44	1.04	1.58	1.38
Ranking for manufacture	2nd	4th	1st	3rd

It is assumed that the sales forecasts for the month are correct.

Profit-maximizing production schedule

	Steel used	A	B	C	D
	Rs.	units	units	units	units
Priority order	31,000	30	20	30	20
Sales of C	51,300			270	
Sales of A	67,500	270			
Sales of D	70,200				180
	220,000				
Balance: Sales of B	30,000		60		
Total steel available	250,000				
Total production/sales		300	80	300	200

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b) Components are in short supply and restricted to 400 units

	A	B	C	D
Contribution/unit	Rs.360	Rs.520	Rs.300	Rs.540
Components/unit	1	1	1	1
Contribution/component	Rs.360	Rs.520	Rs.300	Rs.540
Ranking for manufacture	3rd	2nd	4th	1st

Profit-maximizing production schedule

Components used		A	B	C	D
	units	units	units	units	units
Priority order	100	30	20	30	20
Sales of D	180				180
	280				
Balance: Sales of B	120		120		
Total available	400				
Total production/sales		30	140	30	200

c) Labour is in short supply and restricted to 2,125 hours

Casing	A	B	C	D
Contribution/unit	Rs.360	Rs.520	Rs.300	Rs.540
Labour hours/unit	7.50	7.50	6.25	12.5
Contribution per hour	Rs.48.00	Rs.69.33	Rs.48.00	Rs.43.20
Ranking for manufacture	2nd	1st	2nd	4th

Profit-maximizing production schedule

Labour hours		A	B	C	D
		units	units	units	units
Special order	812.5	30	20	30	20
Remaining hours	1,312.5		175		
Total hours	2,125.0				
Total production/sales		30	195	30	20

d) Make or buy decision

	A	B	C	D
	Rs.	Rs.	Rs.	Rs.
Contribution if made	360	520	300	540
Contribution if bought in	285	475	250	490
Extra contribution if made	75	45	50	50
Labour hours	7.5	7.5	6.25	12.5
Extra contribution per hour	**Rs.10**	**Rs.6**	**Rs.8**	**Rs.4**
Ranking/priority for making	1st	3rd	2nd	4th

Profit-maximizing production schedule

Casing	Hours	A	B	C	D
Special order	812.5	30	20	30	20
Remaining hours	1,312.5	175			
Total hours	2,125.0				
Made internally		205	20	30	20
Purchased externally		95	180	270	180
Total sales		300	200	300	200

- *Example 13:*

Galaxy Engineers (GE) manufactures and sells a wide range of products. One of the raw materials XPI is in short supply and only 80,000 kg are available in GE's stores. Following information pertains to the products in which XPI is used:

		Product A	Product B	Product C
Budgeted local sales/requirement	Units	4,500	1,000	2,500
Committed export sales as per agreement	Units	-	800	-
		---------------- Per unit-----------------		
Sales price	Rs.	20,000	14,100	For internal use
Material XPI (Rs. 500 per kg)	kg	14	12	2
Other material (Rs. 300 per kg)	kg	5	3	1
Direct labour hours (Rs. 100 per hour)	hours	20	15	5
Variable overheads based on labour cost	%	80%	80%	80%
Fixed overheads per direct labour hour	Rs.	95	75	60

Product C is used in other products made by GE. If it could not be produced internally, it has to be purchased from market at Rs. 3,000 per unit.

When required to determine the number of units of each product that should be manufactured, to earn maximum profit, following analysis may be of some assistance.

	Product A	Product B	Product C	Material XPI
	---------- Units---------			kg
Budgeted sales/requirements	**4,500**	**1,800**	**2,500**	
	---------- Rupees ----------			
Sales price per unit	20,000	14,100	**For internal use only**	
Opportunity cost per unit (Purchase price)	-	-	3,000	

	Product A	Product B	Product C	Material XPI
	---------- Units----------			kg
Cost of production per unit:				
Material XPI usage at Rs. 500 per kg	(7,000)	(6,000)	(1,000)	
Other material usage at Rs. 300 per kg	(1,500)	(900)	(300)	
Direct labour at Rs. 100 per hour	(2,000)	(1,500)	(500)	
Variable overheads at 80% of labour cost	(1,600)	(1,200)	(400)	
	(12,100)	(9,600)	(2,200)	
CM/savings from own manufacturing **(A)**	**7,900**	**4,500**	**800**	
Per unit usage of material XPI **(B) kg**	14	12	2	
CM per one kg of material XPI **(A)÷(B) Rs.**	564	375	400	
Ranking based on CM per XPI kg	**1st**	**3rd**	**2nd**	
Production from available material XPI:				
Production of committed export sales	-	800	-	9,600
Production in ranking order	4,500	200	2,500	70,400
Optimal production Units	**4,500**	**1,000**	**2,500**	**80,000**

- *Example 14:*

Condaco produces two products with the following costs and revenue per unit:

	Product A	Product B
	Rs.	Rs.
Sales price	20	10
Variable cost	8	6
Fixed cost	4	3
	units	units
Sales demand	2,000	3,000

There are only 7,000 machine hours available, and Product A requires 4 machine hours per unit and Product B requires 1 machine hour per unit

Following calculations to be used when required calculate the profit-maximizing production and sales mix.

Total machine hours required to meet sales demand = (2,000 × 4) + (3,000 × 1) = 11,000. Since only 7,000 hours are available, machine hours are a limiting factor.

	Product A	Product B
	Rs.	Rs.
Sales price	20	10
Variable cost	8	6
Contribution	12	4
Machine hours per unit	4	1
Contribution per hour	Rs.3	Rs.4
Priority for manufacture	2nd	1st

Decision: produce and sell the following products:

Product	Units	Machine hours	Contribution per unit	Total contribution
			Rs.	Rs.
B	3,000	3,000	4	12,000
A (balance)	1,000	4,000	12	12,000
		7,000		24,000

Now assume that all the data is the same, except that we are able to sub-contract the products for an additional variable cost of Rs.1 per unit for A and Rs.0.50 per unit for B. The profit-maximizing decision would be evaluated as follows:

	Product A	Product B
	Rs.	Rs.
Extra cost of external purchase	1	0.50
Machine hours saved by external purchase	4	1
Extra cost per machine hour saved	Rs.0.25	Rs.0.50
Priority for manufacture	1st	2nd

Item	Number of units	Machine hours	Contribution per unit	Contribution
Make			Rs.	Rs.
A	1,750	7,000	12	21,000
Buy				
A (balance)	250	(12 – 1)	11	2,750
B	3,000	(4 – 0.5)	3.5	10,500
Total contribution				34,250

▶ *Example 15:*

NK Enterprises produces various components for telecom companies. The demand of these components is increasing. However, NK's production facility is restricted to 50,000 machine hours only. Therefore, NK is considering to buy certain components externally. In this respect, the following information has been gathered:

Description	Components			
	X-1	X-2	X-3	X-4
Estimated demand in units	6,500	2,000	7,100	4,500
Machine hours required per unit	8	4	5	2
In-house cost per unit:	------------ Rupees ------------			
Direct material	20.0	28.0	23.0	22.0
Direct labour	9.0	5.0	9.0	8.0
Factory overheads	16.0	8.0	8.5	5.0
Allocated administrative overheads	5.0	4.0	3.0	2.0
	50.0	45.0	43.5	347.0
External price of the component per unit	35.0	40	34.0	33.0

Factory overheads include fixed overheads estimated at Rs. 1.50 per machine hour.

The number of units to be produced in-house and bought externally, would be determined as follows:

		X-1	X-2	X-3	X-4
Demand in units	(A)	6,500	2,000	7,100	4,500
Machine hours per unit	(B)	8	4	5	2
		---------------- Rupees ----------------			
In-house cost		50.00	45.00	43.50	37.00

		X-1	X-2	X-3	X-4
Irrelevant cost for decision making					
- Fixed overheads	1.5×B	(12.00)	(6.00)	(7.50)	(3.00)
- Allocated administrative overheads		(5.00)	(4.00)	(3.00)	(2.00)
Relevant production cost	(C)	**33.00**	**35.00**	**33.00**	**32.00**
Per unit cost of buying externally	(D)	**35.00**	**40.00**	**34.00**	**33.00**

		X-1	X-2	X-3	X-4
Incremental cost in case of external buying:					
- Per unit	(C-D) **(E)**	2.00	5.00	1.00	1.00
- Per machine hour	(E÷B)	0.25	1.25	0.20	0.50
Ranking for **in-house production**		**3rd.**	**1st.**	**4th.**	**2nd.**
No. of units for in-house production:					
*[50,000–(2,000×4) – (4,500×2)]/8 **(F)**		***4,125**	**2,000**	**-**	**4,500**
No. of units to be bought externally	**A-F**	**2,375**	**-**	**7,100**	**-**

3.2 Make-or-buy decisions: non-financial considerations

When relevant costs are used to make a decision, it is assumed that the decision should be based on financial considerations and whether the decision will add to profit (cash flows).

In reality, however, managers are likely to think about non-financial issues as well as financial issues when making their decisions as it is most critical decision. The non-financial considerations in any decision will depend on the circumstances, and will vary from one decision to another. Non-financial considerations can influence a decision. In your examination, be prepared to identify relevant non-financial issues in a particular situation, and discuss their potential implications.

Non-financial considerations that will often be relevant to a make-or-buy decision include the following.

- When work is outsourced, the entity loses some control over the work. It will rely on the external supplier to produce and supply the outsourced items. There may be some risk that the external supplier will:
  - produce the outsourced items to a lower standard of quality, or
  - fail to meet delivery dates on schedule, so that production of the end-product may be held up by a lack of components.
- The entity will also lose some flexibility. If it needs to increase or reduce supply of the outsourced item at short notice, it may be unable to do so because of the terms of the agreement with the external supplier. For example, the terms of the agreement may provide for the supply of a fixed quantity of the outsourced item each month.

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- A decision to outsource work may have implications for employment within the entity, and it may be necessary to make some employees redundant. This will have cost implications, and could also adversely affect relations between management and other employees.
- It might be appropriate to think about the longer-term consequences of a decision to outsource work. What might happen if the entity changes its mind at some time in the future and decides either (a) to bring the work back in-house or (b) to give the work to a different external supplier? The problem might be that taking the work from the initial external provider and placing it somewhere else might not be easy in practice, since the external supplier might not be co-operative in helping with the removal of its work.
- The company cannot hope to maintain any competitive advantage from the work of the external supplier, since the competitors can hire the same supplier.

The non-financial factors listed above are all reasons against outsourcing work. There might also be non-financial **benefits** from outsourcing work to an external supplier.

- If the work that is outsourced is not specialized, or is outside the entity's main area of expertise, outsourcing work will enable management to focus their efforts on those aspects of operations that the entity does best. For example, it could be argued that activities such as the management of an entity's fleet of delivery vehicles, or the monthly payroll work, should be outsourced because the entity itself has no special expertise on these areas.
- The external supplier, on the other hand, may have specialist expertise which enables it to provide the outsourced products or services more efficiently and effectively. For example, a company might outsource all its IT support operations, because it cannot recruit and retain IT specialists. An external service provider, on the other hand, will employ IT specialists.

4. OTHER SHORT TERM DECISIONS

The principles of relevant costing can be applied to any type of management decision, not just make-or-buy decisions. Examples of other types of management decision where relevant costing may be used are:

- One-off contract decisions (Already discussed in Chapter 14)
- Shutdown decisions
- Joint product further processing decisions.

4.1 Shutdown decisions

A shutdown decision is a decision about whether or not to shut down a part of the operations of a company. From a financial viewpoint, an operation should be shut down if the benefits of shutdown exceed the relevant costs.

A shutdown decision may be a long-term decision when there are large initial expenditures involved (for example, costs of making the work force redundant). For the purpose of the examination, however, any shutdown decision will be a short-term decision.

In order to consider this decision as short-term, it is assumed that cost of shut-down the process is approximately equal to revenue generated from disposal of its assets. Therefore, we consider only the short-term related costs in shut-down decision.

► *Example 16:*

Company V makes four products, P, Q, R and S. The budget for next year is as follows:

	P	Q	R	S	Total
	Rs.000	Rs.000	Rs.000	Rs.000	Rs.000
Direct materials	300	500	400	700	1,900
Direct labour	400	800	600	400	2,200
Variable overheads	100	200	100	100	500
	800	1,500	1,100	1,200	4,600
Sales	1,800	1,650	2,200	1,550	7,200
Contribution	1,000	150	1,100	350	2,600
Directly attributable fixed costs	(400)	(250)	(300)	(300)	(1,250)
Share of general fixed costs	(200)	(200)	(300)	(400)	(1,100)
Profit/(loss)	400	(300)	500	(350)	250

'Directly attributable fixed costs' are cash expenditures that are directly attributable to each individual product. These costs would be saved if operations to make and sell the product were shut down.

Decision would be required regarding whether any of the products should be withdrawn from the market. Following reasons and calculations may be observed:

From a financial viewpoint, a product should be withdrawn from the market if the savings from closure exceed the benefits of continuing to make and sell the product. If a product is withdrawn from the market, the company will lose the contribution, but will save the directly attributable fixed costs.

Product P and product R both make a profit even after charging a share of general fixed costs. On the other hand, product Q and product S both show a loss after charging general fixed costs, and we should therefore consider whether it might be appropriate to stop making and selling either or both of these products, in order to eliminate the losses.

Effect of shutdown	P	Q	R	S
	Rs.'000	Rs.'000	Rs.'000	Rs.'000
Contribution forgone	(1,000)	(150)	(1,100)	(350)
Directly attributable fixed costs saved	400	250	300	300
Increase/(reduction) in annual cash flows	(600)	100	(800)	(50)

Although product S makes a loss, shutdown would reduce annual cash flows because the contribution lost would be greater than the savings in directly attributable fixed costs.

However, withdrawal of product Q from the market would improve annual cash flows by Rs. 100,000, and withdrawal is therefore recommended on the basis of this financial analysis.

Decision recommended: Stop making and selling product Q but carry on making and selling product S.

4.2 Joint product further processing decisions

Joint products are products manufactured from a common process. In some instances, a company might have a choice between:

- selling the joint product as soon as it is output from the common process i.e. split-off point, or
- processing the joint product further before selling it (at a higher price).

This is a short-term decision, and the financial assessment should be made using relevant costs and revenues. The financial assessment should compare:

- the revenue that will be obtained (less any selling costs) from selling the joint product as soon as it is output from the common process, and
- the revenue that will be obtained if the joint product is processed further, less the incremental costs of further processing and then selling the product.

Applying relevant costing, the costs of the common process are irrelevant to the decision, because these costs will be incurred anyway, whatever the decision. The decision should be to further process the joint product if the extra revenue from further processing exceeds the extra (relevant) costs of the further processing.

▶ *Example 17:*

A company produces two joint products from a common process. For every 100 kilograms of input to the common process, output consists of 40 kilograms of joint product 1 (JP1) and 60 kilograms of joint product 2 (JP2). The costs of the common process are Rs.400 per 100 kilograms of input.

JP1 can be sold for Rs.10 per kilogram and JP2 can be sold for Rs.16 per kilogram.

Alternatively, JP1 can be processed to make a finished product, FP1. Costs of further processing consist of variable costs of Rs.6 per kilogram and fixed costs of Rs. 120,000 per year. Of these fixed costs, Rs. 96,000 would be directly attributable to the further processing operations, and the remaining Rs. 24,000 would be an apportionment of general fixed overhead costs. The further processed product (FP1) would have a selling price of Rs.28 per kilogram.

It is estimated that 15,000 kilograms of JP1 will be produced each year. There are no losses in any process.

Should JP1 be sold as soon as it is produced from the common process, or should it be further processed into Product FP1? Following may be the solution

The common processing costs are irrelevant to the further processing decision. The annual relevant costs and benefits of further processing JP1 are as follows:

	Rs.
Revenue from selling FP1 (per kilogram)	28
Variable further processing cost	(6)
Additional variable revenue from further processing	22
Opportunity cost: sales of JP1 forgone	(10)
Benefit per kilogram from further processing	12
Number of kilograms produced each year	15,000
Total annual benefits before directly attributable fixed costs	180,000
Directly attributable fixed costs of further processing	(96,000)
Net annual benefits of further processing	84,000

Recommendation: The joint product should be processed to make FP1, because this will increase annual profit by Rs. 84,000.

4.3 Equipment/Plant Replacement and investment decisions

Equipment buying or replacement decisions are capital investment decisions which require discounted cash flow analysis. Moreover, book value of the replaced asset is irrelevant of sunk cost in this situation.

▶ *Example 18:*

Decimal World Limited manufactures and sells modems. It manufactures its own circuit boards (CB), an important part of the modem.

The present cost to manufacture a CB is as follows:

	Rupees
Direct material	440
Direct labour	210
Variable overheads	55
Fixed overheads	
Depreciation	60
General overheads	30
Total cost per unit	795

The company manufactures 400,000 units annually. The equipment being used for manufacturing CB has worn out completely and requires replacement. The company is presently considering the following options:

a) Purchase new equipment which would cost Rs. 240 million and have a useful life of six years with no salvage value. The company uses straight-line method of depreciation. The new equipment has the capacity to produce 600,000 units per year. It is expected that the use of new equipment would reduce the direct labour and variable overhead cost by 20%.

b) Purchase from an external supplier at Rs.730 per unit under a two year contract.

The total general overheads would remain the same in either case. The company has no other use for the space being used to manufacture the CBs.

In analyzing company's situation which course of action would you recommend to the company assuming that 400,000 units are needed each year?

	Differential Cost per Modem	
	Make	Buy
	Rs.	Rs.
Outside supplier's costs		730
Direct materials	440	
Direct labour (Rs. 210 x 80%)	168	
Variable overheads (Rs. 55x80%)	44	
Depreciation (Rs. 240,000,000 ÷ 6 years ÷ 400,000)	100	
	752	730

The company should accept the offer of external supplier because the price offered is lower than the variable costs of product.

Recommendation for the company when its annual requirements were 600,000 units would require following analysis

	Differential Cost per Modem	
	Make	Buy
	Rs.	Rs.
Outside supplier's costs		730
Direct materials	440.00	
Direct labour (Rs. 210 x 80%)	168.00	
Variable overheads (Rs. 55 x 80%)	44.00	
Depreciation (Rs. 240,000,000 ÷ 6 years ÷ 600,000)	66.67	
	718.67	730

The company should purchase the new equipment and make the modems if 600,000 modems per year are needed.

However, there may be other factors that the company should consider, before making a decision. These are

i. Will volume in future years be increasing? If yes, then buying the new equipment becomes more desirable.
ii. Will quality control be maintained if the CB purchased from external suppliers?
iii. Will the external supplier be dependable in making delivery schedules?
iv. Can the company begin making the CB again if the supplier proves to be unacceptable?
v. If the external supplier's offer is accepted and the needs for CB increases in future years, will the supplier have the added capacity to provide more than 400,000 CB per year?
vi. If the order size increases, will the supplier given any additional bulk quality discount.
vii. Will the external supplies be able to supply the CB after 2 years?

4.4 Decisions for Discontinuing operations

Some operations are more profitable than the others. In this respect, organizations may often consider less profitable ventures to be discontinued for allocation of resources to those making more profits.

► *Example 19:*

Stamba makes two components, A and B, for which costs in the next year are expected to be as follows:

	A	B
Production (units)	30,000	20,000
Variable costs per unit:	Rs.	Rs.
Direct materials	6	5
Direct labour	3	9
Variable production overheads	1	3
Variable production cost	10	17

Direct labour is paid Rs.12 per hour. There will be only 19,500 hours of direct labour time available next year, and any additional components must be purchased from an external supplier.

Total fixed costs per annum are expected to be as follows:

	Rs.
Incurred as a direct consequence of making A	40,000
Incurred as a direct consequence of making B	50,000
Other fixed costs	30,000
	120,000

An external supplier has offered to supply units of A for Rs.12.50 and units of B for Rs.23.

a) Recommendation regarding whether Stamba should shut down internal production of Component A or Component B and switch to external purchasing is given below.

	Component A	Component B
	Rs.	Rs.
Cost of making internally	10.0	17.0
Cost of buying	12.5	23.0
Extra variable cost of buying	2.5	6.0
Quantities required next year	30,000	20,000
Total extra variable cost of buying	75,000	120,000
Fixed costs saved by closure	40,000	50,000
Net extra costs of buying	35,000	70,000

It appears that it would cost the company more each year to shut down internal production of either component and switch to external purchasing.

b) Recommendation regarding the quantities that Stamba should make of the components, and the quantities that it should buy externally, in order to obtain the required quantities of both components at the minimum cost would be as follows.

In addition, the total annual cost will be calculated below

Tutorial note. To answer part (b), you will need to consider that labour is a limiting factor.

Production hours required	hours
Component A (30,000 × 0.25 hours)	7,500
Component B (20,000 × 0.75 hours)	15,000
Total hours required	22,500
Total hours available	19,500
Shortfall	3,000

There are insufficient hours available to manufacture everything internally. Some components must be purchased externally.

	Component A	Component B
	Rs. per unit	Rs. per unit
Cost of making internally	10.0	17.0
Cost of buying	12.5	23.0
Cost saved by making	2.5	6.0
Hours required to make internally	0.25 hours	0.75 hours
(Rs.3/Rs.12 per hour: Rs.9/Rs.12 per hour)		
Costs saved per hour by making	Rs.10	Rs.8
(Rs.2.50/0.25 hours: Rs.6/0.75 hours)		

It is better to make Component A internally than Component B.

Component	Units	Hours	Cost/unit	Cost
			Rs.	Rs.
A	30,000	7,500	10	300,000
B (balance)	16,000	12,000	17	272,000
Variable cost of internal manufacture		19,500		572,000
Cost of external purchase – balance of units required	4,000		23	92,000
Fixed costs				120,000
Total costs				784,000

c) Non-financial considerations relevant to make-or-buy decision are discussed below:

Risks of outsourcing work:

i. Supplier may produce items to a lower standard of quality.

ii. The supplier may fail to meet delivery dates and the buyer may dependent on the supplier to commit onward delivery to its buyer. In case of buying of a component, production process of the end-product may be held up by a lack of component.

Benefits of outsourcing work:

i. Outsourcing work will enable the management to focus all of its efforts on those aspects of operation the entity does best.

ii. The external supplier may have specialist expertise which enables it to provide outsourced products more efficiently and at a cheaper price.

5. COMPREHENSIVE EXAMPLES

- *Example 01:*

Areesh Limited deals in various products. Relevant details of the products are as under:

	AW	AX	AY	AZ
Estimated annual demand (units)	5,000	10,000	7,000	8,000
Sales price per unit (Rs.)	150	180	140	175
Material consumption:				
Q (kg)	2	2.5	1.5	1.75
S (kg)	0.5	0.6	0.4	0.65
Labour hours	2	2.25	1.75	2.5
Variable overheads (based on labour cost)	75%	80%	100%	90%
Fixed overheads per unit (Rs.) (based on 80% capacity utilization)	10	20	14	16
Machine hours required:				
Processing machine hours	5	6	8	10
Packing machine hours	2	3	2	4

Company has a long term contract for purchase of material Q and S at a price of Rs. 15 and Rs. 20 per kg respectively. Wage rate for 8-hours shift is Rs. 200.

The estimated overheads given in the above table are exclusive of depreciation expenses. The company provides depreciation on number of hours used basis. The depreciation on each machine based on full capacity utilization is as follows:

	Hours	Rs.
Processing machine	150,000	150,000
Packing machine	100,000	50,000

The company has launched an advertising campaign to promote the sale of its products. Rs. 2 million have been spent on such campaign. This cost is allocated to the products on the basis of sale.

The number of units of each product that the company should produce in order to maximize the profit and the product wise and total contribution at optimal product mix can be calculated as follows:

	AW	AX	AY	AZ	Total
Sale price	150.00	180.00	140.00	175.00	
Less: Variable cost					
Material Q at Rs 15	30.00	37.50	22.50	26.25	
Material S at Rs 20	10.00	12.00	8.00	13.00	
Labour cost at Rs. 25 per hour	50.00	56.25	43.75	62.50	
Overheads	37.50	45.00	43.75	56.25	
	127.50	150.75	118.00	158.00	
Contribution margin per unit	**22.50**	**29.25**	**22.00**	**17.00**	
Annual demand (Units)	5,000	10,000	7,000	8,000	

	AW	AX	AY	AZ	Total
Possible production under each machine:					
Processing machine:					
Machine hours required per unit	5.00	6.00	8.00	10.00	
Average CM per hour	4.50	4.88	2.75	1.70	
Production priority	2	1	3	4	
No. of units that can be produced in available hours in order of CM priority (Restricted to annual demand)	5,000	10,000	7,000	900	
Hours required	**25,000**	**60,000**	**56,000**	**9,000**	**150,000**
Contribution margin (Rs.)	**112,500**	**292,500**	**154,000**	**15,300**	**574,300**

Production for product 'Z' has to be restricted to 900 units due to limited number of machine hours.

	AW	AX	AY	AZ	Total
Packing machine:					
Machine hours required per unit	2.00	3.00	2.00	4.00	
Average CM per hour	**11.25**	**9.75**	**11.00**	**4.25**	
Production priority	1	3	2	4	
No. of units that can be produced in available hours in order of CM priority (Restricted to annual demand)	5,000	10,000	7,000	8,000	
Hours required	**10,000**	**30,000**	**14,000**	**32,000**	**86,000**

Conclusion:

The packing machine can meet the full demand but capacity of processing machine is limited. Therefore, product mix of processing machine will be manufactured.

Assumption:

It has been assumed that the wage rate per eight hours is divisible.

▶ *Example 02:*

Jaseem Limited manufactures a stationery item in three different sizes. All the sizes are manufactured at a plant having annual capacity of 1,800,000 machine hours.

Relevant data for each product is given below:

	Small Size	Medium Size	Large Size
Sales price per unit (Rs.)	75	90	130
Direct material cost per unit (Rs.)	25	32	35
Labour hours per unit	3	4	5
Variable overheads per unit (Rs.)	5	7	8
Machine hours per unit	2	4	5
Demand (Units)	210,000	150,000	180,000
Minimum production required (Units)	100,000	100,000	100,000

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Other relevant information is as under:

i. Cost of the monthly payroll is Rs. 1,500,000.

ii. Fixed overheads are Rs. 110,000 per month and are allocated on the basis of machine hours.

The number of units to be produced for each size may involve following calculations

	Small size	Medium size	Large size
Sales price	75.00	90.00	130.00
Direct material cost	(25.00)	(32.00)	(35.00)
Variable overheads	(5.00)	(7.00)	(8.00)
Contribution margin	**45.00**	**51.00**	**87.00**
Machine hours	2.00	4.00	5.00
Contribution margin per hour	22.50	12.75	17.40
Priority based on contribution per machine hour	**1**	**3**	**2**

Units to be produced:	Small size	Medium size	Large size	Machine hours
Minimum production - Units	100,000	100,000	100,000	
Hours consumed for minimum production	200,000	400,000	500,000	1,100,000
Units in excess of minimum production in CM priority:				
Small size - Units	110,000			220,000
Large size - Units			80,000	400,000
Medium size – Units		20,000		80,000
Total	**210,000**	**120,000**	**180,000**	**1,800,000**

► *Example 03:*

Bauxite Limited (BL) is engaged in the manufacture and sale of three products viz. Pentagon, Hexagon and Octagon. Following information is available from BL's records for the month of February 2012:

	Pentagon	Hexagon	Octagon
Sales price per unit (Rs.)	2,300	1,550	2,000
Material cost per Kg. (Rs.)	250	250	250
Labour time per unit (Minutes)	20	30	45
Machine time per unit (Hours)	4	2.5	3
Net weight per unit of finished product (Kg.)	6	4	5
Yield (%)	90	95	92
Estimated demand (Units)	10,000	20,000	9,000

Each worker is paid monthly wages of Rs. 15,000 and works a total of 200 hours per month. BL's total overheads are estimated at 20% of the material cost.

Fixed overheads are estimated at Rs. 5 million per month and are allocated to each product on the basis of machine hours. 100,000 machine hours are estimated to be available in February 2012.

Based on optimum product mix, computation of BL's net profit for the month of February 2012 would be as follows:

Computation of net profit on the basis of optimum product mix:

	Pentagon	Hexagon	Octagon
Selling price	2,300	1,550	2,000
Less: Variable Costs			
Direct Material			
(250 × 6 /0.9)	1,666.67		
(250 × 4 /0.95)		1,052.63	
(250 × 5 /0.92)			1,358.70
Direct Labour			
[15,000 /200 × (20/60)]	25.00		
[15,000 /200 × (30/60)]		37.50	
[15,000 /200 × (45/60)]			56.25
Variable Overheads			
[1666.66 × 20% - (Rs. 50 × 4 hrs)]	133.33		
[1052.63 × 20% - (Rs. 50 × 2.5 hrs)]		85.53	
[1358.70 × 20% - (Rs. 50 × 3 hrs)]			121.74
Total Variable Cost	1,825.00	1,175.66	1,536.69
Contribution per unit	475.00	374.34	463.31
Machine Hours required per unit	4.0	2.5	3.0
Contribution per Machine Hour	118.75	149.74	154.44
Ranking	3	2	1

Now, the scarce Hours will be allocated as per ranking.

Product	Volume	Hours required	Hours used	Balance unused
				100,000
Octagon	9,000	3.0	27,000	73,000
Hexagon	20,000	2.5	50,000	23,000
Pentagon (Bal.)	5,750	4.0	23,000	-

Profit arising from above production plan

Product	Units	Contribution per unit	Contribution margin
Octagon	9,000	463.31	4,169,790
Hexagon	20,000	374.34	7,486,800
Pentagon	5,750	475.00	2,731,250
Total Contribution			14,387,840
Less: Fixed costs			(5,000,000)
Net Profit			9,387,840

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- *Example 04:*

The following projections are contained in the budget of Scientific Chemicals Limited for the year ending 31 December 2014:

i. Annual local and export sales

	Product C031		Product C032	
	Rs. Per unit	Units	Rs. Per unit	Units
Local sales	1,965	40,000	1,410	50,000
Export sales	2,100	25,000	1,500	24,000

ii. Raw material and labour per unit

	Product C031	Product C032
Raw material-A at Rs. 25 per kg. (Kg.)	4.0	3.0
Raw material-B at Rs. 60 per kg. (Kg.)	3.5	2.6
Skilled labour hours at Rs. 250 per hour (Hours)	2.4	2.0
Semi-skilled hours at Rs. 120 per hour (Hours)	5.0	2.5

iii. Variable overheads for each unit of product C031 and D032 are estimated at Rs. 125 and Rs. 60 respectively.

iv. Fixed overheads including admin & selling overheads would amount to Rs. 3 million per month.

The company is faced with the under-mentioned constraints:

- The supplier of material-B can supply 27,700 kg. per month only.
- Only 35 skilled workers will be available for each shift of 8 hours while factory will be operated for 25 days in a month on 3 shift basis.

Determination of optimal production plan for the next year assuming that the company cannot afford to terminate the export sales contract because of the heavy damages payable in case of default, is given below.

			Product C031	Product C032
			Rupees per unit	
Sales price			1,965	1,410
Variable costs:	2,100	25,000	1,500	24,000
Material A	4x25	3x25	(100)	(75)
Material B	3.5x60	2.6x60	(210)	(156)
Labour skilled	2.4x250	2x250	(600)	(500)
Labour semi skilled	5x120	2.5x10	(600)	(300)
Overheads			(125)	(60)
			(1,635)	(1,091)
Contribution per unit		**A**	**330**	**319**
Contribution margin per limiting factor				
Material B	A/3.5	A/2.6	94.29	122.69
Skilled labour	A/2.4	A/2.0	137.50	159.50
Priority			**2**	**1**

Optimal Production using limiting factors	Material B Kg	Skill labour hours
Available resources per annum (27,700×12), (35×3×25×12×8)	332,400	252,000
Total required resources:		
C031 (40,000+25,000)×3.5, 2.4	(227,500)	(156,000)
D032 (50,000+24,000)×2.6, 2.0	(192,400)	(148,000)
Shortage of material B and skilled labour	(87,500)	(52,000)
Reduction in production of C031 **(priority 2)** [(87,500÷3.5), (52,000÷2.4)]	(25,000)	(21,667)

Production would be as under:	C031	C032
	Units	
1st priority for export sales	25,000	24,000
Local sales – Product C031: (40,000-25,000)	15,000	50,000

- *Example 05:*

Alpha Limited (AL) manufactures and sells products A, B and C. In view of limited production capacity, AL is meeting the demand for its products partly through imports.

The following information has been extracted from the budget for the next year:

	A	B	C
Machine hours used in production	240,000	225,000	270,000
	-------------- No. of units --------------		
Sale	42,000	35,000	26,500
Production	30,000	25,000	22,500
Imports	12,000	10,000	4,000
	------------- Rs. in million -------------		
Sales	252.00	175.00	185.50
Cost of production:			
- Direct material	48.00	31.25	40.50
- Direct labour	45.00	40.00	56.25
- Variable overheads	33.00	25.00	29.25
- Fixed overheads	28.80	27.00	32.40
Cost of import of finished products	68.40	47.00	26.88

Additional information:

a) AL is working at 100% capacity.

b) AL believes that it can obtain substantial quantity discounts from foreign suppliers if it increases the import volumes. Each product is supplied by a different supplier. After intense negotiations, the suppliers have offered discounts of 15%, 10% and 12% for products A, B and C respectively.

In preparing a product-wise plan of production/imports to maximize the company's profitability, please see below analysis

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		Product-A	Product-B	Product-C
Capacity utilization	Machine hours **(A)**	240,000	225,000	270,000
Sales of units to be produced	**(B)**	30,000	25,000	22,500
Sales of units to be imported	**(C)**	12,000	10,000	4,000
Total sale units		**42,000**	**35,000**	**26,500**

		Rupees in million		
Variable Cost of production:				
		Product-A	**Product-B**	**Product-C**
Direct material		48.00	31.25	40.50
Direct labour		45.00	40.00	56.25
Overheads		33.00	25.00	29.25
Total cost	**(D)**	126.00	96.25	126.00
Cost per produced unit	**E (D÷B)**	**4,200.00**	**3,850.00**	**5,600.00**

	Rupees in million		
Cost of imports:	**Product-A**	**Product-B**	**Product-C**
Existing cost of imported finished goods	68.40	47.00	26.88
Bulk discount offered	15%	10%	12%
Discounted price of imported goods **(F)**	58.14	42.30	23.65

		Rupees		
Cost per imported unit	**G (F÷C) Rs.**	**4,845.00**	**4,230.00**	**5,912.00**
Loss per unit on imports	**(G-F)**	**(645.00)**	**(380.00)**	**(312.50)**
Production Plan:				
Machine hours per unit	**H (A÷B)**	8.00	9.00	12.00
Loss per machine hour on imports	**Rs.**	(80.63)	(42.22)	(26.04)
Production priority to save loss on imports		**1st.**	**2nd.**	**3rd.**
Production from available hours of 735,000 in sequence of the above priority:				
Product-A	Units demand	42,000		
	Hours utilized (42,000×8)	336,000		
Product-B	Units demand		35,000	
	Hours utilized (35,000×9)		315,000	
Product-C	Units from remaining hours			7,000
	Remaining hours [735-336-315]			84,000
Import plan:				
Product-C: Demand exceeding production	(26,500-7,000)	-	-	19,500
Total units		**42,000**	**35,000**	**26,500**

► *Example 06:*

Artery Limited (AL) produces and markets three products viz. Alpha, Beta and Gamma. Following information is available from AL's records for the manufacture of each unit of these products:

		Alpha	Beta	Gamma
Selling price	(Rs.)	66	88	106
Material-A (Rs.4 per kg)	(Rs.)	8	0	12
Material-B (Rs.6 per kg)	(Rs.)	12	18	24
Direct labour (Rs. 10 per hour)	(Rs.)	25	30	25

		Alpha	Beta	Gamma
Variable overhead based on:				
– Labour hours	(Rs.)	1.5	1.8	1.5
– Machine hours	(Rs.)	1.6	1.4	1.2
Total	(Rs.)	3.1	3.2	2.7
Other data:				
Machine hours		8	7	6
Maximum demand per month (units)		900	3,000	5,000

Additional information:

i. AL is also engaged in the trading of a fourth product Zeta, which is very popular in the market and generates a positive contribution. AL currently purchases 600 units per month of Zeta from a supplier at a cost of Rs. 40 per unit. In-house manufacture of Zeta would require: 2.5 kg of material-B, 1 hour of direct labour and 2 machine hours.

ii. Materials A and B are purchased from a single supplier who has restricted the supply of these materials to 22,000 kg and 34,000 kg per month respectively. This restriction is likely to continue for the next 8 months.

iii. AL has recently accepted a Government order for the supply of 200 units of Alpha, 300 units of Beta and 400 units of Gamma each month for the next 8 months. These quantities are in addition to the maximum demand stated above.

iv. There is no beginning or ending inventory.

In determining whether AL should manufacture Zeta internally or continue to buy it from the supplier during the next 8 months, following are the required calculations

The internal manufacturing cost of Zeta would be as follows:

		Rs. per unit
Direct material-**B** (2.5 kg @ Rs. 6/kg)		15.00
Direct labour (1 hours @ Rs. 10/hour)		10.00
Variable overhead	**W-1**	
Direct labour (1 hour @ Rs. 0.60/hour)		0.60
Machine hours (2 hours @ Rs. 0.20/hour)		0.40
Total		**26.00**

The buying price of the component is Rs. 40 per unit so if resources are readily available the company should manufacture the component. However, due to the scarcity of resources during the next 8 months the contribution earned from the component needs to be compared with the contribution that can be earned from the other products.

W-1:

Using Alpha (though any product could be used) the variable overhead rate per hour can be calculated:

Labour related variable overheads per unit = Rs 1.5

Direct labour hours per unit = Rs 25 / Rs 10 = 2.5 hours

Labour related variable overhead per hours = Rs. 1.5 / 2.5 hour = Rs 0.60 per hour

Machine related variable overhead per hour = Rs. 1.6 / 8 hour = Rs 0.2 per hour

Both material-**A** and material-**B** are limited in supply during the next 8 months, but calculations are required to determine whether this scarcity affects the production plans of AL. The resources required for the maximum demand must be compared with the resources available to determine whether either of the materials is a binding constraint.

Total quantity of each product to be manufactured:

	Government order	Market demand	Total
	Units		
Alpha	200	900	1,100
Beta	300	3,000	3,300
Gamma	400	5,000	5,400
Zeta	0	600	600

All figures in kg:

Resource	Available	Requirement	Alpha	Beta	Gamma	Zeta
Direct material-**A**	22,000	18,400	2,200	0	16,200	0
Direct material-**B**	34,000	35,200	2,200	9,900	21,600	1,500

It can be seen from the above that the scarcity of material-B is a binding constraint and therefore the contributions of each product and the component per kg of material-B must be compared.

	Alpha	Beta	Gamma	Zeta
	Rupees			
Contribution per unit	17.9	36.8	42.3	14.0
Contribution /kg of material-**B**	8.95	12.27	10.58	5.60
Rank	**3**	**1**	**2**	**4**

AL should manufacture 120 units of Zeta and continue to purchase 480 units from the market.

- *Example 07:*

Snooker (Private) Limited (SNPL) manufactures a component 'Beta' which is used as input for many products. The current requirement of Beta is 18,000 units per annum. Current production cost of Beta is as follows:

	Rs. per unit
Direct material	3,670
Direct labour	1,040
Variable manufacturing overheads	770
Fixed manufacturing overheads	870
Total cost	**6,350**

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A supplier has recently offered SNPL to supply Beta at Rs. 7,000 per unit. The management has nominated a team to evaluate the offer which has gathered the following information:

1. There is a shortage of labour. However, some of the labour would become available due to outsourcing of Beta, which would be utilized for production of a product 'Zee'. The estimated selling price of Zee is Rs. 5,800 per unit whereas production cost would be as follows:
   a. Direct material would cost Rs. 2,600 per unit.
   b. Each unit of Zee would require 20% more labour as compared to each unit of Beta.
   c. Estimated variable manufacturing overheads would be Rs. 480 per unit.
2. Outsourcing of Beta and production of Zee would result in net reduction in fixed manufacturing overheads by Rs. 1,900,000 per annum.

The decision regarding outsourcing by SNPL would require following evaluation:

Snooker Private Limited		Rupees
Additional cost of outsourcing of component Beta	**W-1**	(27,360,000)
Additional contribution from utilizing spare capacity by producing Zee	**W-2**	22,080,000
Net savings of fixed factory overheads		1,900,000
Loss due to outsourcing		**(3,380,000)**

Opinion: SNPL should not outsource the production of component X.

W-1: Difference between cost of production and cost of outsourcing of component Beta		Rupees
Purchase cost	(18,000×7,000)	126,000,000
Variable production costs saved	[18,000×(3,670+1,040+770)]	98,640,000
Allocation of shared cost (irrelevant)	Ignore	-
Additional cost of outsourcing component Beta		**27,360,000**

W-2: Profit from spare capacity - Production of Zee		Rupees
Sales revenue of Zee	[5,800×15,000 **(W-3)**]	87,000,000
Material	[(2,600×15,000 **(W-3)]**	(39,000,000)
Labour	(1,040×15,000 **(W-3)**×1.2)	(18,720,000)
Variable manufacturing overheads	(480×15,000)	(7,200,000)
Profit from Zee		**22,080,000**

W-3: Production of Zee	Units
18,000 /1.2	15,000

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▶ *Example 08:*

Lily (Private) Limited (LPL) has two factories. LPL manufactures a product Delta in its Quetta factory. One unit of Delta is assembled from three components P, Q and R which are produced in the Hub factory. Monthly demand of Delta is estimated at 5,000 units.

Following information is available in respect of each component:

	P	Q	R
Quantity required for one unit of Delta	2	2	3
Machine hours required for producing each component	4	3	5
Cost of production per unit:	---------Rupees--------		
Direct material	900	800	300
Direct Labour	270	250	240
Factory overheads	500	700	280
Allocated administrative overheads	40	30	50

Fixed factory overheads are charged at Rs. 20 per machine hour.

Production capacity at Hub factory is restricted to 100,000 machine hours per month. In order to meet the demand, LPL is considering to purchase P, Q and R from a vendor at Rs. 1,700, Rs. 1,800 and Rs. 870 per unit respectively.

In determining how LPL can optimize its profit in the above situation, please see below working

		P	Q	R
Quantity required to produce one unit of Delta	**A**	2	2	3
Machine hours to produce the components	**B**	4	3	5
Components required to produce 5,000 units of Delta (5,000×A)	**C**	10,000	10,000	15,000
Relevant production cost per component:		---------- Rupees --------		
Direct material		900	800	300
Direct labour		250	250	240
Variable overheads 500–(B×20); 700–(B×20); 280–(B×20)		420	640	180
Fixed overheads	**(Not relevant)**	-	-	-
Allocated administrative overheads	**(Not relevant)**	-	-	-
Total relevant cost	**D**	**1,590**	**1,690**	**720**
		---------- Rupees --------		
External purchase price per component	**E**	1,700	1,800	870
Savings per component in case of in-house production	E–D = **F**	110	110	150
Savings per machine hour for in-house production	F÷B	27.50	36.67	30.00
Priority for in-house production		**3rd.**	**1st.**	**2nd.**
In-house production in sequence of priority	Units **G**	**-**	**10,000**	**14,000**
Use of available hours	G×B	-	30,000	70,000
External purchase	Units **C–G**	**10,000**	**-**	**1,000**

▶ *Example 09:*

Qamber Limited (QL) is engaged in the manufacture and sale of textile products. In February 2013 QL received an order from JCP, a chain of stores, for the supply of 11,000 packed boxes of its products per month at an agreed price of Rs. 8,000 per box. The boxes would be supplied every month for a period of one year. It was further agreed that:

- Each box would contain a pillow cover, a bed sheet and a quilt cover.
- QL would be solely responsible for the quality of supplied products whether they are being manufactured at its own facility or outsourced to third party, either wholly or partially.
- JCP would provide its logo and printed materials for the packing of these boxes.

Following information is available for the manufacture of each unit of these products:

		Products		
		Pillow Cover	Bed Sheets	Quilt Cover
Cloth required	**(Meters)**	1	4	5
Cost of cloth per meter	**(Rs.)**	200	300	400
Direct labour per meter	**(Minutes)**	30	15	18
Machine time	**(Minutes)**	30	75	120
Variable overheads per machine minute	**(Rs.)**	5	4	3.75
Outsourcing cost	**(Rs.)**	750	2,000	3,500

For in-house completion of the above order, a total of 45,000 machine hours and 25,500 labour hours are estimated to be available each month. The labourers are paid at a uniform rate of Rs. 400 per hour. The cost incurred on quality check, before supply of the boxes to JCP, is estimated at Rs. 300 per box. Fixed overheads are estimated at Rs. 10,000,000 per month.

Calculation of net profit for the month, assuming QL wants to produce as many products as possible within the available resources, and outsource the rest to a third party, is given below.

Computation of limiting factor	
Estimated labour hours available each month	25,500
Divided by : labour hours required per box [(30 × 1)+(15 × 4)+(18×5)] ÷ 60	3
No. of boxes that can be produced within available labour hours	8,500
Estimated machine hours available each month	45,000
Divided by : machine hours required per box [(30 + 75 + 120)] ÷ 60	3.75
No. of boxes that can be produced within available machine hours	12,000

Therefore, limiting factor is labour hours.

	Products		
	Pillow Cover	Bed Sheets	Quilt Cover
Direct material [1×200],[4×300],[5×400]	200	1,200	2,000
Direct labour [400×30÷60×1],[400×15÷60×4],[400×18÷60×5]	200	400	600
Variable overhead [5×30],[4×75],[3.75×120]	150	300	450
Variable cost per product	550	1,900	3,050
Less: Outsourcing cost per product	(750)	(2,000)	(3,500)
Cost saving from in-house production	200	100	450
Direct labour hours per unit	0.50	1.00	1.50
Cost saving per labour hour	400	100	300
Ranking	1	3	2

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Scarce hours allocated as per ranking

	Quantity	Labour hours used	Available hours
			25,500
First Produce – Pillow cover	11,000	5,500	20,000
Then Produce – Quilt cover	11,000	16,500	3,500
Finally produce – Bed sheet	3,500	3,500	-
No. of Bed sheets to be outsourced	7,500		

Statement showing net profit for the month

	Products			Rs. In 000
	Pillow Cover	Bed Sheets	Quilt Cover	
		----------Rupees-----------		
Sales [11,000 × Rs. 8,000]				88,000
Less: Expenses:				
Units produced	11,000	3,500	11,000	
Variable manufacturing cost per product	550	1,900	3,050	
	6,050,000	6,650,000	33,550,000	(46,250)
Units outsourced		7,500		
Outsourced cost per bed sheet		2,000		
		15,000,000		(15,000)
Cost of quality check (11,000 x 300)				(3,300)
Total variable costs				(64,550)
Total contribution				23,450
Less: Fixed costs				(10,000)
Net profit for the month				**13,450**

► *Example 10:*

Zee Chemicals Limited (ZCL) produces two joint products, Alpha and Beta from a single production process. Both products are processed up to split-off point and sold without any further processing.

Presently, ZCL is considering the following proposals:

- Expansion of the existing facility by installing a new plant
- Installation of a refining plant to sell either Alpha or Beta after refining

To assess the above proposals, following data has been gathered:

i. Actual cost incurred in the month of December 2014:

	Rs. in '000
Direct material	15,000
Variable conversion costs (Rs. 230 per hour)	4,890
Fixed overheads	2,600

ii. Actual production and selling price for the month of December 2014:

	Liters	Selling price per liter (Rs.)
Alpha	11,300	1,000
Beta	14,700	1,125

iii. There is no process loss and joint costs are apportioned between Alpha and Beta according to the weight of their output.

iv. Details of the proposed plans are as follows:

	Expansion of existing facility	Installation of refining plant
Capacity in machine hours per month	5,000	5,000
	------------ Rs. in '000 ------------	
Cost of plant and its installation	20,000	25,000
Estimated residual value at the end of life	1,400	2,800
Estimated additional fixed overheads per month	250	500
Estimated useful life of the plant	20 Years	20 Years

v. Estimated variable cost of refining and sales price of refined products:

	Alpha	Beta
	Rupees per liter	
Direct material	90	125
Conversion cost (Rs. 150 per hour)	68	80
Selling price	1,380	1,525

vi. There would be no loss during the refining process. There is adequate demand for Alpha and Beta at split-off point and after refining.

It is important to evaluate each of the above proposals and give recommendations. Following calculations may be of some help:

	Expansion (Sale at split-off point)		Refining plant (Sale after refining)	
	Alpha	Beta	Alpha	Beta
Sales/incremental sales value per liter	1,000	1,125	380	400
			(1,380–1,000)	(1,525 – 1,125)
Variable cost at split-off point/cost of refining per liter	(765)	(765)	(158)	(205)
	(15,000+4,890) ÷ (11,300+14,700)		(90+68)	(125+80)
Contribution margin per liter **A**	**235**	**360**	**222**	**195**
CM from 5,000 hours:				
Total hours worked in December 2014	21,261 Hrs. (4,890,000÷230)			
Hours per liter for refining			0.453 Hrs. (68÷150)	0.533 Hrs. (80÷150)

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	Expansion (Sale at split-off point)		Refining plant (Sale after refining)	
	Alpha	**Beta**	**Alpha**	**Beta**
Production from 5,000 hours **B**	2,657 Ltrs. (5,000/21,261×11,300)	3,457 Ltrs. (5,000/21,261×14,700)	11,038 Ltrs. (5,000÷0.453)	9,381 Ltrs. (5,000÷0.533)
Contribution margin **(A×B)**		**1,868,915** (2,657×235)+(3,457×360)	**2,450,436** (11,038×222)	**1,829,295** (9,381×195)
Fixed overheads:				
Depreciation per month (20,000-1,400)÷20÷12		(77,500)		
(25,000-2,800)÷20÷12			(92,500)	(92,500)
Additional fixed overheads per month		(250,000)	(500,000)	(500,000)
Net profit per month		**1,541,415**	**1,857,936**	**1,236,795**

Recommendations: As refining of Alpha produces the highest profit, ZCL should install refining plant to refine and sell 11,038 liters of Alpha.

- *Example 11:*

Binary Ltd. (BL) manufactures three products, A, B and C. It is the policy of the company to apportion the joint costs on the basis of estimated sales value at split off point. BL incurred the following joint costs during the month of August 20X3:

	Rs. in '000
Direct material	16,000
Direct labour	3,200
Overheads (including depreciation)	2,200
Total joint costs	21,400

During the month of August 20X3 the production and sales of Product A, B and C were 12,000, 16,000 and 20,000 units respectively. Their average selling prices were Rs. 1,200, Rs. 1,400 and Rs. 1,850 per unit respectively.

In August 20X3, processing costs incurred on Product A after the split off point amounted to Rs. 1,900,000.

Product B and C are sold after being packed on a specialized machine. The packing material costs Rs. 40 per square foot and each unit requires the following:

Product	**Square feet**
B	4.00
C	7.50

The monthly operating costs associated with the packing machine are as follows:

	Rupees
Depreciation	480,000
Labour	720,000
Other costs	660,000

All the above costs are fixed and are apportioned on the basis of packing material consumption in square feet.

a) The joint costs to be apportioned to each product, would be calculated as follows:

Total joints costs as given in the question	Rs. 21,400,000

	Joint Costs (Rs.)
Product A:	
Rs. 12,500,000 **(W-1)** / Rs. 61,480,000 **(W-1)** x Rs. 21,400,000	4,351,008
Product B:	
Rs. 19,283,738 **(W-1)** / Rs. 61,480,000 **(W-1)** x Rs. 21,400,000	6,712,297
Product C:	
Rs. 29,696,262 **(W-1)** / Rs. 61,480,000 **(W-1)** x Rs. 21,400,000	10,336,695
	21,400,000

W-1 : Computation of sales value at split off point	Product A	Product B	Product C	Total
	Rs.	Rs.	Rs.	
Sales value				
Rs. 1,200 x 12,000	14,400,000			
Rs. 1,400 x 16,000		22,400,000		
Rs. 1,850 x 20,000			37,000,000	
Less:				
Further processing costs – A	(1,900,000)			
Packing costs - Fixed **B:** Rs. 1,860,000 (W2)×64,000 ÷ 214,000 (W3) **C:** Rs. 1,860,000 (W2)×150,000 ÷ 214,000 (W3)		(556,262)	(1,303,738)	
Packing costs – Variable **B:** 64,000 x Rs. 40 **C:** 150,000 x Rs. 40		(2,560,000)	(6,000,000)	
Estimated sales value at split off point	**12,500,000**	**19,283,738**	**29,696,262**	**61,480,000**

W-2: Fixed costs relating to packing machine = 480,000 + 720,000 + 660,000 = Rs. 1,860,000

W-3: Total Volume in Square Feet

Product	Square Feet per Unit	Units produced	Total Volume
B	4.00	16,000	64,000
C	7.50	20,000	150,000
			214,000

a) BL has received an offer from another company to purchase the total output of Product B without packaging, at Rs. 1,200 per unit. Determine the viability of this offer.

To sell Product B without packaging for Rs. 1,200 per unit, following calculations would be required:

	Packaged (Rs.)	Unpackaged (Rs.)
Selling price per unit	1400	1,200
Less: Variable cost of packing (Rs.40 x 4)	160	-
Contribution margin	1,240	1,200

Conclusion: Since the alternative option has a lower contribution margin, the decision should be to continue to sell Product B with packaging at Rs. 1,400 per unit

- *Example 12:*

Cappuccino Limited (CL), incorporated in January 2018, is engaged in manufacturing and marketing of two types of products, S1 and S2. Due to strict quality standards at CL, the ratio of damaged goods is high. Damaged units of S1 can only be identified at 100% completion whereas damaged units of S2 can be identified at 60% completion. Damaged units of S1 and S2 can be sold at 80% and 50% of market prices respectively.

CL's production department believes that damaged units can be sold at full market price after incurring per unit rectification costs of Rs. 150 and Rs. 450 on S1 and S2 respectively. Additional information:

- Following information has been extracted from CL's latest records:

	S1	S2
	Units	
No. of units sold	347,000	218,000
Closing inventory	47,000	34,000
	Rupees in '000	
Sales	492,800	463,760
Cost of goods manufactured	431,430	349,370
Closing inventory	(51,465)	(48,287)
Cost of goods sold	379,965	301,083
Gross profit	112,835	162,677

- Closing inventory includes units of S1 and S2 damaged during the year i.e. 15,000 and 22,500 units respectively.
- Fixed costs are incurred at the beginning of period and variable costs are incurred throughout the manufacturing process.
- Cost of goods manufactured includes fixed cost of Rs. 80 million which is allocated on the basis of total units produced.
- Selling expenses during the period was 1% of sales.

a) Whether CL should sell damaged units of each product with or without further processing, is calculated as under.

Conclusion

	Without further processing		With further processing	
	S1	S2	S1	S2
Sales price [Sales/Quantity]	1,136 (1,420×80%)	1,064 (2,127×50%)	1,420 (492,000/347)	2,127 (463,760/218)
Costs:				
Fixed cost (Irrelevant)	-	-	-	-
Variable cost (W-1)	971	786	971	1,309
Further processing costs (given)	-	-	150	450
Selling Expense (1% of sales price)	11	11	14	21
Cost of goods sold	(982)	(797)	(1,135)	(1,780)
Profit	154	267	285	347

Sell S1 after further processing

Sell S2 after further processing

b) Determination of value of damaged units of S1 and S2 included in the closing inventories, under each of the following situations:

– If CL opts for further processing

– If CL does not opt for further processing

	Without further processing		With further processing	
	S1	S2	S1	S2
Without further processing				
NRV [Sales price less selling costs] A	1,125	1,053	1,256	1,656
Costs [Variable +Fixed costs] B	1,095	910	1,095	1,433
Lower of costs or NRV	**1,095**	**910**	**1,095**	**1,433**
Value of damaged units	16,425,000	20,475,000	16,425,000	32,242,500
Adjustments requirement in the books	No	No	No	No

W-1 Variable cost per unit	S1	S2
	Rupees in '000	
Total costs (given)	431,430	349,370
Fixed cost (W-2)	48,793	31,207
Variable cost (Total cost – Fixed cost)	382,637	318,163
No. of units manufactured (W-3)	394	243
Variable cost per unit (382,637÷394, 318,163÷243)	971	1,|309

W-2 Fixed cost per unit	S1	S2	Total
		Rupees in '000	
Fixed costs (given)			80,000
No. of units produced (W-3)	394	252	646
Fixed cost per unit (80,000÷646)			124
Allocated fixed cost (394÷646×80,000, 252÷646×80,000)	48,793	31,207	

W-3 No. of completed units manufactured	S1	S2
No. of units sold [given	347,000	218,000
Closing stock [given]	47,000	34,000
No. of completed units manufactured [including damaged units]	394,000	252,000
Damaged stock [Damaged × 1 – Completion]	-	(9,000)
No. of completed units manufactured [excluding damaged goods]	394,000	243,000

▶ *Example 13:*

DEL Limited manufactures radiators for car manufacturers. In normal operations, about 200,000 units are sold per annum at an average selling price of Rs. 15,000 per unit. Manufacturing process is carried out by 500 highly skilled labours who work an average of 180 hours per month at Rs. 250 per hour. Raw material cost is Rs. 3,000 per unit. Annual factory overheads are estimated at Rs. 540 million. Variable overheads are 150% of labour cost.

DEL had received an offer from TRU Limited to manufacture 4,000 units of radiators of trucks, at Rs. 50,000 per unit. DEL had expected to earn significantly high margin on this order and had planned to stop normal production for this purpose. It had already procured the raw material for Rs. 60 million but before the start of manufacturing it came to know that TRU has gone into liquidation.

To deal with the situation, DEL's marketing department has negotiated with another truck manufacturer, NTR Limited. NTR's specifications are slightly different and the price offered by NTR is Rs. 40,000 per unit.

The costs to be incurred on the new order and other relevant details are as follows:

1. Additional raw material of Rs. 12 million would have to be purchased for NTR's order.
2. DEL expects that first unit would take 10 hours. The labour time would be subject to a 95% learning rate upto 1,000 units. Thereafter, the learning rate would stop. The index of 95% learning curve is -0.074.
3. Variable overheads would be 240% of the cost of labour.
4. Fixed overheads are to be applied at Rs. 400 per labour hour.
5. Total cost of preparing the plant for NTR's order and resetting it to the normal production would be Rs. 4 million.

If the order from NTR is not accepted, raw materials of Rs. 60 million already procured would have to be sold at 70% of their cost. However, raw material worth Rs. 10 million can be utilized in the car's radiators after slight alteration at a cost of Rs. 1 million. The altered raw material can produce 30% components of 10,000 car radiators.

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Whether DEL may accept the order from NTR would require following calculations:

DEL Limited		
Acceptance of order from NTR Limited for truck radiators		**Rs. in million**
Revenue from NTR Limited	40,000×4,000	160.00
Additional raw material		(12.00)
Raw material already procured – sales value	(60-10)×70%	(35.00)
– use value for truck radiators	(10,000×3,000×30%)-1	(8.00)
Labour cost	[22,647.91 **(W-1)**×250]	(5.66)
Variable overheads	(5.66×240%)	(13.58)
Preparation and resetting cost of the plant		(4.00)
Fixed overheads applied	**To be ignored**	-
		81.76
Loss of CM for not producing car radiators	4,194 **(W-2)** ×8,625 **(W-3)**	(36.17)
Profit on acceptance of the order from NTR		**45.59**
Conclusion: DEL should accept the order from NTR Limited		
W-1: Direct labour hours for production of truck radiators		**Hours**
Direct labour hours for 1,000 units	$[1{,}000\times10\times(1{,}000)^{-0.074}]$	5,997.91
Direct labour hours for 999 units	$[999\times10\times(999)^{-0.074}]$	(5,992.36)
Hours per unit for 1,001 and onward		**5.55**
Direct labour hours for first 1,000 units		5,997.91
Direct labour hours for next 3,000 units	(5.55×3,000)	16,650.00
		22,647.91
W-2: No. of Car radiators to be produced if NTR's order is not accepted		
Labour hours per unit of car radiator	(500×180×12)÷200,000 **Hrs.**	5.40
No. of car radiators to be produced	22,647.91 **(W-1)** ÷ 5.40 **Nos.**	**4,194**
W-3: Contribution margin per unit/hour for car radiators		**Rupees**
Selling price		15,000
Raw material cost		(3,000)
Labour cost	(500×180×250×12)÷200,000	(1,350)
Variable overheads	150%×1,350	(2,025)
Contribution margin per unit		**8,625**

▶ *Example 14:*

In May 2015, the board of directors of Sahil Limited (SL) had decided to close one of SL's operating segments at the end of the next year. The sales and production for the next year were budgeted at 50,000 units and on the basis thereof, the budget of the segment for the next year was approved as follows:

	Rs. in '000
Sales	5,000
Direct material (50,000 kg)	(950)
Direct labour	(1,000)
Variable production overheads	(500)
Fixed production overheads	(1,750)
Administrative and selling overheads	(500)
Budgeted net profit	300

However, rumors of the closure prompted majority of the segment's skilled labour to leave the company. Consequently, the management is considering the following alternatives to cope with the issue:

- Close the segment immediately and rent the factory space for one year at a rent of Rs. 40,000 per month; or
- Employ contract labour which would be able to produce a maximum of 40,000 units in the year. The quality of the product is however expected to suffer due to this change.

The following further information is available:

1. The sales manager estimates that a sales volume of 30,000 units could be achieved at the current selling price whereas sales volume of 40,000 units would only be achieved if the price was reduced to Rs. 90 per unit.
2. 25,000 kg of raw material is in stock. Any quantity of the material may be sold in the market at a price of Rs. 19 per kg after incurring a cost of Rs. 2 per kg. Up to 15,000 kg can be used in another segment of the company in place of a material which currently costs Rs. 18 per kg.
3. Wages of contract labour would be Rs. 24 per unit. SL would also be required to spend Rs. 40,000 on the training of the contract labour.
4. Due to utilization of contract labour, variable production overheads per unit are expected to increase by 20%.
5. Fixed production overheads include:
   - Depreciation of three machines used in the segment amounting to Rs. 170,000. These machines originally costed Rs. 1.7 million and could currently be sold for Rs. 830,000. If the machines are used for production in the next year, their sales value would reduce by Rs. 5 per unit of production.
   - All other costs included in 'fixed production overheads' represent apportionments of general overheads.
6. 40% of administrative and selling overheads are variable whereas the remaining amounts represent apportionment of general overheads.

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In advising the best course of action for Sahil Limited, please see below:

	Available options		
	Immediate closure and renting of factory bldg.	Operation using contract labour	
		To produce 30,000 units	To produce 40,000 units
	------------- Rupees -------------		
Incremental savings			
Sales (30,000×100), 40,000×90)		3,000,000	3,600,000
Rental income (40,000×12)	480,000		
Proceeds from sale of machine (830,000-30,000×5), (830,000-40,000×5)	830,000	680,000	630,000
Direct material - Use for other segment (15,000×18)	270,000	-	-
Direct material - sale externally [10,000×(19-2)]	170,000	-	-
Fixed production overheads; apportionment of general overheads (1,750-170= 1580)	-	-	-
Fixed admin and selling overheads; apportionment of general overheads (500×60%=300)	-	-	-
Incremental costs			
Purchase of direct material (5,000×19), (15,000×19)	-	(95,000)	(285,000)
Training of contract labour	-	(40,000)	(40,000)
Contract labour cost (30,000×24), (40,000×24)	-	(720,000)	(960,000)
Variable production overhead (500÷50×1.2×30,000),(500÷50×1.2×40,000)	-	(360,000)	(480,000)
Variable admin. & selling overheads: [(500×40%)÷50×30], [(500×40%)÷50×40]	-	(120,000)	(160,000)
Net savings	**1,750,000**	**2,345,000**	**2,305,000**

Conclusion: Since the highest savings occur with a production level of 30,000 units, SL should operate the segment at this level of activity.

- *Example 15:*

Sarwar Limited (SL) manufactures two industrial products i.e. K2 and K9. It also manufactures other products in accordance with the specification of customers. SL's products require specialized skilled labour. Maximum labour hours available with the company are 300,000 per month.

Following information has been extracted from SL's budget:

	K2	K9
	---- Rs. per unit ----	
Selling price	16,500	26,000
Direct material	6,000	8,000
Direct labour (Rs. 300 per hour)	4,500	7,500
Variable production overheads (based on labour hours)	1,875	3,125
Applied fixed production overheads (based on labour hours)	1,500	2,500
Monthly demand (Units)	5,000	8,000

An overseas customer has offered to purchase 3,000 units of a customized industrial product 'A-1' at a price of Rs. 35,000 each. The duration of contract would be one month.

The cost department has ascertained the following facts in respect of the contract:

i. Each unit of A-1 would require 3 units of raw material B-1 and 2 units of raw material C-3. B-1 is available in the local market at Rs. 2,500 per unit. However, the required quantity of C-3 is not available in the local market and would be imported from Srilanka at a landed cost of Rs. 2.4 million.

ii. Each unit of A-1 would require 35 labour hours.

iii. A specialized machinery would be hired for five days. However, due to certain production scheduling issues, it is difficult for SL to exactly predict when the machine would be required.

As a result of negotiations, SL has received the following offers:

Falah Modarba has quoted a rent of Rs. 0.9 million for the entire month. If accepted, SL would be able to sublet the machine at Rs. 20,000 per day.

Tech Rentals has quoted a rent of Rs. 57,000 per day and guaranteed availability of machinery when required.

The management believes that it can increase/decrease the production of K2 and K9, if required.

The maximum profit that can be earned by SL, in the above situation can be determined as below:

		K2	K9	A-1
		------------------- Rs. per unit -------------------		
Selling price	Given	16,500.00	26,000.00	35,000.00
Variable cost		12,375.00 (6,000+4,500+1,875)	18,625.00 (8,000+7,500+3,125)	23,270.00 (W-1)
Contribution per unit	A	4,125.00	7,375.00	11,730.00
Labour hours required per unit B		15 (4,500/300)	25 (7,500/300)	35 Given
CM per labour hour (Rs.) A/B		275.00	295.00	335.14
Ranking		3	2	1
Allocation of 300,000 hours	C		195,000 (300,000–105,000)	105,000 (35×3,000)
Units to be produced	C/B		7,800.00	3,000.00

Contribution margin for the month after accepting special contract		Rs. in million
A-1	(3,000×11,730) 35.19 K-9 (7,800×7,375)	57.53
Contribution margin		92.72
Fixed cost	(1,500/15)×300,000	30.00
Maximum profit		**62.72**

W-1: Relevant cost for A-1	Rs. per unit
Material cost - B1 (3×2,500)	7,500.00
Material cost - C3 (2,400,000/3,000)	800.00
Labour cost (35×300)	10,500.00
Variable overheads [{1875÷(4,500÷300)}×35]	4,375.00
Machine hire cost [Lower of (57,000×5) and {900,000–(20,000×25)}]/3,000	95.00
Variable cost per unit of A-1	**23,270.00**

▶ *Example 16:*

Ideal Chemicals (IC) blends and markets various cleaning chemicals. Presently, IC's plant is working at 70% capacity. To utilize its idle capacity, IC is planning to acquire rights to produce and market a new brand of chemical namely Z-13 on payment of fee of Rs. 160,000 per month.

In this respect, the relevant information is summarized as under:

i. Z-13 would be produced using the existing plant whose cost is Rs. 81 million. Processing would be carried out in batches of 2,000 liters of raw-materials.

   Production costs per batch are estimated as under:

Raw material: Imported	1,200 liters	@ Rs. 1,500 per liter
Local	800 liters	@ Rs. 900 per liter
Direct labour	4,000 hours	@ Rs. 165 per hour
Variable production overheads		@ Rs. 120 per direct labour hour

   1,700 liters of Z-13 is produced from each batch. 100 liters are lost by way of evaporation whereas 200 liters of input is converted into solid waste. The approximate weight of the solid waste is 225 kg per batch.

ii. Net volume of each bottle of Z-13 would be 1.25 liters.

iii. The solid waste would be refined to produce a by-product, polishing wax. Refining would cause an estimated loss of 2% of by-product output.

iv. Cost of refining and sales price of wax would be Rs. 250 and Rs. 400 per kg respectively. Net sales revenue (sales less refining cost) from sale of wax is to be deducted from the cost of the main product.

v. Variable selling overheads are estimated at Rs. 175 per unit.

vi. The plant is depreciated at 10% per annum. It is estimated that production of Z-13 would utilize 20% capacity of the plant.

vii. To introduce Z-13, IC plans to launch a sales campaign at an estimated cost of Rs. 3.5 million.

viii. IC wishes to sell Z-13 at a contribution margin of 40% on sales.

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In determining Z-13's sale price per unit and annual units to be sold, if IC intends to earn an incremental profit before tax of Rs. 10 million from its sale; please see below:

Ideal Chemicals		Units
Finished units per batch	1,700÷1.25 **(A)**	**1,360**
By-product units per batch	225÷1.02	**221**

Variable production cost per unit:		Rupees
Material: Imports	1,200×1,500	1,800,000
Local	800×900	720,000
Direct labour	4,000×165	660,000
Variable production overheads	4,000×120	480,000
Net sales revenue from sale of by-product	221×(400–250)	(33,150)
	(B)	**3,626,850**
Variable production cost per unit	**(B÷A)**	2,666.80
Variable selling overheads per unit		175.00
Variable cost per unit	**(C)**	**2,841.80**
Sales price per unit to earn 40% contribution on sale	**D=(C÷0.6)**	**4,736.33**

No. of sale units to earn annual profit before tax of Rs. 10,000,000		
Incremental fixed overheads and profit:		
- Fee for blending and marketing of Z-13	160,000×12	1,920,000
- Sales promotion expenses		3,500,000
- Required incremental profit before tax		10,000,000
	(E)	**15,420,000**
Required annual sales units	**No. of units E÷ (D-C)**	**8,139**

- *Example 17:*

Jasmine Limited (JL) manufactures various products according to customers' specifications. In March 2019, JL is required to submit a tender for supply of 5,000 plastic bodies of a washing machine. In this respect, following information has been gathered:

i. The production would be carried out on JL's plant at its Sialkot factory. Cost of the plant is Rs. 3,600,000. Its estimated useful life is 96,000 hours. Each plastic body (unit) would require 2 machine hours.

ii. Production would be carried out in ten batches of 500 units each. Cost per unit for the first batch has been estimated as under:

		Rupees
Direct material	2 kg	150
Direct Labour	3 labour hours	300
****Overheads (based on direct labour hours):***		
Variable overheads		240
Fixed overheads		360
****Overheads do not include depreciation of the plant***		

AT A GLANCE SPOTLIGHT STICKY NOTES

iii. Direct material consumption would reduce by 5% in each subsequent batch up to the third batch and would become constant thereafter.

iv. Applicable learning curve effect is 95% but it will remain effective for the first six batches only. The index of 95% learning curve is –0.074.

The bid amount that JL should quote to earn 30% contribution margin, would be calculated as follows:

		Rs. in '000
Direct material cost:		
For first 3 batches	$75{,}000 + (75{,}000\times0.95) + [75{,}000\times(0.95)^2]$	214
For last 7 batches	$75{,}000\times(0.95)^2\times7$	474
	A	**688**
Direct labour cost:		
For first 6 batches	**(W-1)** 7,882×100	788
For last 4 batches	**(W-1)** 1,224×4×100	490
	B	**1,278**
Overheads		
Variable overheads based on direct labour hours	240÷3×1278	1,022
Variable overheads based on machine hours (molding plant depreciation)	3,600÷96,000×(5,000×2)	375
		1,397
Fixed overheads		-
	C	**1,397**
Bid amount to earn 30% contribution margin	(A+B+C)÷0.7	**4,804**

W-1: Direct labour hours at 95% learning curve		**Hours**
For the first 6 batches	$6\times(500 \text{ units} \times 3 \text{ hours})\times(6)^{-0.074}$	7,882
For the first 5 batches	$5\times(500 \text{ units} \times 3 \text{ hours})\times(5)^{-0.074}$	(6,658)
For the 7th. batch and onwards		**1,224**

▶ *Example 18:*

Pizza Inc. has pizza outlets in all major shopping malls in the city. It prepares and sells approximately 4,850 standard pizzas per week. A premium quality imported cheese (cheese), the key ingredient for pizza preparation is purchased from a supplier at Rs. 1,200 per kg. Other costs related to cheese are as follows:

	Rupees
Administration cost per order	150,000
Transportation cost per order	22,500
Quality inspection cost per order	20,000
Refrigeration cost per kg	250
Warehouse cost per annum	4,420,000
Cost of financing the stock per month	1.5%

Other information:

(i) The company places orders on the basis of Economic Order Quantity (EOQ).

(ii) Each standard size pizza requires 0.25 kg of cheese. However, 3% of cheese is lost in refrigeration.

(iii) 80% of administration cost and 50% of warehouse cost are variable. All other costs are fixed.

(iv) The company operates throughout the year which is 52 weeks.

The supplier has offered to reduce 5% price if the company agrees to double the size of order for the coming year. However, it would have following implications:

(i) 4% of cheese would be lost in refrigeration.

(ii) Variable cost of warehouse, transportation cost and inspection cost would increase by 50%.

(iii) Refrigeration cost would increase by 75%. Required: Advise whether Pizza Inc. should accept offer of the supplier.

In order to measure whether Pizza Inc. should accept the offer or not, it is based on following calculation.

For determining EOQ and warehouse cost:

Ordering cost = Carrying cost

Annual demand/EOQ × Per order cost = [250+216+{(4,420,000×0.5)/(EOQ/2)}] × EOQ/2

65,000/x × 162,500 = [250+216+{(4,420,000×0.5)/(x/2)}] × x/2

10,562,500,000/x = 233x + 2,210,000

10,562,500,000 = 233x2 + 2,210,000x

233x2 + 2,210,000x – 10,562,500,000 = 0

By using quadratic equation: x = 3,493 unit

	Existing	Proposed
Number of orders	19 (65,000/3,493)	10 **W-4**
Purchase cost	78,000,000 (65,000w-1x1,200)	74,871,875 (65,677w-4x1,200x0.95)
Ordering cost	3,087,500 (162,500w-2x19)	1,837,500 (187,500w-5x10)
Holding cost	3,023,192 (3,493/2×1,731(W-3))	5,560,856 (6,986/2×1,592(W-6))
	84,110,692	**82,270,231**

Conclusion:

The company should accept the offer of supplier as it would save Rs. 1,840,461

W-1	**Rupees**
Annual Demand [(4,850×0.25×52)/0.97]	65,000
W-2 Ordering cost per order	**Rupees**
- Administration cost (150,000×0.8)	120,000
- Transportation cost	22,500
- Quality inspection cost	20,000
	162,500
W-3 Carrying cRost per unit	**Rupees**
- Refrigeration cost	250
- Financing cost (1,200×0.015×12)	216
- Warehouse cost [(4,420,000×0.5)/(3,493/2)]	1,265
	1,731
W-4 Number of orders	**Rupees**
Annual demand [(65,000×0.97)/0.96]	65,677
Order size (3,493×2)	6,986
Number of orders	10
W-5 Ordering cost per order	**Rupees**
- Administration cost	150,000
- Transportation cost (22,500×1.5)	33,750
- Quality inspection cost (20,000×1.5)	30,000
	183,750
W-6 carrying cost per kg	**Rupees**
- Refrigeration cost (250×1.75)	438
- Financing cost (1,200×0.95×0.015×12)	205
- Warehouse cost [(4,420,000×0.5)/(6,986/2)] × 1.5	949
	1,592

▶ *Example 19:*

Siyab Limited (SL) is involved in manufacturing and exporting of products BA, CA and DA. Keeping in view the continuous operating losses in product BA, the management is considering to discontinue the production of BA. Summarised operating results of BA for the year 2019 are as follows:

Units sold (2018: 156,250 units)	150,000
	Rs. In 000
Sales revenue	30,000
Raw material consumption	(12,000)
Labour	(6,000)
Variable manufacturing overheads	(3,000)
Fixed manufacturing overheads:	
Directly attributable	(2,800)
Allocated (30% of total)	(750)
Selling expenses (2018: Rs. 8,050,000)	(7,800)
Operating loss	(2,350)

Chief Financial Officer (CFO) is of the view that discontinuance of BA would save all manufacturing and selling expenses except allocated fixed manufacturing overheads. It is estimated that total allocated fixed manufacturing overheads will be reduced by 10%.

In a recent management meeting, SL's sales director does not agree with the suggestion to discontinue this product. She is of the view that BA is in high demand in the local market and the management should consider to launch this product in the local market through an online marketplace, Jamal Express (JE). She argues that this will not only minimize the selling expenses but also allow SL to reach maximum customers.

Following information have been available in respect of launching an online store of BA at JE:

(i) Existing production capacity of BA is 172,000 units.

(ii) Existing demand of BA in the online market is sufficient to boost sales by 10% from the previous year. However, for achieving this target level of sales, a digital marketing service provider would be hired at an annual cost of Rs. 800,000.

(iii) BA would be sold at Rs. 180 per unit.

(iv) SL would have to pay an annual subscription fee of Rs. 110,000 to JE to operate as a seller. In addition, JE would charge 2% sales commission.

(v) JE also provides an additional facility of handling delivery and sales return to its clients. This service can be availed by paying either an annual lump sum fee of Rs. 1,500,000 or an additional commission of 5% of the selling price. If this service is availed, entire fixed selling expenses will be saved.

(vi) Fixed and variable selling expenses pertaining to BA would be reduced by 10% and 80% respectively.

(vii) Additional support staff would be hired at a cost of Rs 200,000 per month. This additional hiring cost can be reduced to 80% if existing staff is given additional responsibilities with overtime payment which would increase variable selling expense by 10%.

Evaluation of suggestions of CFO and sales director and recommend the best course of action to the management, is given below.

Optional 1: Discontinue BA	**Rupees**
Contribution forgone (20(W-1)×150,000)	3,000,000
Savings from discontinuing BA	
Directly attributable fixed cost	2,800,000
Reduction in joint fixed overheads (750,000/0.3×0.1)	250,000
Fixed selling expenses W-1.1	1,800,000
	4,850,000
Net benefit from discontinuing BA	**1,850,000**

Optional 2: Online marketing	**Existing**	**Online**	**Incremental**
	---------------Rupees in thousand-------------		
Sales	30,000	29,700	(300)
Less: Commission 2%	-	(594)	(594)
Less: Additional commission 5% W-2	-	(1,485)	(1,485)
Net sales	30,000	27,621	(2,379)
Less: raw materials	(12,000)	(13,200)	(1,200)
Less: Labour	(6,000)	(6,600)	(600)
Less: variable overheads	(3,000)	(3,300)	(300)
Less: variable selling overhead	(6,000)	(1,320)	4,680
Less: increase in variable selling overheads W-3	-	(132)	(132)
CM	**3,000**	**3,069**	**69**

	Existing	Online	Incremental
	---------------Rupees in thousand-------------		
Less: Fixed overheads:			
-Directly attributable	(2,800)	(2,800)	-
-Allocated	(750)	(750)	-
Less: selling expense	(1,800)	-	1,800
Less: digital marketing cost	-	(800)	(800)
Less: annual subscription	-	(110)	(110)
Less: Additional support staff W-3	-	(1,920)	(1,920)
Operating loss	**(2,350)**	**(3,311)**	**(961)**

Conclusion:

The benefit of discounting BA is Rs. 2,811,000 as compared to the option of selling through an online market place. Hence the management should discontinue production of BA.

W-1	**Rupees**
Sales (30,000/150)	200
Less: Variable costs	
Raw material (12,000/150)	80
Labour (6,000/150)	40
Variable overheads (3,000/150)	20
Variable selling expense (W-1.1)	40
	180
CM per unit	**20**

W-1.1	**2018**	**2018**	**Difference**
Units sold	156,250	150,000	6,250
Selling expense Rs.	8,050,000	7,800,000	250.000
Variable selling expense per unit (250,000/ 6,250)			**40**
Fixed selling expense [7,800,000- (40 x 150,000)]			**1,800,000**

W-2	**Rupees**
Lump sum fee	1,500,000
Commission @ 5% (lowest) (180×150,000×1.1×5%)	1,485,000
Fixed selling expense (1,800,000×0.9)	1,620,000

W-3	**Rupees**
Option 1: Additional support staff (200,000×12)	2,400,000
Option 2: Combination of additional staff and overtime to the exiting staff (lower)	
- Additional support staff reduced (2,400,000×0.8)	1,920,000
- Increase in variable selling expense (150,000×40×1.1×0.2×0.1)	132,000
	2,052,000

► *Example 20:*

Design Limited (DL) produces and markets two products viz. Olive and Mint. Following information is available from DL's records for the year ended 30 June 2013:

	Olive	Mint
Selling price per unit Rs.	760	550
Variable production cost per unit Rs.	520	430
Selling and distribution cost per unit Rs.	40	20
Fixed cost Rs.	4,400,000	5,200,000
Number of units produced and sold	120,000	150,000

The above sales volumes are based on the market demand for these products. DL is currently operating at 75% of the installed capacity. Time required for producing each unit of Olive and Mint is the same. In order to utilize the spare capacity of the plant, the marketing department has suggested the following options to the management:

Option 1: Introduce a single pack of both the products Olive and Mint. The price of the single pack would be 90% of the combined price of separate products. It would increase overall market demand for these products resulting in utilisation of full capacity. However, it is estimated that the sale of separate units of each product would reduce by 18%.

Option 2: To launch a new product Salsa at a price of Rs. 380 per unit. Salsa is estimated to have a demand of 80,000 units per annum and a unit variable cost equal to 40% of the variable cost of Olive. It would result in additional fixed costs of Rs. 3,200,000 per annum.

Evaluation of above options and advise the management about the most feasible option, is given below.

	Olive	Mint
Sales price Rs.	760	550
Less: Variable production cost per unit Rs.	(560)	(450)
Contribution margin per unit Rs.	200	100
Number of units produced and sold	120,000	150,000
Existing contribution margin (Rs. In 000)	**24,000**	**15,000**

Option 1: Additional profit from introduction of packaged products	**Units**
Quantity of packaged products:	
Reduction in sale of Olive [120,000 × 18%]	21,600
Reduction in sale of Mint [150,000 × 18%]	27,000
Under-utilization of existing capacity [(120,000 + 150,000)÷75%] –270,000	90,000
	138,600
Units of packaged products [138,600 ÷ 2]	69,300

	Rupees
Selling price per package (760 + 550) × 90%	1,179
Variable cost [560 + 450]	1,0,10
Contribution margin of packaged products	169
Contribution margin from sale of packaged products [69,300 × 169]	11,710,700
Less: Reduction in contribution margin [200 × 21,600] + [100 × 27,000]	(7,020,000)
	4,691,700
Option 2:	
Additional profit from Salsa	
Contribution margin from Salsa [380 × 80,000] – [560 × 40% × 80,000]	12,480,000
Less: Additional fixed cost	(3,200,000)
	9,280,000
Additional profit [9,280,000 – 4,691,700]	4,588,300

Decision:

The management should produce Salsa as it would result in an additional profit of Rs. 4,588,300 as compared to the introduction of a single pack of both the products.

STICKY NOTES

In profitability decisions, limiting factors refer to the circumstances in which in availability of production resources are scarce. Identifying the limiting factor will help meet the sale or profit demand with the available resources.

Often companies have to go through make or buy decisions that is decisions whether to make internally or to buy externally. These decisions involve relevant costs that is lower from a financial point of view.

Various non-financial considerations are involved in make or buy decisions which may involve control, employee redundancy as well as maintaining a competitive advantage of the company.