

Chapter 2

Cost Concepts and Behavior

Learning Objectives

- L.O. 1** Explain the basic concept of “cost.”
- L.O. 2** Explain how costs are presented in financial statements.
- L.O. 3** Explain the process of cost allocation.
- L.O. 4** Understand how material, labor, and overhead costs are added to a product at each stage of the production process.
- L.O. 5** Define basic cost behaviors, including fixed, variable, semivariable, and step costs.
- L.O. 6** Identify the components of a product’s costs.
- L.O. 7** Understand the distinction between financial and contribution margin income statements.

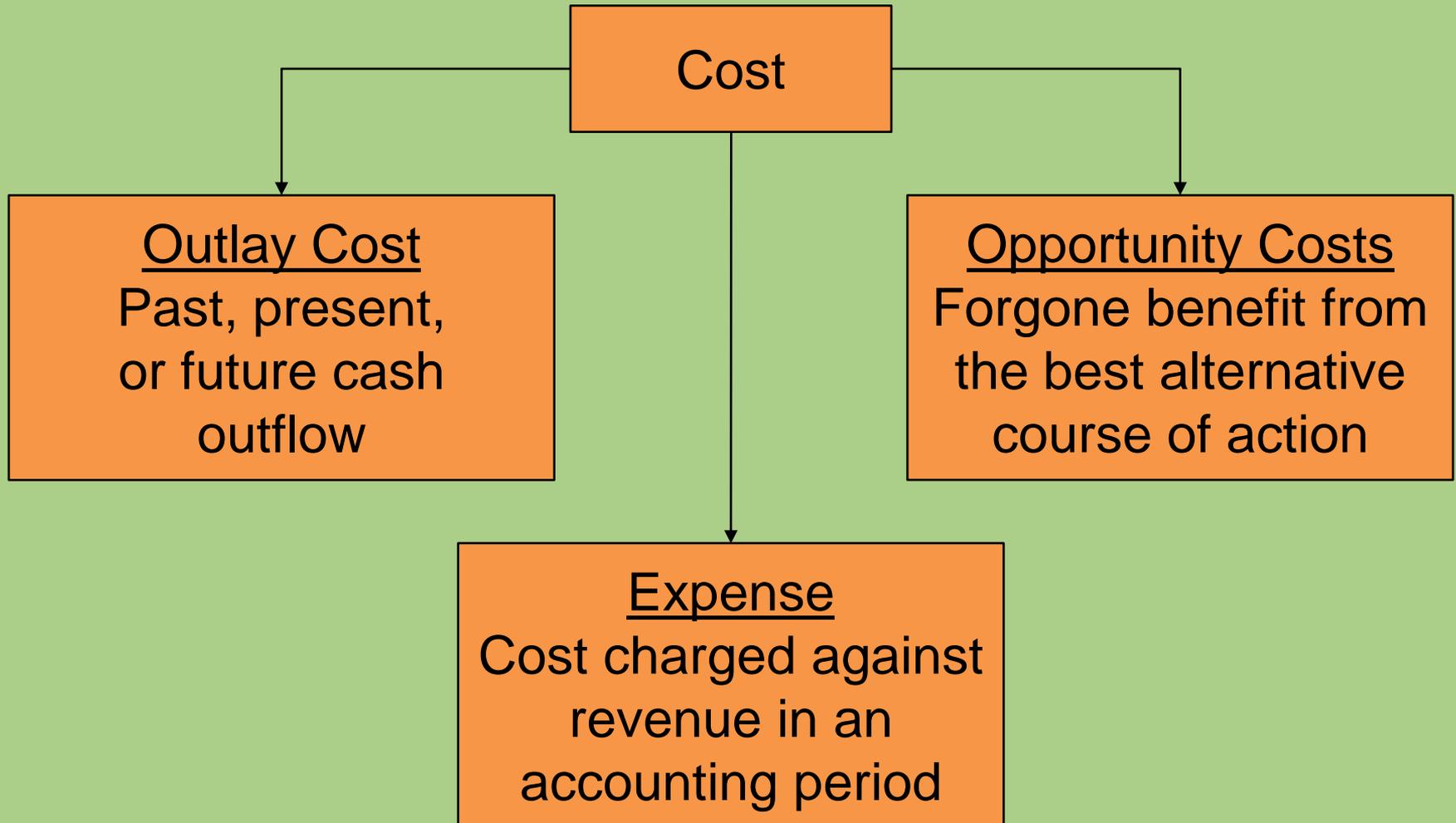
What is a Cost?

L.O. 1 Explain the basic concept of “cost.”

- Cost is a sacrifice of resources.



Cost versus Expenses



Presentation of Costs in Financial Statements

L.O. 2 Explain how costs are presented in financial statements.

Income Statements

Service company

Revenues	
– Cost of services sold	← Cost of billable hours
= Gross margin	
– Marketing and administrative costs	
= Operating profit	←

The excess of operating revenue over costs necessary to generate those revenues

Presentation of Costs in Financial Statements

Income Statements

Merchandising company

Revenues	
– Cost of goods sold	← Expense assigned to products sold during a period
= Gross margin	
– Marketing and administrative costs	
= Operating profit	←

The excess of operating revenue over costs necessary to generate those revenues

Presentation of Costs in Financial Statements

Cost incurred to manufacture
the product sold



Product costs recorded as
“inventory” when cost is incurred

Period costs recorded as
an expense in the period
the cost is incurred

Income Statements

Manufacturing company

Sales revenue

– Cost of goods sold

= Gross margin

– Marketing and
administrative costs

= Operating profit

Expensed
when sold

Product versus Period Costs

- Two types of manufacturing costs:

Product costs:
Costs related to
inventory

Period costs:
Non-manufacturing
costs related to the firm



Product versus Period Costs

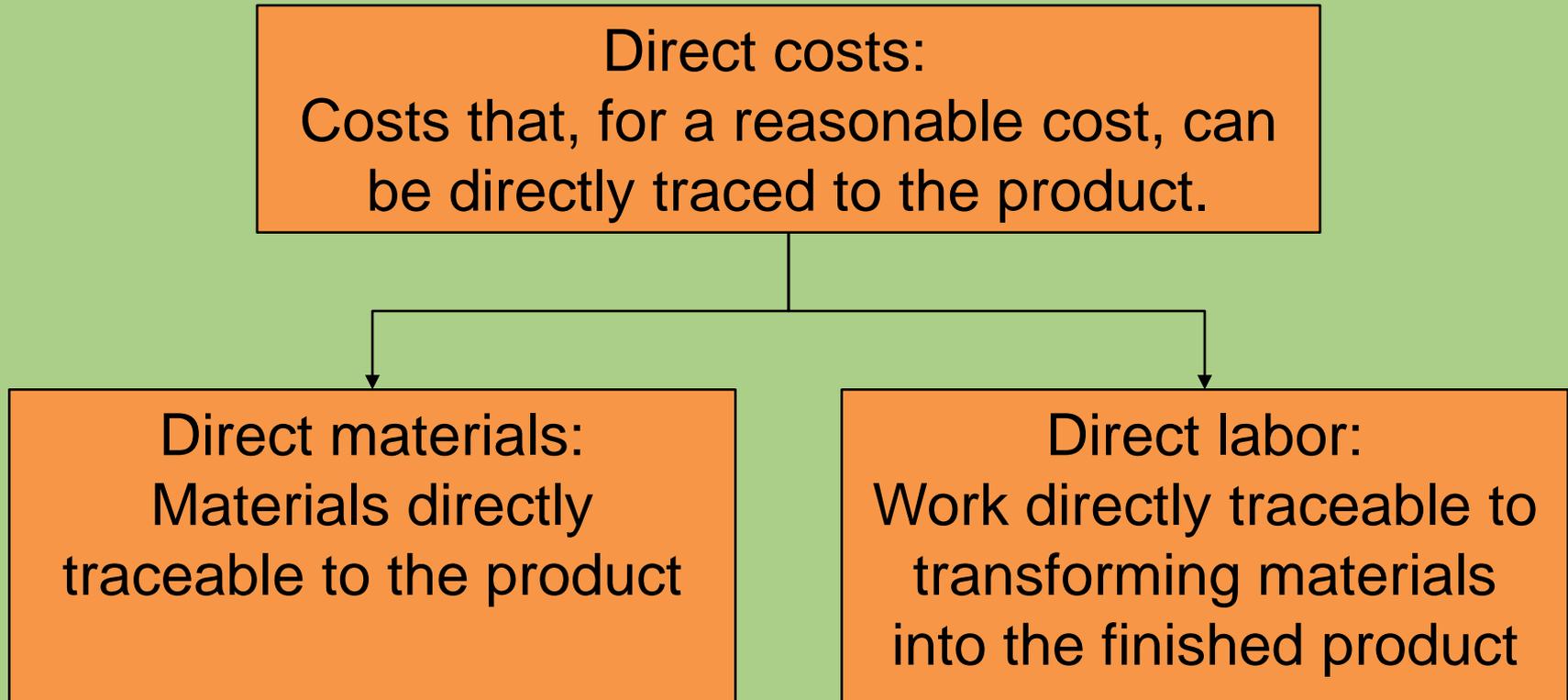
Product costs:

Costs that are recorded as an asset in inventory when incurred and expensed as Cost of Goods Sold when sold

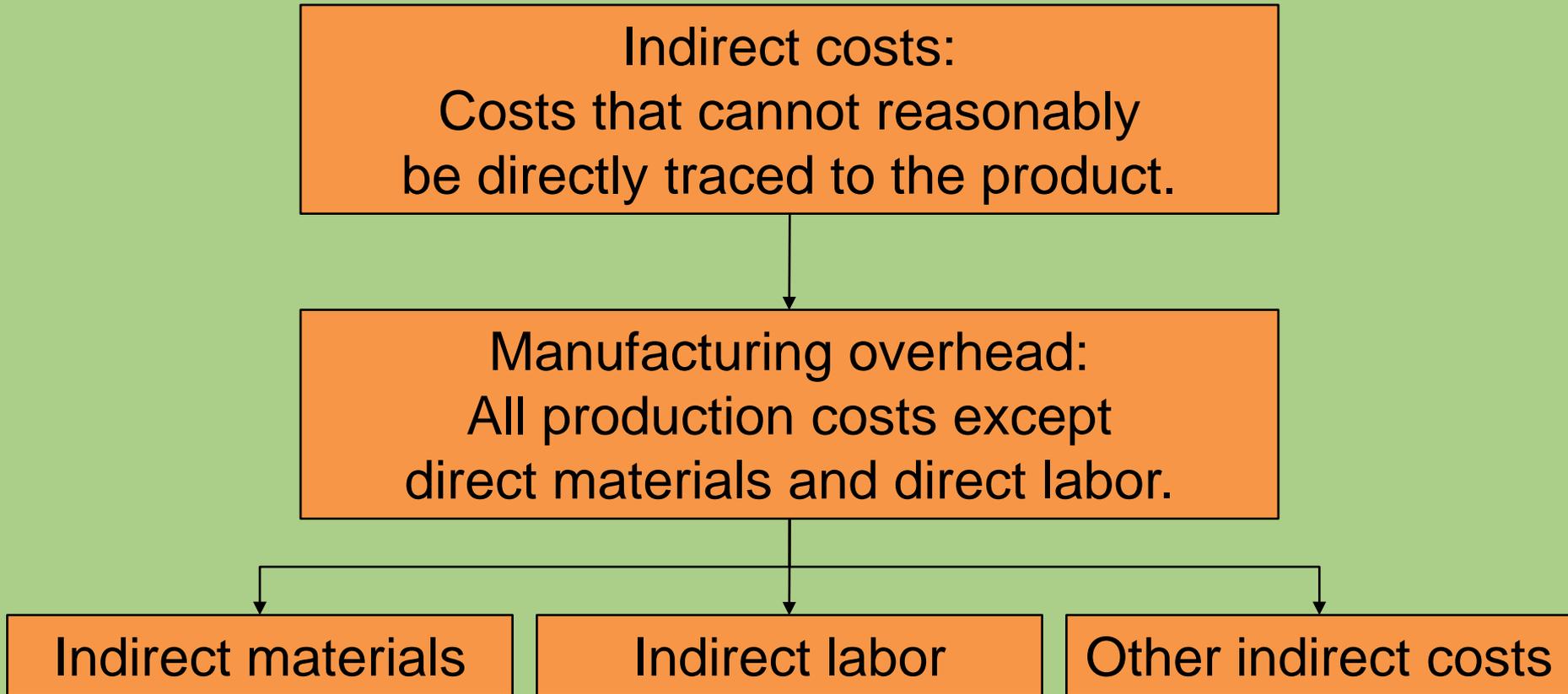
Period costs:

Costs recognized for financial reporting when incurred

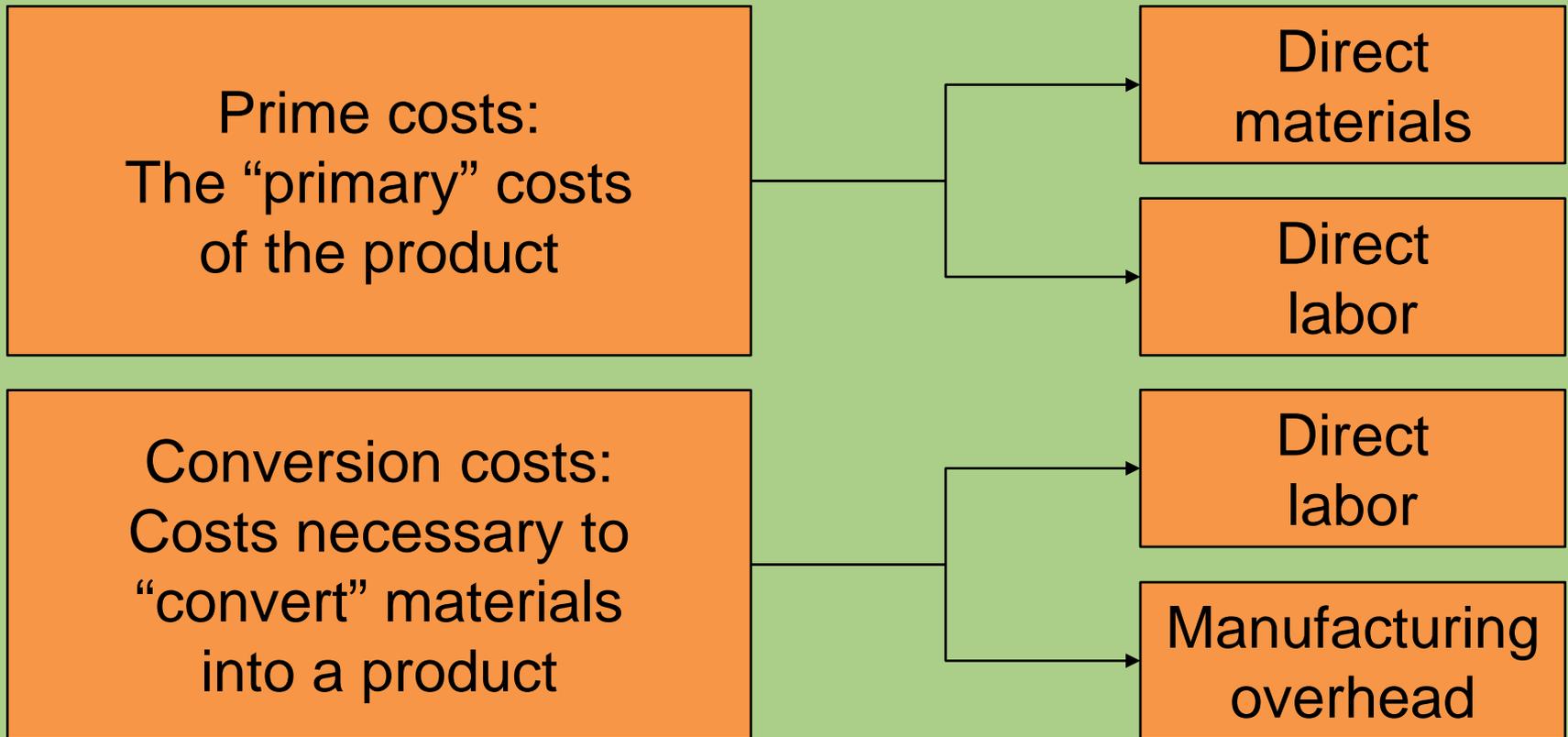
Direct and Indirect Manufacturing Costs



Direct and Indirect Manufacturing Costs

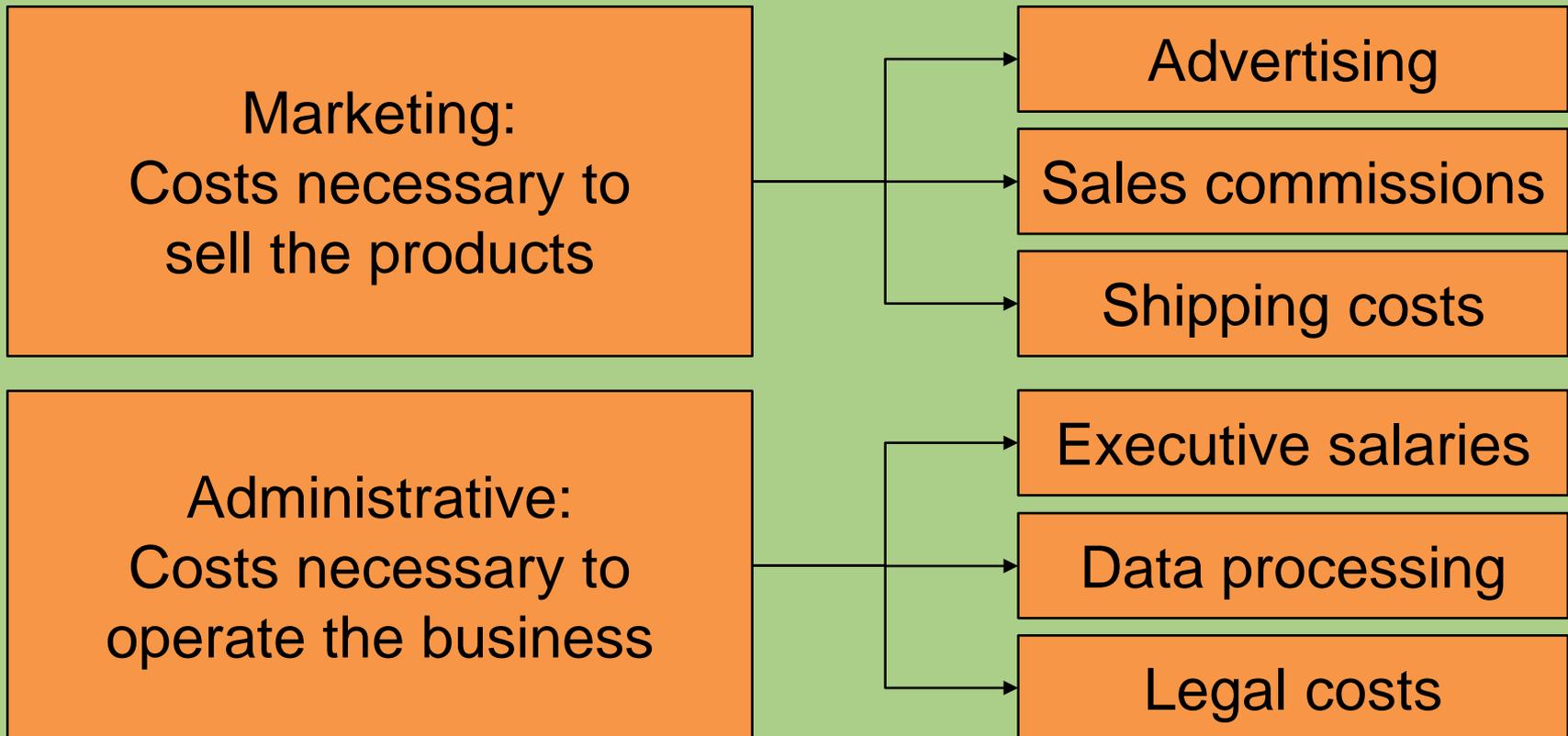


Prime Costs and Conversion Costs



Non-manufacturing Costs

- Recognized as expenses when the costs are incurred



Cost Allocation

L.O. 3 Explain the process of cost allocation.

- It is the process of assigning indirect costs to products, services, business units, etc.



Cost Allocation

1. Define the cost pool:
The collection of costs to be assigned to cost objects
2. Determine the cost allocation rule:
The method used to assign costs in the cost pool to cost objects
3. Assign the costs in the cost pool to the cost object:
Any end to which a cost is assigned – product, product line, department, customer, etc.

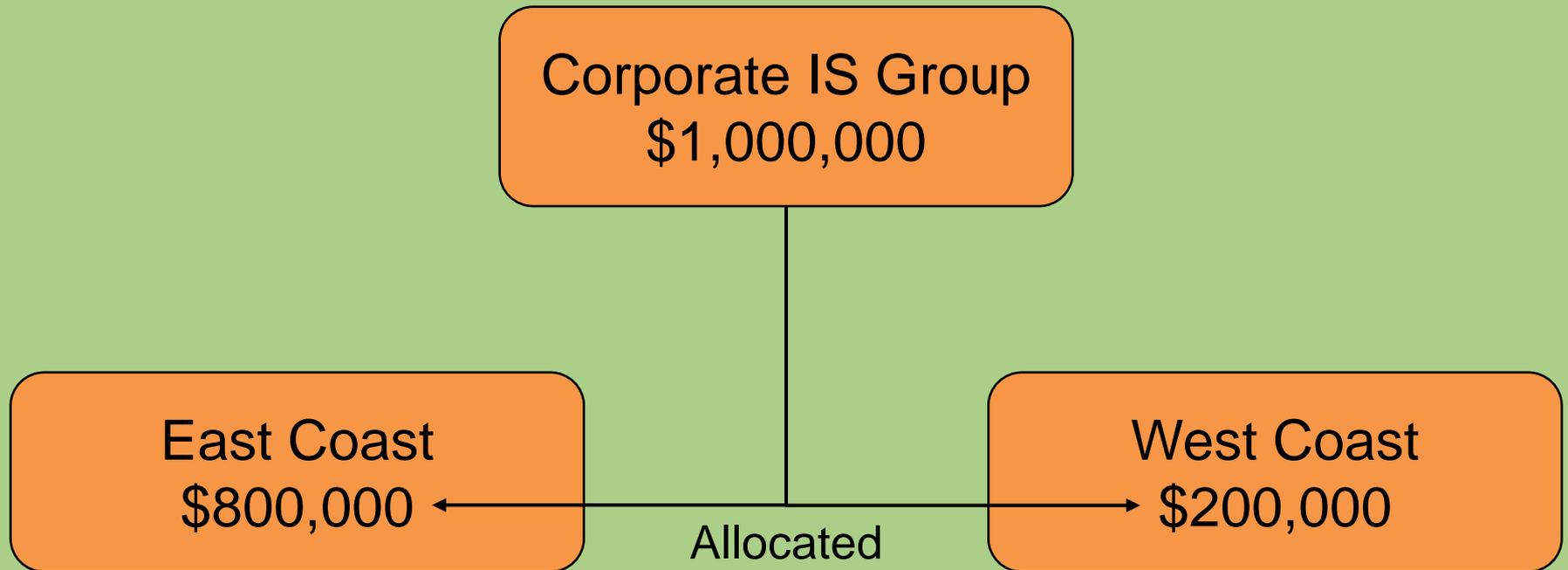
Cost Allocation: Example

- Rockford Corporation has two divisions, East Coast and West Coast. Both divisions are supported by the IS Group.

	East Coast	West Coast	Total
Revenues	\$80 million	\$20 million	\$100 million

1. Define the cost pool: IS department's costs of \$1,000,000
2. Determine the cost allocation rule: IS costs are allocated based on divisional revenue. (% of revenue)
3. Assign to the cost object: East Coast: 80% of cost
West Coast: 20% of cost

Cost Flow Diagram



Details of Manufacturing Cost Flows

L.O. 4 Understand how material, labor, and overhead costs are added to a product at each stage of the production process.

- Product costs are recorded in inventory when costs are incurred.
- A manufacturing company has three inventory accounts:
 1. Raw Materials Inventory:
Materials purchased to make a product
 2. Work-in-Process Inventory:
Products currently in the production process,
but not yet completed
 3. Finished Goods Inventory:
Completed products that have not yet been sold

Inventory Accounts

– The Balance Sheet

Direct Materials Inventory

Beg. RM inventory

+ Purchases

= Raw materials available for production

– Ending RM inventory

= Raw materials transferred to WIP

Work-in-Process Inventory

Beg. WIP inventory

+ Direct materials transferred from raw materials

+ Direct labor

+ Manufacturing overhead

= Total manufacturing costs

= Ending WIP inventory

– Costs of goods completed and transferred to finished goods (or cost of goods manufactured)

Finished Goods Inventory

Beg. FG inventory

+ Cost of goods completed and transferred from WIP

= Goods available for sale

= Ending FG inventory

– Cost of goods sold

To the Income Statement

How Costs Flow Through the Statements

JACKSON GEARS Income Statement

For the Year Ending December 31, Year 200X

Sales	\$20,450,000
Less: Cost of goods sold	<u>13,100,000</u>
Gross margin	\$ 7,350,000
Less: Marketing and administrative expenses	<u>3,850,000</u>
Operating profit	\$ 3,500,000

How Costs Flow Through the Statements

JACKSON GEARS

Cost of Goods Manufactured Statement

For the Year Ending December 31, Year 200X (\$000)

Beginning work-in-process inventory, January 1			\$	270
Manufacturing costs during the year:				
Direct materials:				
Beginning inventory, January 1	\$	95		
Add: Purchases		<u>5,627</u>		
Direct materials available		\$5,722		
Less: Ending inventory, December 31		<u>72</u>		
Direct material put into production			\$5,650	
Direct labor			1,220	
Manufacturing overhead			<u>6,780</u>	
Total manufacturing costs incurred				<u>13,650</u>
Total work in process during the year				\$13,920
Less: Ending work-in-process inventory, December 31				<u>310</u>
Cost of goods manufactured				\$13,610

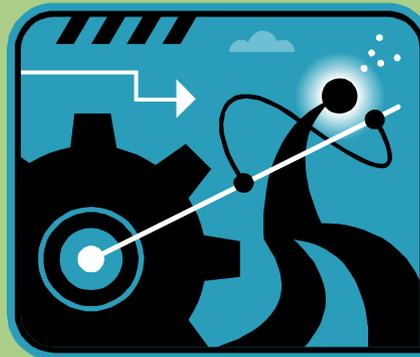
How Costs Flow Through the Statements

JACKSON GEARS

Cost of Goods Sold Statement

For the Year Ending December 31, Year 200X (\$000)

Beginning finished goods inventory, January 1	\$ 420
Cost of goods manufactured	<u>13,610</u>
Finished goods available for sale	\$14,030
Less: Ending Finished Goods Inventory, December 31	<u>930</u>
Cost of goods sold	\$13,100



Cost Behavior

L.O. 5 Define basic cost behaviors, including fixed, variable, semivariable, and step costs.

Cost behavior:

How costs respond to a change in activity level within the relevant range

Relevant range:

Activity levels within which a given total fixed cost or unit variable cost will be unchanged

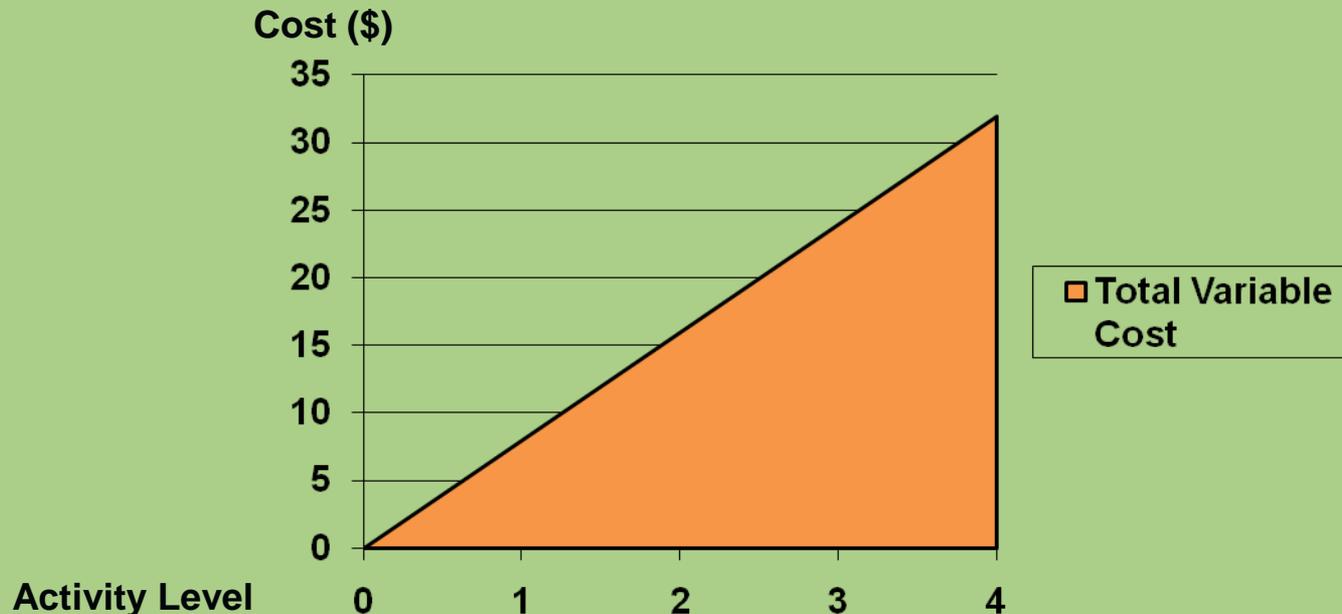
Fixed Costs

- Fixed costs remain unchanged as volume changes within the relevant range.
- Fixed costs per unit varies inversely to a change in activity.
- Fixed costs are “fixed” in “total” as activity changes.

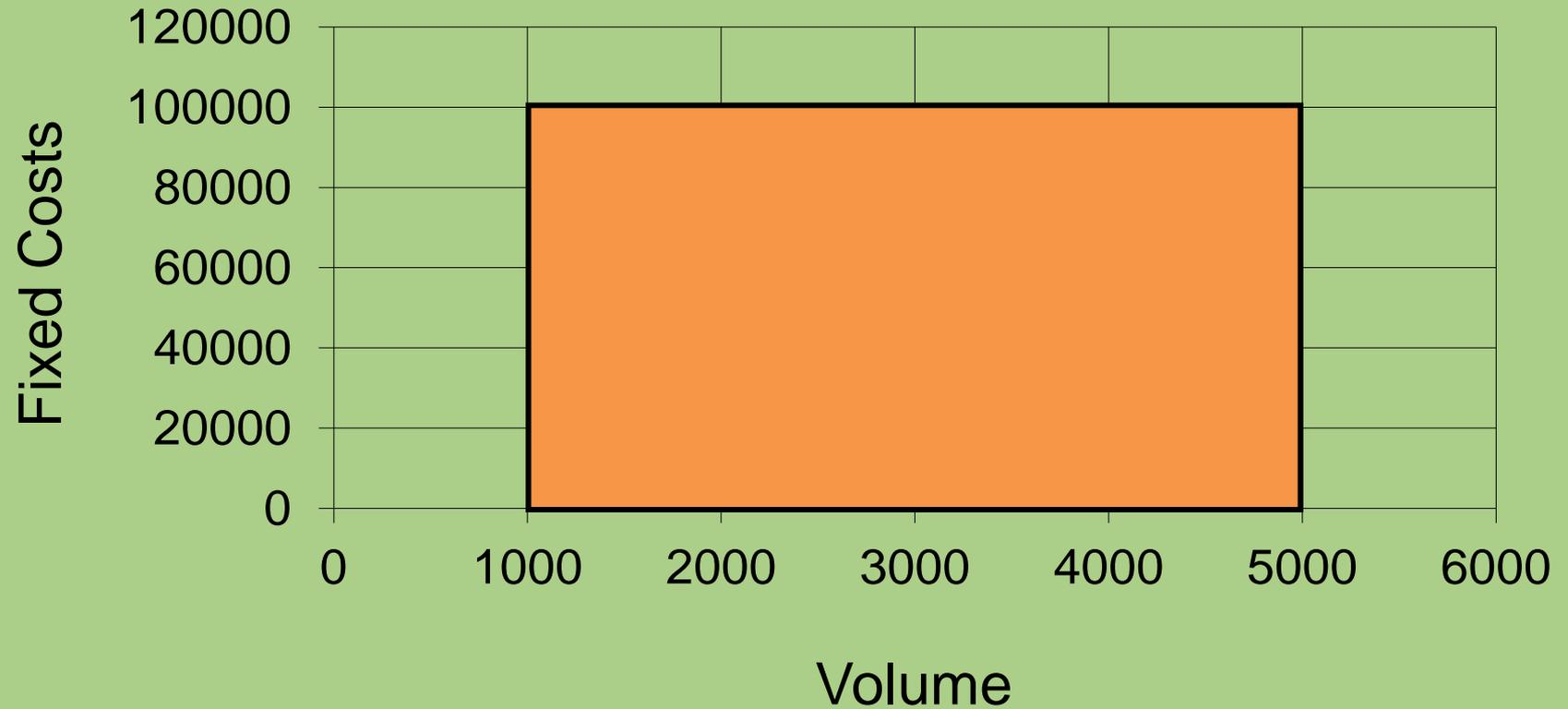


Variable Costs

- Costs that change in direct proportion with a change in the volume within the relevant range
- Variable costs “vary” in “total” as activity changes.
- Variable cost per unit stays constant when activity changes within the relevant range.

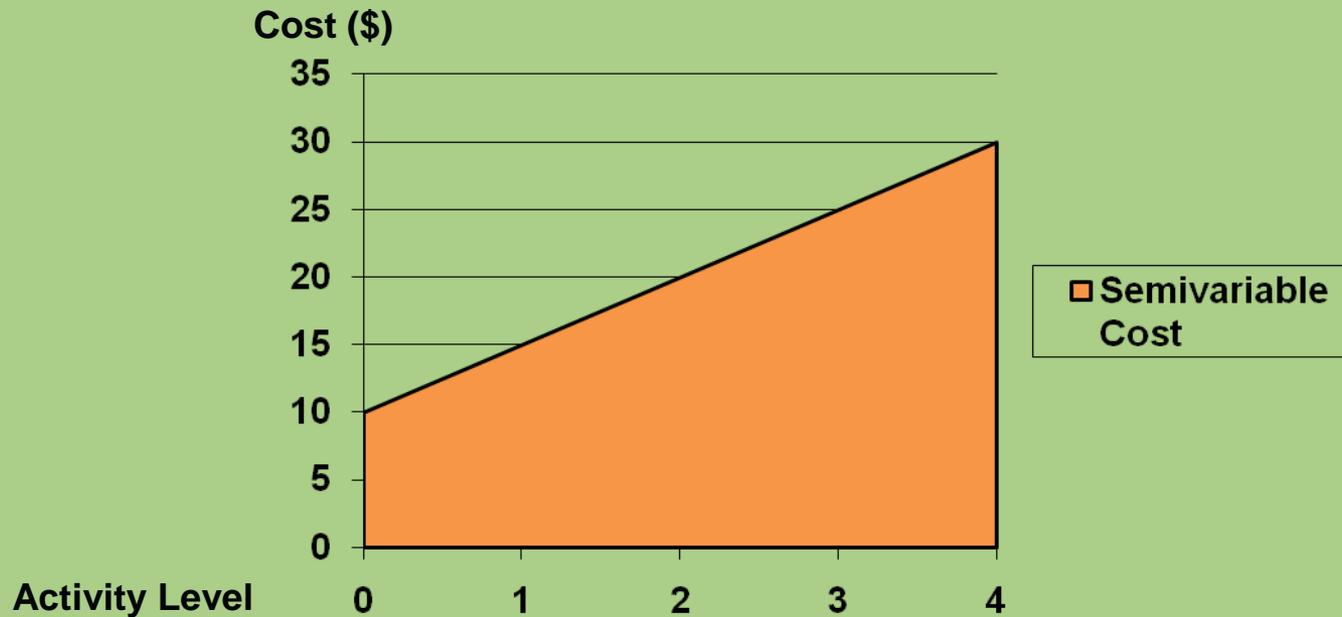


Relevant Range



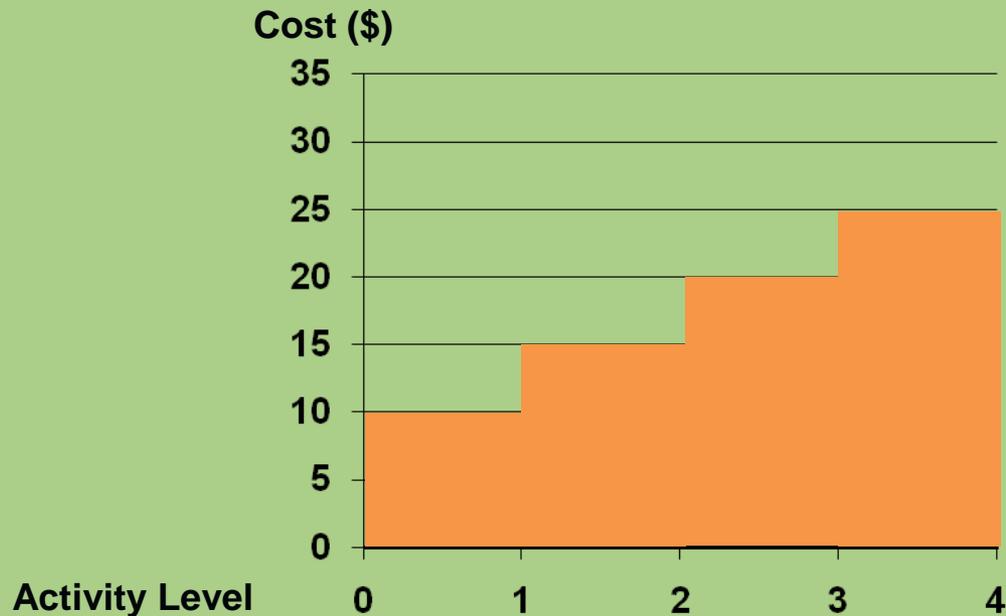
SemivARIABLE Costs

- Costs that have both fixed and variable components
- Also known as mixed costs



Step Costs

- Costs that increase in total with steps when the volume changes to a particular level
- Step costs are also known as semifixed costs.



Components of Product Costs

L.O. 6 Identify the components of a product's costs.

Full cost:

The sum of all costs of manufacturing and selling a unit of the product

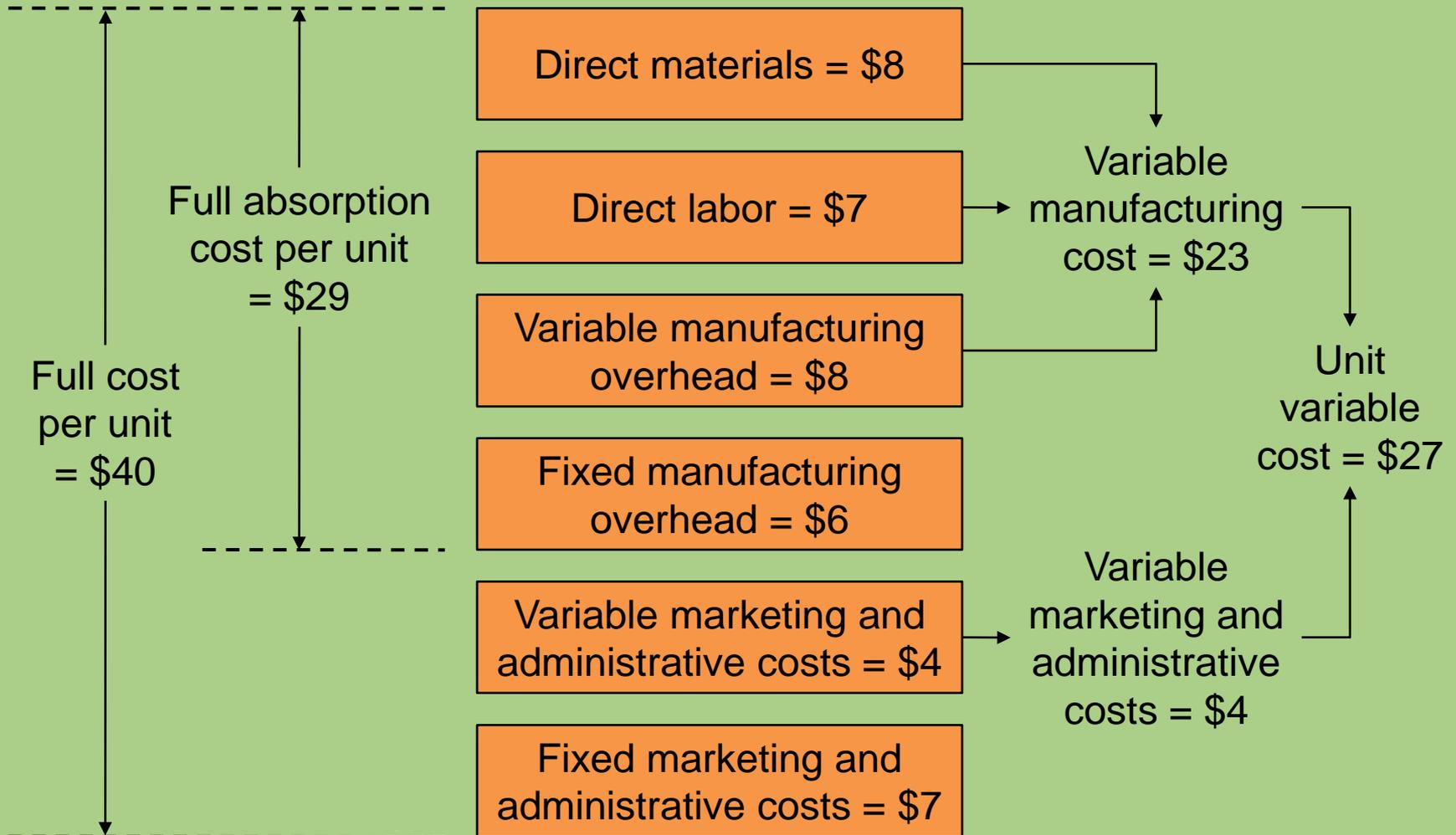
Full absorption cost:

The sum of all variable and fixed costs of manufacturing a unit of the product

Variable cost:

The sum of all variable costs of manufacturing and selling a unit of the product

Components of Product Costs



Making Cost Information Useful

L.O. 7 Understand the distinction between financial and contribution margin income statements.

Full absorption costing:

- Required by GAAP
- Used for:
 - Financial purposes
 - External reporting

Sales revenue

– Cost of goods sold

= Gross margin

Variable costing:

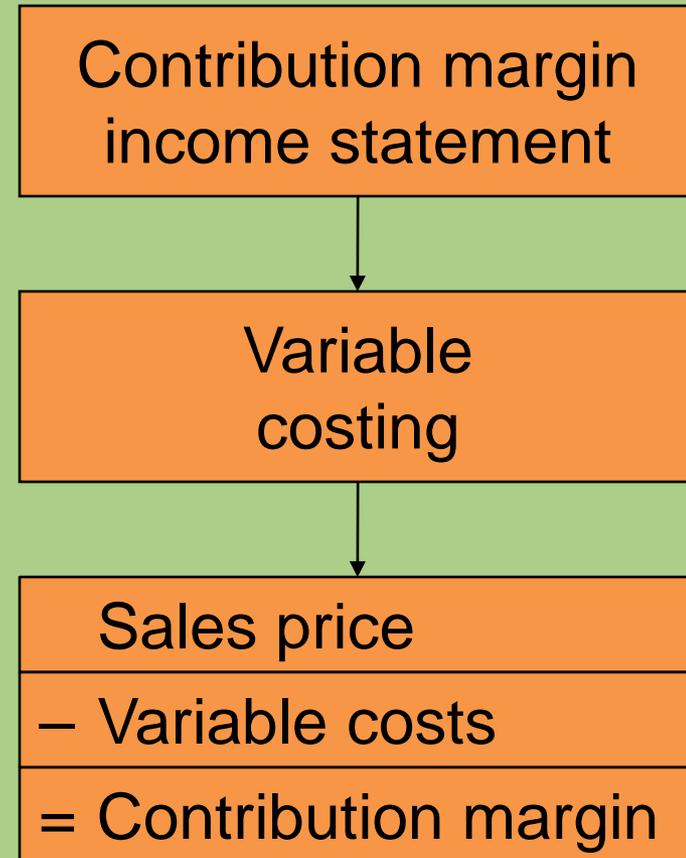
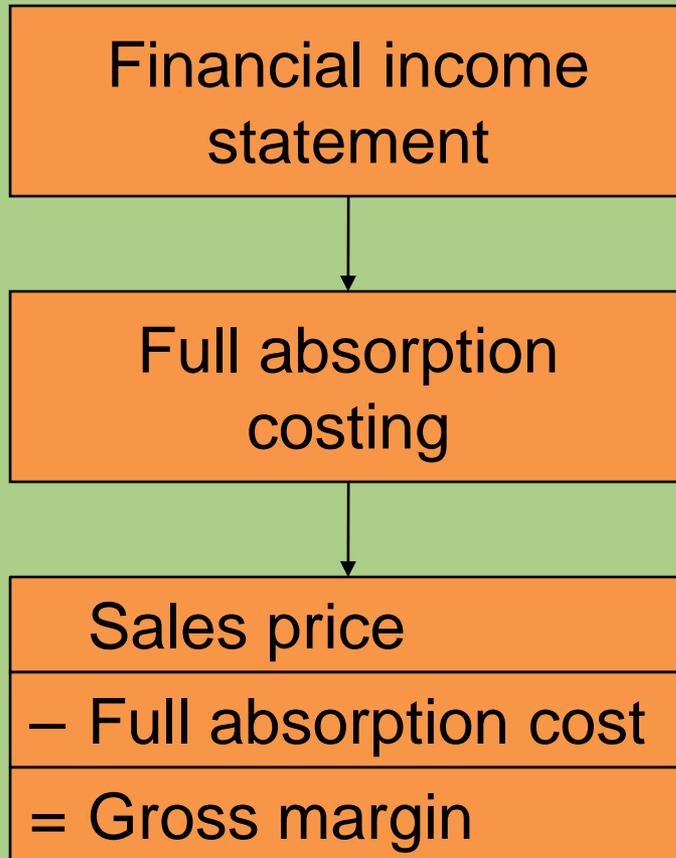
- Used for:
 - Managerial purposes
 - Internal decision making

Sales revenue

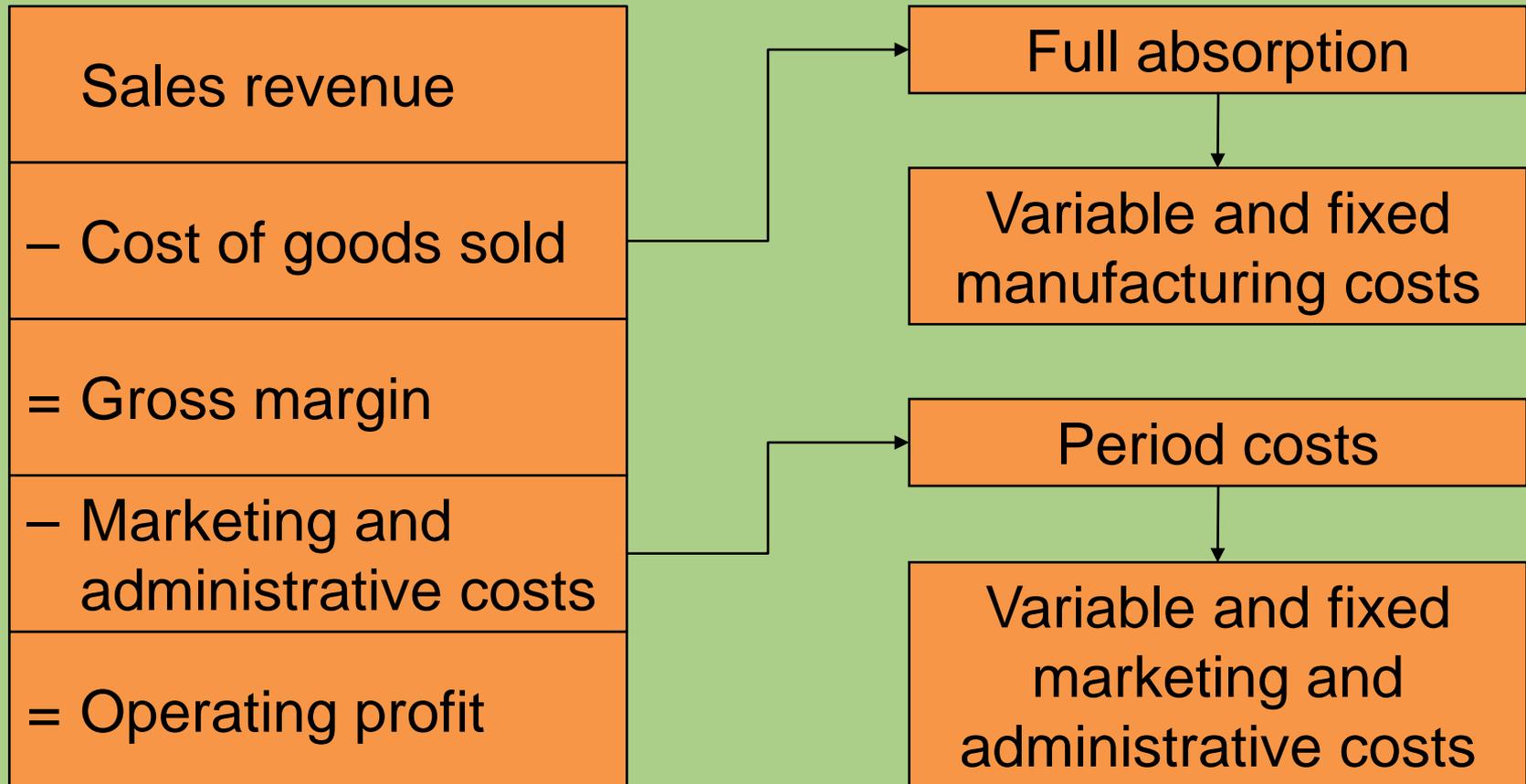
– Variable costs

= Contribution margin

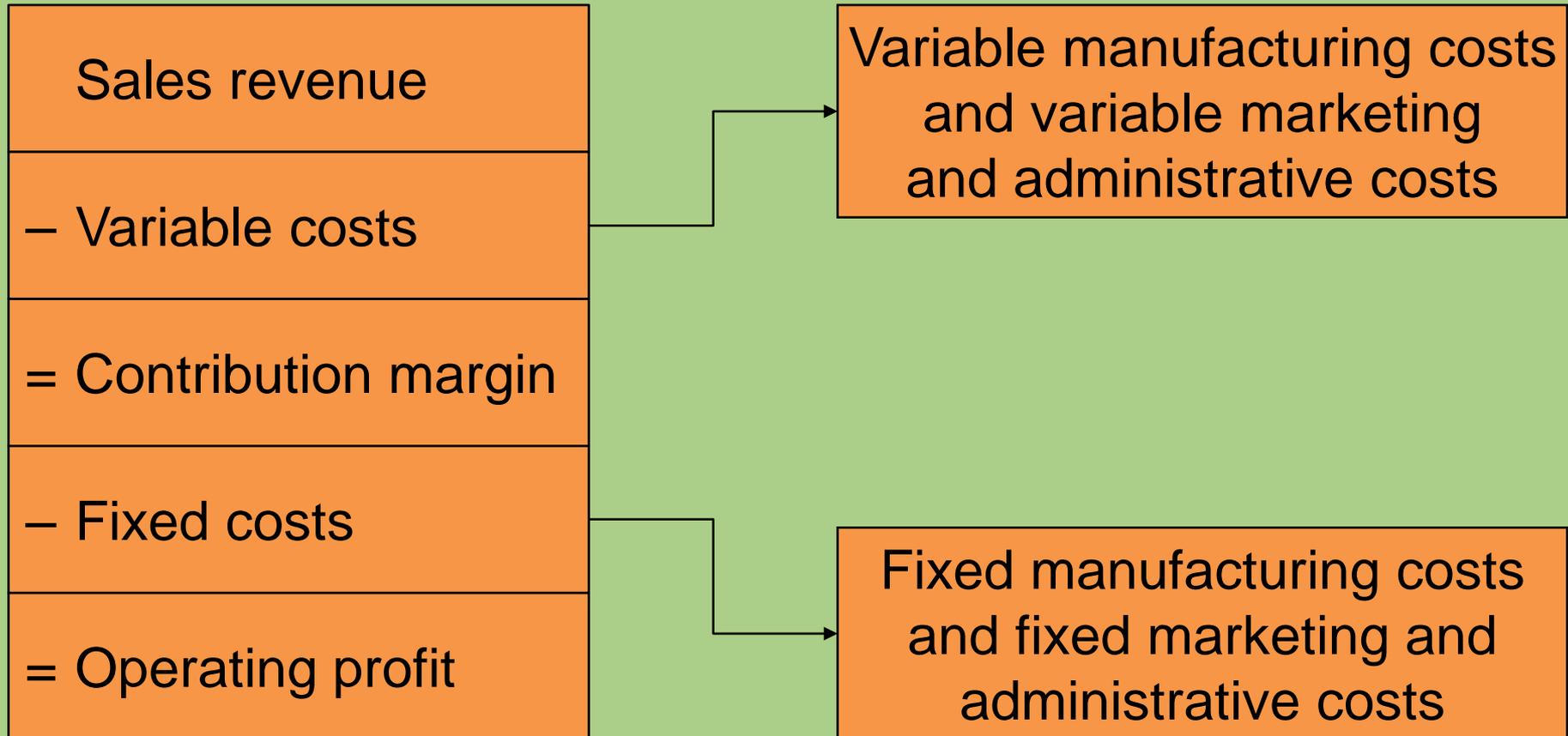
Making Cost Information Useful



Income Statement: Full Absorption Costing



Income Statement: Variable Costing



End of Chapter 2

Chapter 3

Fundamentals of Cost-Volume-Profit Analysis

Learning Objectives

- L.O. 1** Use cost-volume-profit (CVP) analysis to analyze decisions.
- L.O. 2** Understand the effect of cost structure on decisions.
- L.O. 3** Use Microsoft Excel to perform CVP analysis.
- L.O. 4** Incorporate taxes, multiple products, and alternative cost structures into the CVP analysis.
- L.O. 5** Understand the assumptions and limitations of CVP analysis.

Cost-Volume-Profit Analysis

L.O. 1 Use cost-volume-profit (CVP) analysis to analyze decisions.

What is CVP?

- CVP analysis explores the relationship between revenue, cost, and volume and their effect on profits.

Profit Equation

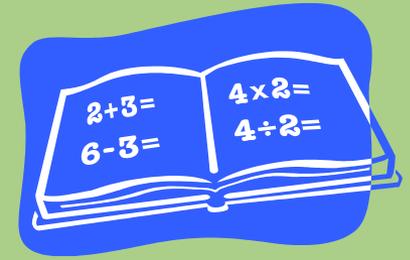
The Income Statement

$$\begin{array}{r} \text{Total revenues} \\ - \text{Total costs} \\ \hline = \text{Operating profit} \end{array}$$

The Income Statement written horizontally

$$\begin{array}{rclclcl} \text{Operating profit} & = & \text{Total revenues} & - & \text{Total costs} \\ \text{Profit} & = & \text{TR} & - & \text{TC} \end{array}$$

Profit Equation



- Total revenue (TR)
= Average selling price per unit (P)
× Units of output produced and sold (X)

$$TR = PX$$

- Total cost (TC)
= [Variable cost per unit (V) × Units of output (X)]
+ Fixed costs (F)

$$TC = VX + F$$

Profit Equation

$$\begin{aligned}\text{Profit} &= \text{Total revenue} - \text{Total costs} \\ &= TR - TC\end{aligned}$$

$$TC = VX + F$$

$$\text{Therefore, Profit} = PX - (VX + F)$$

$$\begin{aligned}\text{Profit} &= (\text{Price} - \text{Variable costs}) \times \text{Units of output} - \text{Fixed costs} \\ &= X(P - V) - F\end{aligned}$$

Contribution Margin

- This is the difference between price and variable cost.
- It is what is leftover to cover fixed costs and then add to operating profit.

Contribution margin = Price per unit – Variable cost per unit

$$P - V$$



CVP Example

U-Develop Income Statement For the Month Ending March 20XX

Sales (12,000 prints at \$0.60)		\$7,200
Less:		
Variable costs of goods sold (12,000 × \$0.30)	\$3,600	
Variable selling costs (12,000 × \$0.06)	<u>720</u>	<u>4,320</u>
Contribution margin		\$2,880
Less: Fixed costs		<u>1,500</u>
Operating profit		\$1,380

- Contribution margin = $\$2,880 \div 12,000 = \0.24

Break-Even Volume in Units

- This is the volume level at which profits equal zero.

$$\text{Profit } 0 = X(P - V) - F$$

$$\text{If profit} = 0, \text{ then } X = F \div (P - V)$$

$$\begin{aligned} \text{Break-even volume (in units)} &= \frac{\text{Fixed costs}}{\text{Unit contribution margin}} \\ &= \$1,500 \div \$0.24 \\ &= 6,250 \text{ prints} \end{aligned}$$

Break-Even Volume in Sales Dollars

Contribution margin percentage (contribution margin ratio) is the contribution margin as a percentage of sales revenue.

What is the contribution margin percentage?

$$\$0.24 \div \$0.60 = 0.40 \text{ (or 40\%)}$$

$$\$1,500 \div 0.40 = \$3,750$$

Target Volume

Assume that management wants to have a profit of \$1,800.

How many prints must be sold?

$$(\$1,500 + \$1,800) \div \$0.24 = 13,750$$

What is the target dollar sales?

$$(\$1,500 + \$1,800) \div 0.40 = \$8,250$$

CVP Summary: Break-Even

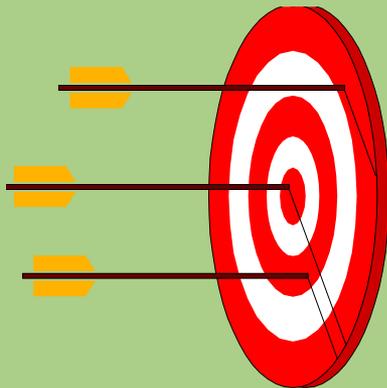
$$\text{Break-even volume (units)} = \frac{\text{Fixed costs}}{\text{Unit contribution margin}}$$

$$\text{Break-even volume (sales dollars)} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

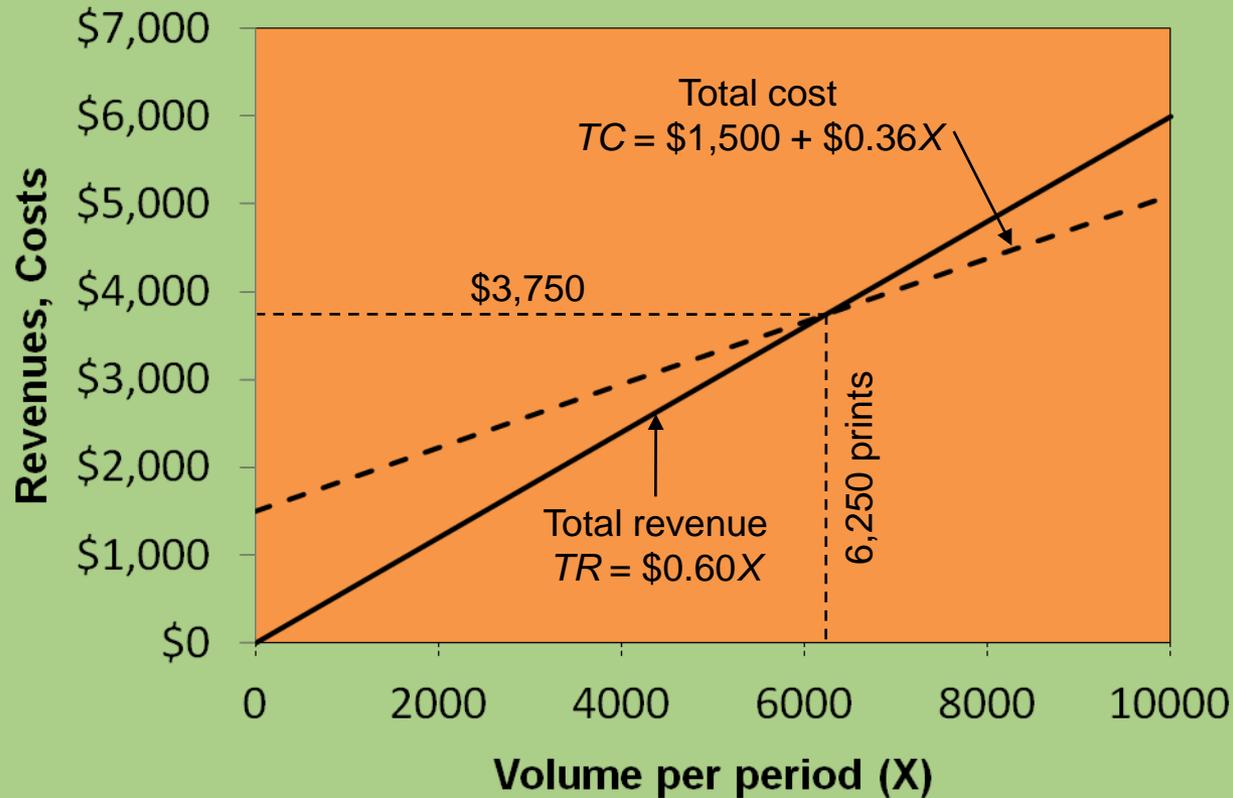
CVP Summary: Target Volume

$$\text{Target volume (units)} = \frac{\text{Fixed costs} + \text{Target profit}}{\text{Unit contribution margin}}$$

$$\text{Target volume (sales dollars)} = \frac{\text{Fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$



Graphic Presentation



Use of CVP to Analyze the Effect of Different Cost Structures

L.O. 2 Understand the effect of cost structure on decisions.

Cost structure:

The proportion of fixed and variable costs to total costs.

Operating leverage:

The extent to which the cost structure is comprised of fixed costs.

Use of CVP to Analyze the Effect of Different Cost Structures

$$\text{Operating leverage} = \frac{\text{Contribution margin}}{\text{Operating profit}}$$

- The higher the organization's operating leverage, the higher the break-even point.

Comparison of Cost Structures

	Lo-Lev Company (1,000,000 units)		Hi-Lev Company (1,000,000 units)	
	Amount	%	Amount	%
Sales	\$1,000,000	100	\$1,000,000	100
Variable costs	<u>750,000</u>	75	<u>250,000</u>	25
Contribution margin	\$ 250,000	25	\$ 750,000	75
Fixed costs	<u>50,000</u>	5	<u>550,000</u>	55
Operating profit	\$ 200,000	20	\$ 200,000	20
Break-even point	200,000 units		733,334 units	
Contribution margin per unit	\$0.25		\$0.75	
Degree of operating leverage	1.25		3.75	

Comparison of Cost Structures

- Suppose Low-Lev and High-Lev both increase sales 10% or \$100,000.

	Lo-Lev	Hi-Lev
Sales increase	\$100,000	\$100,000
Contribution margin	0.25	0.75
Increase in profit	\$ 25,000	\$ 75,000
Prior net income	\$200,000	\$200,000
Net income with sales increase of 10%	\$225,000	\$275,000

Margin of Safety

- The excess of projected or actual sales volume over break-even volume
- **or**
- The excess of projected or actual sales revenue over break-even revenue
- Suppose U-Develop sells 8,000 prints.
- At a break-even volume of 6,250, its margin of safety is:

$$\text{Sales} - \text{Break-even} = 8,000 - 6,250 = 1,750 \text{ prints}$$

CVP Analysis with Spreadsheets

L.O. 3 Use Microsoft Excel to perform CVP analysis.

- A spreadsheet program is ideally suited to performing CPV routinely.

1. Choose “Tools: Goal Seek...” from the menu bar.
2. In the “Set cell” edit field, enter the cell address for the target profit calculation.
3. In the “To value” edit field, enter the target profit.
4. In the “By changing cell” edit field, enter the cell address of the volume variable.
5. Click “OK” and the program will find the break-even volume.

U-Develop	
Price	\$0.60
Variable cost	\$0.36
Fixed cost	\$1,500
Profit	(\$300)
Volume	5,000

U-Develop	
Price	\$0.60
Variable cost	\$0.36
Fixed cost	\$1,500
Profit	\$0.00
Volume	6,250

Extensions of the CVP Model: Income Taxes

L.O. 4 Incorporate taxes, multiple products, and alternative cost structures into the CVP analysis.

- The owners of U-Develop want to generate after-tax operating profits of \$1,800.
- The tax rate is 25%.
- What is the target operating profit?

Target operating profit = $TOP \div (1 - \text{Tax rate})$

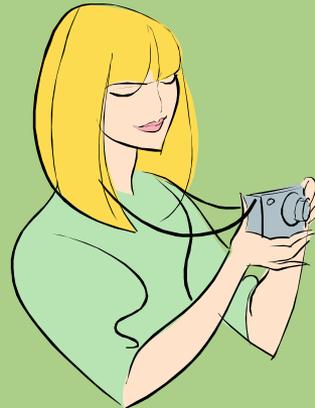
$$TOP = \$1,800 \div (1 - 0.25) = \$2,400$$

Extensions of the CVP Model: Income Taxes

- How many units must be sold?

$$\frac{\text{Fixed costs} + [\text{Target profit} \div (1 - \text{Tax rate})]}{\text{Unit contribution margin}}$$

$$(\$1,500 + \$2,400) \div \$0.24 = 16,250 \text{ prints}$$



Extensions of the CVP Model: Income Taxes

Proof:

Sales: $16,250 \times \$0.60$	\$9,750
Variable costs: $16,250 \times \$0.36$	<u>5,850</u>
Contribution margin	\$3,900
Fixed costs	<u>1,500</u>
Net income before taxes	\$2,400
Income taxes: $\$2,400 \times 25\%$	<u>600</u>
Net income	<u><u>\$1,800</u></u>

Extensions of the CVP Model: Multiproduct Analysis

- Management expects to sell 9 prints at \$.60 each for every enlargement it sells at \$1.00.

	Prints	Enlargements
Selling price	\$0.60	\$1.00
Less: Variable cost	<u>.36</u>	<u>.56</u>
Contribution margin	\$0.24	\$0.44

- Total fixed costs = \$1,820

Extensions of the CVP Model: Multiproduct Analysis

- What is the contribution margin of the mix?

$$(9 \times \$0.24) + (1 \times \$0.44) = \$2.16 + \$0.44 = \$2.60$$

- What is the weighted-average contribution margin of the mix?

$$(.90 \times \$0.24) + (.10 \times \$0.44) = \$0.26$$

- What is the breakeven of the mix?

Extensions of the CVP Model: Multiproduct Analysis

$$\begin{array}{rcl} 7000 \times 90\% & = & 6,300 \text{ prints} \\ 7000 \times 10\% & = & \underline{700} \text{ enlargements} \\ \text{Total units} & = & 7,000 \end{array}$$

$$\text{\$1,820 fixed costs} \div \text{\$0.26} = 7,000 \text{ units}$$

Extensions of the CVP Model: Multiproduct Analysis

$$\begin{array}{rcl} 6,300 \text{ prints} \times \$0.60 & = & \$3,780 \\ 700 \text{ enlargements} \times \$1.00 & = & \underline{\$ 700} \\ \text{Total Dollars} & = & \$4,480 \end{array}$$

$$\begin{array}{r} .90 \times \$0.60 \text{ for prints} + \\ .10 \times \$1.00 \text{ for enlargements} = \underline{\$.64} \end{array}$$

- What is the weighted-average contribution margin percentage?
- \$.26 divided by \$.64 = 40.625%

Extensions of the CVP Model: Multiproduct Analysis

$$\begin{aligned} &\text{Weighted average revenue:} \\ &(.90 \times \$0.60) + (.10 \times \$1.00) = \$0.64 \end{aligned}$$

$$\begin{aligned} &\text{Weighted average contribution margin:} \\ &\$0.26 \div \$0.64 = 40.625\% \end{aligned}$$

$$\$1,820 \div 0.40625 = \$4,480$$

Extensions of the CVP Model: Alternative Cost Structures

- Given: Fixed costs of \$1,500 are sufficient for monthly volumes less than or equal to 5,000 prints.
For every additional 5,000 prints U-Develop must rent a machine for \$480 per month.
- Original break-even was 6,250 units.

$$(\$0.24 \times 6,250) - (\$1,500 + \$480) = (\$480)$$

Extensions of the CVP Model: Alternative Cost Structures

- What is the break-even using new fixed cost containing the rental of the additional machine?

$$\text{Break-even units} = (\$1,500 + \$480) \div \$0.24 = 8,250$$



Assumptions and Limitations of CVP Analysis

L.O. 5 Understand the assumptions and limitations of CVP analysis.

- Although the CVP model is a very strong tool, the output is dependent upon the assumptions made by cost analysts.
- These assumptions include which costs are fixed and which are variable.

Assumptions and Limitations of CVP Analysis

- With the aid of software programs, many of the limitations have been eliminated.
- Complicated cost structures are easily incorporated in CVP analysis when software tools are used.



End of Chapter 3

Chapter 4

Fundamentals of Cost Analysis for Decision Making

Learning Objectives

- L.O. 1** Use differential analysis to analyze decisions.
- L.O. 2** Understand how to apply differential analysis to pricing decisions.
- L.O. 3** Understand several approaches for establishing prices based on costs for long-run pricing decisions.
- L.O. 4** Understand how to apply differential analysis to production decisions.
- L.O. 5** Understand the theory of constraints.

Differential Analysis

L.O. 1 Use differential analysis to analyze decisions.

Differential analysis:

The process of estimating revenues and costs of alternative actions available to decision makers and of comparing these estimates to the status quo

Short run:

The period of time over which capacity will be unchanged, usually one year

Differential Costs

With two or more alternatives, costs that differ among or between alternatives

Costs that change in response to an alternative course of action

Differential costs differ between actions.

Alternative A

Alternative B

Sunk Costs

Costs incurred in the past that cannot be changed by present or future decisions

A sunk cost is NOT relevant for making decisions.



Differential Costs versus Total Costs

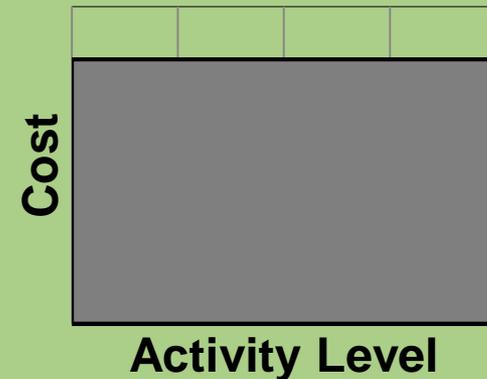
- Information presented to management can show the detailed costs that are included for making a decision, or it can show just the differences between alternatives, as follows.

	Status Quo	Alternative	Difference
Sales revenue	\$750	\$900	\$150
Variable costs	<u>(250)</u>	<u>(300)</u>	<u>(50)</u>
Contribution margin	\$500	\$600	\$100
Fixed costs	<u>(350)</u>	<u>(350)</u>	<u>-0-</u>
Operating profit	<u>\$150</u>	<u>\$250</u>	<u>\$100</u>

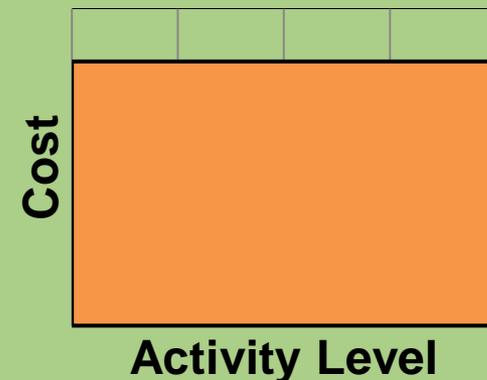
Differential Analysis and Pricing Decisions

L.O. 2 Understand how to apply differential analysis to pricing decisions.

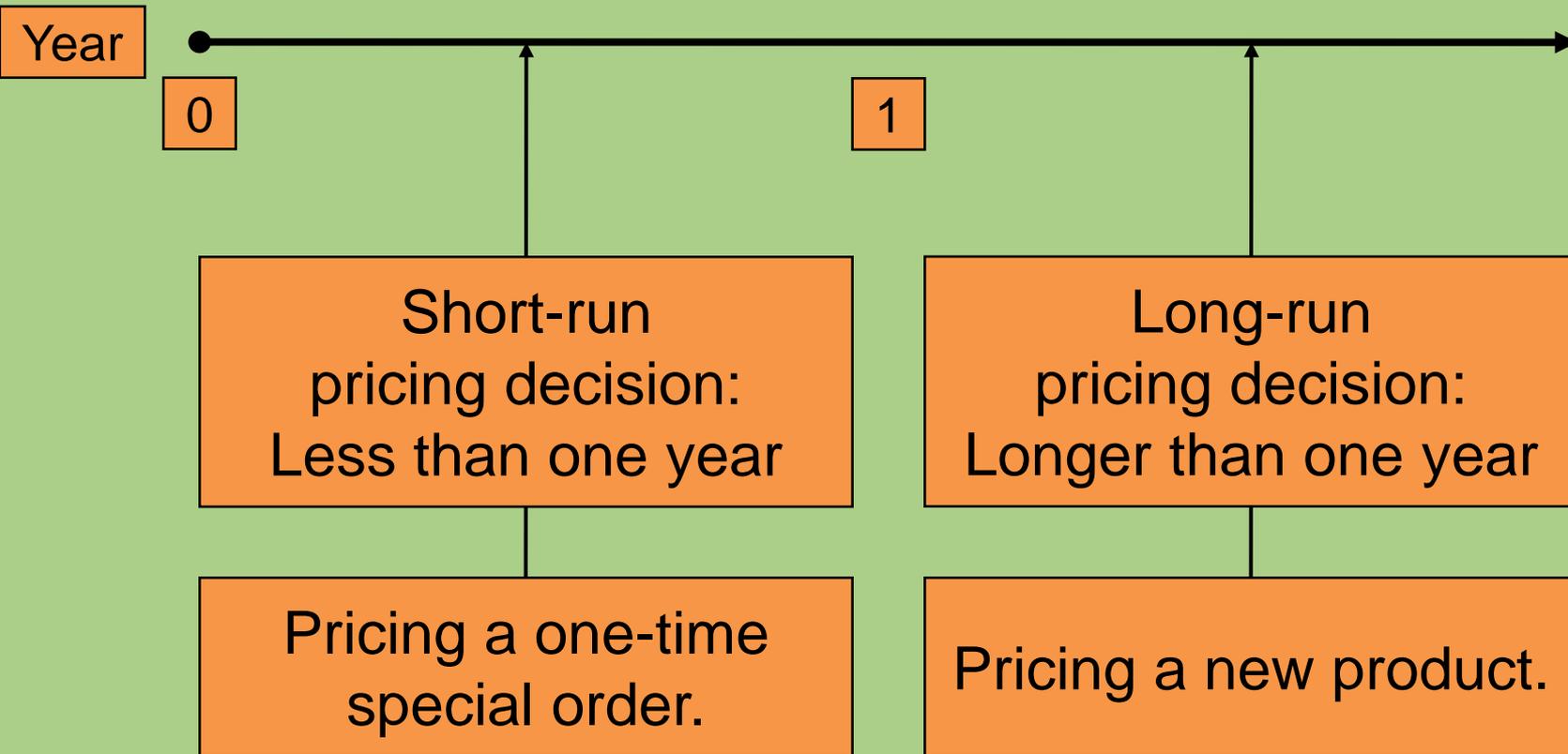
Variable costs must always be covered.



Fixed costs must be covered in the long run.

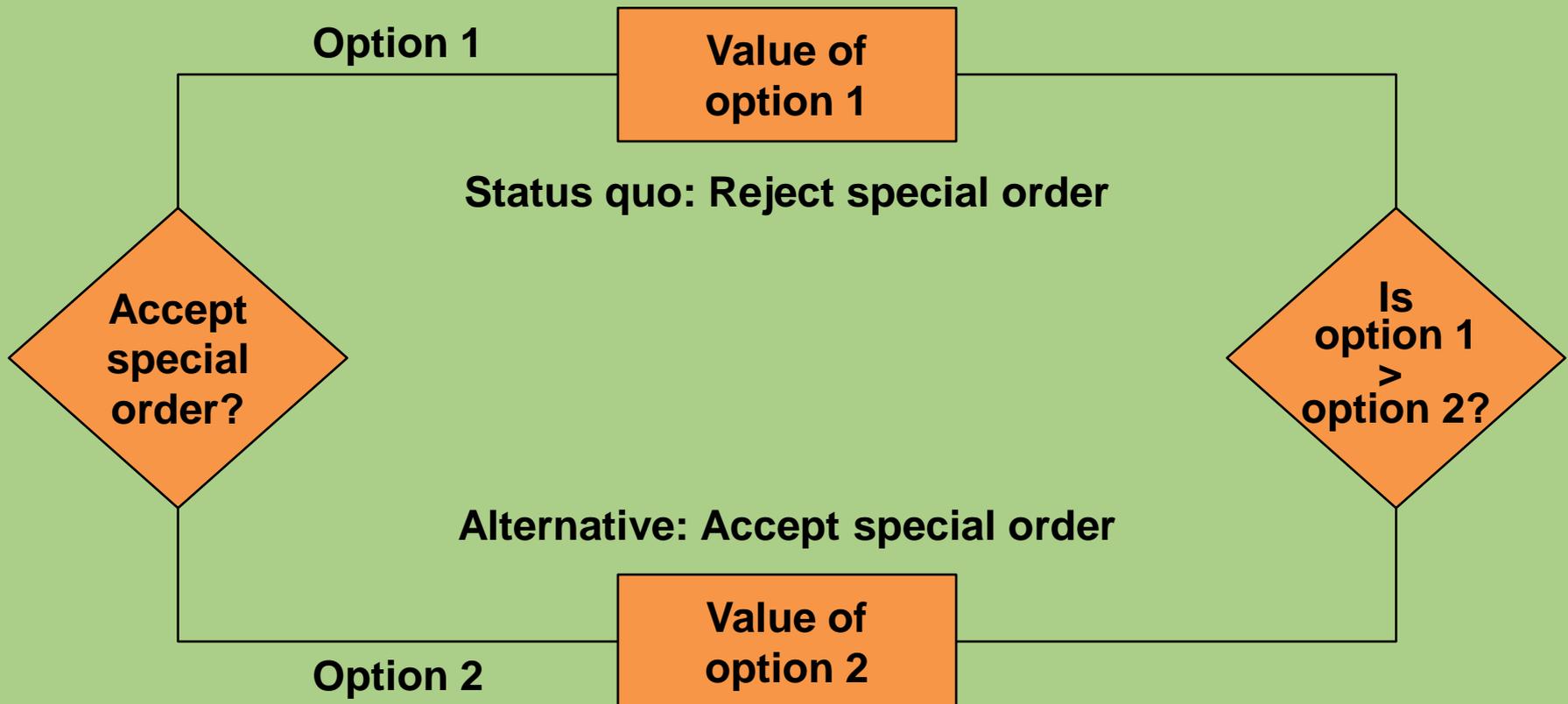


Short-Run versus Long-Run Pricing Decisions



Short-Run Pricing Decisions: Special Orders

- An order that will not affect other sales and is usually a one-time occurrence



Short-Run Pricing Decisions: Special Orders

- U-Develop has received a one-time offer for 500 prints at a special price of 40¢ per print (\$200).
- The regular price is 50¢ and they have enough idle capacity in the week to take the offer.

Sales for the week (5,000 prints at 50¢)	\$2,500
Variable costs, including paper, maintenance, and usage payment to machine owner (5,000 copies at 20¢)	<u>1,000</u>
Total contribution margin	\$1,500
Fixed costs (supplies, plus allocated costs of the print shop)	<u>1,200</u>
Operating profit for the week	<u>\$ 300</u>

Short-Run Pricing Decisions: Special Orders

Analysis of Special Order: U-Develop

	Status Quo: Reject Special Offer	Alternative: Accept Special Offer	Difference
<i>Comparison of Totals</i>			
Sales revenue	\$2,500	\$2,700	\$200
Variable costs	<u>(1,000)</u>	<u>(1,100)</u>	<u>(100)</u>
Total contribution	\$1,500	\$1,600	\$100
Fixed costs	<u>(1,200)</u>	<u>(1,200)</u>	<u>-0-</u>
Operating profit	<u>\$ 300</u>	<u>\$ 400</u>	<u>\$100</u>
<i>Alternative Presentation: Differential Analysis</i>			
Differential sales, 500 at 40¢		\$ 200	
Less: Differential costs, 500 at 20¢		<u>100</u>	
Differential operating profit (before taxes)		\$ 100	

Long-Run Pricing Decisions

L.O. 3 Understand several approaches for establishing prices based on costs for long-run pricing decisions.

- Full cost is the total cost to produce and sell a unit.
- Full costs are relevant for the long-term pricing decisions.

Long-Run versus Short-Run Pricing

- In the short run, differential costs may be very low.
- In the long run, differential costs are higher than in the short run.

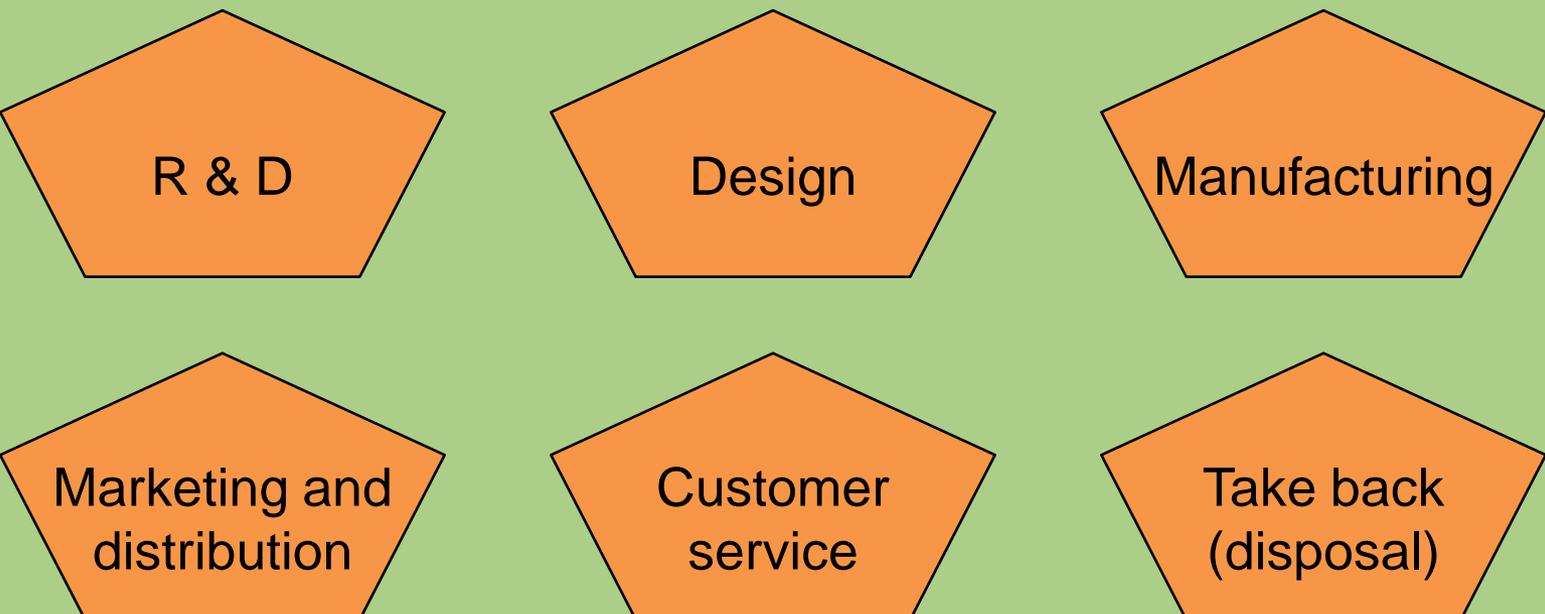
Cost Analysis for Pricing

- In the long run an organization must cover all variable and fixed costs – both manufacturing and selling.



Life-Cycle Product Costing and Pricing

- Product life-cycle is concerned with covering costs in all categories of the life cycle.



R & D

Design

Manufacturing

Marketing and
distribution

Customer
service

Take back
(disposal)

Target Costing from Target Pricing

- Target price:
The price based on customers' perceived value for the product and the price that competitors charge
- What would a customer pay?
- How much profit do I need?
- Can I make it at this cost?

$$\text{Target price} - \text{Desired profit} = \text{Target cost}$$

Legal Issues Relating to Costs and Sales Price

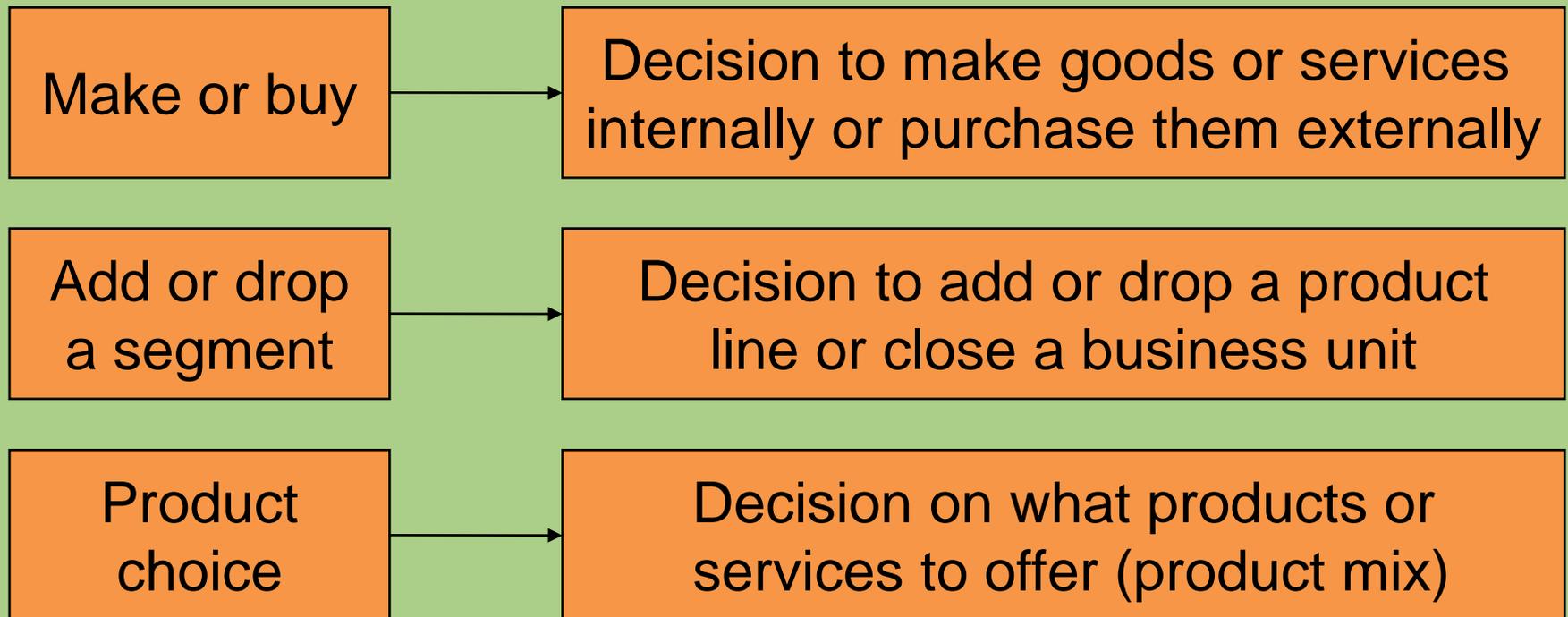
- **Predatory pricing:**
Practice of setting price below cost with the intent to drive competitors out of business
- **Dumping:**
Exporting a product to another country at a price below domestic cost
- **Price discrimination:**
Practice of selling identical goods to different customers at different prices

Legal Issues Relating to Costs and Sales Price

- Peak-load pricing:
Practice of setting prices highest when the quantity demanded for the product approaches capacity.
- Price fixing:
Agreement among businesses to set prices at a particular level.

Use of Differential Analysis for Production Decision

L.O. 4 Understand how to apply differential analysis to production decisions.



Make-or-Buy Decisions

- U-Develop's current costs of developing prints:

	Per unit	100,000 prints
Costs directly traceable:		
Direct materials	\$0.05	\$ 5,000
Direct labor	0.12	12,000
Variable manufacturing overhead	.03	3,000
Fixed manufacturing overhead		4,000
Common costs allocated to this product line		<u>10,000</u>
Total costs		<u>\$34,000</u>

- This year's expected volume is 100,000 prints, so the full cost of processing a print is $\$34,000 \div 100,000 = \0.34

Make-or-Buy Decisions

- U-Develop received an offer from an outside developer to process any number of prints for 25¢ each.
- Should U-Develop accept this offer?
- The accounting department prepared cost analyses at volume levels of 50,000 and 100,000 prints per year.

Make-or-Buy Decisions

100,000 prints	Process prints	Outsource processing	Difference
Direct costs:			
Direct materials	\$ 5,000	\$25,000 ^a	\$20,000 higher
Labor	12,000	-0-	12,000 lower
Variable overhead	3,000	-0-	3,000 lower
Fixed overhead	4,000	-0-	4,000 lower
Common costs	<u>10,000^b</u>	<u>10,000^b</u>	<u>-0-</u>
Total costs	<u>\$34,000</u>	<u>\$35,000</u>	<u>\$ 1,000 higher</u>

^a 100,000 units purchased at \$0.25 = \$25,000

^b These common costs remain unchanged for these volumes.
Because they do not change, they could be omitted from the analysis.

- Differential costs increase by \$1,000, so reject alternative to buy.

Make-or-Buy Decisions

50,000 prints	Process prints	Outsource processing	Difference
Direct costs:			
Direct materials	\$ 2,500	\$12,500 ^a	\$10,000 higher
Labor	6,000	-0-	6,000 lower
Variable overhead	1,500	-0-	1,500 lower
Fixed overhead	4,000	-0-	4,000 lower
Common costs	<u>10,000^b</u>	<u>10,000^b</u>	<u>-0-</u>
Total costs	<u>\$24,000</u>	<u>\$22,500</u>	<u>\$ 1,500</u> lower

^a 50,000 units purchased at \$0.25 = \$12,500

^b These common costs remain unchanged for these volumes.
Because they do not change, they could be omitted from the analysis.

- Differential costs decrease by \$1,500, so accept alternative to buy.

Opportunity Costs of Making

- U-Develop's expected volume is 100,000 prints.
- Assume that the facilities used to process prints could be used to offer a new service that would provide a \$2,000 incremental contribution.
- Should U-Develop accept or reject the alternative?



Opportunity Costs of Making

	Status quo: Process prints	Alternative: Outsource processing	Difference
Total cost of 100,000 prints			
Opportunity cost of using facilities to process prints	\$34,000	\$35,000	\$1,000 higher ^a
Total costs, including opportunity costs	<u>2,000</u>	<u>-0-</u>	<u>2,000 lower^a</u>
	<u>\$36,000</u>	<u>\$35,000</u>	<u>\$1,000 lower^a</u>

^a These indicate whether the alternative is higher or lower than the status quo.

- Differential costs decrease by \$1,000, so accept the alternative.

Add or Drop Decisions

U-Develop Fourth Quarter Product Line Income Statement

	Total	Prints	Cameras	Frames
Sales revenue	\$80,000	\$10,000	\$50,000	\$20,000
Cost of sales (all variable)	<u>53,000</u>	<u>8,000</u>	<u>30,000</u>	<u>15,000</u>
Contribution margin	\$27,000	\$ 2,000	\$20,000	\$ 5,000
Less fixed costs:				
Rent	4,000	1,000	2,000	1,000
Salaries	5,000	1,000	2,500	1,500
Marketing and administrative	<u>3,000</u>	<u>500</u>	<u>1,500</u>	<u>1,000</u>
Operating profit (loss)	<u>\$15,000</u>	<u>\$ (500)</u>	<u>\$14,000</u>	<u>\$ 1,500</u>

Add or Drop Decisions

U-Develop Differential Analysis

	Status quo: Keep prints	Alternative: Drop prints	Difference
Sales revenue	\$80,000	\$70,000	\$10,000 decrease
Cost of sales (all variable)	<u>53,000</u>	<u>45,000</u>	<u>8,000 decrease</u>
Contribution margin	\$27,000	\$25,000	\$ 2,000 decrease
Less fixed costs:			
Rent	4,000	4,000	-0-
Salaries	5,000	4,000	1,000 decrease
Marketing and administrative	<u>3,000</u>	<u>2,750</u>	<u>250 decrease</u>
Operating profit (loss)	\$15,000	\$14,250	\$ 750 decrease

- Profits decrease \$750, so keep prints.

Product Choice Decisions

- Constraints:
Activities, resources, or policies that limit the attainment of an objective.
- Contribution margin per unit of scarce resource:
Contribution margin per unit of a particular input with limited availability.

Product Choice Decisions

U-Develop Revenue and Cost Information

	Metal frames	Wood frames	
Price	\$50	\$80	
Less: Variable costs per unit			
Material	8	22	
Labor	8	24	
Overhead	<u>4</u>	<u>4</u>	
Contribution margin per unit	<u>\$30</u>	<u>\$30</u>	
Fixed costs			Total
Manufacturing			\$3,000
Marketing and administrative			<u>1,500</u>
			<u>\$4,500</u>

Product Choice Decisions

U-Develop Revenue and Cost Information

	Metal frames	Wood frames
Per unit:		
Contribution margin	\$ 30	\$ 30
Machine hours required	<u>÷ 0.5</u>	<u>÷ 1.0</u>
Contribution margin per machine hour	<u>\$ 60</u>	<u>\$ 30</u>

- Metal Frames have a higher contribution margin per machine hour.

Product Choice Decisions

- Suppose U-Develop has 200 machine hours per month available.

	Metal frames	Wood frames
Capacity	400	200
Contribution margin per unit	<u>× \$30</u>	<u>× \$30</u>
Total contribution margin	\$12,000	\$6,000
Less: Fixed manufacturing costs	3,000	3,000
Less: Fixed marketing and admin. costs	<u>1,500</u>	<u>1,500</u>
Operating profit	<u>\$ 7,500</u>	<u>\$1,500</u>

- Selling metal frames will result in higher profits than selling wooden frames.

The Theory of Constraints

L.O. 5 Understand the theory of constraints.

- Theory of constraints:
Focuses on revenue and cost management when faced with bottlenecks
- Bottleneck:
Operation where the work required limits production
The bottleneck is the constraining resource.
- Throughput contribution:
Sales dollars minus direct materials costs and variables such as energy and piecework labor

End of Chapter 4

Chapter 5

Cost Estimation

Learning Objectives

- L.O. 1** Understand the reasons for estimating fixed and variable costs.
- L.O. 2** Estimate costs using engineering estimates.
- L.O. 3** Estimate costs using account analysis.
- L.O. 4** Estimate costs using statistical analysis.
- L.O. 5** Interpret the results of regression output.
- L.O. 6** Identify potential problems with regression data.
- L.O. 7** Evaluate the advantages and disadvantages of alternative cost estimation methods.
- L.O. 8** (Appendix A)
Use Microsoft Excel to perform a regression analysis.
- L.O. 9** (Appendix B)
Understand the mathematical relationship describing the learning phenomenon.



Why Estimate Costs?

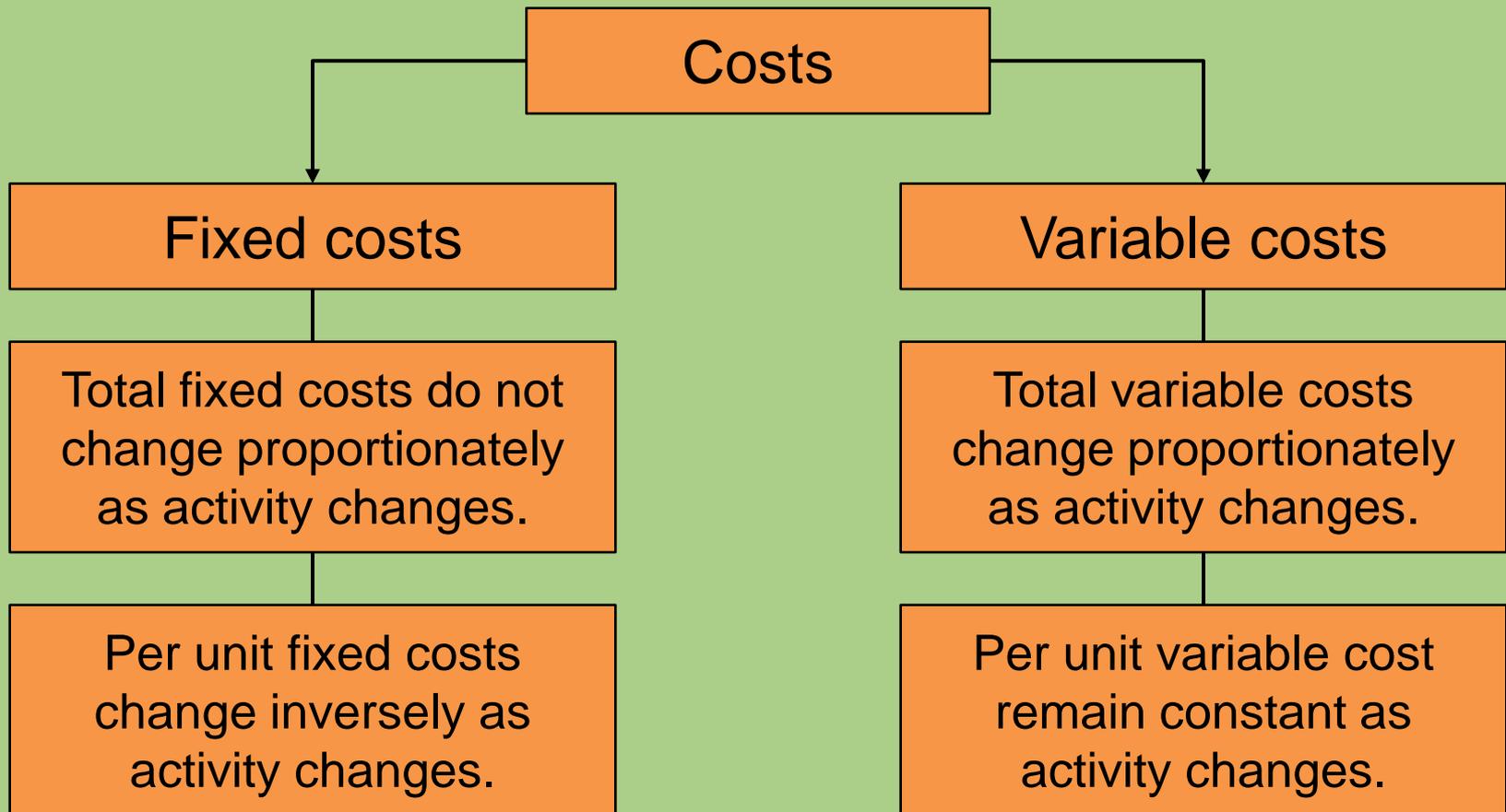
- Managers make decisions and need to compare costs and benefits among alternative actions.

Key question:

- What adds value to the firm?
- Cost estimates can be an important element in helping managers make decisions.

Basic Cost Behavior Patterns

L.O. 1 Understand the reasons for estimating fixed and variable costs.



Methods Used to Estimate Cost Behavior

- Charlene, owner of Charlene's Computer Care (3C), wants to estimate the cost of a new computer repair center.

3 Methods:

- Engineering estimates
- Account analysis
- Statistical methods

Engineering Estimates

L.O. 2 Estimate costs using engineering estimates.

- Cost estimates are based on measuring and then pricing the work involved in a task.
- Identify the activities involved:
 - Labor
 - Rent
 - Insurance
- Estimate the time and cost for each activity.

Engineering Estimates

Advantages:

- Details each step required to perform an operation
- Permits comparison of other centers with similar operations
- Costs for totally new activities can be estimated without prior activity data.

Disadvantages:

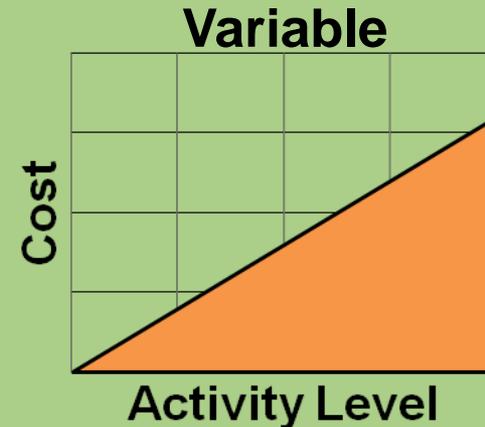
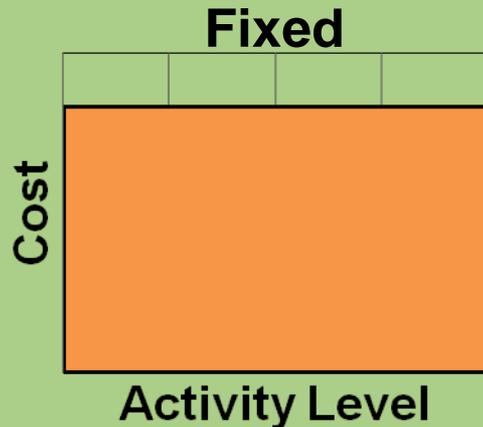
- Can be quite expensive to use
- Based on optimal conditions



Account Analysis

L.O. 3 Estimate costs using account analysis.

- Review each account comprising the total cost being analyzed.
- Identify each cost as either fixed or variable.



Account Analysis

3C Cost estimation using account analysis

Costs for 360 repair-hours

Account	Total	Variable cost	Fixed cost
Office rent	\$ 3,375	\$1,375	\$2,000
Utilities	310	100	210
Administration	3,386	186	3,200
Supplies	2,276	2,176	100
Training	666	316	350
Other	613	257	356
Total	<u>\$10,626</u>	<u>\$4,410</u>	<u>\$6,216</u>
Per repair hour		\$12.25	

Account Analysis

3C Cost estimation using account analysis

Fixed costs + (Variable cost/unit × No. of units) = Total cost

Cost at 360 repair-hours:

$$\$6,216 + (\$12.25 \times 360) = \$10,626$$

Cost at 480 repair-hours:

$$\$6,216 + (\$12.25 \times 480) = \$12,096$$

Account Analysis

Advantages:

- Managers and accountants are familiar with company operations and the way costs react to changes in activity levels.

Disadvantages:

- Managers and accountants may be biased.
- Decisions often have major economic consequences for managers and accountants.

Statistical Cost Estimation

L.O. 4 Estimate costs using statistical analysis.

- Analyze costs within a relevant range, which is the limits within which a cost estimate may be valid.
- Relevant range for a projection is usually between the upper and lower limits (bounds) of past activity levels for which data is available.

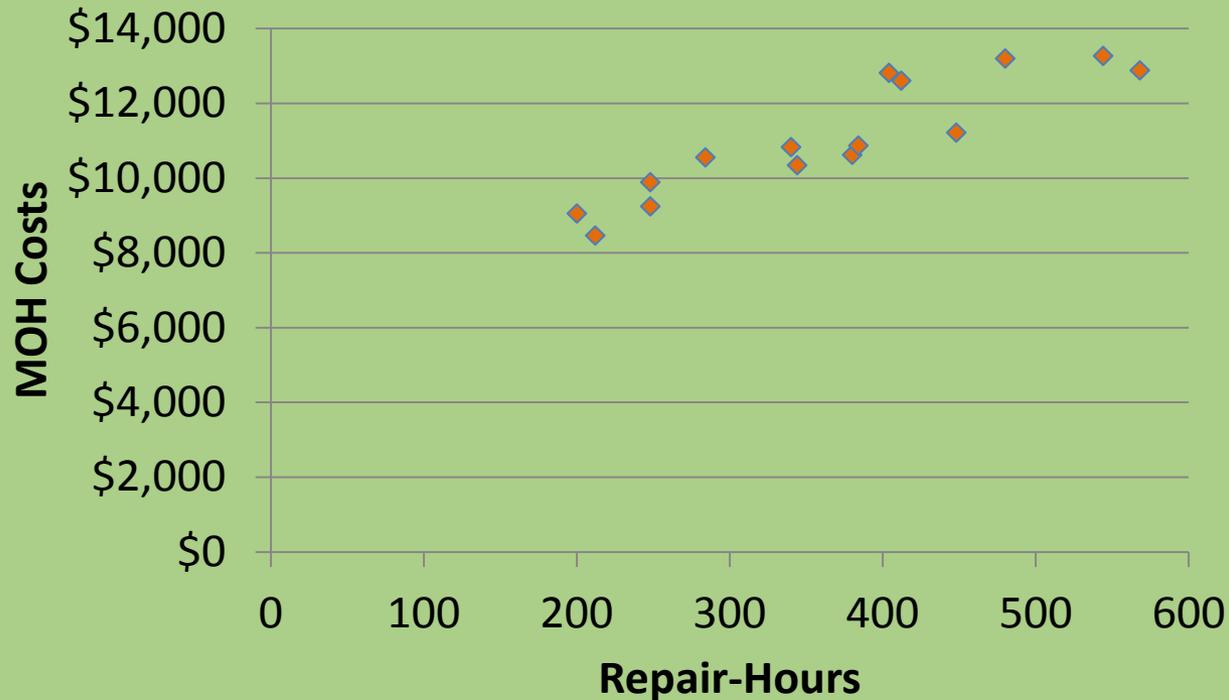
Overhead Cost Estimation for 3C

Month	Overhead costs	Repair-hours
1	\$ 9,891	248
2	\$ 9,244	248
3	\$13,200	480
4	\$10,555	284
5	\$ 9,054	200
6	\$10,662	380
7	\$12,883	568
8	\$10,345	344
9	\$11,217	448
10	\$13,269	544
11	\$10,830	340
12	\$12,607	412
13	\$10,871	384
14	\$12,816	404
15	\$ 8,464	212

These data will be used to estimate costs using a statistical analysis.

Scattergraph

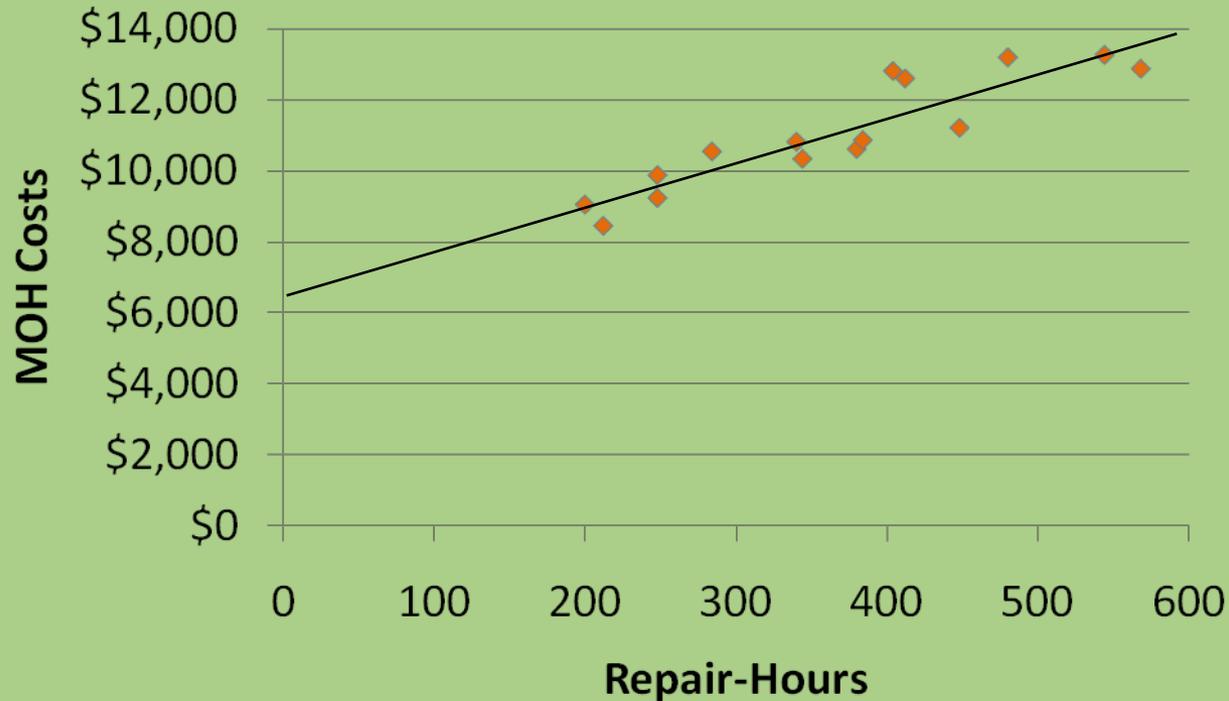
Manufacturing Overhead



Does it look like a relationship exists between repair-hours and overhead costs?

Scattergraph

Manufacturing Overhead



We use “eyeball judgment” to determine the intercept and slope of the line.

Hi-Low Cost Estimation

- This is a method to estimate cost based on two cost observations, the highest and lowest activity level.

Month	Overhead costs	Repair-hours
High	\$12,883	568
Low	\$ 9,054	200
Change	\$ 3,829	368

Hi-Low Cost Estimation

Variable cost per unit (V) =

$$\frac{(\text{Cost at highest activity level} - \text{Cost at lowest activity level})}{(\text{Highest activity level} - \text{Lowest activity level})}$$

Fixed cost (F) =

$$\text{Total cost at highest activity} - (\text{Variable cost} \times \text{Highest activity level})$$

or

$$\text{Total cost at lowest activity} - (\text{Variable cost} \times \text{Lowest activity level})$$

Hi-Low Cost Estimation

$$\text{Variable cost per RH (V)} = \frac{(\$12,883 - \$9,054)}{568 \text{ RH} - 200 \text{ RH}} = \frac{\$3,829}{368 \text{ RH}} = \$10.40 \text{ per RH}$$

$$\text{Fixed costs (F)} = (\$12,883 - (\$10.40 \times 568 \text{ RH})) = \$6,976$$

$$\text{Fixed costs (F)} = (\$9,054 - (\$10.40 \times 200 \text{ RH})) = \$6,974$$

Rounding
difference

Hi-Low Cost Estimation

- How do we estimate manufacturing overhead with 480 repair-hours?

$$TC = F + VX$$

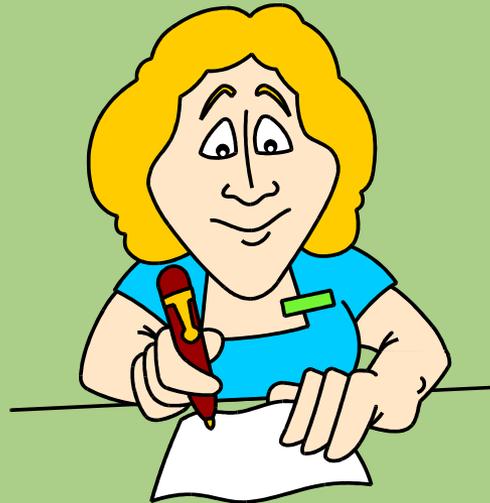
$$TC = \$6,976 + (\$10.40 \times 480) = \$11,968$$

Regression Analysis

- Regression is a statistical procedure to determine the relation between variables.
- It helps managers determine how well the estimated regression equation describes the relations between costs and activities.

Regression Analysis

- Hi-low method:
Uses two data points
- Regression:
Uses all of the data points



Regression Analysis

The Regression Equation:

$$Y = a + bX$$

$$Y = \text{Intercept} + (\text{Slope} \times X)$$

For 3C:

$$\text{OH} = \text{Fixed costs} + (V \times \text{Repair-hours})$$

Interpreting Regression

L.O. 5 Interpret the results of regression output.

- Independent variable:
 - The X term, or predictor
 - The activity that predicts (causes) the change in costs
- Activities:
 - Repair-hours
- Dependent variable:
 - The Y term
 - The dependent variable
 - The cost to be estimated
- Costs:
 - Overhead costs

Interpreting Regression

- The computer output of 3C's scattergraph gives the following formula:

$$\text{Total overhead} = \$6,472 + (\$12.52 \text{ per RH} \times \text{No. of RH})$$

- Estimate 3C's overhead with 480 repair hours.

$$TC = F + VX$$

$$TC = \$6,472 + (\$12.52 \times 480) = \$12,482$$

Interpreting Regression

- Correlation coefficient (R):
This measures the linear relationship between variables. The closer R is to 1.0 the closer the points are to the regression line. The closer R is to zero, the poorer the fit of the regression line.
- Coefficient of determination (R^2):
This is the square of the correlation coefficient. It is the proportion of the variation in the dependent variable (Y) explained by the independent variable(s) (X).

Interpreting Regression

- T-statistic:
This is the value of the estimated coefficient, b , divided by its estimated standard error (Se_b). Generally, if it is over 2, then it is considered significant. If significant, the cost is NOT totally fixed.
- From the data used in the 3C regression, the t -statistic is:

$$\begin{aligned}t &= b \div Se_b \\ &= 12.5230 \div 1.5843 \\ &= 7.9044\end{aligned}$$

Interpreting Regression

- Refer to Exhibit 5.3 in the textbook.
- A 0.91 correlation coefficient means that a linear relationship does exist between repair hours and overhead costs.
- A 0.828 coefficient of determination means that 82.8% of the changes in overhead costs can be explained by changes in repair-hours.
- Both have t-statistics that are greater than 2, so the cost is not totally fixed.

Multiple Regression

- Multiple regression:
When more than one predictor (x) is in the model
- Is repair-hours the only activity that drives overhead costs at 3C?
- Predictors:
 X_1 : Repair-hours
 X_2 : Parts cost
- Equation:
$$TC = VC(X_1) + VC(X_2) + FC$$

Multiple Regression Output

- The adjusted R-squared is the correlation coefficient squared and adjusted for the number of independent variables used to make the estimate.
- The statistics supplied with the output (rounded off) are:
 - Correlation coefficient (R) = 0.953
 - $R^2 = 0.908$
 - Adjusted $R^2 = 0.892$

Multiple Regression Output

$$TC = F + V_1X_1 + V_2X_2$$

$$TC = \$6,416 + (\$8.61 \times 480) + (77\% \times 3,500)$$

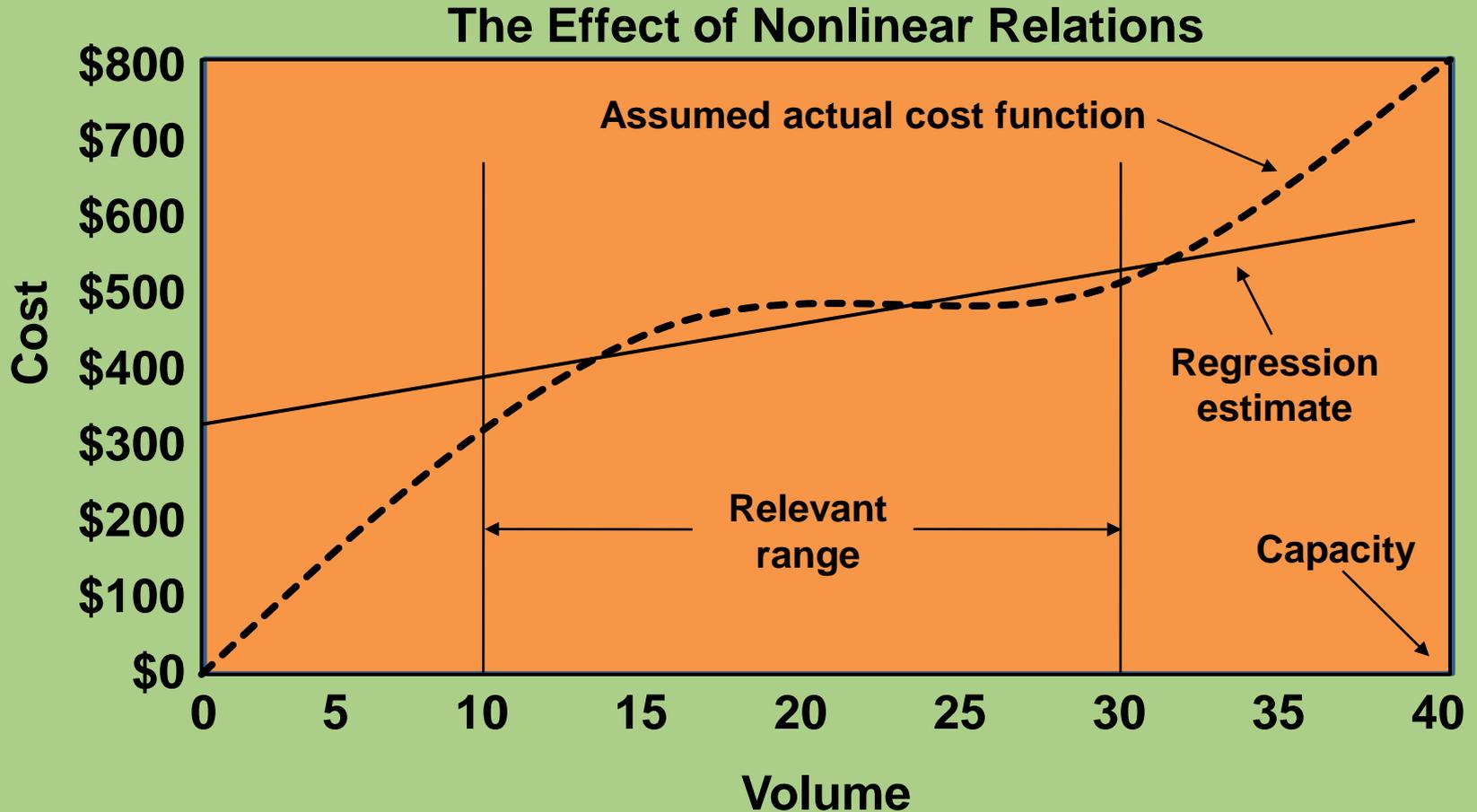
$$TC = \$13,244$$

Practical Implementation Problems

L.O. 6 Identify potential problems with regression data.

- Effect of:
 - Nonlinear relations
 - Outliers
 - Spurious relations
 - Using data that do not fit the assumptions of regression analysis

Practical Implementation Problems

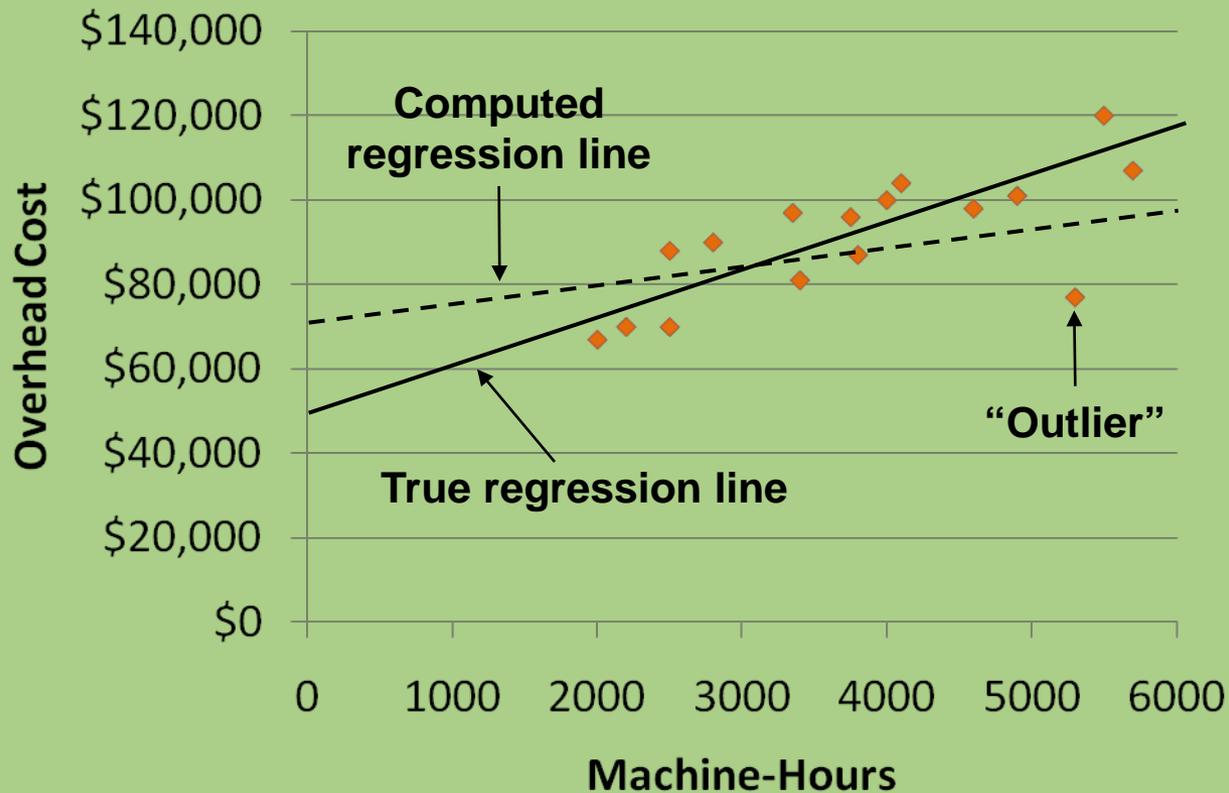


Practical Implementation Problems

- Problem:
Attempting to fit a linear model to nonlinear data
Likely to occur near full-capacity
- Solution:
Define a more limited relevant range.
(Example: from 25-75% capacity)
or design a nonlinear model.

Practical Implementation Problems

The Effect of Outliers on the Computed Regression



Practical Implementation Problems

- Problem:
Outliers move the regression line.
- Solution:
Prepare a scattergraph, analyze the graph, and eliminate highly unusual observations before running the regression.

Practical Implementation Problems

The Effect of Spurious Relations

- Problem:
Using too many variables in the regression (i.e., using direct labor to explain materials costs). Although the association is very high, actually both are driven by output.
- Solution:
Carefully analyze each variable and determine the relationship among all elements before using in the regression.

Practical Implementation Problems

The Effect of Using Data That Do Not Fit the Assumptions of Regression

- Problem:
If the assumptions in the regression are not satisfied, then the regression is not reliable.
- Solution:
There is no clear solution. Limit time to help assure costs behavior remains constant, yet this causes the model to be weaker due to less data.

Learning Phenomenon

- Learning phenomenon is the systematic relationship between the amount of experience in performing a task and the time required to perform it.

Statistical Cost Estimation

L.O. 7 Evaluate the advantages and disadvantages of alternative cost estimation methods.

Advantages:

- Reliance on historical data is relatively inexpensive.
- Computational tools allow for more data to be used than for non-statistical methods.

Disadvantages:

- Reliance on historical data may be the only readily available, cost-effective basis for estimating costs.
- Analysts must be alert to cost-activity changes.

Effect of Different Methods on Cost Estimates

- Estimated manufacturing overhead with 480 repair-hours.

Method	Total estimated costs	Estimated fixed costs	Estimated variable costs
Account analysis	\$12,096	\$6,216	\$12.25/repair-hour
High-low	\$11,968	\$6,976	\$10.40/repair-hour
Simple regression	\$12,482	\$6,472	\$12.52/repair-hour
Multiple regression	\$13,244	\$6,416	\$8.61/repair-hour + 77% of parts cost

Data Problems

- Missing data
- Outliers
- Allocated and discretionary costs
- Inflation
- Mismatched time periods

Appendix A: Microsoft as a Tool

L.O. 8 (Appendix A) Use Microsoft Excel to perform a regression analysis.

- Many software programs exist to aid in performing regression analysis.
- In order to use Microsoft Excel, the Analysis Tool Pak must be installed.
- Data is entered and the user then selects the data and type of regression analysis to be generated.
- The analyst must be well schooled in regression in order to determine the meaning of the output.

Learning Phenomenon

L.O. 9 (Appendix B) Understand the mathematical relationship describing the learning phenomenon.

- This is the systematic relationship between the amount of experience in performing a task and the time required to perform it.

Unit	Time to produce	Calculation of time
First unit	100.0 hours	(assumed)
Second unit	80.0 hours	$80\% \times 100$ hours
Fourth unit	64.0 hours	$80\% \times 80$ hours
Eighth unit	51.2 hours	$80\% \times 64$ hours

- Impact: It causes the unit price to decrease as production increases.
- This implies a nonlinear model.

End of Chapter 5

Chapter 7

Job Costing

Learning Objectives

- L.O. 1** Explain what *job* and *job shop* mean.
- L.O. 2** Assign costs in a job cost system.
- L.O. 3** Account for overhead using predetermined rates.
- L.O. 4** Apply job costing methods in service organizations.
- L.O. 5** Understand the ethical issues in job costing.
- L.O. 6** Describe the difference between jobs and projects.

Defining a Job

L.O. 1 Explain what *job* and *job shop* mean.

- Job:
Unit of a product that is easily distinguishable from other units
- Job shop:
Firm that produces jobs

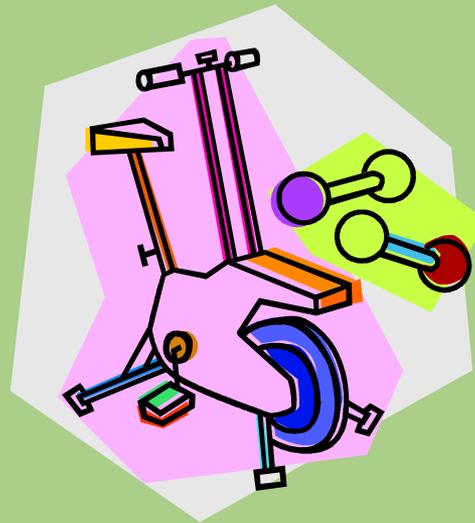
Using Accounting Records in a Job Shop

- Job cost sheet:
Record of the cost of the job kept in the accounting system
- Subsidiary ledger account:
Account that records financial transactions for a specific job, customer, or vendor (Job 1 WIP, Job 2 WIP, Job 3 WIP, etc.)
- Control account:
Account in the general ledger that summarizes a set of subsidiary ledger accounts

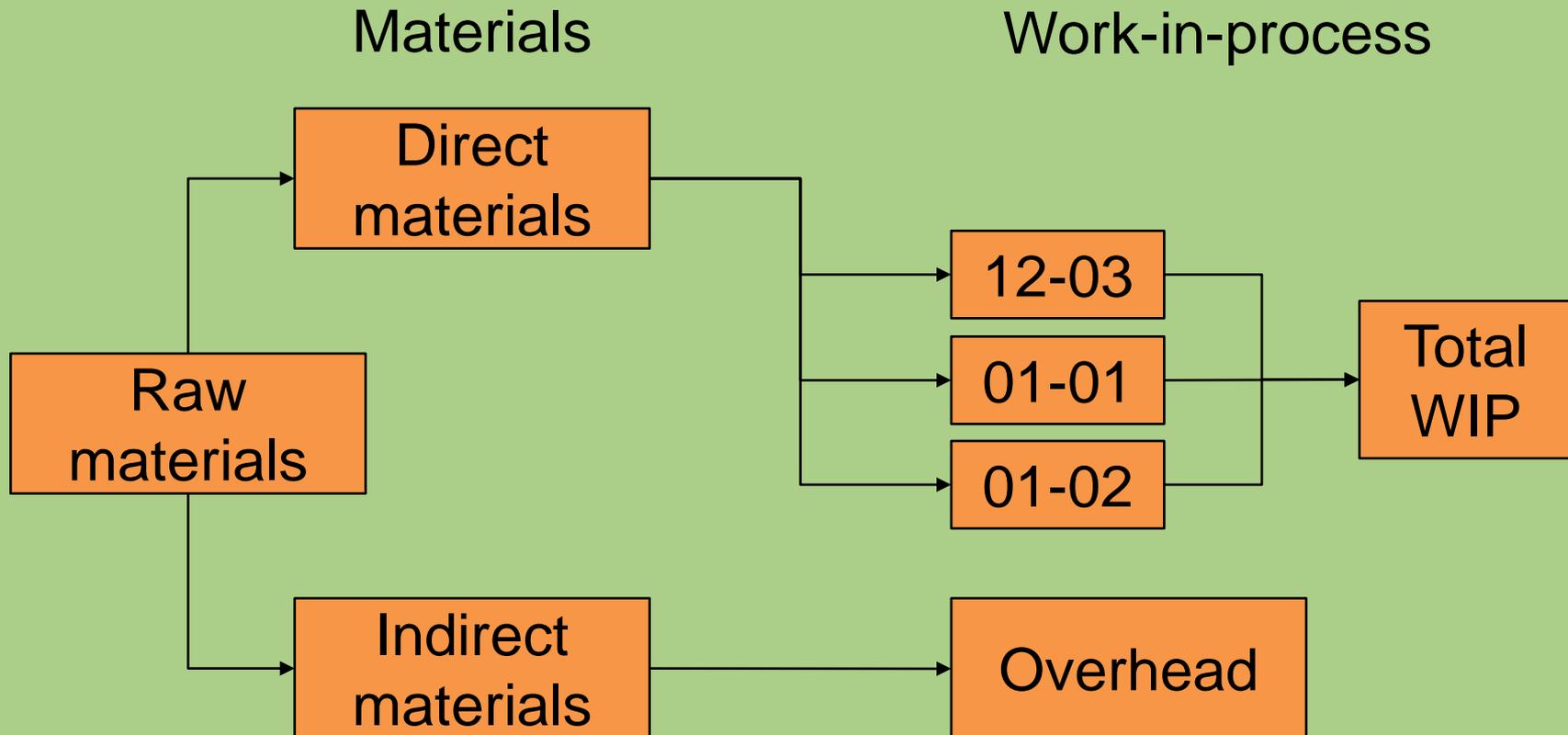
Production Process at InShape

L.O. 2 Assign costs in a job cost system.

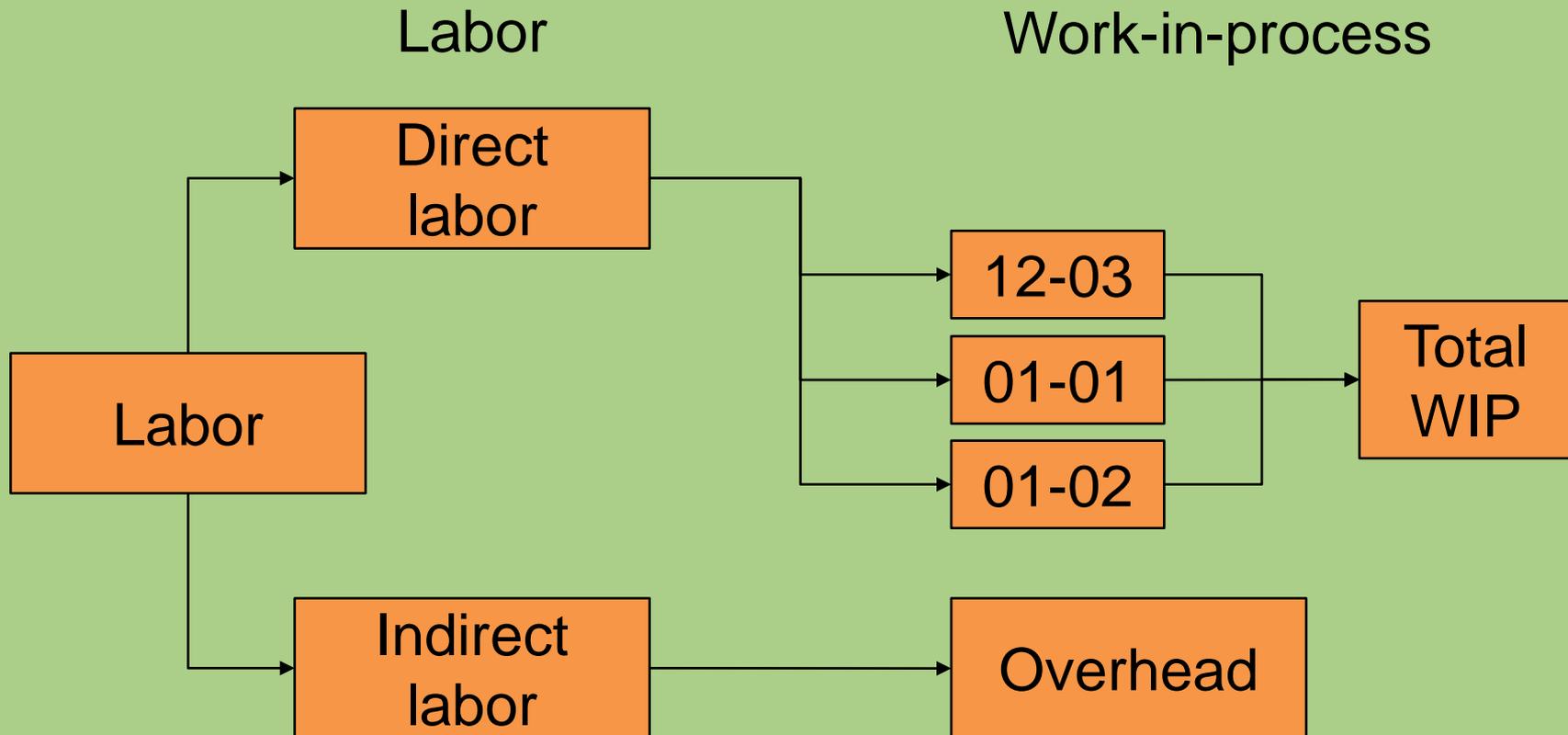
- Suppose InShape, Inc. manufactures custom workout and training equipment for schools and gyms.



Records of Costs at InShape



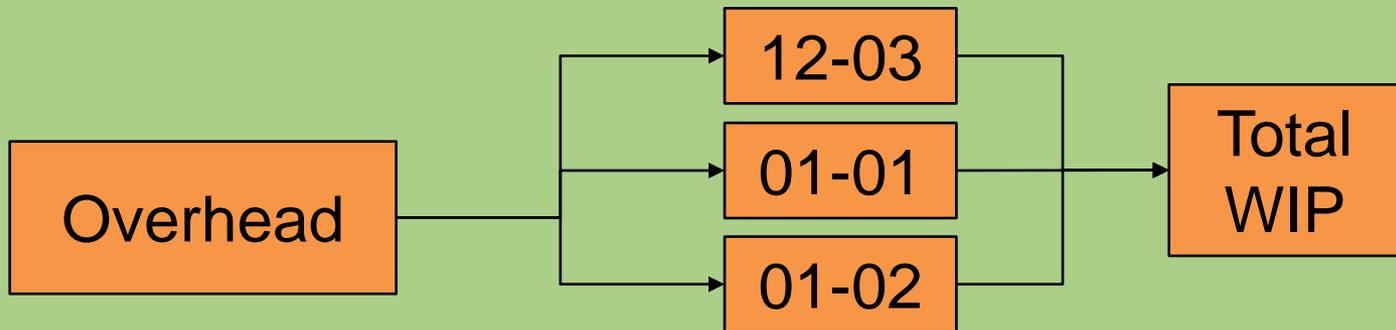
Records of Costs at InShape



Records of Costs at InShape

Overhead

Work-in-process



- OH costs are applied to each job using the POHR.

Inventory Accounts

- On January 1, InShape has the following balances in each of its three inventory accounts:

Direct materials inventory		\$30,000
Work-in-process inventory	(Job 12-03)	\$41,000
Finished goods inventory	(Job 12-02)	\$27,000

- Now, let's record January's activities for InShape.

Direct Materials

- InShape purchased \$135,000 of raw materials on account.

Materials Inventory	
BB	30,000
(1)	135,000

Accounts Payable	
17,000	BB
135,000	(1)

Direct Materials

- InShape used \$12,000 of direct materials for 12-03. They also started 01-01 and 01-02 and used \$102,000 and \$15,000 of direct materials respectively.

Materials Inventory	
BB 30,000	
(1) 135,000	129,000 (2)

WIP Inventory	
BB 41,000	
(2) 129,000	

WIP 12-03		WIP 01-01		WIP 01-02	
BB 41,000					
(2) 12,000		(2) 102,000		(2) 15,000	

Direct Materials

- Direct labor of \$98,000 was incurred (\$16,000 for 12-03, \$71,000 for 01-01, and \$11,000 for 01-02).

WIP Inventory	
BB	41,000
(2)	129,000
(3)	98,000

Wages Payable	
	98,000 (3)

WIP 12-03		WIP 01-01		WIP 01-02	
BB	41,000	(2)	102,000	(2)	15,000
(2)	12,000	(3)	71,000	(3)	11,000
(3)	16,000				

Manufacturing Overhead

- InShape incurred the following “actual” overhead costs in January:

JE#	Item	Amount
(4)	Indirect material requisitioned	\$12,000
(5)	Indirect labor incurred	9,500
(6)	Utilities & other factory expenses (credit A/P)	13,750
(6)	Prepaid factory expenses used	5,000
(6)	Factory depreciation	<u>11,200</u>
	Total actual overhead expenses	\$51,450

- With this information, let's continue recording InShape's activities.

Manufacturing Overhead

MOH Control		Prepaid Expense		Accum. Depreciation	
(4)	12,000		5,000 (6)		11,200 (6)
(5)	9,500				
(6)	13,750				
(6)	5,000				
(6)	11,200				

Materials Inventory		Accounts Payable		Wages Payable		
<i>BB</i>	30,000	(4)	12,000	17,000	<i>BB</i>	98,000 (3)
(1)	135,000			135,000 (1)		9,500 (5)
				13,750 (6)		

How Manufacturing Overhead Costs Are Recorded at InShape

- Two common events that lead to manufacturing overhead being recorded are:
 1. Preparing financial statements
 2. Completing a job



Predetermined Rate

L.O. 3 Account for overhead using predetermined rates.

- The estimated manufacturing overhead predetermined rate is the estimated overhead divided by the estimated activity for the allocation base.
- InShape uses estimates based on annual manufacturing overhead and annual production volume.

Why?

- Because it does not want erratic or monthly costs or production volumes to affect the long-run production costs.

Application of Manufacturing Costs to Jobs

- Overhead is allocated to jobs using direct labor cost as its base.
- InShape estimated that the manufacturing overhead for the coming year would be \$600,000 and that direct labor cost would be \$1,200,000.
- What is the predetermined overhead rate?

Application of Manufacturing Costs to Jobs

$$\text{POHR} = \frac{\text{Estimated overhead \$}}{\text{Estimated allocation base}}$$

└─ Direct labor costs

$$\text{POHR} = \$600,000 \div \$1,200,000 = \$0.50/\text{DL\$}$$

Application of Manufacturing Costs to Jobs

Job #	DL\$	Rate	OH Applied
12-03	\$16,000	0.50	\$ 8,000
01-01	71,000	0.50	35,500
01-02	<u>11,000</u>	0.50	<u>5,500</u>
Total	\$98,000	0.50	\$49,000

Application of Manufacturing Costs to Jobs

MOH - Applied

43,500 (7)
5,500 (11)

WIP 12-03

BB	41,000
(2)	12,000
(3)	16,000
(7)	8,000

WIP 01-01

(2)	102,000
(3)	71,000
(7)	35,500

WIP 01-02

(2)	15,000
(3)	11,000
(11)	5,500

Cost of Jobs Completed in January

- InShape completed Jobs 12-03 and 01-01 and transferred them to Finished Goods.

Job Ticket Summary	Job 12-03	Job 01-01
Beginning inventory January 1	\$41,000	\$ -0-
Direct materials – January	12,000	102,000
Direct labor – January	16,000	71,000
OH applied – January	<u>8,000</u>	<u>35,500</u>
Total cost on job tickets	\$77,000	\$208,500

- What is the journal entry?

Cost of Jobs Completed in January

Finished Goods Inventory (12-03)	77,000	
Finished Goods Inventory (01-01)	208,500	
Work-in-Process Inventory (12-03)		77,000
Work-in-Process Inventory (01-01)		208,500

- Jobs 12-02 and 12-03 were sold for \$35,000 and \$95,000, respectively.
- What are the journal entries?

Cost of Jobs Sold in January

Cost of Goods Sold (12-02)	27,000	
Cost of Goods Sold (12-03)	77,000	
Finished Goods Inventory (12-02)		27,000
Finished Goods Inventory (12-03)		77,000

Accounts Receivable (12-02)	35,000	
Accounts Receivable (12-03)	95,000	
Revenue (12-02)		35,000
Revenue (12-03)		95,000

Cost Flows Through T-Accounts

Materials Inventory	
EB 24,000	

Work-in-Process Inventory	
EB 31,500	

Finished Goods Inventory	
EB 208,500	

Cost of Goods Sold	
EB 104,000	

The Job Cost Sheet

INSHAPE, INC.

Job Number: 01-01

Customer: Eastern State College

Date Started: 1/11

Date completed: 1/26

Description: Assemble and test athletic equipment

Direct Materials			Direct Labor			Overhead			Total
Date	Req.#	Cost	Date	BN	Cost	Date	Cost	Cost.	
		\$			\$			\$	
Total		\$			\$			\$	\$

The Job Cost Sheet

Total Costs for Job 01-01

Direct materials	\$102,000
Direct labor	71,000
Manufacturing overhead	<u>35,500</u>
Total	<u><u>\$208,500</u></u>
Transferred to finished goods inventory	
Direct materials	\$102,000
Direct labor	71,000
Manufacturing overhead	<u>35,500</u>
Total	<u><u>\$208,500</u></u>

An Alternative Method of Recording and Applying Manufacturing Overhead

- Assume InShape maintains two manufacturing overhead accounts:
- Manufacturing Overhead Control
Used to track all actual overhead expenses
- Applied Manufacturing Overhead
Used to allocate overhead to jobs based on the predetermined OH rate
- Some companies combine these two accounts into one account.

An Alternative Method of Recording and Applying Manufacturing Overhead

- Underapplied overhead
The excess of actual overhead costs incurred over applied overhead costs
- Overapplied overhead
The excess of applied overhead costs over actual overhead costs incurred



Writing Off Over- or Underapplied Overhead

- The two manufacturing overhead accounts are not balance sheet accounts.
- The combined ending balance must be zero.
- The combined OH is \$2,450 underapplied.

Manufacturing Overhead Control	
12,000	
9,500	
13,750	
5,000	
11,200	
<hr/> 51,450	

Applied Manufacturing Overhead	
	49,000
	<hr/> 49,000

Writing Off Over- or Underapplied Overhead

Applied Manufacturing Overhead	Cost of Goods Sold
49,000	104,000
2,450	2,450
51,450	106,450

- After entry, the applied and control overhead accounts sum to zero.

Writing Off Over- or Underapplied Overhead

- Some firms use only one OH account.
- In this condition, the debit side of the OH account contains actual data and the credit side contains applied data.
- For either condition of under- or overapplied, actual must equal applied in the Overhead control account at the end of the period.

Overhead			Cost of Goods Sold	
12,000	49,000		104,000	
9,500	2,450	→	2,450	
13,750			106,450	
5,000				
11,200				
51,450	51,450			

Allocating Over- or Underapplied Overhead

- Some companies prorate the over/under applied MOH to WIP, FG, and COGS.

Accounts at January 31

	Costs	% of Total
Work-in-Process Inventory	\$ 31,500	9.2%
Finished Goods Inventory	208,500	60.6%
Cost of Goods Sold	<u>104,000</u>	<u>30.2%</u>
Total	\$344,000	100.0%

Allocating Over- or Underapplied Overhead

- Allocate underapplied overhead to finished goods, cost of good sold and WIP.

Work-in-Process Inventory

31,500	
225	
(2,450 × 0.092)	

Finished Goods Inventory

208,500	
1,485	
(2,450 × 0.606)	

Cost of Goods Sold

104,000	
740	
(2,450 × 0.302)	

Overhead

51,450	49,000
	2,450

Using Normal, Actual, and Standard Costing

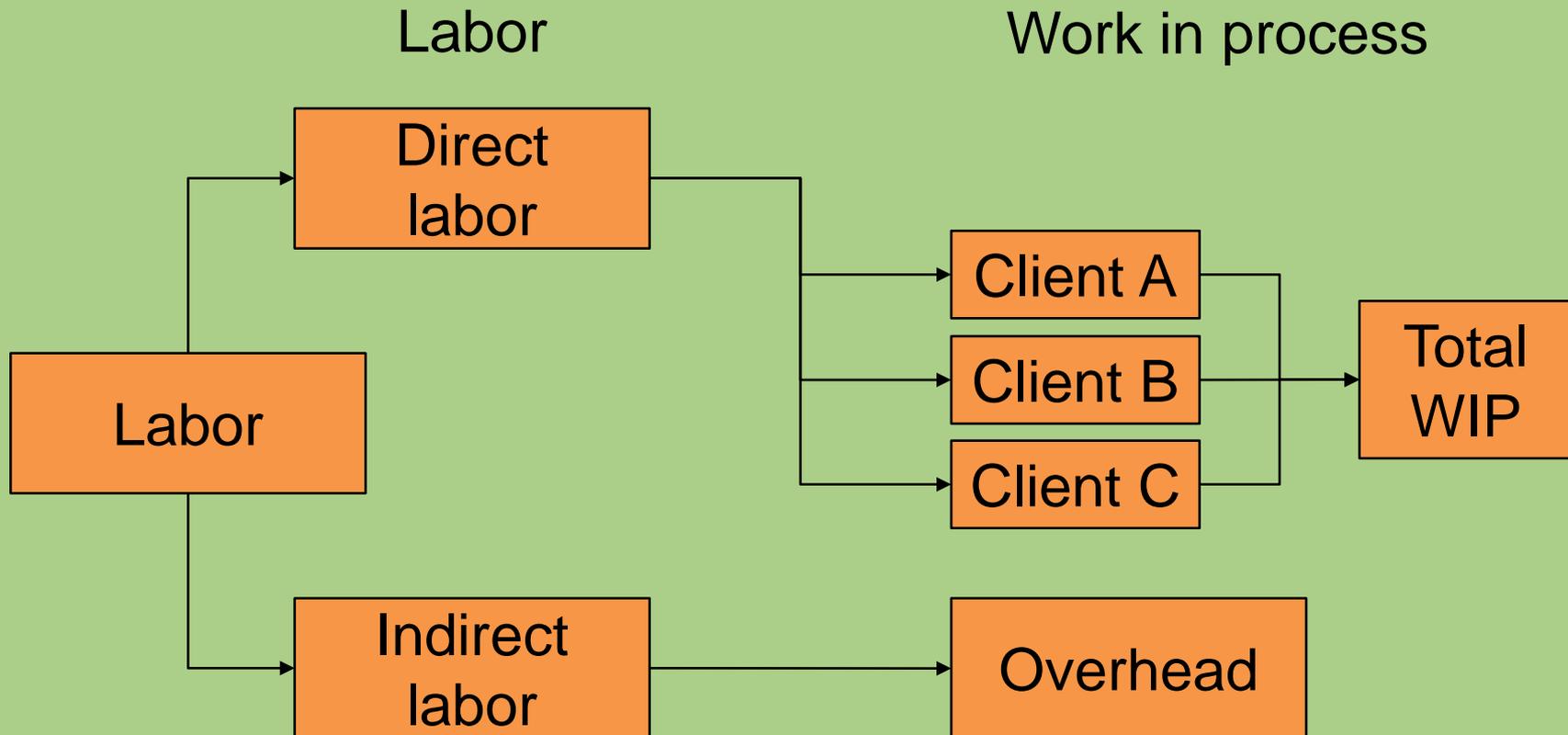
- Normal:
Cost of job determined by actual direct material, actual direct labor, and applied overhead using the POHR and the actual allocation base.
- Actual:
Cost of job determined by actual direct material, actual direct labor, and applied overhead using actual overhead rate and the actual allocation base.
- Standard:
Cost of job determined by standard (budgeted) direct material, standard direct labor, and applied overhead using the POHR and a standard (budgeted) allocation base.

Using Job Costing in Service Organizations

L.O. 4 Apply job costing methods in service organizations.

- Service organizations use fewer direct materials than manufacturing companies.
- Service companies' overhead accounts have slightly different names.
- Finished goods (or services) are charged to Cost of Services Billed.

Using Job Costing in Service Organizations



Ethical Issues

L.O. 5 Understand the ethical issues in job costing.

- Improproprieties Include:
 - Misstating the stage of completion
 - Charging costs to the wrong jobs
 - Misrepresenting the cost of jobs



Managing Projects

L.O. 6 Describe the difference between jobs and projects.

- A project is a complex job that often takes months or years to complete and requires the work of many departments, divisions, or subcontractors.

End of Chapter 7

Chapter 8

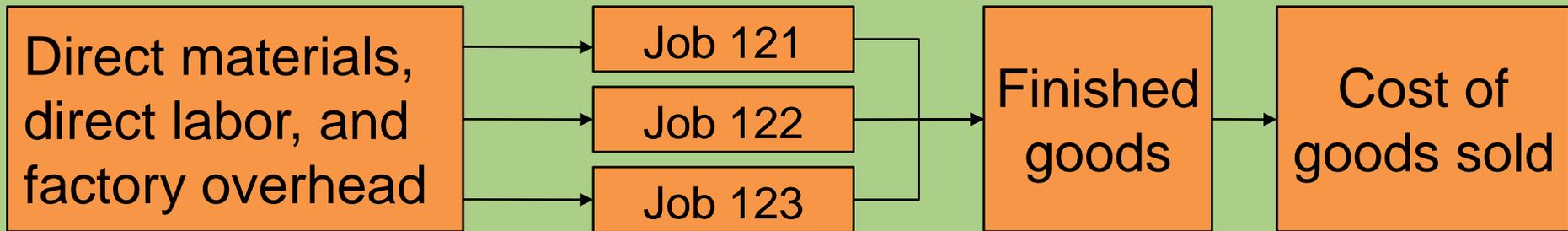
Process Costing

Learning Objectives

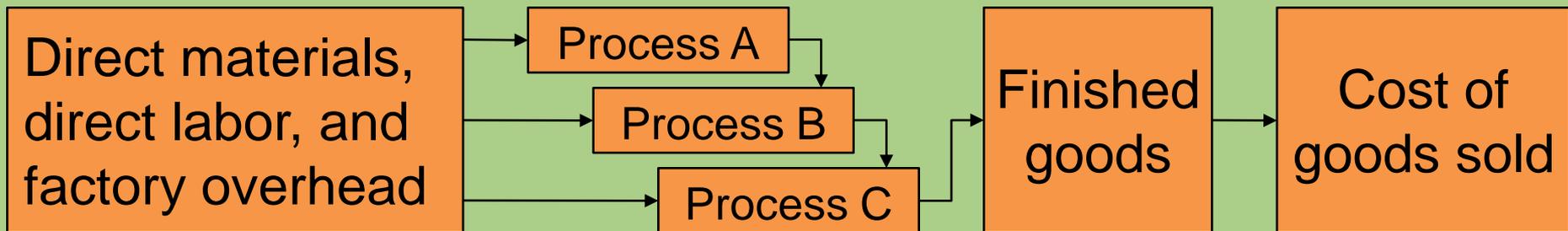
- L.O. 1** Explain the concept and purpose of equivalent units.
- L.O. 2** Assign costs to products using a five-step process.
- L.O. 3** Assign costs to products using weighted-average costing.
- L.O. 4** Prepare and analyze a production cost report.
- L.O. 5** Assign costs to products using first-in, first-out (FIFO) costing.
- L.O. 6** Analyze the accounting choice between FIFO and weighted-average costing.
- L.O. 7** Know when to use process or job costing.
- L.O. 8** Compare and contrast operation costing with job costing and process costing.

Comparison of Cost Flows

Job Costing



Process Costing



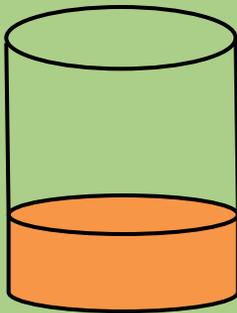
Determining Equivalent Units

L.O. 1 Explain the concept and purpose of equivalent units.

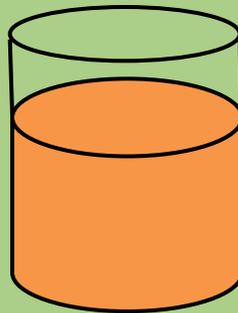
- Equivalent units:
Number of complete physical units to which units in inventories are equal in terms of work done to date.

Determining Equivalent Units

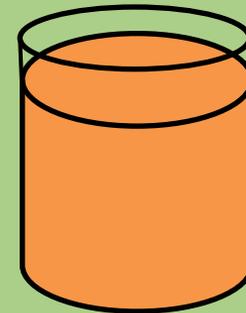
- At month end, three cans of paint are filled as indicated.



30%



75%



90%

$$(30\% + 75\% + 90\%) \div 3 = 65\%$$

- Therefore, ending work-in-process inventory is 65 percent complete, on average.

Using Product Costing in a Process Industry

L.O. 2 Assign costs to products using a five-step process.

Step 1: Measure the physical flow of resources.

Step 2: Compute the equivalent units of production.

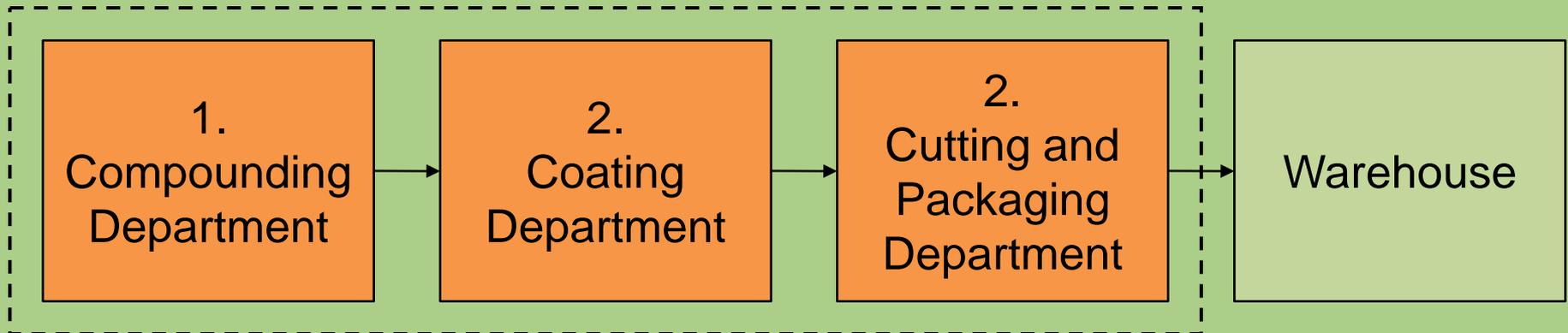
Step 3: Identify the product costs for which to account.

Step 4: Compute the costs per equivalent unit.

Step 5: Assign product cost to batches of work.

Using Product Costing in a Process Industry

- Torrance Tape, Inc. (2T), manufactures adhesives and tapes.
- Production at 2T's Valley Plant takes place in three steps.



Measure the Physical Flow of Resources (Step 1)

	Gallons of Compound
Work in process, March 1	20,000 ^a
+ Gallons of adhesive started	<u>92,000</u>
Total gallons to account for	<u><u>112,000</u></u>
= Transferred out to Coating Department	96,000
+ Work-in-process, March 31	<u>16,000^b</u>
Total units accounted for	<u><u>112,000</u></u>

^a 25% complete with respect to conversion costs

^b 30% complete with respect to conversion costs

Compute the Equivalent Units of Production (Step 2)

Compounding Department, March: Equivalent Units

	Physical units	Equivalent units	
		Materials	Conversion
Transferred out	96,000	96,000	96,000
Work-in-process, March 31	16,000 ^a	<u>16,000</u>	<u>4,800</u>
Total work		<u><u>112,000</u></u>	<u><u>100,800</u></u>

^a 30% complete with respect to conversion costs

Identify the Product Costs for Which to Account (Step 3)

Costs:

Work-in-process costs

Current period costs

Work (EU)

Work-in-process EU*

Current period EU

Weighted
average:

Weighted-Average Unit Costs

$$\frac{(\text{Work-in-process costs} + \text{Current period costs})}{(\text{Work-in-process EU} + \text{Current period EU})}$$

Work-in Process Unit Costs

FIFO:

$$\frac{\text{Work-in-process costs}}{\text{Work-in-process EU}}$$

Current Period Unit Costs

$$\frac{\text{Current period costs}}{\text{Current period EU}}$$

*Note: EU is equivalent unit.

Steps 4 and 5

L.O. 3 Assign costs to products using weighted-average costing.

- Compute the costs per equivalent unit:
Weighted-average (Step 4)
- First, Steps 1, 2, and 3 must be revisited.



Measure the Physical Flow of Resources (Step 1)

	Gallons of Compound
Work in process, March 1	20,000 ^a
+ Gallons of adhesive started	<u>92,000</u>
Total gallons to account for	<u><u>112,000</u></u>
= Transferred out to Coating Department	96,000
+ Work-in-process, March 31	<u>16,000^b</u>
Total units accounted for	<u><u>112,000</u></u>

^a 25% complete with respect to conversion costs

^b 30% complete with respect to conversion costs

Compute the Equivalent Units of Production (Step 2)

Compounding Department, March: Equivalent Units

	Physical units	Equivalent units	
		Materials	Conversion
Transferred out	96,000	96,000	96,000
Work-in-process, March 31	16,000	<u>16,000^a</u>	<u>4,800^b</u>
Total work		<u><u>112,000</u></u>	<u><u>100,800</u></u>

^a 16,000 units × 100% (all materials added in beginning)

^b 16,000 units × 30%

Identify the Product Costs for Which to Account (Step 3)

	Total costs	Materials costs	Conversion costs
Work in process, March 1	\$ 24,286	\$ 16,160	\$ 8,126
Current costs, March	<u>298,274</u>	<u>84,640</u>	<u>213,634</u>
Total	<u>\$322,560</u>	<u>\$100,800</u>	<u>\$221,760</u>

Compute the Cost per Equivalent Unit (Step 4)

	Total costs	Materials costs	Conversion costs
Total costs (Step 3)	\$322,560	\$100,800	\$221,760
Total equivalent units (Step 2)		112,000	100,800
Cost per equivalent unit		\$ 0.90	\$ 2.20

Assign Product Costs to Batches of Work (Step 5)

	Total	Materials costs	Conversion costs
Transferred out:			
Equivalent units		96,000	96,000
Cost per equivalent unit		<u>\$ 0.90</u>	<u>\$ 2.20</u>
Cost assigned	\$297,600	\$ 86,400	\$211,200
Work-in-process, March 31			
Equivalent units		16,000	4,800
Cost per equivalent unit		<u>\$ 0.90</u>	<u>\$ 2.20</u>
Cost assigned	<u>24,960</u>	<u>14,400</u>	<u>10,560</u>
Total cost assigned	<u>\$322,560</u>	<u>\$100,800</u>	<u>\$221,760</u>

The Production Cost Report

L.O. 4 Prepare and analyze a production cost report.

- The production cost report summarizes the production and cost results for a period.
- It is used by managers to monitor production and cost flows
- Following is 2T's Compounding Department production cost report (weighted-average processing costing) for March.

Production Cost Report: Weighted-Average Process Costing

<i>Flow of units</i>	Physical units	Equivalent units	
		Materials	Conversion
Units to be accounted for:			
In work-in-process beginning inventory	20,000 ^a		
Units started this period	<u>92,000</u>		
Total units to account for	112,000		
Units accounted for:			
Completed and transferred out	96,000	96,000	96,000
In work-in-process ending inventory	<u>16,000</u>	<u>16,000^a</u>	<u>4,800^b</u>
Total units accounted for	112,000	112,000	100,800

^a 100 % complete with respect to materials

^b 30% complete with respect to conversion

Production Cost Report: Weighted-Average Process Costing

<i>Flow of costs</i>	Total	Materials Costs	Conversion Costs
Costs to be accounted for:			
Work-in-process beginning inventory	\$ 24,286	\$ 16,160	\$ 8,126
Current period costs	<u>298,274</u>	<u>84,640</u>	<u>213,634</u>
Total costs to be accounted for	\$322,560	\$100,800	\$221,760
Cost per equivalent unit		\$ 0.90 ^c	\$ 2.20 ^d
Costs accounted for:			
Costs assigned to transferred-out units	\$297,600	\$ 86,400 ^e	\$211,200 ^f
Costs assigned to WIP ending inventory	<u>24,960</u>	<u>14,400^g</u>	<u>10,560^h</u>
Total costs accounted for	\$322,560	\$100,800	\$221,760

^c \$100,000 ÷ 112,000 EU

^d \$221,760 ÷ 100,800 EU

^e 96,000 EU × \$0.90 per EU

^f 96,000 EU × \$2.20 per EU

^g 16,000 EU × \$0.90 per EU

^h 4,800 EU × \$2.20 per EU

Assigning Costs Using FIFO

L.O. 5 Assign costs to products using first-in, first-out (FIFO) costing.

- Use the same five-step process.
- Step 1: Measure the physical flow of resources.
- Step 2: Compute the equivalent units of production.
- Step 3: Identify the product costs for which to account.
- Step 4: Compute the costs per equivalent unit.
- Step 5: Assign product cost to batches of work.

Measure the Physical Flow of Resources (Step 1)

- Exactly the same as weighted-average.

	Gallons of Compound
Work in process, March 1	20,000 ^a
+ Gallons of adhesive started	<u>92,000</u>
Total gallons to account for	112,000
= Transferred out to Coating Department	96,000
+ Work-in-process, March 31	<u>16,000^b</u>
Total units accounted for	112,000

^a 25% complete with respect to conversion costs

^b 30% complete with respect to conversion costs

Compute the Equivalent Units of Production (Step 2)

	Physical units	Equivalent units	
		Materials	Conversion
From beginning work in process	20,000	20,000	20,000
Started and completed	<u>76,000</u>	<u>76,000</u>	<u>76,000</u>
Total completed and transferred out	96,000	96,000	96,000
In work-in-process inventory	<u>16,000</u>	<u>16,000</u>	<u>4,800^b</u>
Total units accounted for	112,000	112,000	100,800
Less work from beginning WIP	<u>20,000</u>	<u>20,000</u>	<u>5,000^c</u>
New work done in March	<u><u>92,000</u></u>	<u><u>92,000</u></u>	<u><u>95,800</u></u>

^a 100% complete with respect to materials

^b 30% complete with respect to conversion

^c 20,000 units × 25% complete

Identify the Product Costs for Which to Account (Step 3)

- Exactly the same as weighted-average.

	Total costs	Materials costs	Conversion costs
Work-in-process, March 1	\$ 24,286	\$ 16,160	\$ 8,126
Current costs, March	<u>298,274</u>	<u>84,640</u>	<u>213,624</u>
Total	\$322,560	\$100,800	\$221,760

Compute the Cost per Equivalent Unit (Step 4)

	Total costs	Materials costs	Conversion costs
Current costs, March	\$298,274	\$84,640	\$213,634
Total equivalent units (Step 2)		92,000 ^d	95,800 ^e
Cost per equivalent unit		\$ 0.92	\$ 2.23

^d \$84,640 ÷ 92,000 equivalent units

^e \$213,634 ÷ 92,000 equivalent units

- Note: Include only current period costs and activities.

Assign Product Costs to Batches of Work (Step 5)

	Total	Materials costs	Conversion costs
Costs from beginning WIP	\$ 24,286	\$ 16,160	\$ 8,126
Current costs to complete beginning WIP inventory	<u>33,450</u>	<u>-0-</u>	<u>33,450^f</u>
Total costs from beginning WIP inventory	\$ 57,736	\$ 16,160	\$ 41,576
Current costs of units started and completed	<u>239,400</u>	<u>69,920^g</u>	<u>169,480^h</u>
Total costs transferred out	\$297,136	\$ 86,080	\$211,056
Costs assigned to WIP ending inventory	<u>25,424</u>	<u>14,720ⁱ</u>	<u>10,704^j</u>
Total costs accounted for	<u>\$322,560</u>	<u>\$100,800</u>	<u>\$221,760</u>

^f 15,000 EU × \$2.23 per EU ^g 76,000 EU × \$0.92 ^h 76,000 EU × \$2.23 per EU

ⁱ 16,000 EU × \$0.92 per EU ^j 4,800 EU × \$2.23 per EU

Determining Which is Better: FIFO or Weighted-Average?

L.O. 6 Analyze the accounting choice between FIFO and weighted-average costing.

- **Weighted-average:**
Does not separate prior period and current period activities and costs.
- **FIFO:**
Separates prior period and current period activities and traces the prior period and current period costs to the respective units.

Determining Which is Better: FIFO or Weighted Average?

- Comparison of weighted-average and FIFO process costing (2T's Compounding Department)

	Weighted- average	FIFO
Equivalent unit costs:		
Materials	\$ 0.90	\$ 0.93
Conversion costs	2.20	2.23
Batch costs:		
Cost goods transferred out	\$297,600	\$297,136
Work-in-process, ending inventory	<u>24,960</u>	<u>25,424</u>
Total costs assigned	<u>\$322,560</u>	<u>\$322,560</u>

Using Costs Transferred in from Prior Departments

- Prior department costs are costs incurred in one department and transferred to a subsequent department.
- It is important to distinguish between prior ***department*** costs and prior ***period*** costs.
- Prior period costs are costs that were incurred in a previous accounting period.

Choosing between Job and Process Costing

L.O. 7 Know when to use process or job costing.

Job Costing

An accounting system that traces costs to individual units or to specific jobs, contracts, or batches of goods.

Custom homes
Movies
Services

Process Costing

An accounting system used when identical units are produced through a series of uniform production steps.

Corn flakes
Beverages
Paint

Operation Costing

L.O. 8 Compare and contrast operation costing with job costing and process costing.

- Operation costing is a hybrid of job and process costing.
- It is used in manufacturing goods that have some common characteristics plus some individual characteristics.

Operation Costing

Job Costing

Job shops make customized products.

Operations Costing

Operations separate materials for each batch; common processes are used to produce products.

Process Costing

Mass production is used in continuous processes.

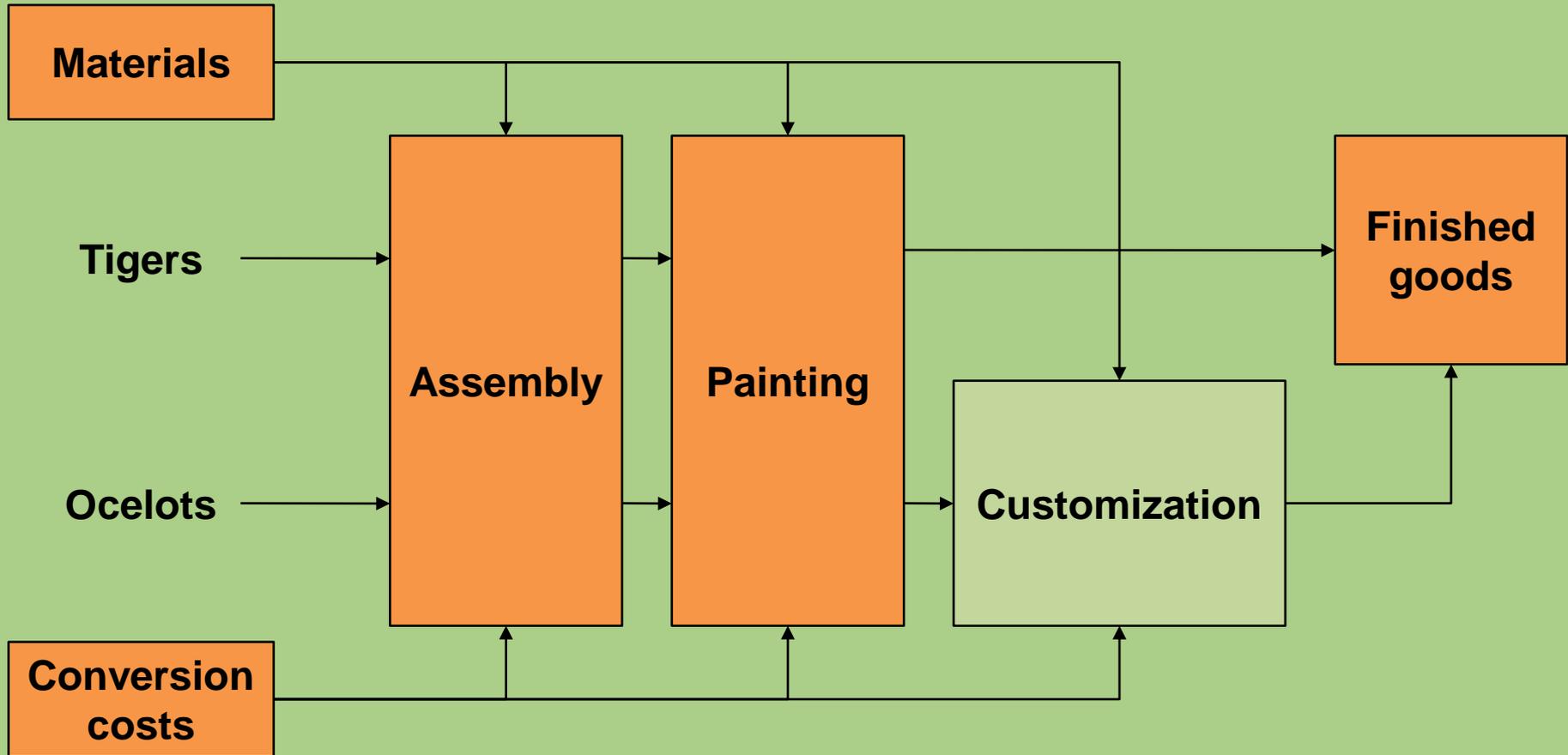
Product Costing in Operations

- St. Ignace Sports Company makes two models of snowmobiles, Ocelots and Tigers.
- The Ocelot has a larger engine and requires more expensive materials.



Product Costing in Operations

Operations—St. Ignace Sports Company



End of Chapter 8