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ENGINEERING ECONOMICS

Cost Concepts and Behavior

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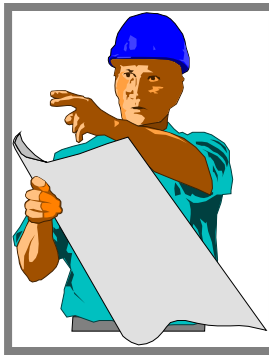
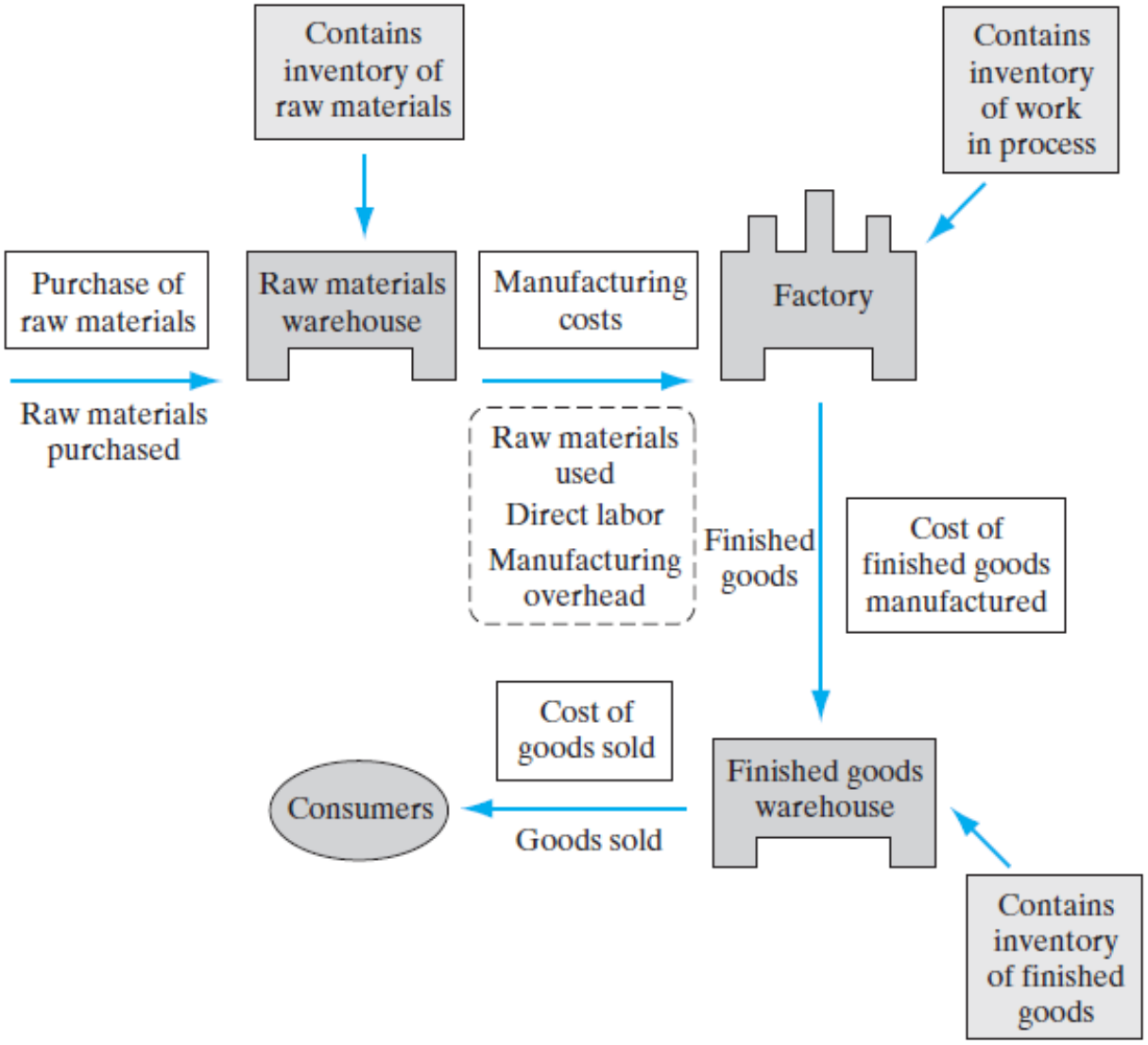
2018



Various types of manufacturing costs incurred by a manufacturer



Costing Systems

Costing systems aim to report costs of products, services in using the resources of the firms.

In **engineering economics**, the term **cost is used in many different ways.**

- **there are many types of costs**, each is classified differently **according to the immediate needs of management**.
  - eg, engineers may want cost data **to prepare external reports**, **to prepare planning budgets**, or **to make decisions**.
- also, **each different use of cost data demands a different classification and definition** of *cost.*
  - *eg, **the** **preparation of external financial reports** requires **the use of historical cost data**, whereas **decision making** may **require current cost data or estimated future cost data**.*

Manufacturing Costs

- In converting raw materials into finished goods, a manufacturer incurs various costs associated with operating a factory.

- Most manufacturing companies divide manufacturing costs into three broad categories:
  - direct raw material costs,
  - direct labor costs,
  - and manufacturing overhead.

Manufacturing Costs

- **Direct Raw Materials:**
  - Direct raw materials are **any materials that are used in the final product** and that **can be easily traced to it**.
  - Eg, wood in furniture, steel in bridge construction, paper in printing firms, and fabric for clothing manufacturers.
  - finished product of one company can become the raw materials of another company.
- **Direct Labor:**
  - Direct labor incurs **costs that go into the production** of a product.
  - Eg, labor costs of assembly-line workers, labor costs of welders in metal-fabricating industries, carpenters or bricklayers in home building, and machine operators in various manufacturing operations.

Manufacturing Costs

- **Manufacturing Overhead :**
  - the third element of manufacturing cost, **includes all costs of manufacturing except** the **costs of direct materials and direct labor**
  - **not easily traceable to specific units of output**
- Eg, costs of indirect materials; indirect labor; maintenance and repairs on production equipment; heat and light, property taxes, depreciation, and insurance on manufacturing facilities; and overtime premiums
  - **finished product of one company** can **become the raw materials of another company**.
- **Sometimes** it may not be worth the effort to trace the **costs of materials that are relatively insignificant** in the finished products. Materials such as solder and glue (*indirect materials)*

Non-Manufacturing Costs

- **Two additional costs** incurred **in supporting any manufacturing operation** are
  1. **Marketing or selling costs and**
  2. **Administrative costs.**
- **Overhead:** Heat and light, property taxes, and depreciation or similar items associated with the company's selling and administrative functions.
- **Marketing:** Advertising, shipping, sales travel, sales commissions, and sales salaries. Marketing costs include all executive, organizational, and clerical costs associated with sales activities.
- **Administrative functions:** Executive compensation, general accounting, public relations, and secretarial support, associated with the general management of an organization.

Classifying Costs for Financial Statements

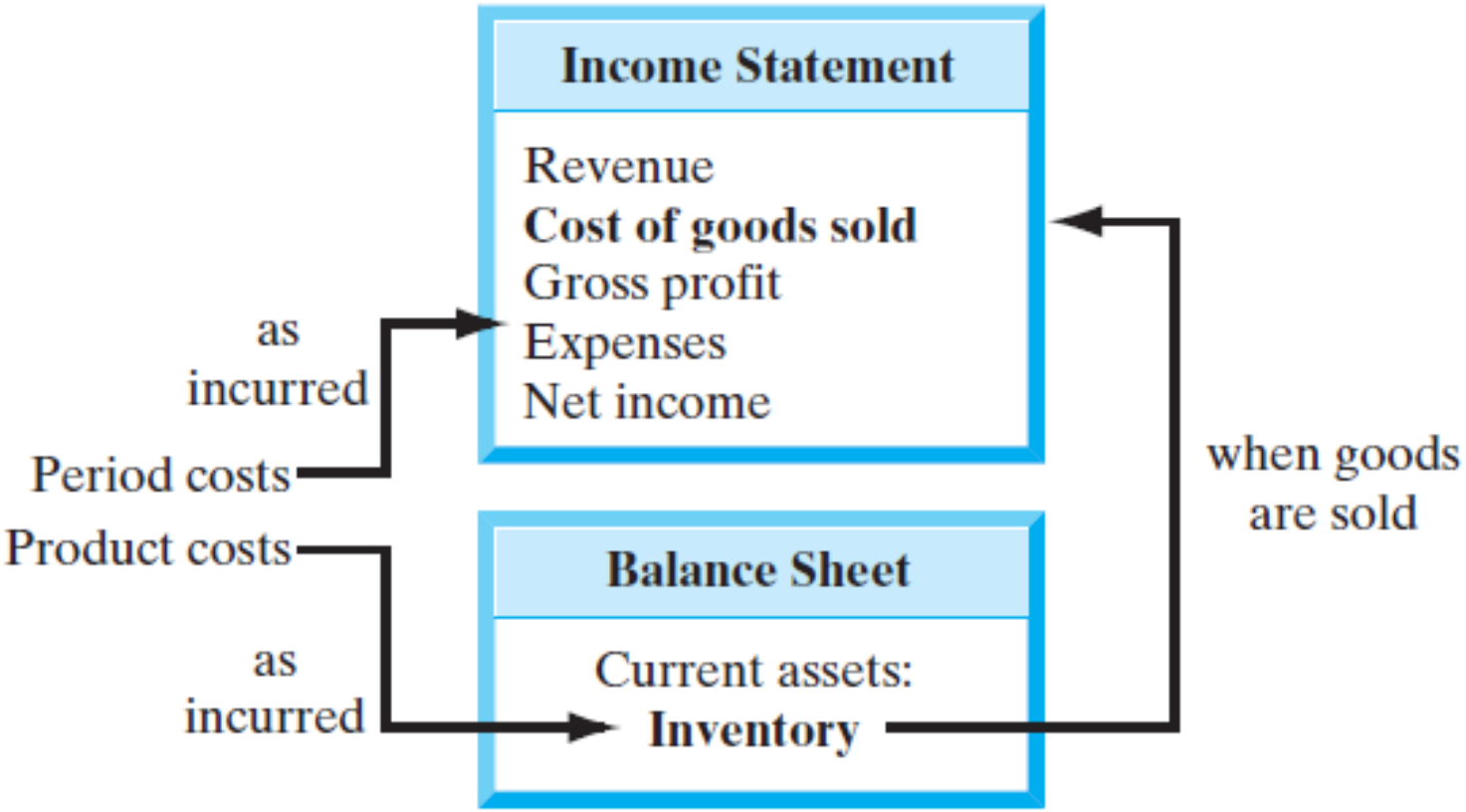
- For purposes of preparing financial statements, we often classify costs as either **period costs** or **product costs**
- **Period costs**: costs charged to expenses in the period in which they are incurred.
  - assumption is that associated benefits are received in the same period the cost is incurred.
  - Eg, all general and administrative expenses, selling expenses, and insurance and income tax expenses. Therefore, advertising costs, executives' salaries, sales commissions, public-relations costs, and other nonmanufacturing costs discussed earlier would all be period costs.
  - not related to the production and flow of manufactured goods, but are deducted from revenue in the income statement. In other words, period costs will appear on the income statement as expenses during the time in which they occur

Classifying Costs for Financial Statements

- **Product costs:** Some costs are better matched against products than they are against periods.
  - **consist of the costs involved in the purchase or manufacture of goods**.
  - In the case of **manufactured goods**, product costs are **the costs of direct materials, direct labor costs, and manufacturing overhead**. Product costs are not viewed as expenses; rather, they are the cost of creating inventory. Thus, product costs are considered an asset until the associated goods are sold. At the time they are sold, the costs are released from inventory as expenses (typically called cost of goods sold) and matched against sales revenue.
  - Since product costs are assigned to inventories, they are **also known as *inventory costs***.

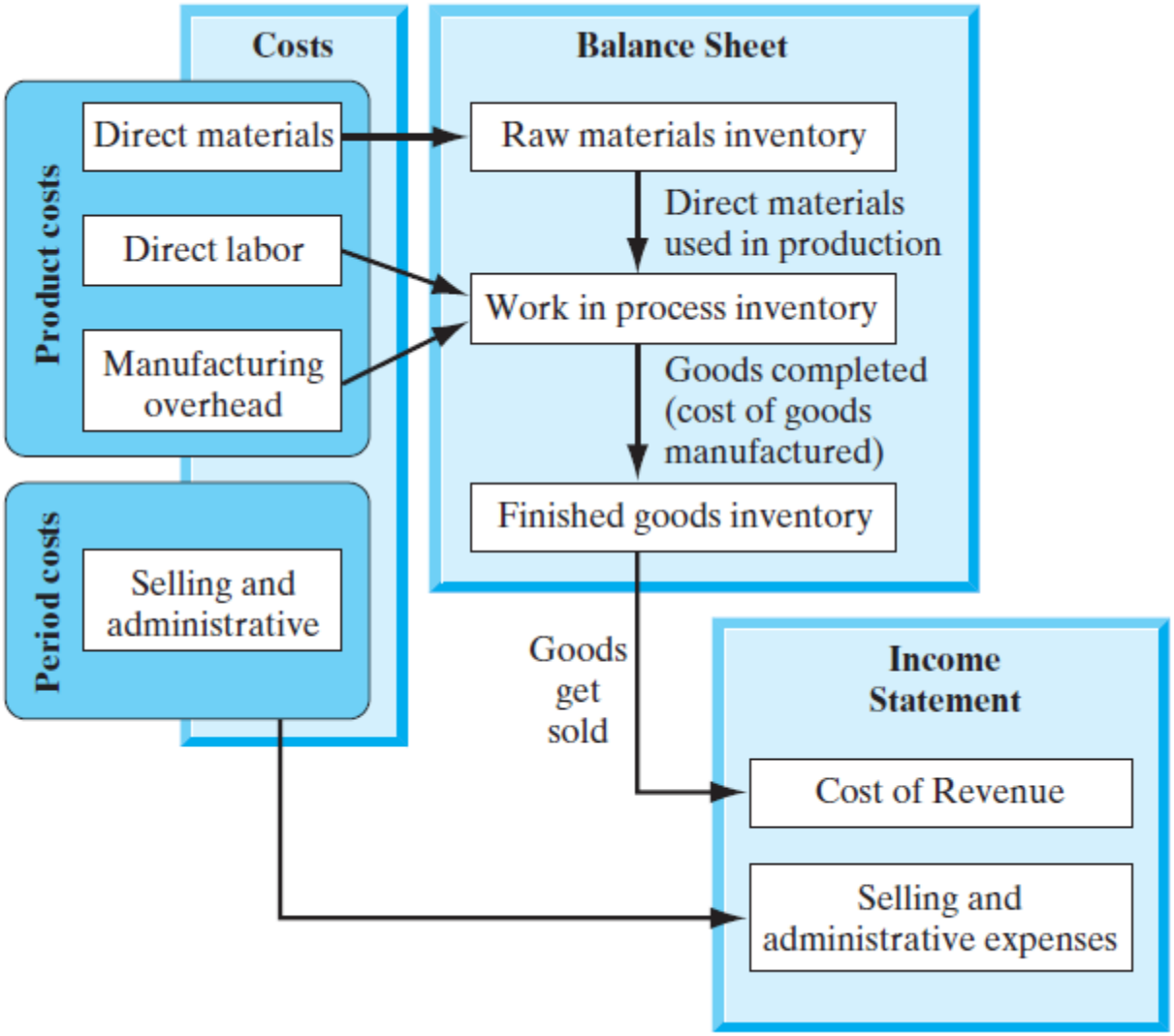
Classifying Costs for Financial Statements

How the period costs and product costs flow through financial statements from the manufacturing floor to sales.



Classifying Costs for Financial Statements

Cost flows and classifications in a manufacturing company



EXAMPLE 8.1 Classifying Costs for Uptown Ice Cream Shop

Here is a look at why it costs $2.50 for a single-dip ice cream cone at a typical store in Washington, DC. The annual sales volume (the number of ice cream cones sold) averages around 185,000 cones, bringing in revenue of $462,500. This is equivalent to selling more than 500 cones a day, assuming a seven-day operation. The following table shows the unit price of an ice cream cone and the costs that go into producing the product:

*Based on an annual volume of 185,000 cones.

Items	Total Cost	Unit Price*	% of Price
Ice cream (cream, sugar, milk, and milk solids)	$120,250	$0.65	26%
Cone	9,250	0.05	2
Rent	112,850	0.61	24
Wages	46,250	0.25	10
Payroll taxes	9,250	0.05	2
Sales taxes	42,550	0.23	9
Business taxes	14,800	0.08	3
Debt service	42,550	0.23	9
Supplies	16,650	0.09	4
Utilities	14,800	0.08	3
Other expenses (insurance, advertising, fees, and heating and lighting for shop)	9,250	0.05	2
Profit	24,050	0.13	5
Total	**$462,500**	**$2.50**	**100**

Product costs: **Costs incurred in preparing 185,000 ice cream cones per year**

Raw materials:	
Ice cream @ $0.65	$120,250
Cone @ $0.05	9,250
Labor:	
Wages @ $0.25	46,250
Overhead:	
Supplies @ $0.09	16,650
Utilities @ $0.08	14,800
Total product cost	$207,200

Period costs: **Costs incurred in running the shop regardless of sales volume**

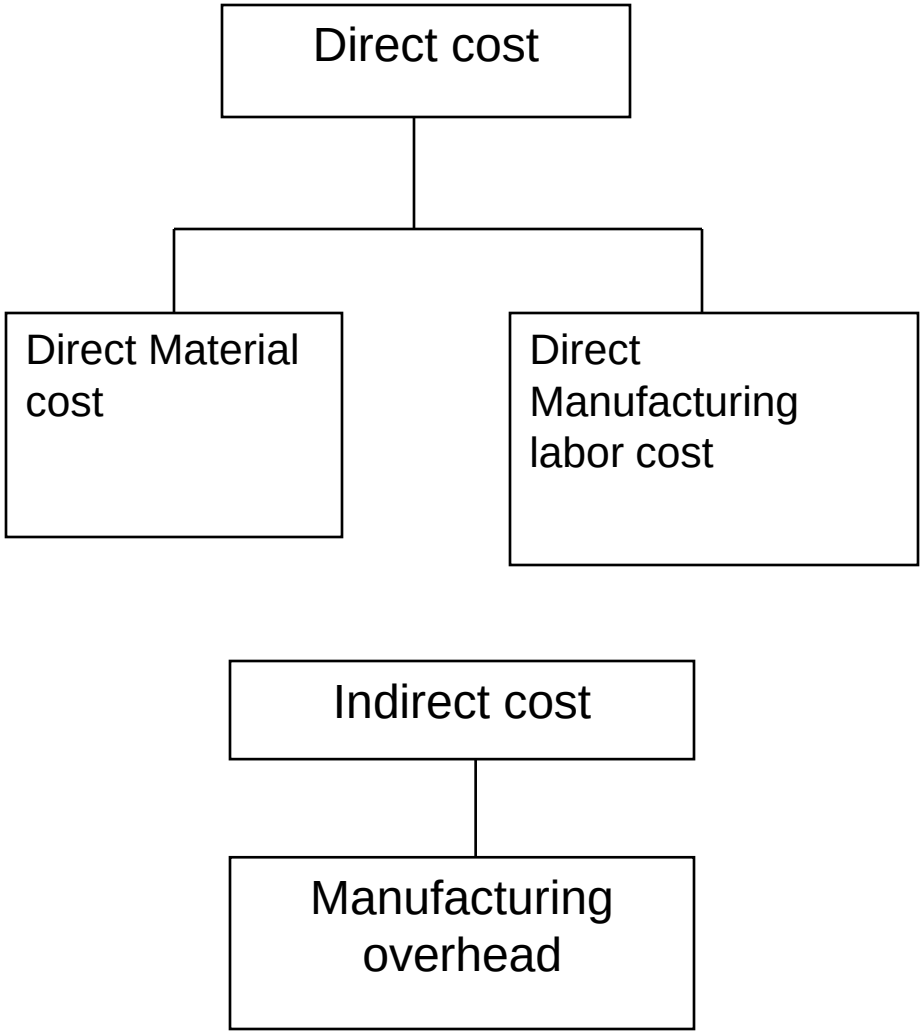
Business taxes:	
Payroll taxes @ $0.05	$ 9,250
Sales taxes @ $0.23	42,550
Business taxes @ $0.08	14,800
Operating expenses:	
Rent @ $0.61	112,850
Debt service @ $0.23	42,550
Other @ $0.05	9,250
Total period cost	$231,250

Job and Process Costing System

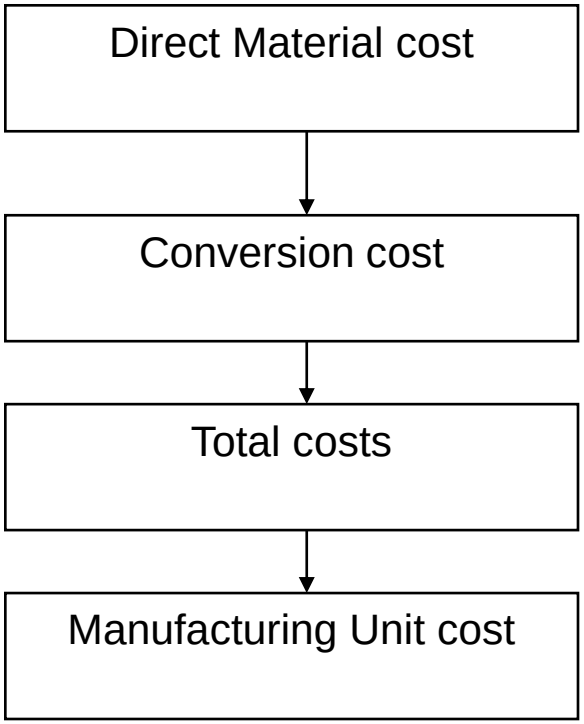
Job Costing System
In this system, the cost of a product or service is obtained by assigning costs to a distinct, identifiable product or service.

Process Costing System
In this system, the cost of a product or service is obtained by assigning costs to masses of similar units and then calculating units costs on an average basis.

Job Costing System in Manufacturing



Process Costing Systems in Manufacturing



Conversion costs: All manufacturing costs other than direct materials costs.

Cost Behaviors

Fixed cost: A cost that remains Constant, regardless of any change in a company's activity (production volume).
Eg: the **annual insurance premium, property tax, and license fee are fixed costs**, since they are independent of the production volume per year for manufacturing company or number of miles driven per year for transport company, building rents; depreciation of buildings, machinery, and equipment; and salaries of administrative and production personnel.

Variable cost: A cost that changes in proportion to a change in a company's activity or business.
Eg: **Gasoline** is a good example of a **variable automobile cost**, because fuel consumption is directly related to miles driven. Similarly, the cost of replacing tires will increase as a vehicle is driven more.

Cost Behaviors

Mixed cost: Costs are fixed for a set level of production or consumption, becoming variable after the level is exceeded.

Eg: In **automobile example, depreciation (loss of value) is a mixed cost**. On the one hand, some depreciation occurs simply from the passage of time, regardless of how many miles a car is driven, and this represents the fixed portion of depreciation. On the other hand, the more miles an automobile is driven a year, the faster it loses its market value, and this represents the variable portion of depreciation.
A typical example of a mixed cost in manufacturing is **the cost of electric power**. Some components of power consumption, such as lighting, are independent of the operating volume, while other components (e.g., the number of machine-hours equipment is operated) may vary directly with volume.

Cost Behaviors

Average Unit Cost: We often use the term **average cost to express** activity cost on a per unit basis. In terms of unit costs, the description of cost is quite different:

•**Variable cost per unit** of volume is a **constant**.

• **Fixed cost per unit** varies with **changes in volume**: As the volume increases, the fixed cost per unit decreases.

• **Mixed cost per unit** also **changes as volume changes**, but the amount of change is smaller than that for fixed costs.

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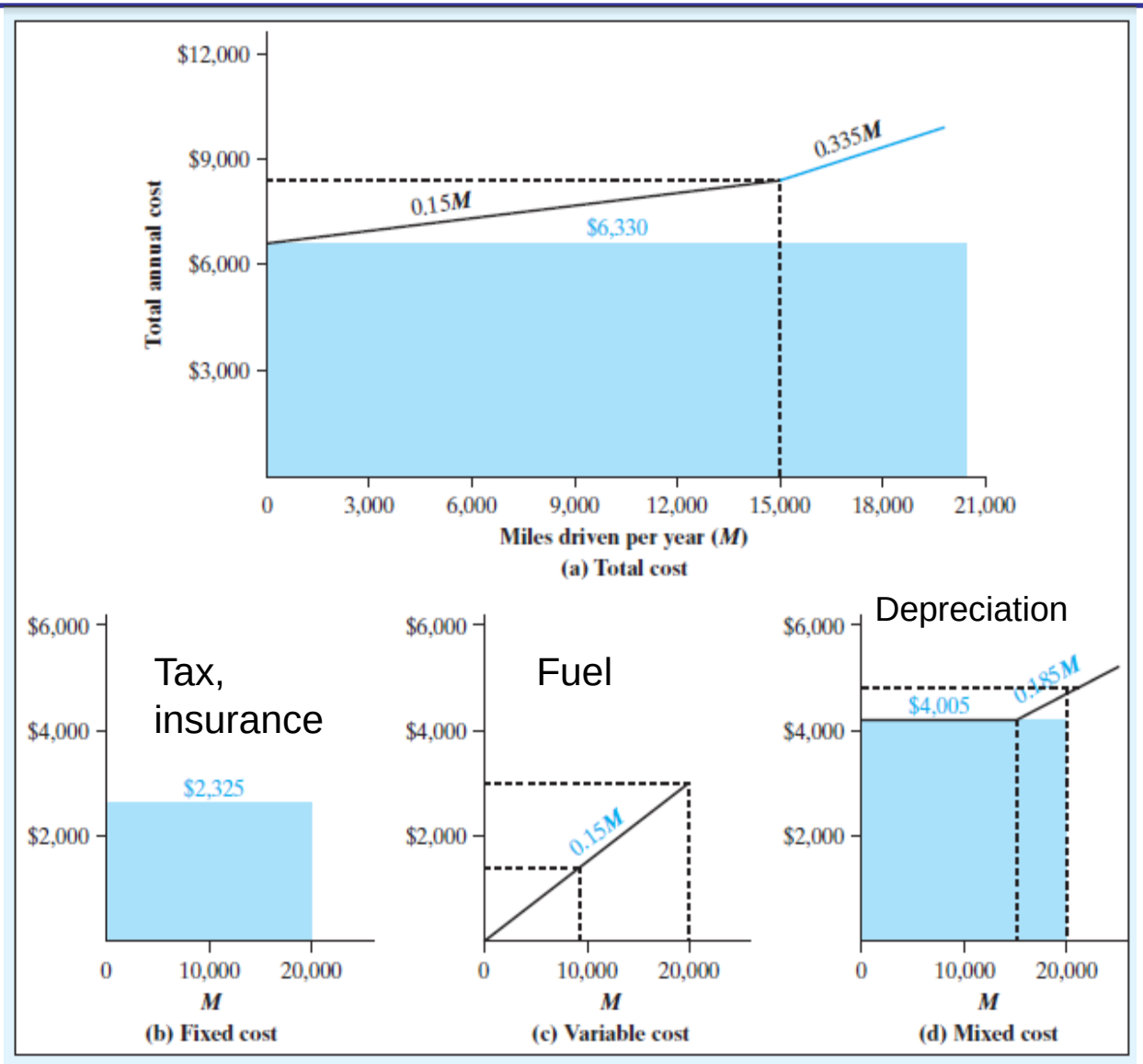
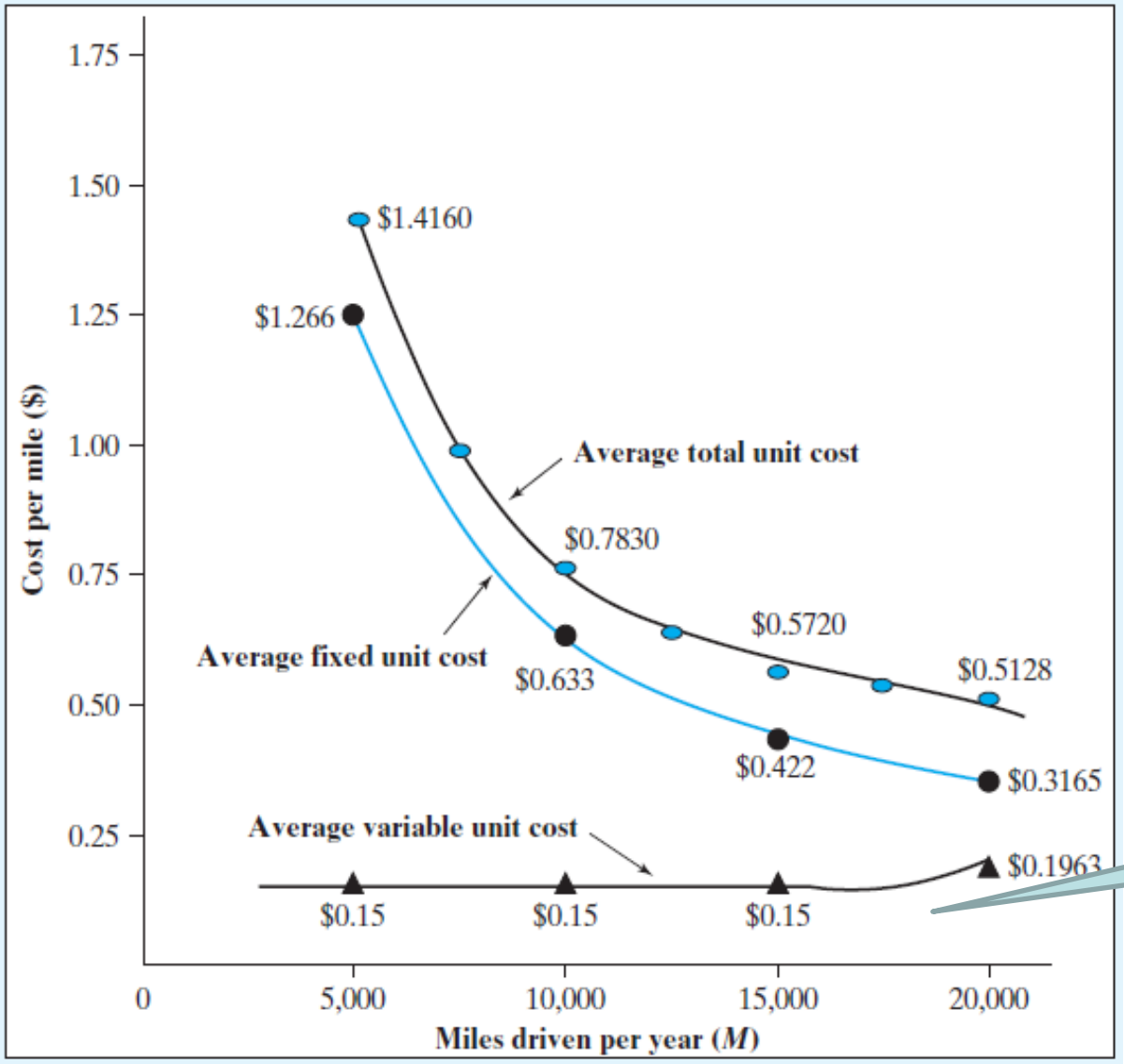
Cost–volume relationships pertaining to annual automobile costs



Average cost per mile of owning and operating a car



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Cost Driver

Any **factor that affects costs** is called cost driver.

Variable cost

It is a cost **that changes** in total **in proportion to changes in a cost driver**.

Fixed cost

It is a cost that **does not change** in total **despite changes of a cost driver**.

Capitalized cost

A cost that is **first recorded as an asset** and **then becomes an expense** such as depreciation of machines, computers, equipment etc.

Inventoriable cost

Cost associated with **purchase of materials and other manufacturing inputs**.

Period cost
A cost that is **reported as an expense** in a particular period.

Product cost
A cost of **creating inventory** and is **considered an asset** until the associated good is **sold where it is released from inventory as expenses** and matched against sales revenue.

Differential (incremental) costs: Costs that represent differences in total costs, which result from selecting one alternative instead of another.

Opportunity costs: Benefits that could have been obtained by taking an alternative action.

Sunk costs: Past costs not relevant to decisions because they cannot be changed no matter what actions are taken.

Marginal costs: Added costs that result from increasing rates of outputs, usually by single units.

Cost Concepts Relevant to Decision Making

1. Method Change

Variable costs:	Current Die	Better Die	Differential Cost
Materials	$150,000	$170,000	+ $20,000
Machining labor	85,000	64,000	- 21,000
Electricity	73,000	66,000	- 7,000
Fixed costs:			
Supervision	25,000	25,000	0
Taxes	16,000	16,000	0
Depredation	40,000	43,000	+ 3,000
Total	**$389,000**	**$384,000**	**- $5,000**

Cost Concepts Relevant to Decision Making

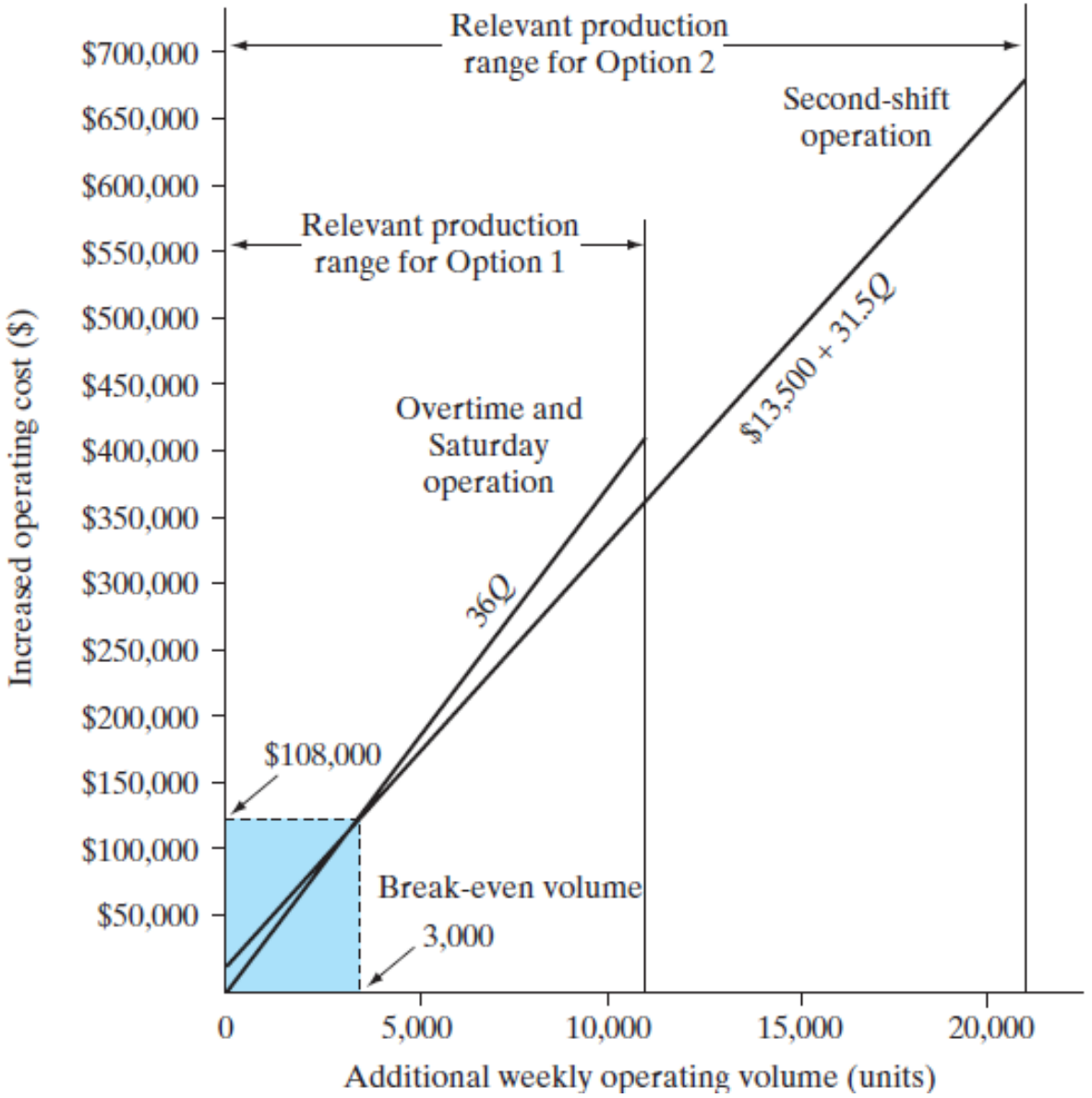
2. Operation Planning (Break-Even Volume Analysis)

- 24,000 initial order
- 4,000 extra
- **Option 1 – extra time or Saturday running** with 12,000

($36 extra per unit)

- **Option 2 – Second shift operation** with 21,000

(13,500 + 31.5 Q)



Cost Concepts Relevant to Decision Making

3. Make or Buy Decision

	Make Option	Buy Option	Differential Cost
Variable cost			
Direct materials	100,000		- 100,000
Direct labor	190,000		-190,000
Power and water	35,000		-35,000
Gas filters		340,000	340,000
Fixed costs			
Heating light	20,000	20,000	0
Depreciation	100,000	100,000	0
Rental income		-35,000	-35,000
Total cost,	**$445,000**	**$425,000**	**-$20,000**
Unit cost	**$22.25**	**$21.25**	**$1.00**

Marginal versus average cost per kWh

Consider a company that has an available electric load of 37 horsepower and that purchases its electricity at the following rates:

kWh/Month	@$/kWh	Average Cost ($/kWh)
First 1,500	$0.050	$0.050
Next 1,250	0.035	$\frac{\$75 + 0.0350(X - 1{,}500)}{X}$
Next 3,000	0.020	$\frac{\$118.75 + 0.020(X - 2{,}750)}{X}$
All over 5,750	0.010	$\frac{\$178.25 + 0.010(X - 5{,}750)}{X}$

According to this rate schedule, the unit variable cost in each rate class represents the marginal cost per kilowatt-hours (kWh). Alternatively, we may determine the average costs in the third column by finding the cumulative total cost and dividing it by the total number of kWh (X). Suppose that the current monthly consumption of electric power averages 3,200 kWh. On the basis of this rate schedule, determine the marginal cost of adding one more kWh and, for a given operating volume (3,200 kWh), the average cost per kWh.

Marginal versus average cost per kWh

SOLUTION

Given: Marginal cost schedule for electricity; operating volume = 3,200 kWh.
Find: Marginal and average cost per kWh.

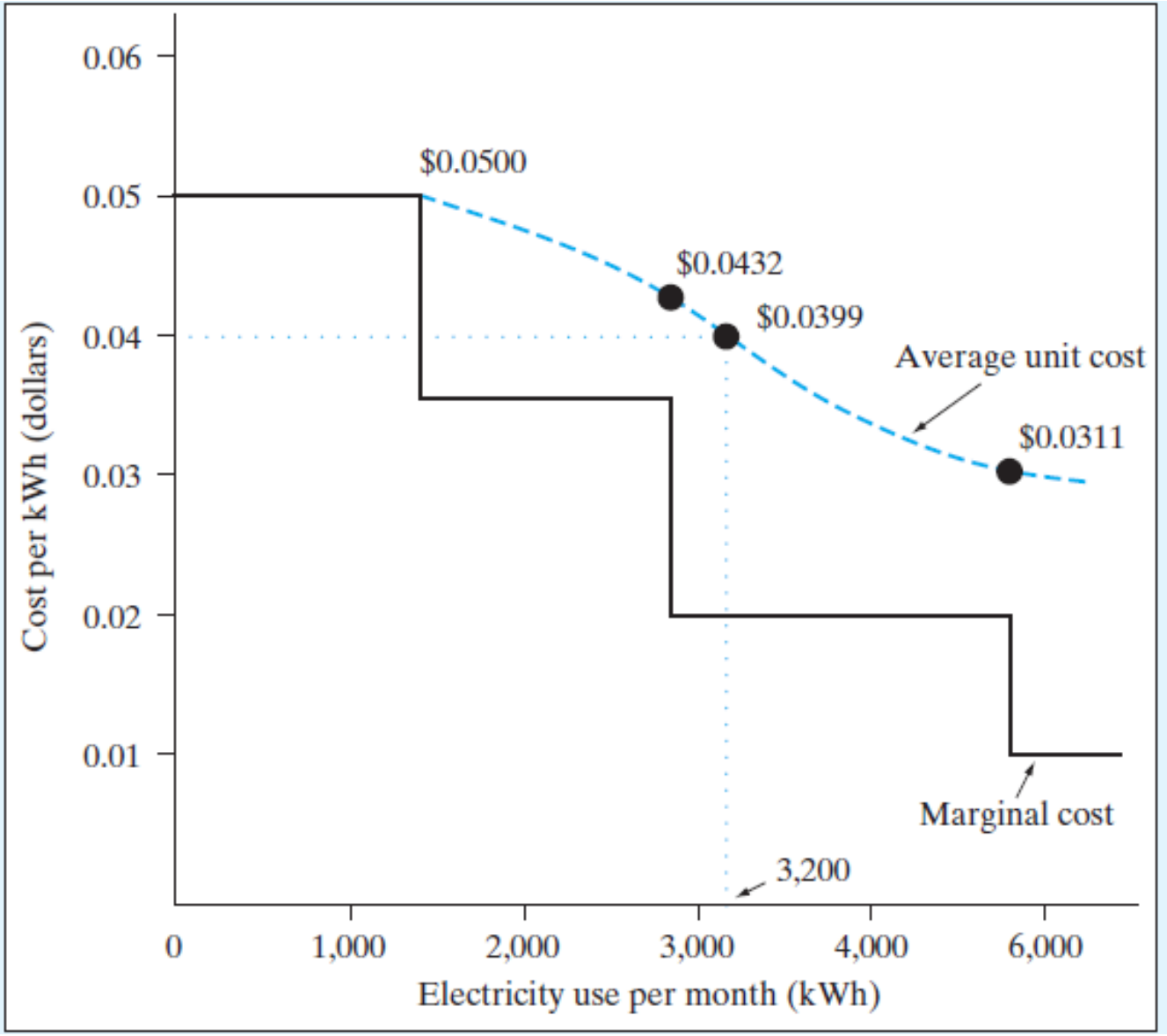
The marginal cost of adding one more kWh is $0.020. The average variable cost per kWh is calculated as follows:

kWh	Rate ($/kWh)	Cost
First 1,500	0.050	$75.00
Next 1,250	0.035	43.75
Remaining 450	0.020	9.00
Total		$127.75

The average variable cost per kWh is $127.75/3,200 kWh = $0.0399 kWh. Or we can find the value by using the formulas in the third column of the rate schedule:

$$\frac{\$118.75 + 0.020(3{,}200 - 2{,}750)}{3{,}200} = \frac{\$127.75}{3{,}200\ \text{kWh}} = \$0.0399\ \text{kWh}.$$

Marginal versus average cost per kWh



Profit Maximization Problem : Marginal Analysis
Example 8.7

Given: Sales price, \$10 per case for generic aspirin, \$30 per case for band aspirin; fixed cost, \$5,000; variable cost, \$7 per case during weekdays, \$12 per case on Sunday operation; weekly production, 6,000 cases of generic aspirin, 1,000 cases of brand-name aspirin.

Find: (a) Optimal production mix and (b) break-even volume.

THANK YOU