

# Introductory to Accounting

## Lecture 12 Cost



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# Lecture 12      Cost and profit

## ● Management Accounting

- Cost Classifications
- Cost Accumulates and Assignments
- Relationship of Total Cost to Volume of Activity
- Application of Cost-Volume-Profit Analysis  
本-量-利分析
- Break-even points and operating leverage

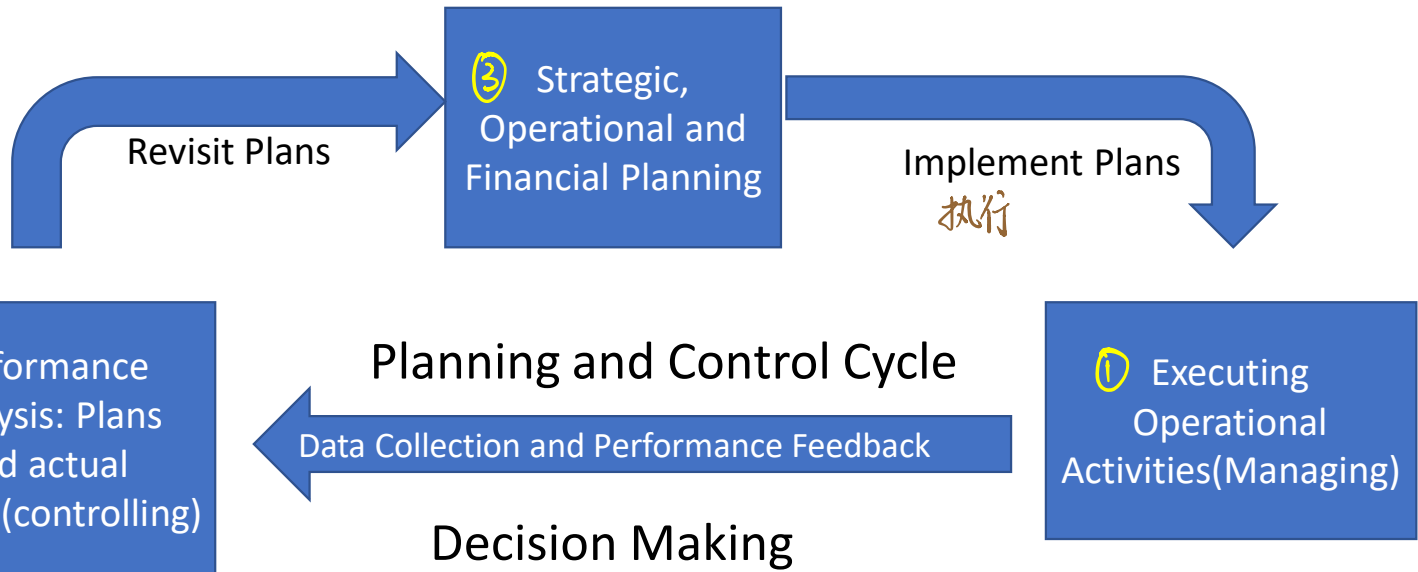
# Management Accounting

管理会计

Do not need to provide standard report.

- Management accounting supports the **internal planning** decisions made by management

➤ Management accounting refers to the process of planning, organizing and controlling an entity's activities so that the organization can **achieve its desired outcomes** *Managers' behaviors.*



# Management Accounting

Characteristic	Managerial Accounting	Financial Accounting
Service perspective	Internal to managers	External to investors and creditors
Time frame	Present and future for planning and control	Past: financial statements are historical
Breadth of concern	Micro: individual units of the organization plan and act	Macro: financial statements are for the organization as a whole
Reporting frequency and promptness 敏捷 实时性	Control reports issued frequently and promptly	Most financial statements issued quarterly, annually
Degree of precision of data used	Reasonable accuracy desired, but “close counts” — relevance is often more important than reliability	High accuracy desired, with time usually available to achieve it: reliability is of utmost importance
Reporting standards	Non imposed because of internal and pragmatic orientation	Imposed by generally accepted accounting principles and the FASB

# Lecture 12



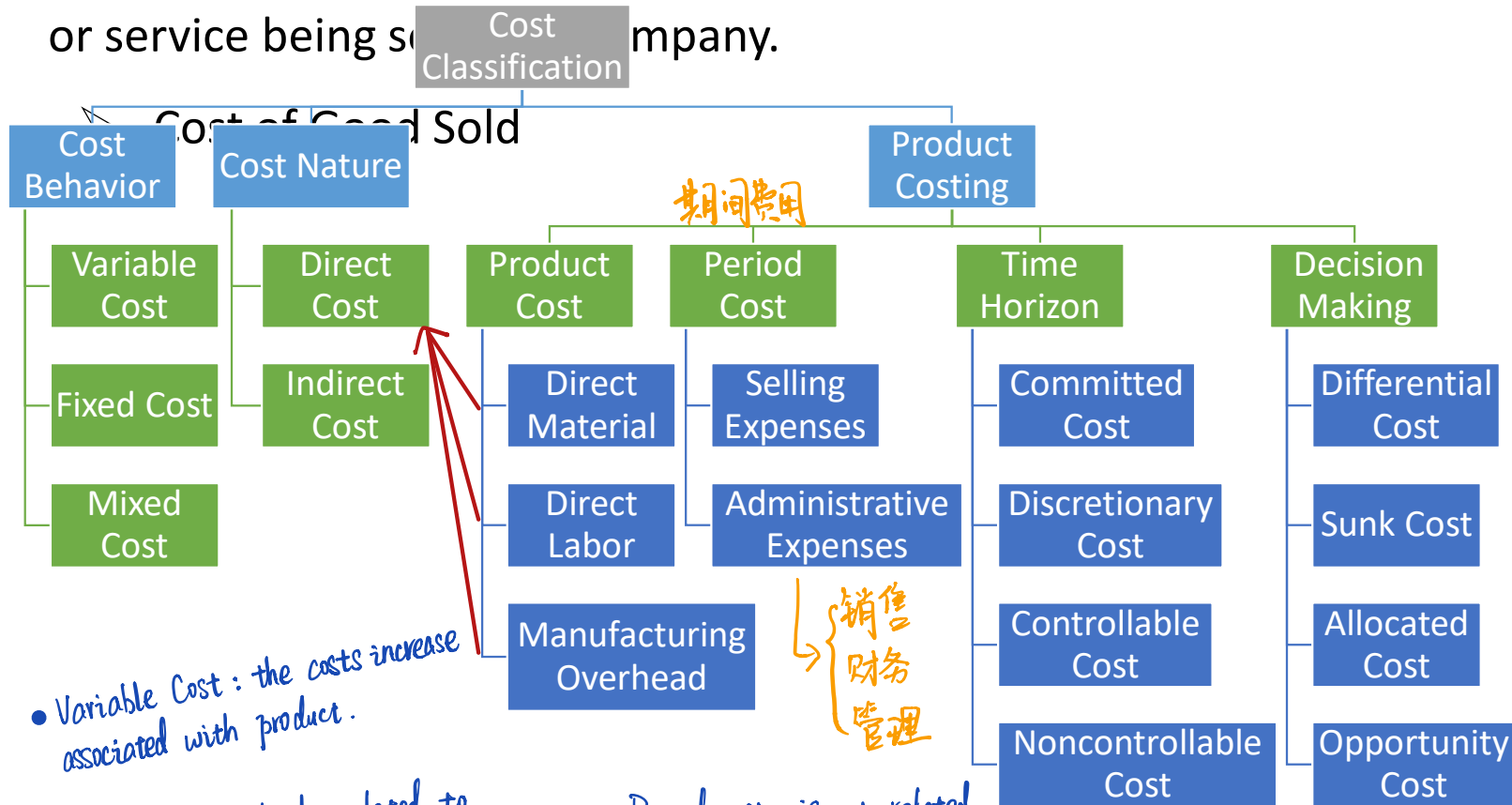
- Management Accounting
- **Cost Classifications**
- Cost Accumulates and Assignments
- Relationship of Total Cost to Volume of Activity
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# Cost Classifications

- Definition of Cost: Cost is typically the expense incurred for a product or service being sold by a company.
  - Cost of Good Sold

# Cost Classifications

- Definition of Cost: Cost is typically the expense incurred for a product or service being sold by a company.



● Variable Cost: the costs increase associated with product.

● Direct cost: closely related to products/services.

● Period cost: is not related to certain product but covers all the period.

↓  
The profit brought by next optimal choice

# Cost Classifications

- **Committed cost** is a cost that a business entity has already made and cannot recover by any means, as well as obligations already made that the business cannot get out of.  
*已交付成本 (约束性成本)*
- **A discretionary cost** is a cost or capital expenditure that can be curtailed or even eliminated in the short term without having an immediate impact on the short-term profitability of a business.  
*附加成本 (自由支配成本)*
  - Eg. Advertising, employee training...
- **Controllable costs** are those costs that can be altered in the short term.  
*可控成本*
  - Noncontrollable costs: taxes ⇒ *by reducing income*
- **Differential cost** is the difference between the cost of two alternative decisions, or of a change in output levels.  
*差别成本*
- **Allocated Cost** is a type of expense that is clearly associated with and so can be readily assigned to a certain business process, project or department.  
*分配成本*



# Lecture 12



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# Cost Accumulation and Assignment

管理会计中成本和费用  
没有本质区别

- **Cost Accumulation**: the process of **collecting and recording** transaction data through the accounting information system.

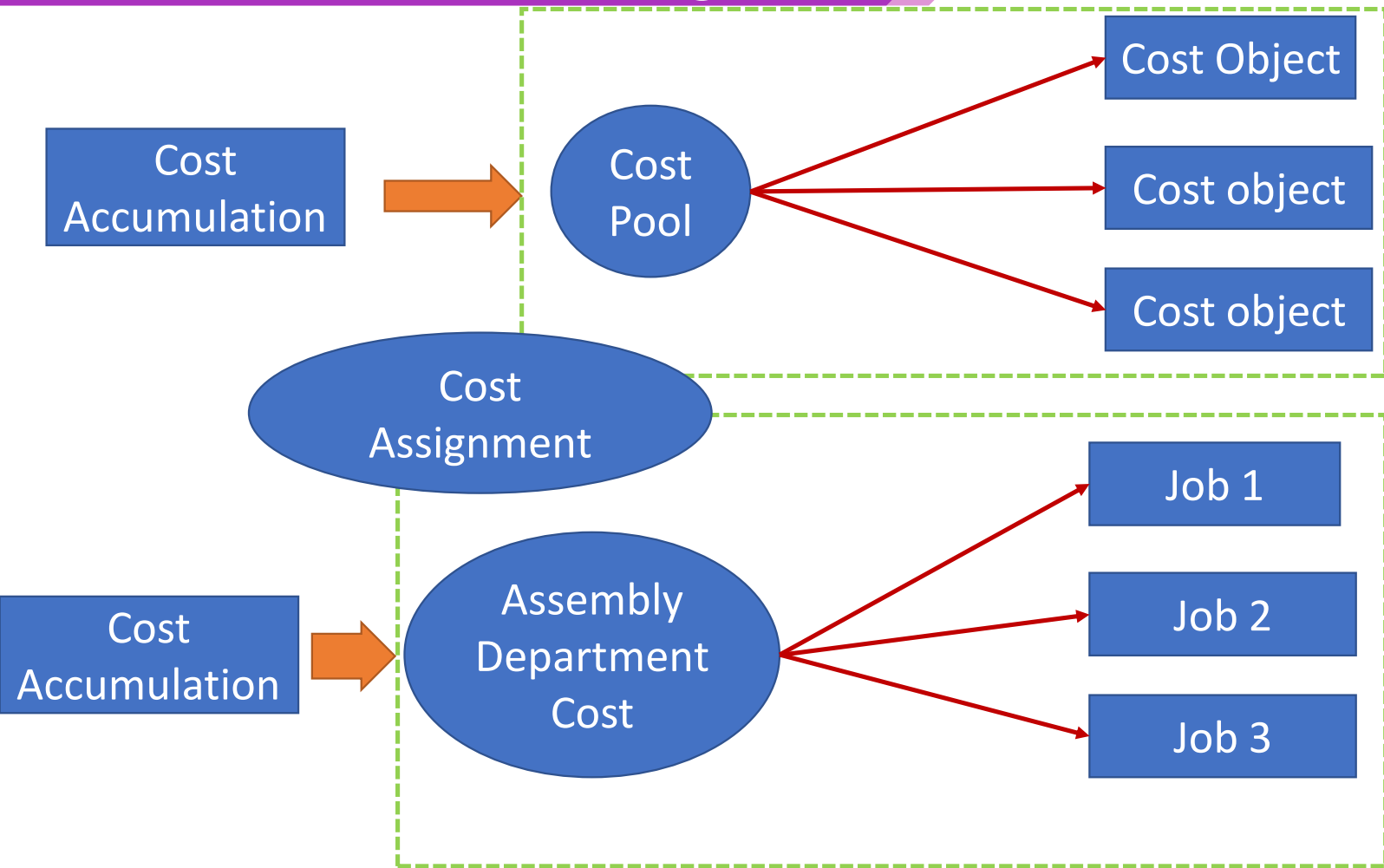


- **Cost Pool**: The total amount of cost accumulated by the system is then **logically categorized** in different ways



- **Cost Assignment**: the process of **attributing** an appropriate amount of cost in the cost pool to each cost object

# Cost Accumulation and Assignment

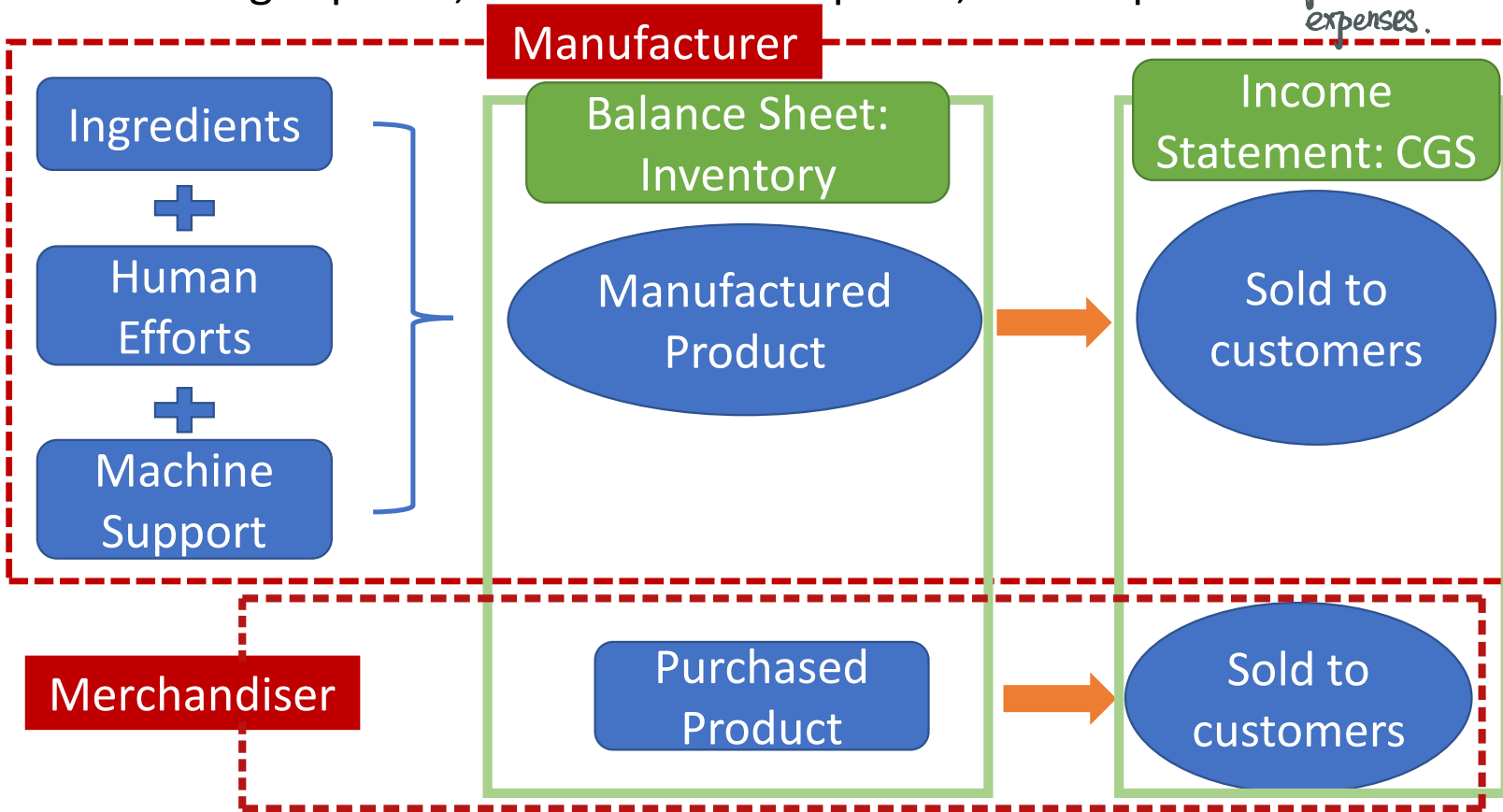


# Cost Accounting and Product Cost

- Cost accounting relates to the determination of product, process, or service costs
- Product costs are used by manufacturing firms and merchandising firms to determine inventory values
  - The cost of the product is recorded and reported as an asset(inventory) until the product is sold (Cost of goods sold).
- Product cost associated with manufacturing inputs:
  - Raw materials: ingredients of the product *生产成本 → 存货增加*
  - Direct labor: efforts provided by workers who are directly involved with the manufacture of the product
  - Manufacturing overhead: all manufacturing costs except those for raw materials and direct labor

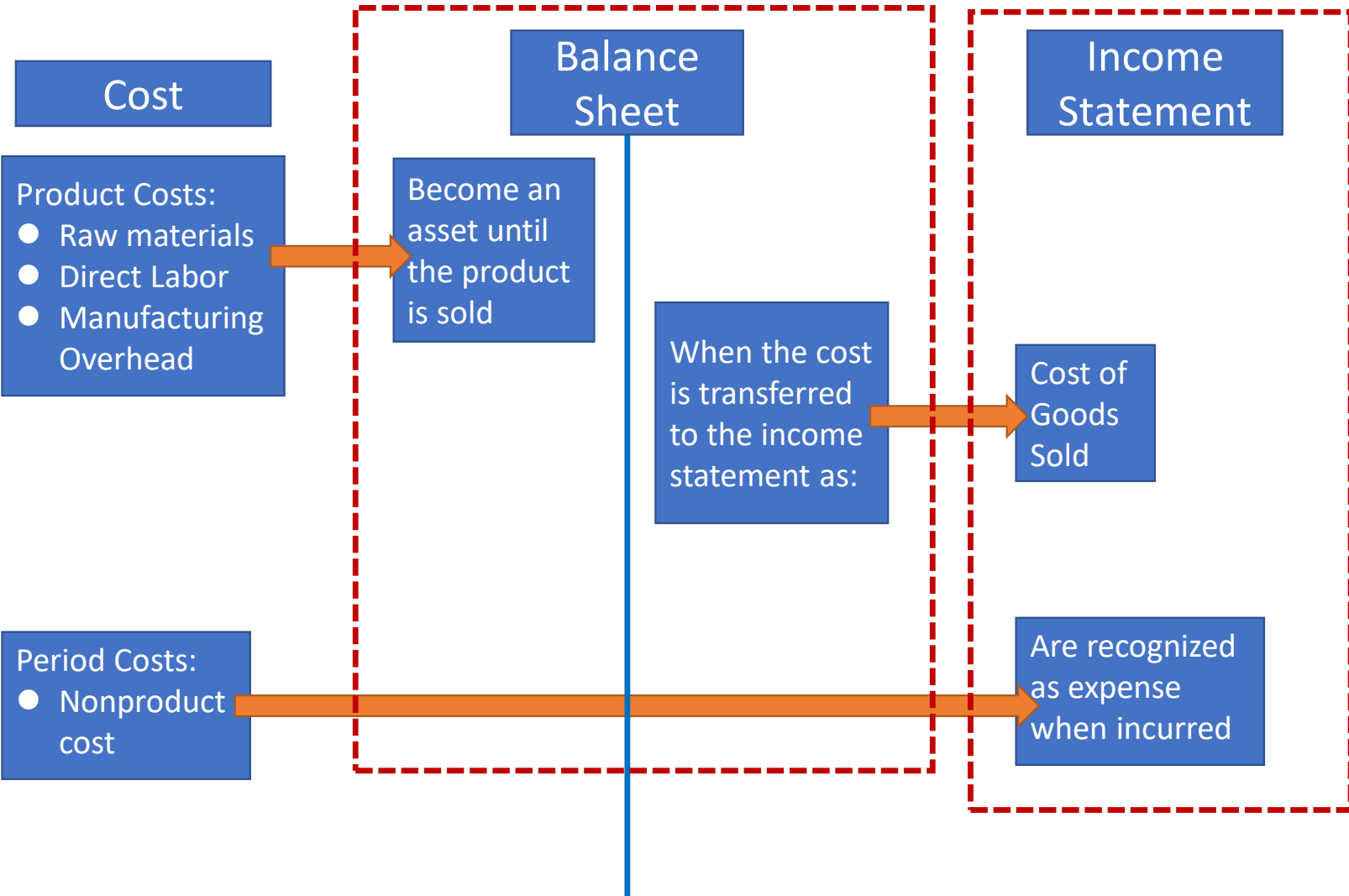
# Cost Accounting and Product Cost

- period cost: costs that are not directly related to production activities and are recorded as expense in income statement
  - Selling expense, administrative expense, R&D expense... *financial expenses.*



	Balance Sheet		Income Statement			
Product Costs	Asset	Liability	OE	NI	Revenues	Expenses
Become an asset until the product is sold						
Raw Materials	+Inventory(when incurred)	+Accounts Payable				
Direct Labor	+Inventory(when incurred)	+Accrued Wages Payable				
Manufacturing Overhead	+Inventory(when incurred)	Other Accrued Liabilities				
	-Inventory(when sold)					-Cost of Goods Sold
Period Costs: Non product costs such as selling expense, advertising expense, and interest expense are recognized as expenses when incurred		+Accounts Payable				-Selling Expense
		+other accrued Liabilities				-advertising expenses
		+interest payable				-interest expense

# Cost Accounting and Product Cost



# Lecture 12



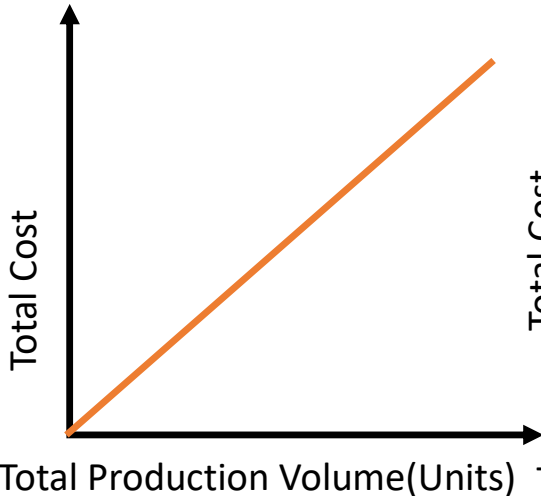
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- **Relationship of Total Cost to Volume of Activity**
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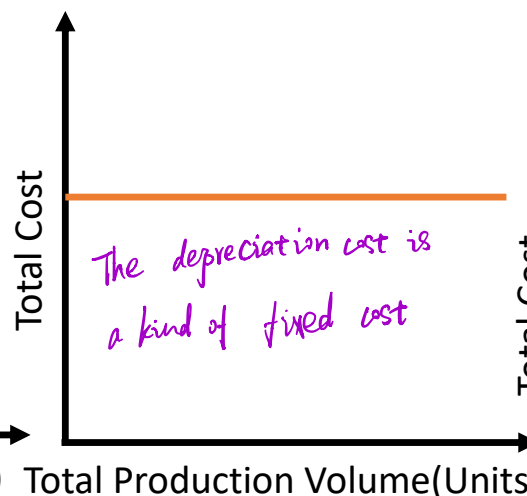
## Relationship of Total Cost to Volume of Activity

- The relationship of total cost to volume of activity describes the cost behavior pattern, one of the most important cost classification methods to understand.
  - Variable Cost (变动成本) : cost that **changes** in total as the volume of activity changes
  - Fixed Cost (固定成本) : cost that **does not change** in total as the volume of activity changes

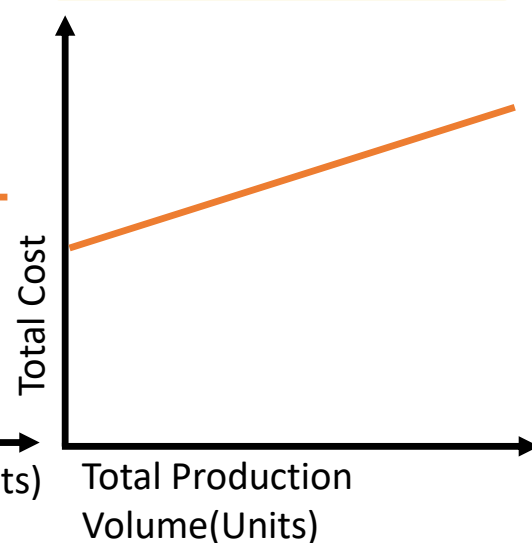
Variable Cost Behavior Pattern



Fixed Cost Behavior Pattern



Mixed Cost Behavior Pattern



## Relationship of Total Cost to Volume of Activity

- Direct Cost and indirect cost are terms used to relate a cost to a product or activity
  - **Direct cost:** A direct cost is totally traceable to the production of a specific item, such as a product or service.
    - ✓ Often belongs to the **variable cost**
    - ✓ Would not continue to be incurred even if the product or activity were discontinued
  - **Indirect cost:** cost that cannot be assigned to the production of a specific item, such as a product or service
    - ✓ Often belongs to the **fixed cost**
    - ✓ Would continue to be incurred even if the product or activity were discontinued

## Relationship of Total Cost to Volume of Activity

Variable Costs	Fixed Costs
Manufacturing Labor Wages	Supervisor's Salary
Supplies used in production	Factory rent
Shipping costs	Advertising
Sales commissions	Property taxes
<u>保修</u> Warranty Costs	Sales manager's salary

- The fixed or variable label refers to the behavior of total cost relative to a change in production activity
  - Variable costs are constant per unit but fixed costs change as the level of activity changes.

	As Activity Changes	
	Total	Per Unit
Fixed Cost	Remains constant	Changes inversely
Variable Cost	Changes directly	Remains constant

*The more you produce, the less the average cost is.*

## Relationship of Total Cost to Volume of Activity

- Assumption 1: Relevant range assumption
  - The range of activity over which the identified or assumed cost behavior pattern exists(fixed cost)

Implication 1: Over some relevant range of production, the total cost will not change.

Implication 2: When a cost is identified as fixed and cost projections are made based on that cost behavior pattern classification, the limits of the relevant range assumption must be considered.

- Assumption 2: The cost behavior pattern is linear, not curvilinear
  - Variable cost

## Relationship of Total Cost to Volume of Activity

- Semi-variable Costs: costs that are partly fixed and partly variable with a mixture of behavior pattern

➤  $Total\ Cost = Fixed\ Cost + Variable\ Cost$

$$= Fixed\ Cost +$$

$$(Variable\ rate\ per\ unit\ of\ activity \times units\ of\ activity)$$

➤ 总成本 = 固定成本 + 变动成本

$$= 固定成本 + (单位产品的变动成本 \times 作业量)$$

Example: the fixed cost for utilities is 350 per month and the variable rate for utilities is 30 cents per machine hour. Total estimated utilities cost for a month in which 6,000 machine hours were planned would be:

$$Total\ Cost = 350 + (0.30 \times 6,000) = 2,150$$

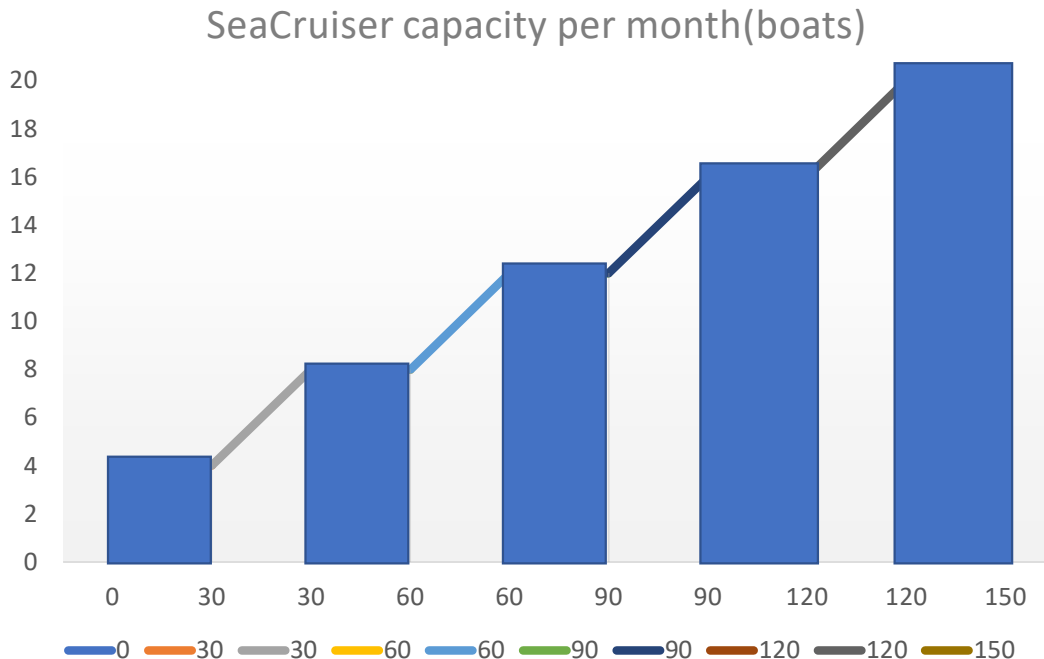
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## Application of Cost-Volume-Profit Analysis

- Cost-volume-profit (CVP) (本量利分析) analysis is a method of cost accounting that quantitatively examines the impact that varying levels of costs and volume have on operating profit.
  - Break-even point : The point the company makes 0 profit. 收支平衡点
- The key to CVP is Estimating Cost Behavior Patterns.



## Application of Cost-Volume-Profit Analysis

- **Estimating Cost Behavior Patterns:** a particular cost's estimated behavior pattern is determined by analyzing cost and activity over time. One analytical technique involves using a scatter gram to identify high and low cost-volume data relationships; then simple arithmetic is used to compute the variable rate and cost formula ("high-low" method)

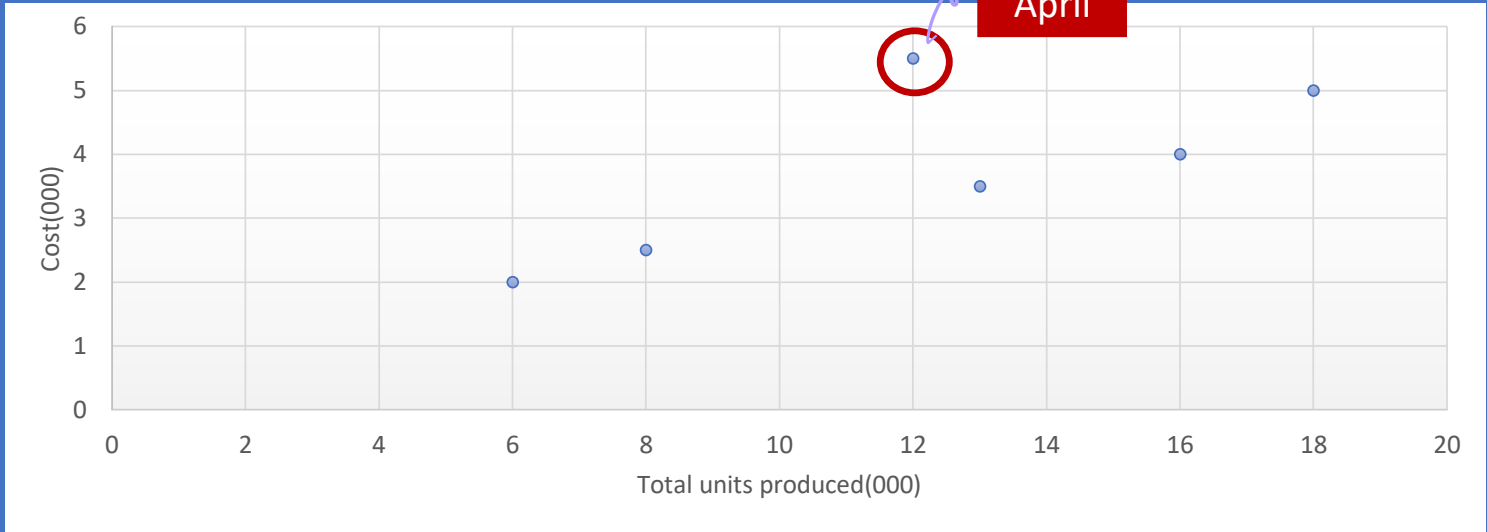
Illustration of "high-low" method: During the months of January through June, the following utility costs were incurred at various production volumes:

Month	Total Utility Cost	Total Production Volume
January	2,500	8,000 units
February	3,500	13,000 units
March	4,000	16,000 units
April	5,500	12,000 units
May	2,000	6,000 units
June	5,000	18,000 units



# Application of Cost-Volume-Profit Analysis

- Scattergram:



- Calculate the variable cost behavior pattern:

$$\begin{aligned}\text{Variable rate} &= \frac{\text{High Cost} - \text{Low Cost}}{\text{High Activity} - \text{Low Activity}} \\ &= \frac{5,000 - 2,000}{18,000 \text{ units} - 6,000 \text{ units}} \\ &= \frac{3,000}{12,000 \text{ units}} \\ &= 0.25 \text{ per unit}\end{aligned}$$

## Application of Cost-Volume-Profit Analysis

- Calculate the fixed cost behavior pattern:
  - Total Variable Cost at 18,000 units of activity:  $18,000 \times 0.25 = 4,500$
  - Fixed Cost Calculation:

$$\textit{Total Cost at 18,000 units} = 5,000$$

$$\textit{Variable Cost at 18,000 units} = 4,500$$

$$\textit{Fixed Cost} = 500$$

- Total Variable Cost at 6,000 units of activity:  $6,000 \times 0.25 = 1,500$
- Fixed Cost Calculation:

$$\textit{Total Cost at 6,000 units} = 2,000$$

$$\textit{Variable Cost at 6,000 units} = 1,500$$

$$\textit{Fixed Cost} = 500$$

## Application of Cost-Volume-Profit Analysis

- The Cost Formula:

$$\textit{Total Cost} = \textit{Fixed Cost} + \textit{Variable Cost} = 500 + 0.25 \textit{ per unit produced}$$

- The cost formula can be used to estimate total utility costs at any level of activity within the relevant range.

$$\textit{Total Cost for 14,000 units} = 500 + 0.25 \times 14,000 \text{ units} = 4,000$$



Note: it may be a coincidence if the cost formula explains total cost accurately at points not used in the high-low calculation. This is because that the calculation assumes a linear relationship between the observations used, and in practice exact linearity will not exist

## Application of Cost-Volume-Profit Analysis

- A Modified Income Statement Format: income statement with a contribution margin format used in CVP analysis for internal purposes
  - Classifies costs according to the cost behavior pattern
- Contribution Margin: incremental money generated for each product/unit sold after deducting the variable portion of the firm's costs.  $\text{= Sales Revenue} - \text{Variable Costs} = \text{Operating Income} + \text{Fixed Costs}.$ 
  - Sales Revenue minus Variable Costs

Question: As revenues increase as a result of selling more products or providing more services, how does the variable costs change? And how about the contribution margin and fixed costs?

## Application of Cost-Volume-Profit Analysis

Traditional Format (Expenses Classified by Function)		Contribution Margin Format (Expenses Classified by Cost Behavior Patterns)	
Revenues	100,000	Revenues	100,000
Cost of Goods Sold	50,000	Variable Costs	60,000
Gross Profit	50,000	Contribution Margin	40,000
Operating Expenses	40,000	Fixed Expenses	30,000
Operating Income	10,000	Operating Income	10,000

● **Contribution Margin Ratio:** the ratio of contribution margin to revenues.

- The portion of each amount of sales that remains after covering the variable costs and is available to cover fixed costs or provide profits

## Application of Cost-Volume-Profit Analysis

Example 1: Management wants to know the contribution margin and operating income from a product that has the following revenue, cost, and volume characteristics

Selling price per case	15
Variable expenses per case	9
Fixed expenses associated with the product for the relevant period	40,000
Sales volume in case	8,000 cases

	Per unit	X	Volume	=	Total	%
Revenue	15					
Variable Expenses	9					
Contribution Margin	6	X	8,000	=	48,000	40%
Fixed Expenses					40,000	
Operating Income					8,000	

## Application of Cost-Volume-Profit Analysis

Example 2: Suppose management wants to know what would happen to operating income and variable costs if a 3 per unit price cut were to result in a volume increase of 5,000 units, to a total of 13,000 units.

<b>Selling price per case</b>	<b>12</b>
Variable expenses per case	9
Fixed expenses associated with the product for the relevant period	40,000
Sales volume in case	13,000 cases

	Per unit	X	Volume	=	Total	%
Revenue	12					
Variable Expenses	9					
Contribution Margin	3	X	13,000	=	39,000	25%
Fixed Expenses					40,000	
Operating Income					-1,000	

## Application of Cost-Volume-Profit Analysis

Example 3: Suppose management proposes the same 3 per unit price cut in conjunction with a 3,000 increase in advertising, with the expectation that volume will increase to 18,000 units. What will happen to the operating income and contribution margin?

Selling price per case	12
Variable expenses per case	9
Fixed expenses associated with the product for the relevant period	43,000
Sales volume in case	18,000 cases

	Per unit	X	Volume	=	Total	%
Revenue	12					
Variable Expenses	9					
Contribution Margin	3	X	18,000	=	54,000	25%
Fixed Expenses					43,000	
Operating Income					11,000	



## Application of Cost-Volume-Profit Analysis

Example 4: Using the original data for selling price and variable expenses, suppose management wanted to know the sales volume required to have operating income of 23,000.

Selling price per case	15
Variable expenses per case	9
Fixed expenses associated with the product for the relevant period	40,000
Sales volume in case	?
Operating Income	23,000

	Per unit	X	Volume	=	Total	%
Revenue	15					
Variable Expenses	9					
Contribution Margin	6	X	<b>10,500</b>	=	<b>63,000</b>	<b>40%</b>
Fixed Expenses					40,000	
Operating Income					23,000	

## Application of Cost-Volume-Profit Analysis

Example 5: Suppose the fixed expense increases by 9,000, how much increase in revenues and sales volume would be necessary to cover the increase in fixed expense? Assume the contribution margin is still 40%

Selling price per case	15
Variable expenses per case	9
Fixed expenses associated with the product for the relevant period	49,000
Sales volume in case	?

- Contribution margin has to increase by the same amount to keep operating income constant, so the contribution margin has to increase by 9,000:  $9,000/40\% = 22,500$  (increase of revenues)
- Increase in volume:  $22,500/15 = 1,500$

## Application of Cost-Volume-Profit Analysis

Example 6: the contribution margin model is frequently used to analyze the impact on the operating income of an entire product line that is sold in a variety of package or size configurations, assuming that each configuration has the same, or very nearly the same, contribution margin ratio. If a product line has a contribution margin ratio of 30%, will an advertising program costing 21,000 be cost-effective if it generates an additional 80,000 of revenue?

Increase in contribution margin	<u><math>80,000 \times 30\% = 24,000</math></u>
Increase in advertising (fixed expense)	<u>21,000</u>
Increase in operating income	<u><math>24,000 - 21,000 = 3,000</math></u>

- The advertising program would be cost-effective.

## Application of Cost-Volume-Profit Analysis

Example 7: Although all of the examples used so far have expressed volume as units of product, the contribution margin model is also useful for organizations that provide services rather than sell products. A day care center could identify variable expenses by type of activity and then set charges to achieve a target contribution margin to cover fixed expenses and operating income. The expected variable expenses is 18 per week per child, and a target contribution margin ratio is 40%. How much revenue generated per child under such circumstances?

	Per child	X	Volume	=	Total	%
Revenue	?					
Variable Expenses	18					?
Contribution Margin	?	X	?	=	?	40%
Fixed Expenses					?	
Operating Income					?	

## Application of Cost-Volume-Profit Analysis

Example 7: Although all of the examples used so far have expressed volume as units of product, the contribution margin model is also useful for organizations that provide services rather than sell products. A day care center could identify variable expenses by type of activity and then set charges to achieve a target contribution margin to cover fixed expenses and operating income. The expected variable expenses is 18 per week per child, and a target contribution margin ratio is 40%. How much revenue generated per child under such circumstances?

	Per child	X	Volume	=	Total	%
Revenue	30					
Variable Expenses	18					?
Contribution Margin	12	X	?	=	?	40%
Fixed Expenses					?	
Operating Income					?	

## Application of Cost-Volume-Profit Analysis

When the contribution margin model is applied using data for more than one product or service, the sales mix issue must be considered

- Sales mix: relative proportion of total sales accounted for by different products or services.

	Product A			Product B			Total Company
	Per unit	Volume	Total	Per unit	Volume	Total	
Revenue	40	2,000	80,000	30	2,000	60,000	140,000
Variable Costs	30			18			
Contribution Margin	10	2,000	20,000(25%)	12	2,000	24,000 (40%)	44,000 (31.4%)
Fixed Costs							30,000
Operating Income							14,000

## Application of Cost-Volume-Profit Analysis

- Assume that the sales mix changes and instead of sales volume of 2,000 units of each product, sales volume becomes 2,500 units of product A and 1,500 units of product B. The company's contribution margin format income statement becomes:

	Product A			Product B			Total Company
	Per unit	Volume	Total	Per unit	Volume	Total	
Revenue	40	2,500	100,000	30	1,500	45,000	145,000
Variable Costs	30			18			
Contribution Margin	10	2,500	25,000(25%)	12	1,500	18,000 (40%)	43,000 (29.7%)
Fixed Costs							30,000
Operating Income							13,000

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## Break-Even Point Analysis

- Break-Even Point: the amount of revenue that must be realized for the firm (or product or activity or group of products or activities) to have neither profit nor loss (operating income equals to zero).
- The contribution margin is used to determine the break-even point by setting operating income equal to zero and solving the model for the revenue or physical sales volume that will cause that result.

Selling price per unit	12
Variable cost per unit	8
Total fixed cost	45,000

	Per unit	X	Volume	=	Total	%
Revenue	12					
Variable Expenses	8					
Contribution Margin	4	X	?	=	?	33.8%
Fixed Expenses					45,000	
Operating Income					0	

## Break-Even Point Analysis

- Contribution margin is set equal to the fixed cost:

$$\begin{aligned} \text{Volume in units at breakeven} &= \frac{\text{Fixed Costs}}{\text{Contribution margin per unit}} \\ &= \frac{45,000}{4} = 11,250 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Total Revenues at Breakeven} &= \frac{\text{Fixed Costs}}{\text{Contribution margin ratio}} \\ &= \frac{45,000}{33.3\%} = 135,000 \end{aligned}$$

## Break-Even Point Analysis

- the margin of safety: a measurement of risk that describes a company's current sales performance relative to its break-even sales
  - *Margin of Safety = Total Sales – Breakeven Sales*
  - *Margin of Safety ratio =  $\frac{\text{Margin of safety}}{\text{Total Sales}}$*
  - Margin of safety ratio tells the managers the maximum percentage the sales can drop in order to ensure the company is operating at the break-even point.

## Break-Even Point Analysis

- Break-even formula is also used to determine the total revenue and units for desired level of operating income. Assume the desired operating income is 10,000.

*Volume in units for desired operating income of 10,000*

$$= \frac{\text{Fixed Costs} + \text{Desired Operating Income}}{\text{Contribution margin per unit}}$$

$$= \frac{45,000 + 10,000}{4} = 13,750 \text{ units}$$

*Total Revenue for desired operating income of 10,000*

$$= \frac{\text{Fixed Costs} + \text{Desired Operating Income}}{\text{Contribution margin ratio}}$$

$$= \frac{45,000 + 10,000}{33.3\%} = 165,000$$

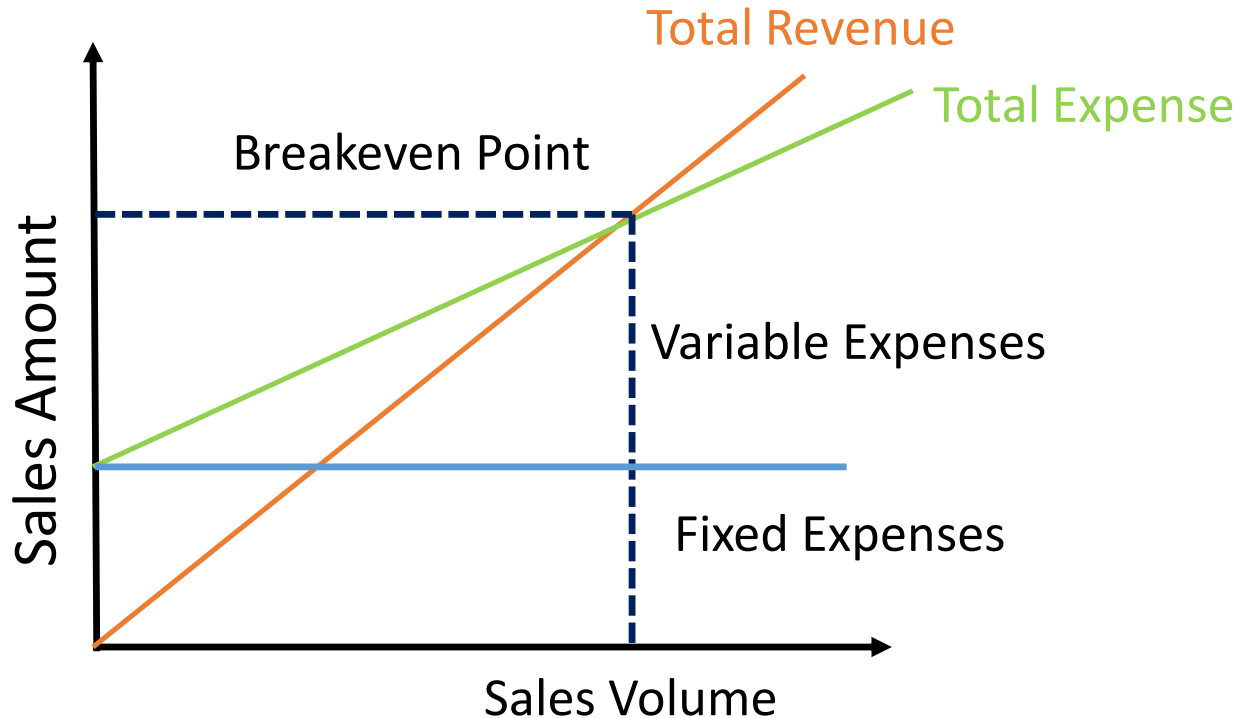
- Break-even analysis can be performed when multiple products exist by using the average contribution margin ratio:

*Total Revenue at breakeven*

$$= \frac{\text{Fixed Costs}}{\text{Average contribution margin ratio}}$$

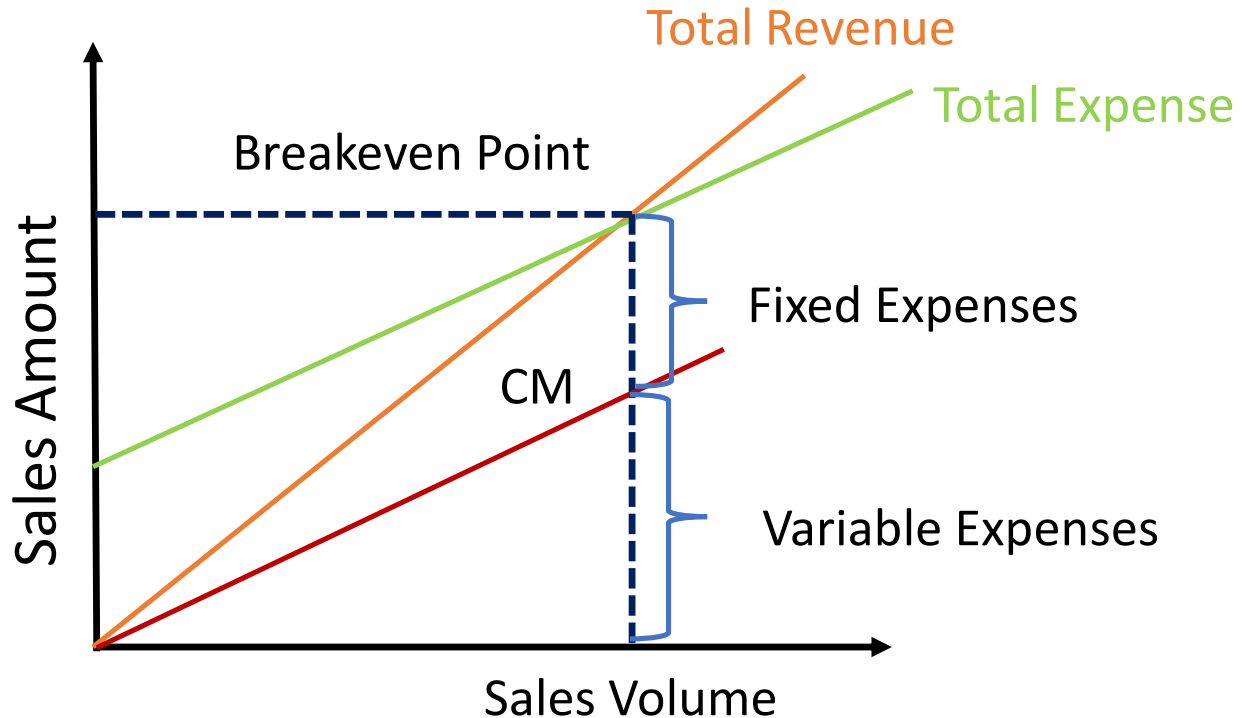
## Break-Even Point Analysis

Group Discussion: try to explain and compare the following graphs using the break-even point analysis



## Break-Even Point Analysis

Group Discussion: try to explain and compare the following graphs using the break-even point analysis



## Operating Leverage

- Operating Leverage measures the degree to which a firm or project can increase operating income by increasing revenue.
  - Magnification of effect on operating income from a change in revenue
  - High operating leverage increases the risk that a small percentage decline in revenues will cause a relatively larger percentage decline in operating income
  - The higher the contribution margin ratio, the greater the operating leverage



## Operating Leverage

Assume two companies make similar products but the companies have adopted different cost structures. Company A's product is made in a labor-intensive operation with relatively high variable costs but relatively low fixed costs, and company B's product is made in a capital-intensive operation with relatively low variable costs but relatively high fixed costs. Each firm presently sells 10,000 units of product. A contribution margin model for each firm is presented as follows

	Company A			Company B		
	Per unit	Volume	Total	Per unit	Volume	Total
Revenue	50			50		
Variable Costs	35			20		
Contribution Margin	15	10,000	150,000 (30%)	30	10,000	300,000 (60%)
Fixed Costs			50,000			200,000
Operating Income			100,000			100,000

## Operating Leverage

- Effect on operating income of an increase in volume from 10,000 to 11,000 units

	Company A			Company B		
	Per unit	Volume	Total	Per unit	Volume	Total
Contribution Margin	15	11,000	165,000 (30%)	30	11,000	330,000 (60%)
Fixed Costs			50,000			200,000
Operating Income			115,000			130,000
Percentage change in volume		+10%			+10%	
Percentage change in operating income			15%			30%

Company B's operating income increased at a much higher rate, and to a considerably higher amount, than Company A's operating income. Operating leverage results in the operating income of each firm increasing proportionately more than the change in volume of activity.

## Operating Leverage

- Effect on operating income of a decrease in volume from 10,000 to 9,000 units

	Company A			Company B		
	Per unit	Volume	Total	Per unit	Volume	Total
Contribution Margin	15	9,000	135,000 (30%)	30	9,000	270,000 (60%)
Fixed Costs			50,000			200,000
Operating Income			85,000			70,000
Percentage change in volume		-10%			-10%	
Percentage change in operating income			-15%			-30%

Company B's operating income decreased at a much higher rate, and to a considerably lower amount, than Company A's operating income. Operating leverage results in the operating income of each firm decreasing proportionately more than the change in volume of activity.

- indifference point: two companies achieve an identical amount of operating income

- Setting total cost of each alternative equal to one another and solve the corresponding volume

- $\text{Fixed Costs} + (\text{variable cost per unit} \times \text{Volume})$

- $\text{Fixed Cost}(A) + \text{Variable Cost per unit}(A) \times \text{Volume} =$   
 $\text{Fixed Cost}(B) + \text{Variable Cost per unit}(B) \times \text{Volume}$