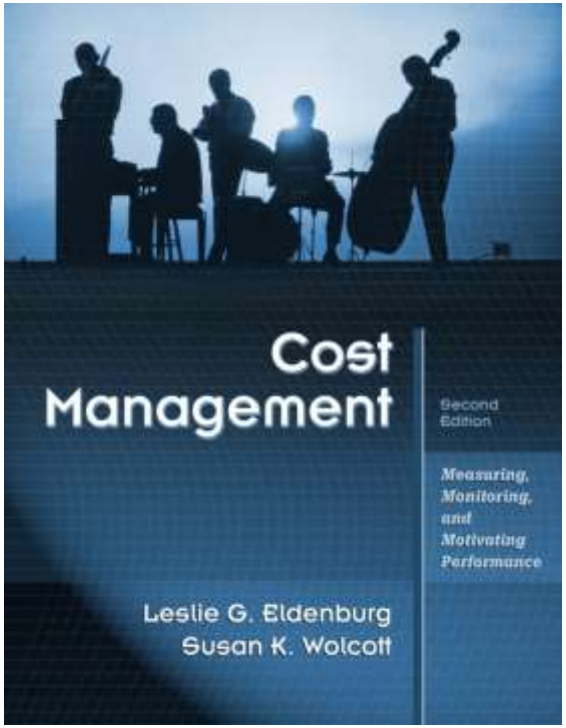
Cost Management
Measuring, Monitoring, and Motivating Performance

Chapter 1

The Role of Accounting Information in Management Decision Making



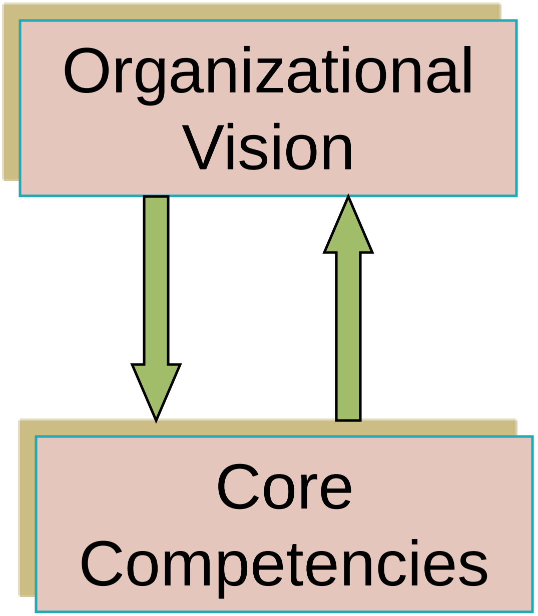
Learning objectives

- Q1 - What is the process of strategic management and decision making?
- Q2 - What types of control systems do managers use?
- Q3 - What is the role of accounting information in strategic management?
- Q4 - What information is relevant for decision making?
- Q5 - How does business risk affect management decision making?
- Q6 - How do biases affect management decision making?
- Q7 - How can managers make higher-quality decisions?
- Q8 - What is ethical decision making, and why is it important?

Q1: Organizational Vision and Core Competencies

- The organizational vision is the core purpose and ideology of the organization.
- Determining the organizational vision precedes all other management decision making.
- Management must also isolate the organization's core competencies – its strengths relative to competitors.

Q1: Organizational Vision and Core Competencies



The organizational vision and the core competencies are closely related.

The organization’s strengths should help shape the vision.

The vision should help locate the organization’s strengths.

If you were starting an accounting practice, what would be your organizational vision?

What do you think would be your core competencies?

Q1: Organizational Strategies

Organizational Vision & Core Competencies

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Organizational Strategies

Organizational strategies are the tactics that managers use to work toward the organizational vision while taking advantage of the core competencies.

These strategies are long-term in nature.

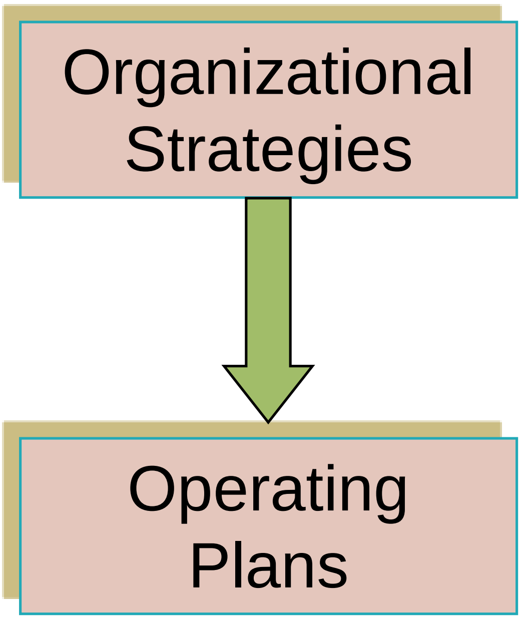
Examples include organization structure, financial structure, and long-term resource allocation strategies.

If you were starting an accounting practice, what would be some of your organizational strategies?

How do these work toward your organizational vision?

How do they take advantage of your core competencies?

Q1: Operating Plans



Operating plans are the short-term implementations of the organizational strategies.

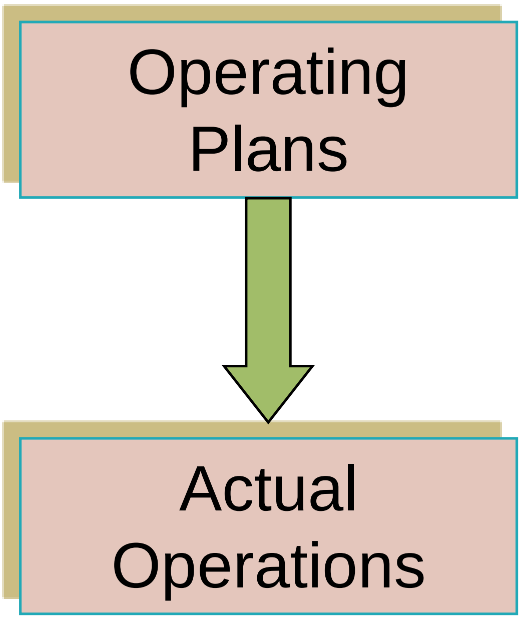
Operating plans usually include budgeted goals for revenues and expenses.

Examples include schedules for employees and procedures for daily relationship management decisions with suppliers.

If you were starting an accounting practice, what would be some of your operating plans?

How do these relate to your organizational strategies?

Q1: Actual Operations



Actual operations are the actions taken and the results achieved.

The organization's information system measures the results of actual operations.

Examples include number of units sold, advertising expense, and the wage expense for the period.

If you had an accounting practice, what would information would you want to collect about the results of your actual operations?

Q1: Monitoring and Motivating Performance

Actual Operations

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Organizational Vision & Core Competencies

Managers use the results of actual operations to monitor performance and ensure that it is in line with the organizational vision.

Managers may find that the results of actual operations make them re-think the organizational vision or their view of the organization's core competencies.

If you had an accounting practice, can you think of an example of a measure of actual operations and how you would use it to motivate performance?

Can you think of an example of a measure of actual operations that might make you redefine your organizational vision or your view of your core competencies?

Q2: Management Control Systems

- Belief Systems
  - Vision, Mission, Core Values Statements
- Boundary Systems
  - Code of Conduct, Procedure Manuals, Compliance Actions
- Diagnostic Control Systems
  - Measure, monitor, and motivate employees against preset goals
- Interactive Control Systems
  - Recurring information and reports to evaluate performance and direct actions

Q3: Financial, Managerial, and Cost Accounting

Financial accounting prepares reports most frequently used by decision makers external to the organization.

Managerial accounting prepares reports most frequently used by decision makers internal to the organization.

Cost accounting includes both financial and nonfinancial information and is used for both financial and managerial accounting.

Q3: Strategic Cost Management and the Balanced Scorecard

- Strategic cost management is an approach to reducing costs while strengthening the organization's strategic position.
- The balanced scorecard can be used to formalize strategic cost management efforts by detailing financial and nonfinancial benchmarks for all segments of the organization.
- Examples of such benchmarks include:
  - Personnel can reduce costs by completing all hiring within 20 days of initial interview.
  - Production can reduce costs and improve quality if Engineering can reduce the number of processes in the production process.

Q4: What Information is Relevant for Decision Making?

- Information is relevant if:
  - *Differs* across the alternatives, and
  - Is about the *future*.
- Relevant information can be quantitative or qualitative
- Information is irrelevant if:
  - *Does not vary* with the option chosen or action taken

Irrelevant information is NOT useful in decision making!

Q4: Relevant Cash Flows

- Relevant cash flows are future cash flows that differ across the alternatives.
  - also called incremental cash flows
  - also called avoidable cash flows
- Irrelevant cash flows are:
  - non-incremental and unavoidable cash flows
  - do not vary among alternatives
- Must look at the cash flow relevance to the decision being made
  - Electricity costs *are relevant* to the decision to open a business or not
  - Electricity costs *are not relevant* in the decision to lease or buy a building for your business

Q4: What Information is Relevant for Decision Making?

You have a small computer repair company and are deciding whether to replace your old copy machine or repair it. In the list of information below, identify which data are relevant to this decision and which are irrelevant.

- The purchase price of the copy machine was $1200.
- The repair costs are $320.
- The copy machine can make 20 copies per minute.
- If you repair it, the machine will use less toner than it does now.
- You make approximately 1000 copies per month.
- The repair won't fix the broken stapler.
- The repair carries a one-year warranty.
- The copy machine was a gift from your spouse.

Q4: Relevance of Income Statement Information

- Income Statements include:
  - Period costs
  - Product costs (recorded as cost of goods sold)
- Many business decisions require the incremental cost to produce a unit
- Cost per unit on the income statement includes both fixed and variable costs
- Including fixed costs does not represent the true incremental cost of a unit

Q5: Impact of Business Risk on Decision Making

- Business Risk is the possibility an event will occur and interfere with the organization's strategic goals

Economic & Financial

People, Legal & Health

Political and Social

Reputation

Weather

Criminal and Terrorist

Informational & Operational

Environment & Man Made

- The existence of business risk can cloud management's decision making process

Q6: Uncertainties, Biases, and Decision Quality

- Uncertainties are issues and information about which there is doubt.
- Biases are preconceived notions adopted without careful thought.
- Decision quality refers to the characteristics of a decision that affect the likelihood of achieving a positive outcome.
- Both uncertainty and bias reduce decision quality.

Q6: Uncertainties and Biases in Information

- Uncertainties come from many sources and can be exogenous or endogenous.
  - The future is always uncertain.
  - Managers may be uncertain that the right information was captured in a report.
- Biases can come from many sources.
  - The decision maker may be biased towards or against a particular alternative (predisposition bias)
  - The methods used to collect information could have introduced bias (information bias)
  - The decision maker may exercise an error in judgment or processing information (cognitive bias)

Q6: Motorola's Iridium Project

- How did uncertainties and bias effect Motorola's decision making process?

Q6: Uncertainties, Biases, and Decision Quality

Lori loves to sew and has always made her own clothes. People often tell her that she is the best-dressed person they've ever met. She can design and sew a lovely outfit in under 2 days. She is considering opening a store that could sell her home-made fashions. Then she could combine her work with her hobby.

Can you identify some of the uncertainties Lori faces? Can you think of any way she can reduce some of these uncertainties?

Can you identify any possible personal biases that Lori may have? How could these affect her decision making process?

Q7: Characteristics of Higher-Quality Decisions

Higher quality decisions come from a higher quality decision making process. Such a process is thorough, unbiased, focused, strategic, creative, and visionary.

This process requires reports that are relevant, understandable, and available.

These reports must contain information that is more certain, complete, relevant, timely and valuable.

Q8: Components of Ethical Decision Making

1. Identify ethical problems as they arise
2. Consider the well being of others and society
3. Clarify and apply ethical values
4. Continuously improve your personal ethics

Q8: The IMA's Code of Ethics

- The Institute of Management Accountants (IMA) has a Code of Ethics that states that IMA members have a responsibility to:
  - maintain an appropriate level of professional competence and perform their professional duties in accordance with laws, regulations, and standards;
  - refrain from disclosing confidential information (unless legally obligated), or using (or even appearing to use) confidential information to illegal advantage;
  - avoid actual and apparent conflicts of interest; and
  - communicate information fairly and objectively, and disclose all relevant information to decision makers.

Q8: Ethical Decision Making

Suppose you work for the Lee K. Fawcett Plumbing Company as Mr. Fawcett's administrative assistant. Recently Mr. Fawcett asked you to type some financial statements from his hand-written notes so that he can take them to the bank as part of a loan application.

This exercise seems odd to you because the company's CPA recently delivered the monthly financial statements that she prepares.

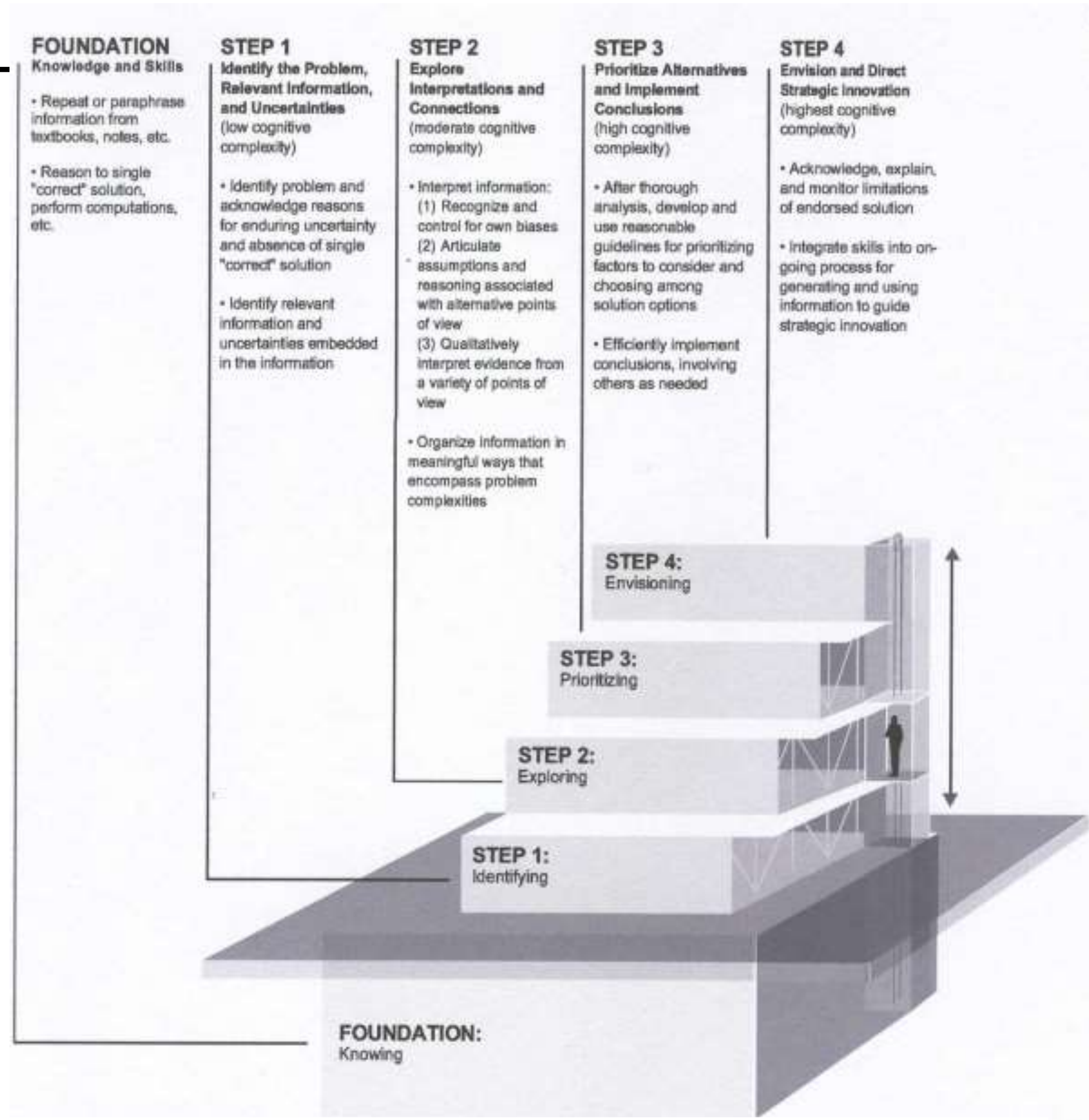
While typing the financial statements you notice that the building the company rents is listed as an asset. Also, you write checks each month for the monthly payments on two car loans, and these are not listed as liabilities.

Do you have an ethical dilemma? Discuss your approach to handling this situation.

Appendix: Steps for Better Thinking

Steps for Better Thinking is a process to help address open-ended questions.

Open-ended questions have no single correct solution; managers must seek the *best* solution.



Source: (c) 2002. C. L. Lynch, S. K. Wolcott, and G. E. Huber, "Steps for Better Thinking: A Developmental Problem-Solving Process" (August 5, 2002).

Appendix: Steps for Better Thinking – Foundation (Knowing)

- Foundation level skills include a knowledge of the terminology and basic concepts that are relevant to the decision at hand.
- An individual with Foundation level skills can:
  - perform calculations to arrive at correct answer
  - define terms in his/her own words
  - describe a concept
  - list the elements contained in a concept or process

Appendix: Steps for Better Thinking - Identifying

- Step 1 skills include the ability to identify relevant information and uncertainties.
- An individual with Step 1 skills can:
  - create a list of issues related to the decision
  - sort information that is relevant
  - identify the reasons for the underlying uncertainties
  - perform research to obtain input into the decision

Appendix: Steps for Better Thinking - Exploring

- Step 2 skills include the ability to explore interpretations of the information and connections between alternative solutions approaches.
- An individual with Step 2 skills can:
  - recognize and control for his/her own biases
  - articulate assumptions and reasoning associated with alternative points of view
  - organize information in meaningful ways to encompass problem complexities
  - compare and contrast different approaches to a problem's solutions

Appendix: Steps for Better Thinking - Prioritizing

- Step 3 skills include the ability to prioritize alternatives, come to a decision, and implement the decision.
- An individual with Step 3 skills can:
  - develop guidelines for prioritizing alternatives
  - prioritize alternatives after objective analysis
  - communicate findings in a manner appropriate to the audience
  - describe how the solution or decision might change if priorities change

Appendix: Steps for Better Thinking - Envisioning

- Step 4 skills include the ability to monitor the decision and innovate new strategies to modify the decision when circumstances change.
- An individual with Step 4 skills can:
  - explain the limitations of the decision made
  - establish a plan for monitoring the performance of the decision
  - explain how conditions may change in the future and how this may change the decision

Cost Management

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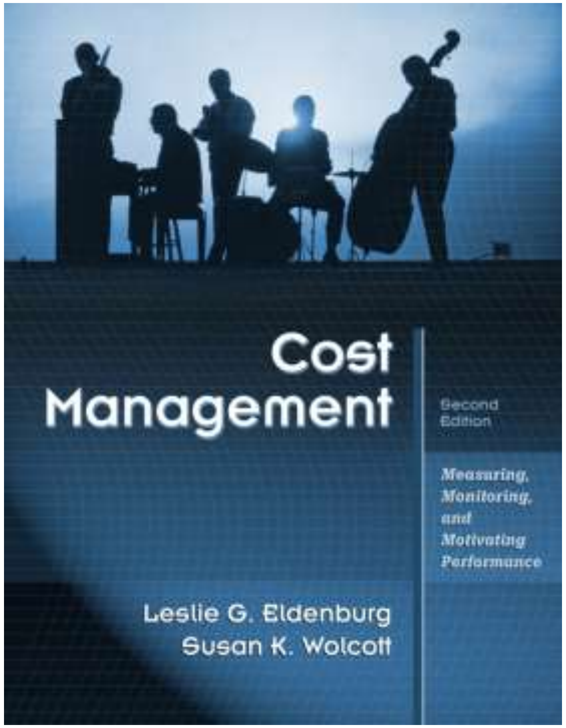
Chapter 2

The Cost Function



Learning objectives

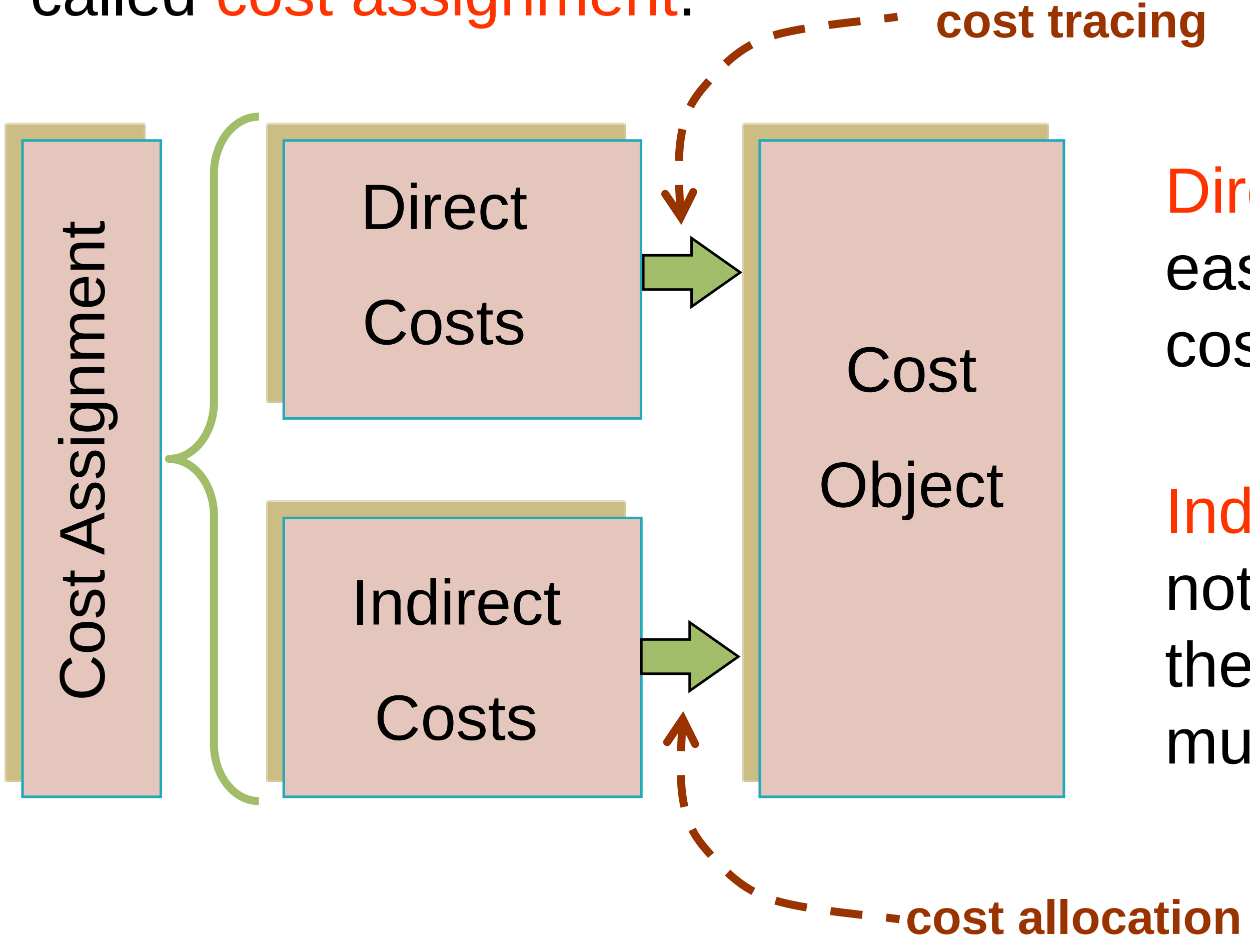
- Q1: What are the different ways to describe cost behavior?
- Q2: What process is used to estimate future costs?
- Q3: How are engineered estimates, account analysis, and two-point methods used to estimate cost functions?
- Q4: How does a scatter plot assist with categorizing a cost?
- Q5: How is regression analysis used to estimate a cost function?
- Q6: How are cost estimates used in decision making?

Q1: Different Ways to Describe Costs

- Costs can be defined by how they relate to a cost object, which is defined as any thing or activity for which we measure costs.
- Costs can also be categorized as to how they are used in decision making.
- Costs can also be distinguished by the way they change as activity or volume levels change.

Q1: Assigning Costs to a Cost Object

Determining the costs that should attach to a cost object is called cost assignment.



Direct costs are easily traced to the cost object.

Indirect costs are not easily traced to the cost object, and must be allocated.

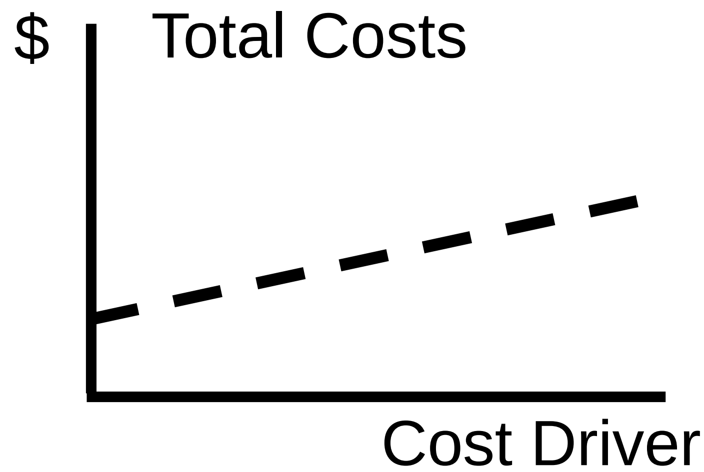
Q1: Direct and Indirect Costs

- In manufacturing:
  - all materials costs that are easily traced to the product are called direct material costs
  - all labor costs that are easily traced to the product are called direct labor costs
  - all other production costs are called overhead costs
- Whether or not a cost is a direct cost depends upon:
  - the definition of the cost object
  - the precision of the bookkeeping system that tracks costs
  - the technology available to capture cost information
  - whether the benefits of tracking the cost as direct exceed the resources expended to track the cost
  - the nature of the operations that produce the product or service

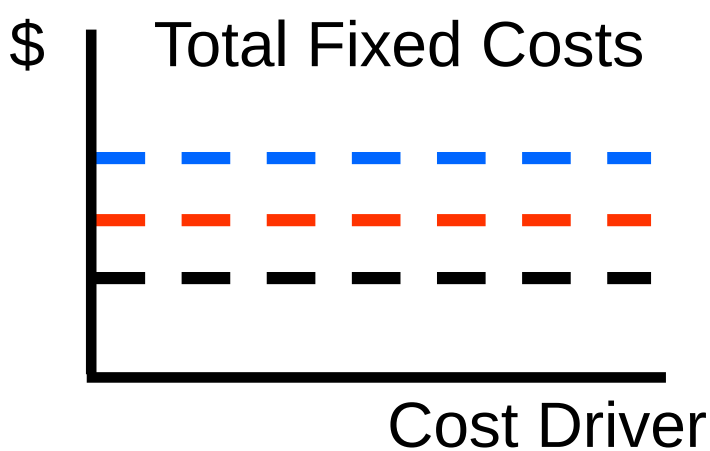
Q1: Linear Cost Behavior Terminology

- Total fixed costs are costs that do not change (in total) as activity levels change.
- Total variable costs are costs that increase (in total) in proportion to the increase in activity levels.
- Total costs equal total fixed costs plus total variable costs.
- The relevant range is the span of activity levels for which the cost behavior patterns hold.
- A cost driver is a measure of activity or volume level; increases in a cost driver cause total costs to increase.

Q1: Behavior of Total (Linear) Costs



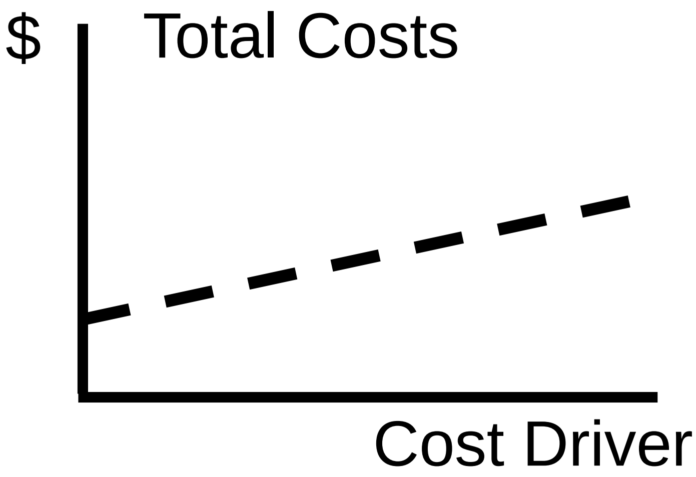
If costs are linear, then total costs graphically look like this.



Total fixed costs do not change as the cost driver increases.

Higher total fixed costs are higher above the x axis.

Q1: Behavior of Total (Linear) Costs



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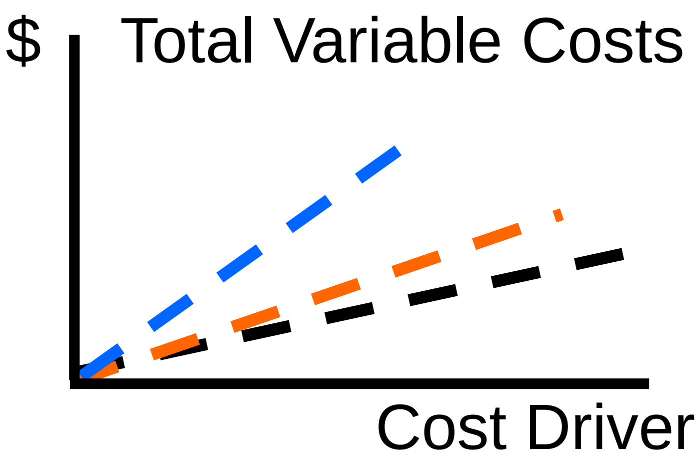
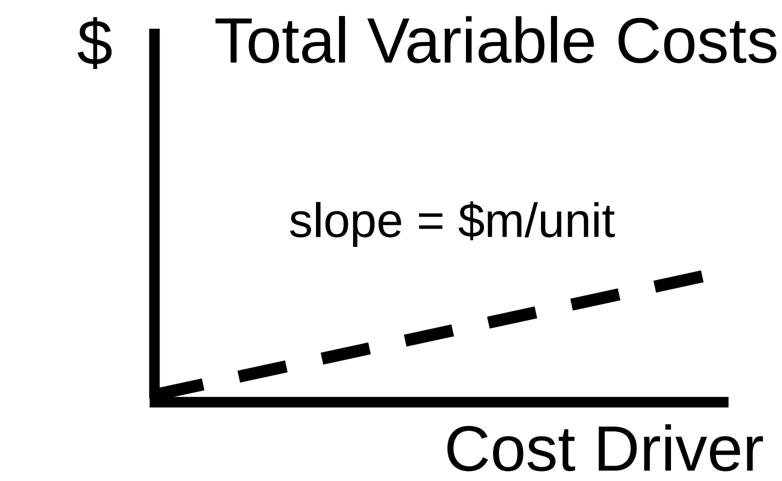


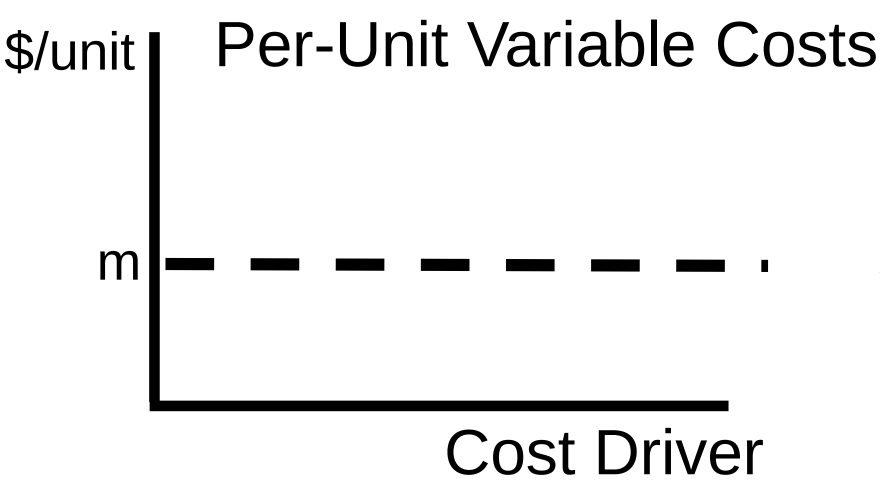
Total variable costs increase as the cost driver increases.

A steeper slope represents higher variable costs per unit of the cost driver.

Q1: Total Versus Per-unit (Average) Cost Behavior

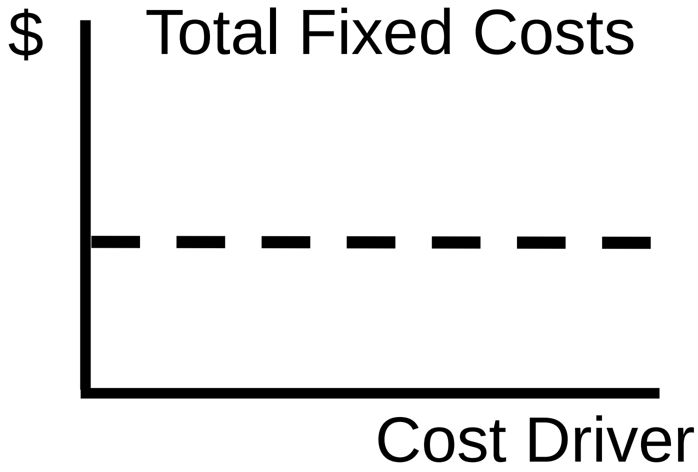


If total variable costs look like this . . .



. . . then variable costs per unit look like this.

Q1: Total Versus Per-Unit (Average) Cost Behavior



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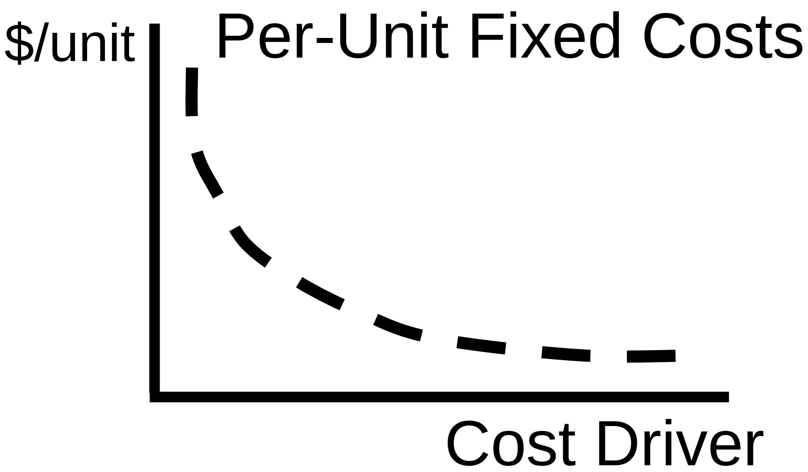


. . . then fixed costs per unit look like this.

Q1: Total Versus Per-Unit (Average) Cost Behavior

Lari's Leather produces customized motorcycle jackets. The leather for one jacket costs $50, and Lari rents a shop for $450/month. Compute the total costs per month and the average cost per jacket if she made only one jacket per month. What if she made 10 jackets per month?

Average variable costs are constant

Total variable costs go up

1 Jacket

	Total Costs/ Month	Average Cost/ Jacket
Leather	$50	$50
Rent	$450	$450
Total	$500	$500

10 Jackets

	Total Costs/ Month	Average Cost/ Jacket
Leather	$500	$50
Rent	$450	$45
Total	$950	$95

Total fixed costs are constant

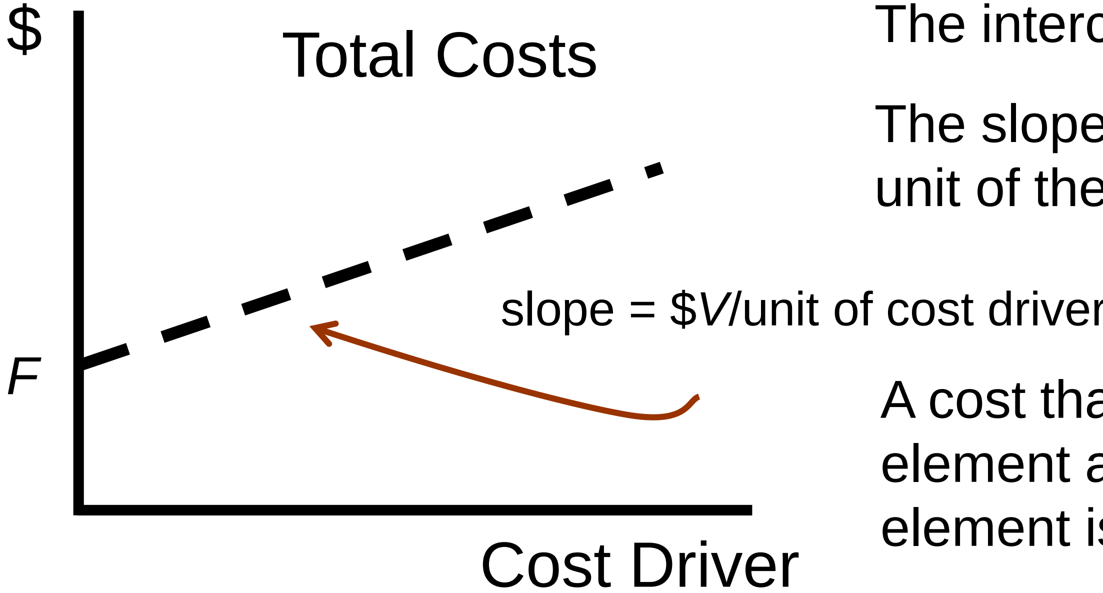
Average fixed costs go down

Q1: The Cost Function

When costs are linear, the cost function is:

$TC = F + V \times Q$, where

F = total fixed cost, *V* = variable cost per unit of the cost driver, and *Q* = the quantity of the cost driver.



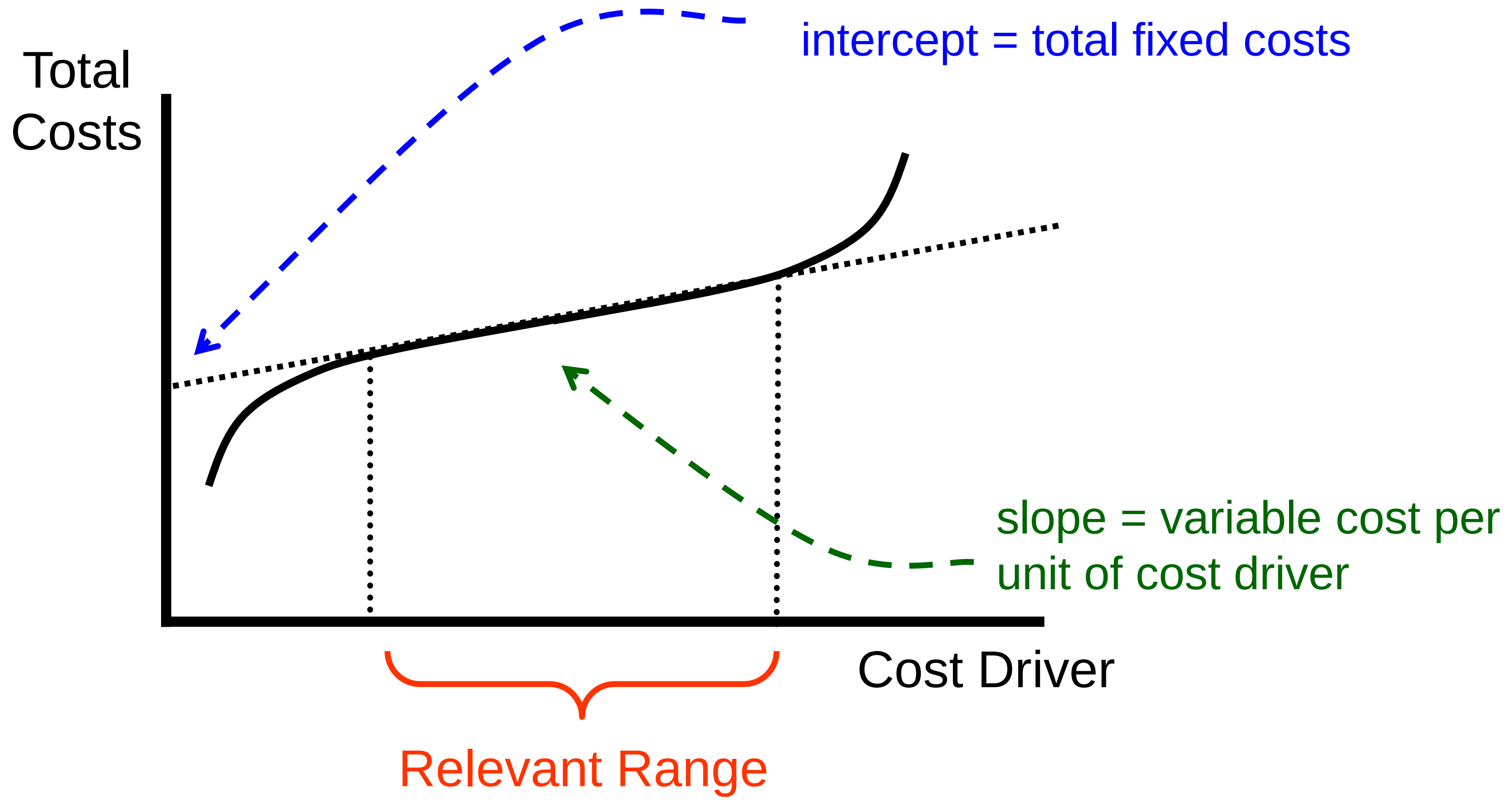
The intercept is the total fixed cost.

The slope is the variable cost per unit of the cost driver.

A cost that includes a fixed cost element and a variable cost element is known as a mixed cost.

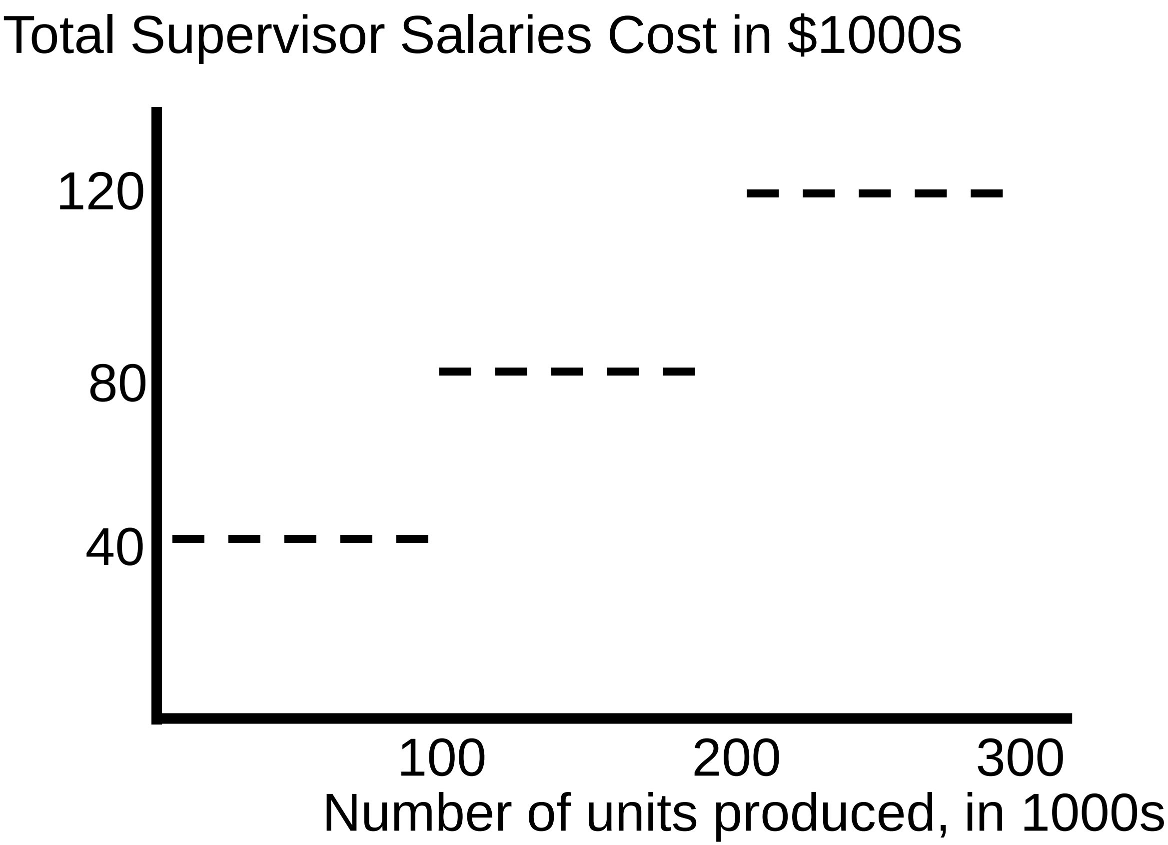
Q1: Nonlinear Cost Behavior

Sometimes nonlinear costs exhibit linear cost behavior over a range of the cost driver. This is the relevant range of activity.



Q1: Stepwise Linear Cost Behavior

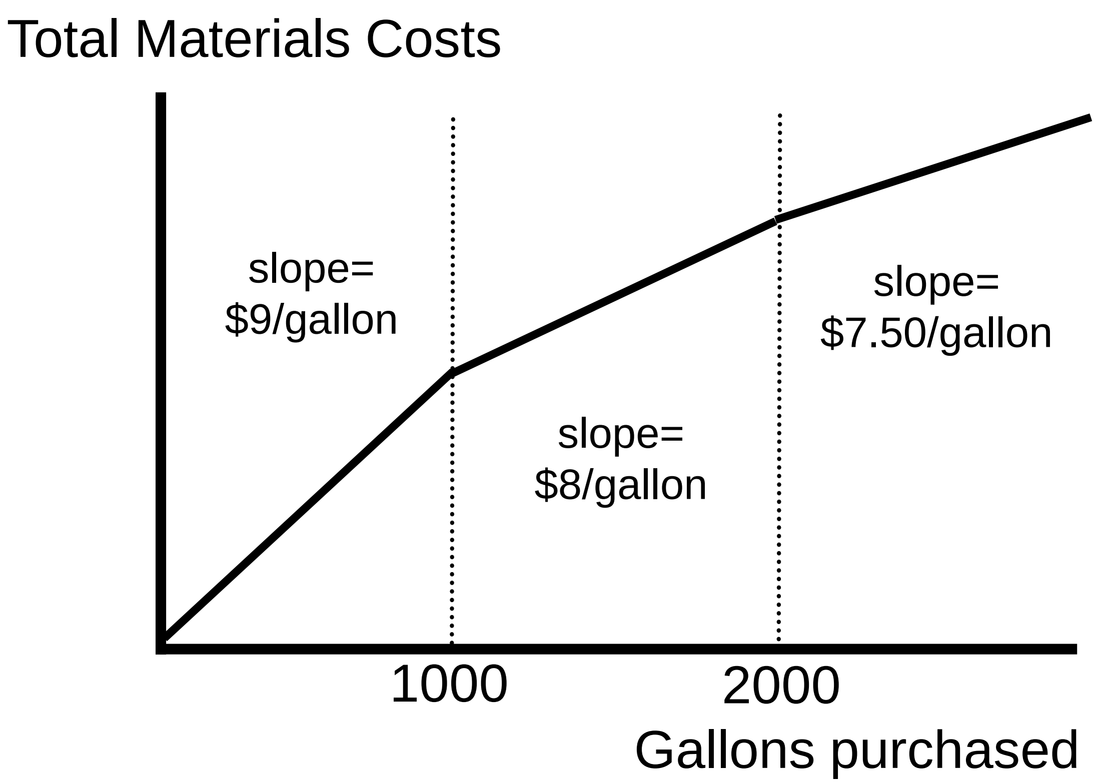
Some costs are fixed at one level for one range of activity and fixed at another level for another range of activity. These are known as stepwise linear costs.



Example: A production supervisor makes $40,000 per year and the factory can produce 100,000 units annually for each 8-hour shift it operates.

Q1: Piecewise Linear Cost Behavior

Some variable costs per unit are constant at one level for one range of activity and constant at another level for another range of activity. These are known as piecewise linear costs.



Example: A supplier sells us raw materials at $9/gallon for the first 1000 gallons, $8/gallon for the second 1000 gallons, and at $7.50/gallon for all gallons purchased over 2000 gallons.

Q1: Cost Terms for Decision Making

- In Chapter 1 we learned the distinction between relevant and irrelevant cash flows.
- Opportunity costs are the benefits of an alternative one gives up when that alternative is not chosen.
  - Opportunity costs are difficult to measure because they are associated with something that did not occur.
  - Opportunity costs are always relevant in decision making.
- Sunk costs are costs that were incurred in the past.
  - Sunk costs are never relevant for decision making.

Q1: Cost Terms for Decision Making

- Discretionary costs are periodic costs incurred for activities that management may or may not determine are worthwhile.
  - These costs may be variable or fixed costs.
  - Discretionary costs are relevant for decision making only if they vary across the alternatives under consideration.
- Marginal cost is the incremental cost of producing the next unit.
  - When costs are linear and the level of activity is within the relevant range, marginal cost is the same as variable cost per unit.
  - Marginal costs are often relevant in decision making.

Q2: What Process is Used to Estimate Future Costs?

Past costs are often used to estimate future, non-discretionary, costs. In these instances, one must also consider:

- whether the past costs are relevant to the decision at hand
- whether the future cost behavior is likely to mimic the past cost behavior
- whether the past fixed and variable cost estimates are likely to hold in the future

Q3: Engineered Estimates of Cost Functions

- Use accountants, engineers, employees, and/or consultants to analyze the resources used in the activities required to complete a product, service, or process.

- For example, a company making inflatable rubber kayaks would estimate some of the following:
  - the amount and cost of the rubber required
  - the amount and cost of labor required in the cutting department
  - the amount and cost of labor required in the assembly department
  - overhead costs and the best cost allocation base to use
  - the selling costs, including commissions and advertising
  - the distribution costs

Q3: Account Analysis Method of Estimating a Cost Function

- Review past costs in the general ledger and past activity levels to determine each cost's past behavior.
- For example, a company producing clay wine goblets might review its records and find:
  - the cost of clay is piecewise linear with respect to the number of pounds of clay purchased
  - skilled production labor is variable with respect to the number of goblets produced
  - unskilled production labor is mixed, and the variable portion varies with respect to the number of times the kiln is operated
  - production supervisors' salary costs are stepwise linear
  - distribution costs are mixed, with the variable portion dependent upon the number of retailers ordering goblets

Q3: Example - Account Analysis Method of Estimating a Cost Function

- The table on the right contains the expenditures for Scott Manufacturing during the last year.
- 100,000 units were produced and sold
- $500,000 of sales revenue was recorded

Required:

1. Determine the cost function using units produced as the driver
2. Repeat using sales dollars as the driver

Expense	Amount	Variable	Fixed
Direct Materials	$500,000		
Direct Labor	300,000		
Rent	25,000		
Insurance	15,000		
Commissions	200,000		
Property Tax	20,000		
Telephone	10,000		
Depreciation	85,000		
Power & Light	30,000		
Admin Salaries	100,000		
Total	1,285,000		

Q3: Example - Account Analysis Method of Estimating a Cost Function

- Steps in estimating a cost function using account analysis
  - Separate fixed and variable costs
  - Total the fixed costs
  - Total the variable costs
  - Calculate a variable cost per driver
  - Write out the cost function

Q3: Solution - Account Analysis Method of Estimating a Cost Function

Expense	Amount	Variable	Fixed
Direct Materials	$500,000	500,000	
Direct Labor	300,000	300,000	
Rent	25,000		25,
Insurance	15,000		15,
Commissions	200,000	200,000	
Property Tax	20,000		20,
Telephone	10,000		10,
Depreciation	85,000		85,
Power & Light	30,000		30,000
Admin Salaries	100,000		100,000
Total	1,285,000	1,000,000	285,000

Cost Function on Units:

TC = FC + VC/Unit * Qty
TC = $285,000 + ($10/unit) * Qty

Cost Function on Dollars:

TC = FC + VC/Sales $ * Sales $
TC = $285,000 + ($0.20) * Sales $

Q3: Two-Point Method of Estimating a Cost Function

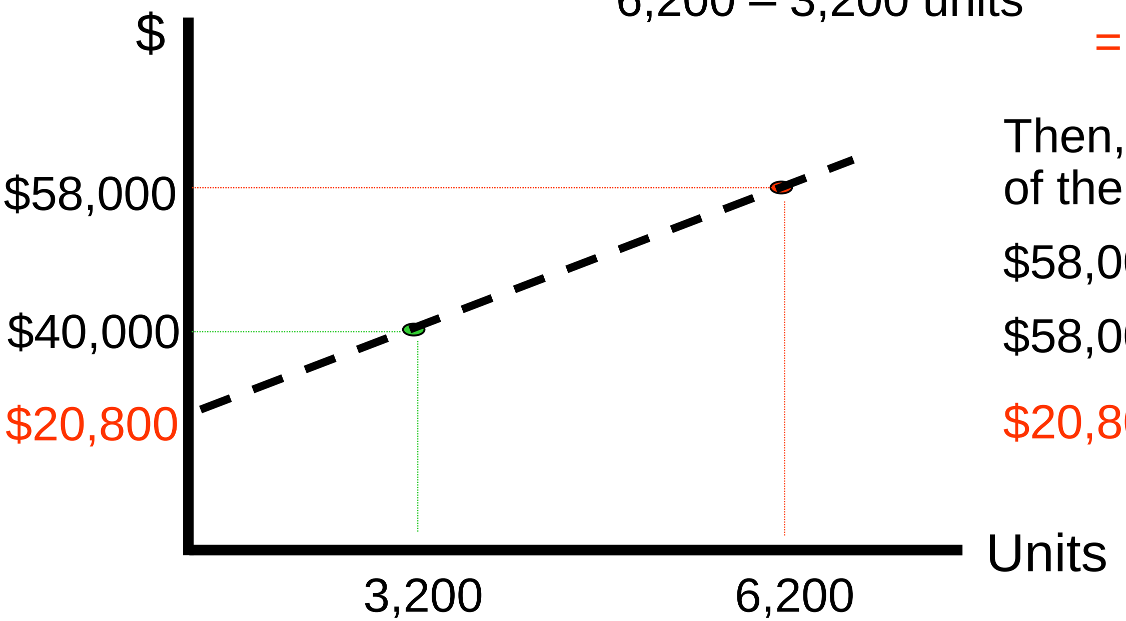
- Use the information contained in two past observations of cost and activity to separate mixed and variable costs.
- It is much easier and less costly to use than the account analysis or engineered estimate of cost methods, but:
  - it estimates only mixed cost functions,
  - it is not very accurate, and
  - it can grossly misrepresent costs if the data points come from different relevant ranges of activity

Q3: Example - Two-Point Method of Estimating a Cost Function

In July the Gibson Co. incurred total overhead costs of $58,000 and made 6,200 units. In December it produced 3,200 units and total overhead costs were $40,000. What are the total fixed factory costs per month and average variable factory costs?

We first need to determine *V*, using the equation for the slope of a line.

$$\text{rise/run} = \frac{\$58{,}000 - \$40{,}000}{6{,}200 - 3{,}200 \text{ units}} = \$18{,}000/3{,}000 \text{ units} = \$6/\text{unit}$$



Then, using TC = *F* + *V* x *Q*, and one of the data points, determine F.

$58,000 = *F* + $6/unit x 6,200 units

$58,000 = *F* + $37,200

$20,800 = *F*

Q3: High-Low Method of Estimating a Cost Function

- The high-low method is a two-point method
  - the two data points used to estimate costs are observations with the highest and the lowest activity levels
- The extreme points for activity levels may not be representative of costs in the relevant range
  - this method may underestimate total fixed costs and overestimate variable costs per unit,
  - or vice versa.

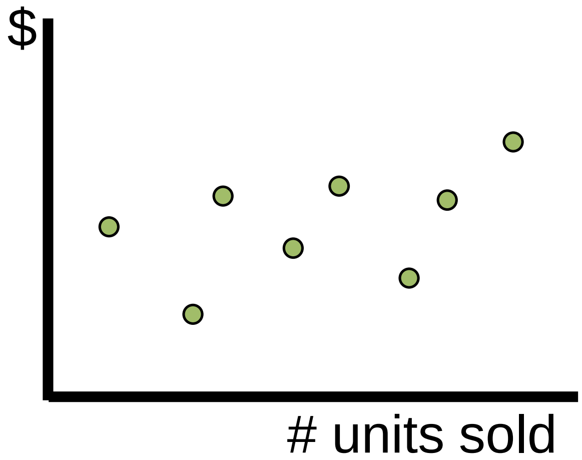
Q4: How Does a Scatterplot Assist with Categorizing a Cost?

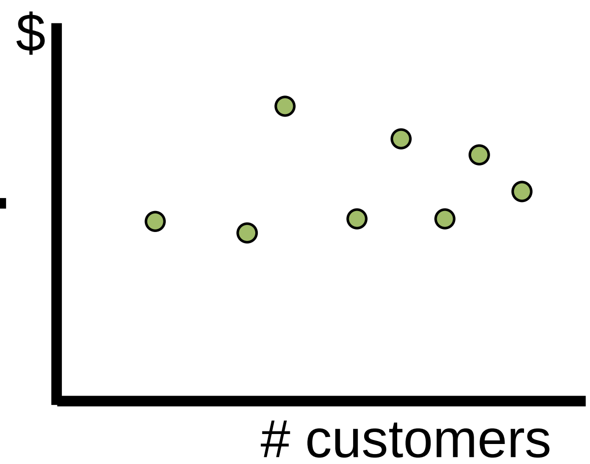
- A scatterplot shows cost observations plotted against levels of a possible cost driver.

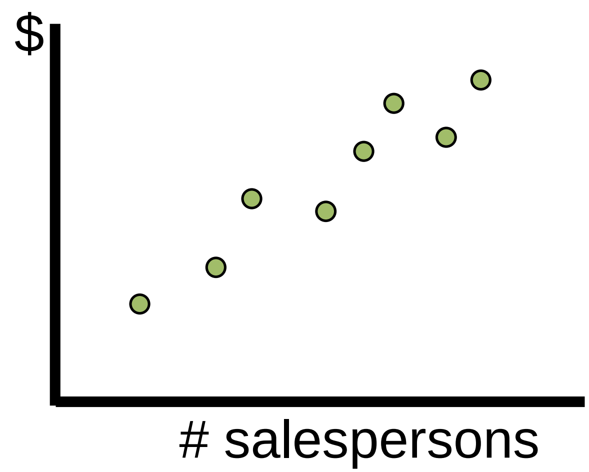
- A scatterplot can assist in determining:
  - which cost driver might be the best for analyzing total costs, and
  - the cost behavior of the cost against the potential cost driver.

Q4: Which Cost Driver Has the Best Cause & Effect Relationship with Total Cost?

8 observations of total selling expenses plotted against 3 potential cost drivers

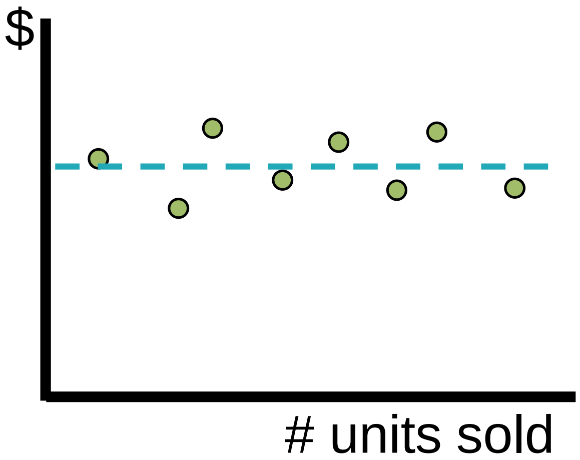




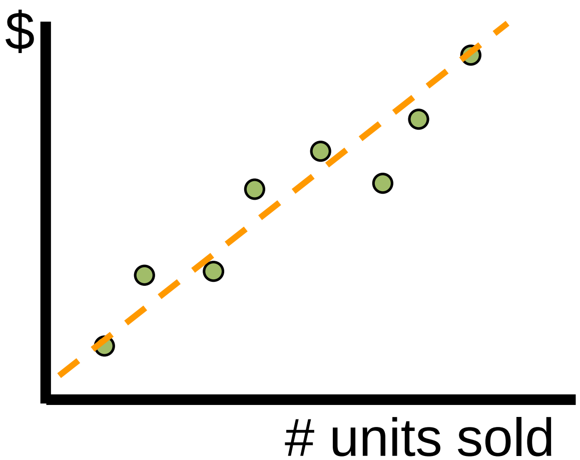


The number of salespersons appears to be the best cost driver of the 3.

Q4: What is the Underlying Cost Behavior?

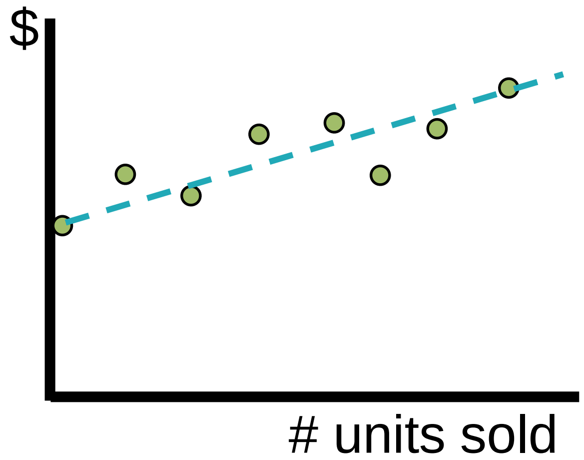


This cost is probably linear and fixed.

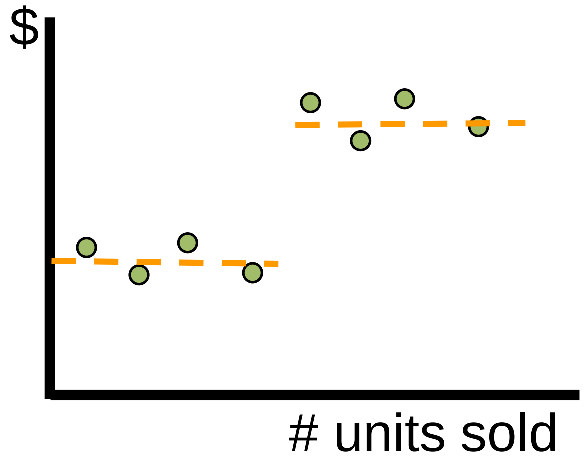


This cost is probably linear and variable.

Q4: What is the Underlying Cost Behavior?

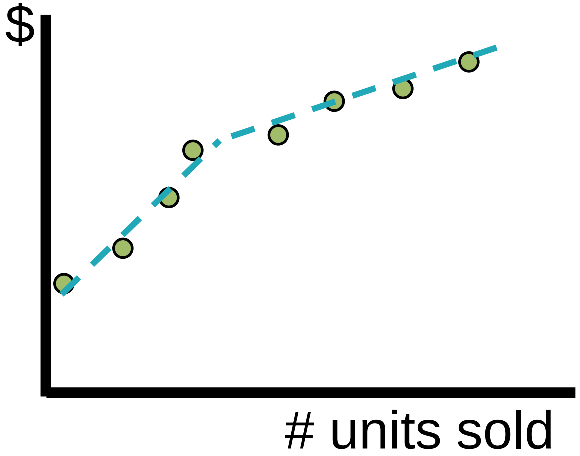


This cost is probably linear and mixed.



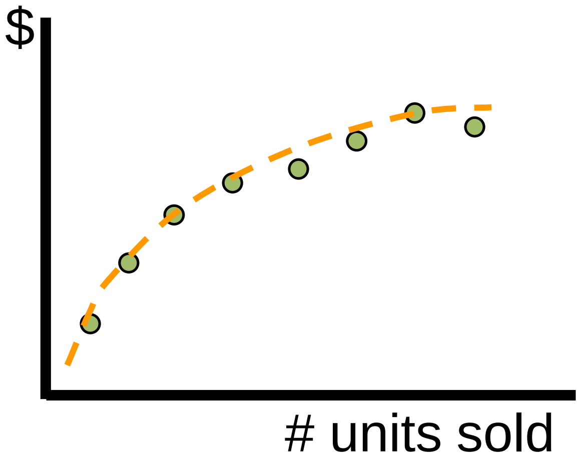
This is likely a stepwise linear cost.

Q4: What is the Underlying Cost Behavior?



This cost may be piecewise linear.

This cost appears to have a nonlinear relationship with units sold.



Q5: How is Regression Analysis Used to Estimate a Mixed Cost Function?

- Regression analysis estimates the parameters for a linear relationship between a dependent variable and one or more independent (explanatory) variables.
- When there is only one independent variable, it is called simple regression.
- When there is more than one independent variable, it is called multiple regression.

$$Y = \alpha + \beta X + \varepsilon$$

dependent variable

independent variable

α and β are the parameters; ε is the error term (or residual)

Q5: How is Regression Analysis Used to Estimate a Mixed Cost Function?

We can use regression to separate the fixed and variable components of a mixed cost.

$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

Y_i is the actual total costs for data point i

the intercept term is total fixed costs

ε_i is the difference between the predicted total cost for X_i and the actual total cost for observation i

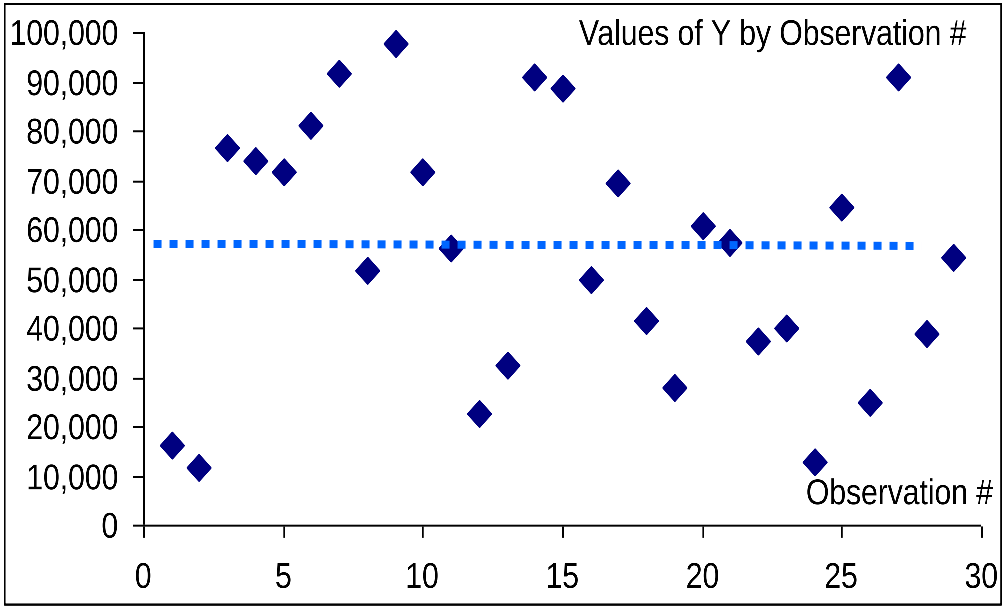
X_i is the actual quantity of the cost driver for data point i

the slope term is the variable cost per unit

Q5: Regression Output Terminology: Adjusted R-Square

- Goodness of fit
  - How well does the line from the regression output fit the actual data points?
  - The adjusted *R*-square statistic shows the percentage of variation in the Y variable that is explained by the regression equation.
  - The next slide has an illustration of how a regression equation can explain the variation in a Y variable.

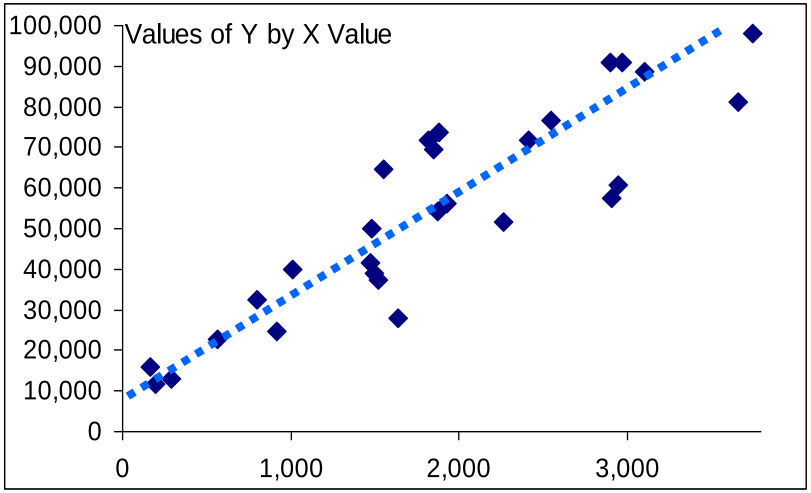
Q5: Regression Output Terminology: Adjusted R-Square



- We have 29 observations of a Y variable, and the average of the Y variables is 56,700.
- If we plot them in order of the observation number, there is no discernable pattern.
- We have no explanation as to why the observations vary about the average of 56,700.

Q5: Regression Output Terminology: Adjusted R-Square

If each Y value had an associated X value, then we could reorder the Y observations along the X axis according to the value of the associated X.



Now we can measure how the Y observations vary from the “line of best fit” instead of from the average of the Y observations. Adjusted *R*-Square measures the portion of Y’s variation about its mean that is explained by Y’s relationship to X.

Q5: Regression Output Terminology: *p*-value and *t*-statistic.

- Statistical significance of regression coefficients
  - When running a regression we are concerned about whether the "true" (unknown) coefficients are non-zero.
  - Did we get a non-zero intercept (or slope coefficient) in the regression output only because of the particular data set we used?

Q5: Regression Output Terminology: *p*-value and *t*-statistic.

- The *t*-statistic and the *p*-value both measure our confidence that the true coefficient is non-zero.
  - In general, if the t-statistic for the intercept (slope) term > 2, we can be about 95% confident (at least) that the true intercept (slope) term is not zero.
  - The p-value is more precise
    - it tells us the probability that the true coefficient being estimated is zero
    - if the p-value is less than 5%, we are more than 95% confident that the true coefficient is non-zero.

Q5: Interpreting Regression Output

Suppose we had 16 observations of total costs and activity levels (measured in machine hours) for each total cost. If we regressed the total costs against the machine hours, we would get . . .

Regression Statistics	
Multiple R	0.885
R Square	0.783
Adjusted R Square	0.768
Standard Error	135.3
Observations	16

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	2937	64.59	45.47	1.31E-16
Machine Hours	5.215	0.734	7.109	5.26E-06

The coefficients give you the parameters of the estimated cost function.

Predicted total costs = $2,937 + ($5.215/mach hr) x (# of mach hrs)

Total fixed costs are estimated at $2,937.

Variable costs per machine hour are estimated at $5.215.

Q5: Interpreting Regression Output

Regression Statistics	
Multiple R	0.885
R Square	0.783
Adjusted R Square	0.768
Standard Error	135.3
Observations	16

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	2937	64.59	45.47	1.31E-16
Machine Hours	5.215	0.734	7.109	5.26E-06

The regression line explains 76.8% of the variation in the total cost observations.

The high *t*-statistics . . .

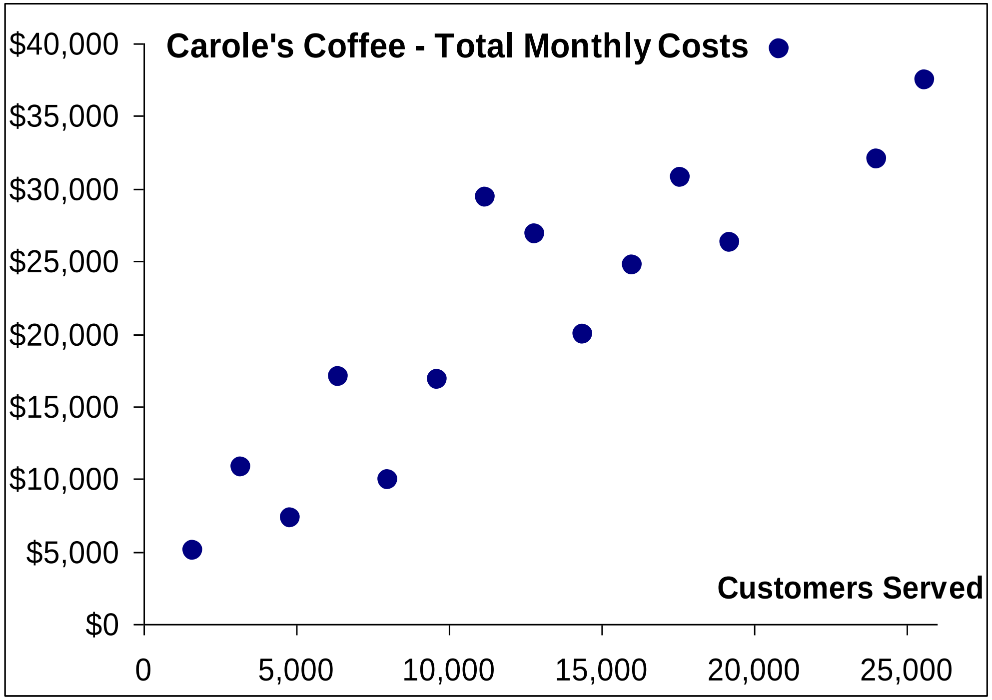
. . . and the low p-values on both of the regression parameters tell us that the intercept and the slope coefficient are "statistically significant".

(5.26E-06 means 5.26 x 10^{-6}, or 0.00000526)

Q5: Regression Interpretation Example

Carole's Coffee asked you to help determine its cost function for its chain of coffee shops. Carole gave you 16 observations of total monthly costs and the number of customers served in the month. The data is presented below, and the a portion of the output from the regression you ran is presented on the next slide. Help Carole interpret this output.

Costs	Customers
$5,100	1,600
$10,800	3,200
$7,300	4,800
$17,050	6,400
$9,900	8,000
$16,800	9,600
$29,400	11,200
$26,900	12,800
$20,000	14,400
$24,700	16,000
$30,800	17,600
$26,300	19,200
$39,600	20,800
$42,000	22,400
$32,000	24,000
$37,500	25,600



Q5: Regression Interpretation Example

Regression Statistics	
Multiple R	0.91
R Square	0.8281
Adjusted R Square	0.8158
Standard Error	4985.6
Observations	16

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	4634	2614	1.7723	0.0980879
Customers	1.388	0.169	8.2131	1.007E-06

What is Carole's estimated cost function? In a store that serves 10,000 customers, what would you predict for the store's total monthly costs?

Predicted total costs = $4,634 + ($1.388/customer) x (# of customers)

Predicted total costs at 10,000 customers = $4,634 + ($1.388/customer) x 10,000 customers

= $18,514

Q5: Regression Interpretation Example

Regression Statistics	
Multiple R	0.91
R Square	0.8281
Adjusted R Square	0.8158
Standard Error	4985.6
Observations	16

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	4634	2614	1.7723	0.0980879
Customers	1.388	0.169	8.2131	1.007E-06

What is the explanatory power of this model? Are the coefficients statistically significant or not? What does this mean about the cost function?

The model explains 81.58% of the variation in total costs, which is pretty good.

The slope coefficient is significantly different from zero. This means we can be pretty sure that the true cost function includes nonzero variable costs per customer.

The intercept is not significantly different from zero. There's a 9.8% probability that the true fixed costs are zero*.

*(Some would say the intercept is significant as long as the p-value is less than 10%, rather than 5%.)

Q6: Considerations When Using Estimates of Future Costs

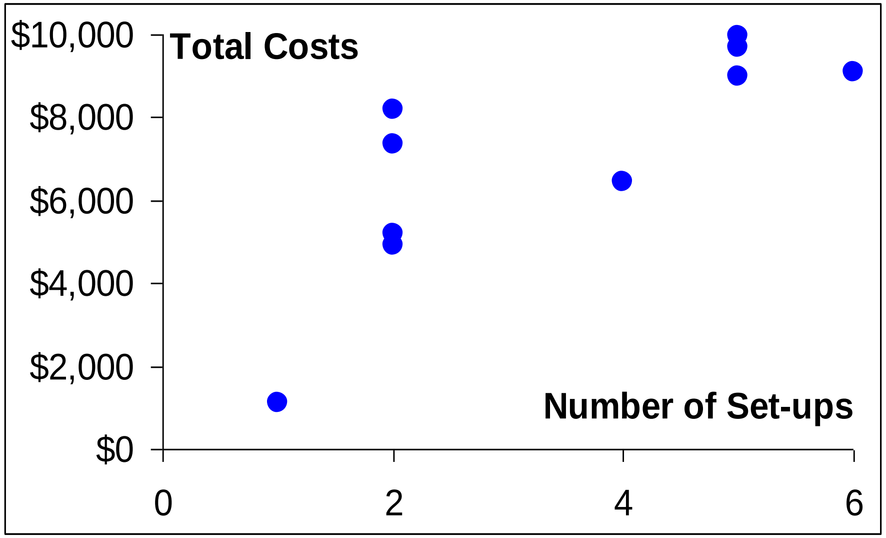
- The future is always unknown, so there are uncertainties when estimating future costs.
  - The estimated cost function may have mis-specified the cost behavior.
  - The cost function may be using an incorrect cost driver.
  - Future cost behavior may not mimic past cost behavior.
  - Future costs may be different from past costs.

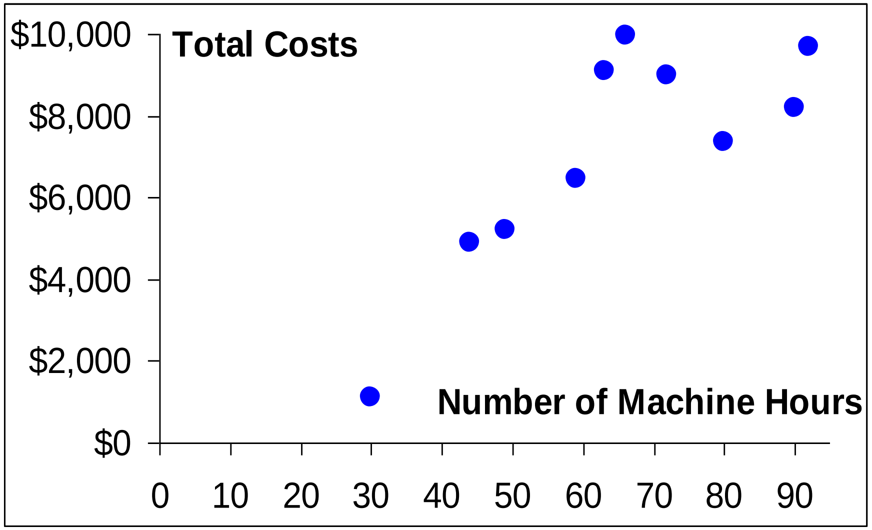
Q6: Considerations When Using Estimates of Future Costs

- The data used to estimate past costs may not be of high-quality.
  - The accounting system may aggregate costs in a way that mis-specifies cost behavior.
  - Information from outside the accounting system may not be accurate.
- The true cost function may not be in agreement with the cost function assumptions.
  - For example, if variable costs per unit of the cost driver are not constant over any reasonable range of activity, the linearity of total cost assumption is violated.

Appendix 2A: Multiple Regression Example

We have 10 observations of total project cost, the number of machine hours used by the projects, and the number of machine set-ups the projects used.





Appendix 2A: Multiple Regression Example

Regress total costs on the number of set-ups to get the following output and estimated cost function:

Regression Statistics	
Multiple R	0.788
R Square	0.621
Adjusted R Square	0.574
Standard Error	1804
Observations	10

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	2925.6	1284	2.278	0.0523
# of Set-ups	1225.4	338	3.62	0.0068

Predicted project costs = $2,926 + ($1,225/set-up) x (# set-ups)

The explanatory power is 57.4%. The # of set-ups is significant, but the intercept is not significant if we use a 5% limit for the p-value.

Appendix 2A: Multiple Regression Example

Regress total costs on the number of machine hours to get the following output and estimated cost function:

Regression Statistics	
Multiple R	0.814
R Square	0.663
Adjusted R Square	0.621
Standard Error	1701
Observations	10

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	-173.8	1909	-0.09	0.9297
# Mach Hrs	112.65	28.4	3.968	0.0041

Predicted project costs = - $173 + ($113/mach hr) x (# mach hrs)

The explanatory power is 62.1%. The intercept shows up negative, which is impossible as total fixed costs can not be negative. However, the *p*-value on the intercept tells us that there is a 93% probability that the true intercept is zero. The # of machine hours is significant.

Appendix 2A: Multiple Regression Example

Regress total costs on the # of set ups *and* the # of machine hours to get the following:

Regression Statistics	
Multiple R	0.959
R Square	0.919
Adjusted R Square	0.896
Standard Error	891.8
Observations	10

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	-1132	1021	-1.11	0.3044
# of Set-ups	857.4	182.4	4.7	0.0022
# of Mach Hrs	82.31	16.23	5.072	0.0014

Predicted project costs = - $1,132 + ($857/set-up) x (# set-ups) + ($82/mach hr) x (# mach hrs)

The explanatory power is now 89.6%. The *p*-values on both slope coefficients show that both are significant. Since the intercept is not significant, project costs can be estimated based on the project's usage of set-ups and machine hours.

Appendix 2B: What is a Learning Curve?

A learning curve is

- the rate at which labor hours per unit decrease as the volume of activity increases
- the relationship between cumulative average hours per unit and the cumulative number of units produced.

A learning curve can be represented mathematically as:

$Y = \alpha X^r$, where

Y = cumulative average labor hours,

α = time required for the first unit,

X = cumulative number of units produced,

r = an index for learning = ln(% learning)/ln(2), and

ln is the natural logarithmic function.

Appendix 2B: Learning Curve Example

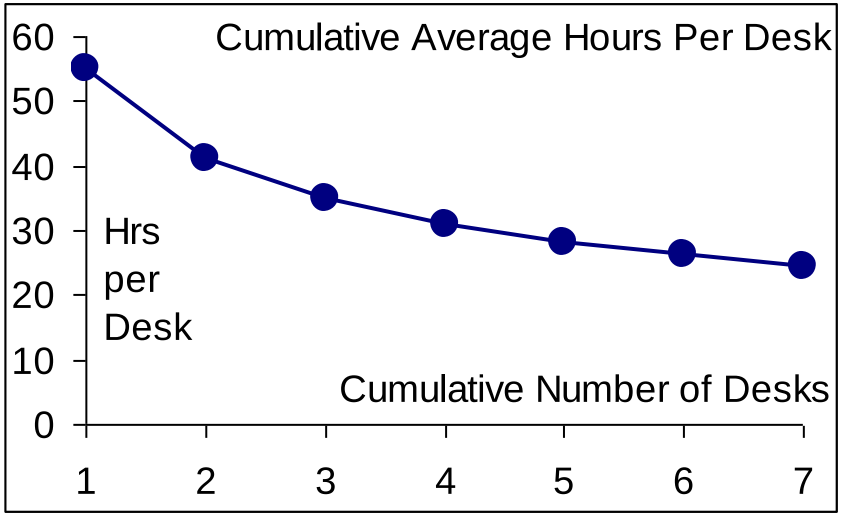
Deanna's Designer Desks just designed a new solid wood desk for executives. The first desk took her workforce 55 labor hours to make, but she estimates that each desk will require 75% of the time of the prior desk (i.e. "% learning" = 75%). Compute the cumulative average time to make 7 desks, and draw a learning curve.

First compute *r*: $r = \ln(75\%)/\ln(2) = -0.2877/0.693 = -0.4152$

Then compute the cumulative average time for 7 desks:

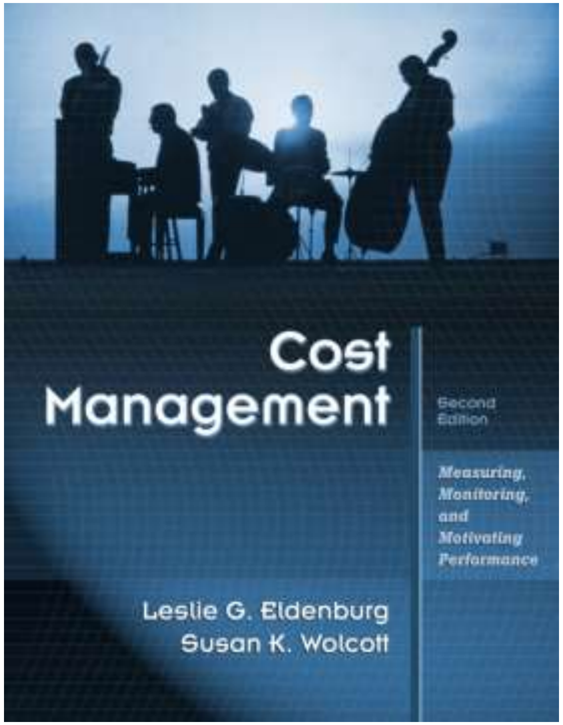
$Y = 55 \times 7^{(-0.4152)} = 25.42$ hrs

In order to draw a learning curve, you must compute the value of *Y* for all *X* values from 1 to 7. . . .



Chapter 3

Cost-Volume-Profit Analysis

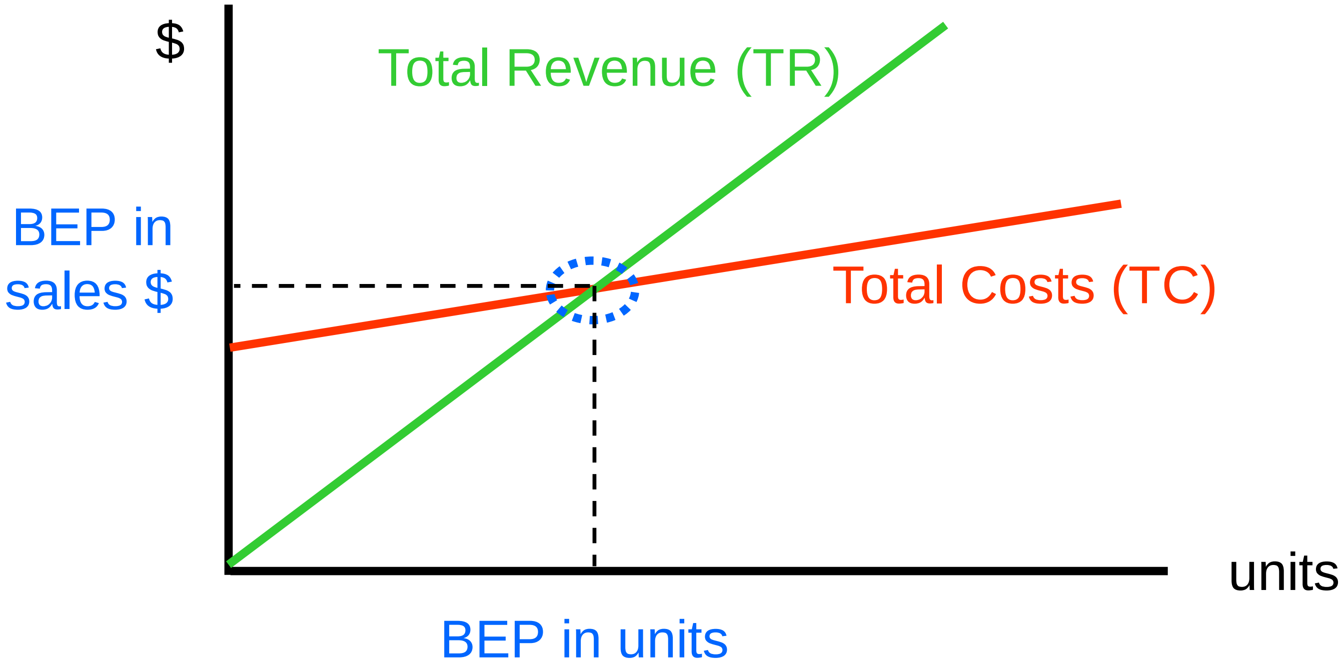


Learning objectives

- Q1: What is cost-volume-profit (CVP) analysis, and how is it used for decision making?
- Q2: How are CVP calculations performed for a single product?
- Q3: How are CVP calculations performed for multiple products?
- Q4: What assumptions and limitations should managers consider when using CVP analysis?
- Q5: How are the margin of safety and operating leverage used to assess operational risk?

Q1: CVP Analysis and the Breakeven Point

- CVP analysis looks at the relationship between selling prices, sales volumes, costs, and profits.
- The breakeven point (BEP) is where total revenue equal total costs.



Q2: How is CVP Analysis Used?

- CVP analysis can determine, both in units and in sales dollars:
  - the volume required to break even
  - the volume required to achieve target profit levels
  - the effects of discretionary expenditures
  - the selling price or costs required to achieve target volume levels
- CVP analysis helps analyze the sensitivity of profits to changes in selling prices, costs, volume and sales mix.

Q2: CVP Calculations for a Single Product

$$\text{Units required to achieve target pretax profit} = Q = \frac{F + \text{Profit}}{P - V}$$

where F = total fixed costs

P = selling price per unit

V = variable cost per unit

$P - V$ = contribution margin per unit

To find the breakeven point in units, set Profit = 0.

Q2: CVP Calculations for a Single Product

$$\text{Sales \$ required to achieve target pretax profit} = \frac{F + \text{Profit}}{CMR}$$

where F = total fixed costs

CMR = contribution margin ratio

= $(P - V)/P$

Note that CMR can also be computed as

$$CMR = \frac{\text{Total Revenue} - \text{Total Variable Costs}}{\text{Total Revenue}}$$

To find the breakeven point in sales \$, set Profit = 0.

Q2: Breakeven Point Calculations

Bill's Briefcases makes high quality cases for laptops that sell for $200. The variable costs per briefcase are $80, and the total fixed costs are $360,000. Find the BEP in units and in sales $ for this company.

$$\text{BEP in units} = \frac{F+0}{P-V} = \frac{\$360{,}000}{\$200/\text{unit} - \$80/\text{unit}}$$

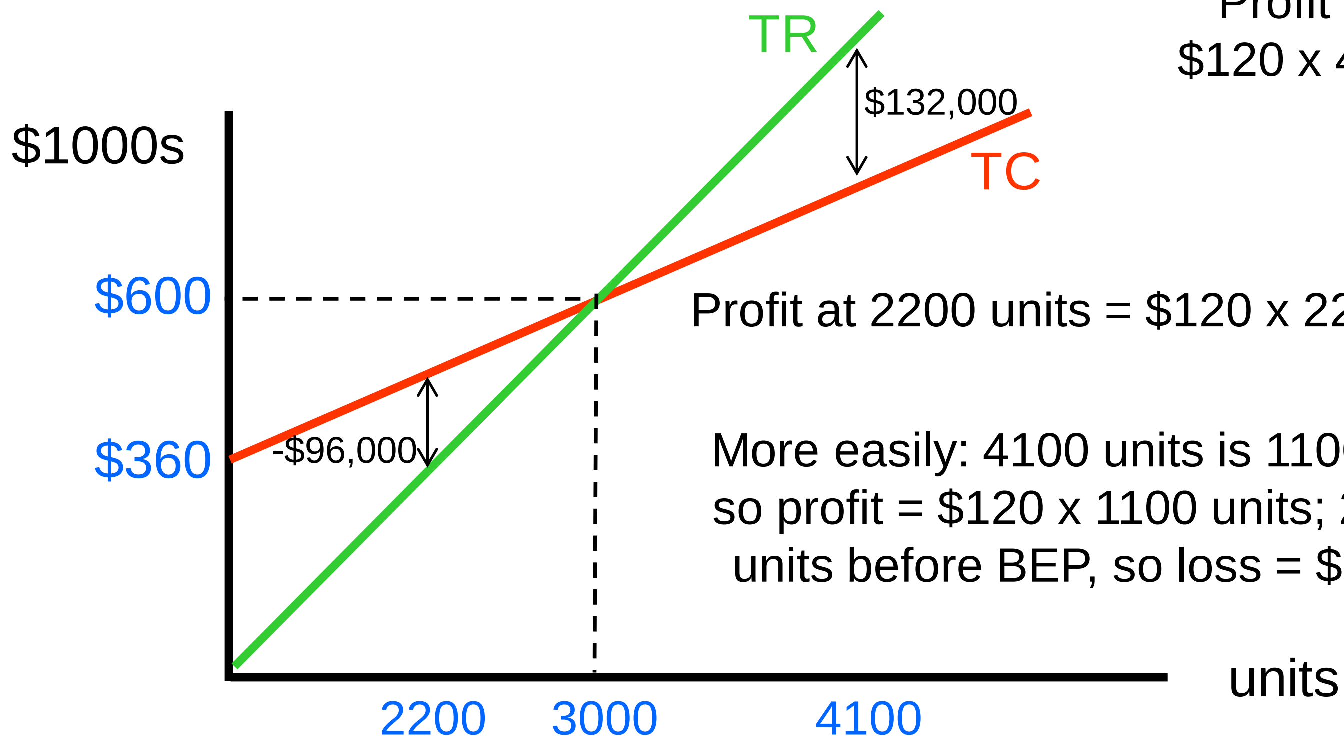
$$= \frac{\$360{,}000}{\$120/\text{unit}} = 3{,}000 \text{ units}$$

$$\text{BEP in sales \$} = \frac{F+0}{CMR} = \frac{F}{(P-V)/P} = \frac{\$360{,}000}{(\$200-\$80)/\$200}$$

$$= \frac{\$360{,}000}{60\%} = \$600{,}000$$

Q2: CVP Graph

Draw a CVP graph for Bill's Briefcases. What is the pretax profit if Bill sells 4100 briefcases? If he sells 2200 briefcases? Recall that *P* = $200, *V* = $80, and *F* = $360,000.



Profit at 4100 units =
$120 x 4100 - $360,000.

Profit at 2200 units = $120 x 2200 - $360,000.

More easily: 4100 units is 1100 units past BEP, so profit = $120 x 1100 units; 2200 units is 800 units before BEP, so loss = $120 x 800 units.

Q2: CVP Calculations

How many briefcases does Bill need to sell to reach a target pretax profit of $240,000? What level of sales revenue is this? Recall that *P* = $200, *V* = $80, and *F* = $360,000.

$$\text{Units needed to reach target pretax profit} = \frac{F + \text{Profit}}{P - V} = \frac{\$360{,}000 + \$240{,}000}{\$120/\text{unit}}$$

$$= 5{,}000 \text{ units}$$

$$\text{Sales \$ required to reach target pretax profit} = \frac{F + \$240{,}000}{CMR} = \frac{F}{(P - V)/P}$$

$$= \frac{\$600{,}000}{60\%} = \$1{,}000{,}000$$

Of course, 5,000 units x $200/unit = $1,000,000, too.

But sometimes you only know the CMR and not the selling price per unit, so this is still a valuable formula.

Q2: CVP Calculations

How many briefcases does Bill need to sell to reach a target after-tax profit of \$319,200 if the tax rate is 30%? What level of sales revenue is this? Recall that P = \$200, V = \$80, and F = \$360,000.

First convert the target after-tax profit to its target pretax profit:

$$\text{Pretax profit} = \frac{\text{After-tax profit}}{(1 - \text{Tax rate})} = \frac{\$319{,}200}{(1 - 0.3)} = \$456{,}000$$

$$\begin{array}{c}\text{Units needed to}\\ \text{reach target}\\ \text{pretax profit}\end{array} = \frac{\$360{,}000 + \$456{,}000}{\$120/\text{unit}} = 6{,}800 \text{ units}$$

$$\begin{array}{c}\text{Sales \$ needed}\\ \text{to reach target}\\ \text{pretax profit}\end{array} = \frac{\$360{,}000 + \$456{,}000}{60\%} = \$1{,}360{,}000$$

Q1,2: Using CVP to Determine Target Cost Levels

Suppose that Bill's marketing department says that he can sell 6,000 briefcases if the selling price is reduced to \$170. Bill's target pretax profit is \$210,000. Determine the highest level that his variable costs can so that he can make his target. Recall that *F* = \$360,000.

Use the CVP formula for units, but solve for V:

$$Q = 6{,}000 \text{ units} = \frac{\$360{,}000 + \$210{,}000}{\$170/\text{unit} - V}$$

$$\$170/\text{unit} - V = \frac{\$360{,}000 + \$210{,}000}{6{,}000 \text{ units}} = \$95/\text{unit}$$

$$V = \$75/\text{unit}$$

If Bill can reduce his variable costs to \$75/unit, he can meet his goal.

Q4: Business Risk in Bill's Decision

- After this analysis, Bill needs to consider several issues before deciding to lower his price to $170/unit.
  - How reliable are his marketing department's estimates?
  - Is a $5/unit decrease in variable costs feasible?
  - Will this decrease in variable costs affect product quality?
  - If 6,000 briefcases is within his plant's capacity but lower than his current sales level, will the increased production affect employee morale or productivity?

Q1: Using CVP to Compare Alternatives

- CVP analysis can compare alternative cost structures or selling prices.
  - high salary/low commission vs. lower salary/higher commission for sales persons
  - highly automated production process with low variable costs per unit vs. lower technology process with higher variable costs per unit and lower fixed costs.
  - broad advertising campaign with higher selling prices vs. minimal advertising and lower selling prices
- The indifference point between alternatives is the level of sales (in units or sales $) where the profits of the alternatives are equal.

Q1,2: Using CVP to Compare Alternatives

Currently Bill's salespersons have salaries totaling \$80,000 (included in F of \$360,000) and earn a 5% commission on each unit (\$10 per briefcase). He is considering an alternative compensation arrangement where the salaries are decreased to \$35,000 and the commission is increased to 20% (\$40 per briefcase). Compute the BEP in units under the proposed alternative. Recall that *P* = \$200 and *V* = \$80 currently.

First compute *F* and *V* under the proposed plan:

$$F = \$360{,}000 - \$45{,}000 \text{ decrease in salaries} = \$315{,}000$$

$$V = \$80 + \$30 \text{ increase in commission} = \$110$$

Then compute *Q* under the proposed plan:

$$\text{Units needed to breakeven} = Q = \frac{F+0}{P-V} = \frac{\$315{,}000}{\$200/\text{unit} - \$110/\text{unit}} = 3{,}500 \text{ units}$$

Q1: Determining the Indifference Point

Compute the volume of sales, in units, for which Bill is indifferent between the two alternatives.

The indifference point in units is the *Q* for which the profit equations of the two alternatives are equal.

	Current Plan	Proposed Plan
Contribution margin per unit	$120	$90
Total fixed costs	$360,000	$315,000

$$\text{Profit (current plan)} = \$120Q - \$360{,}000$$

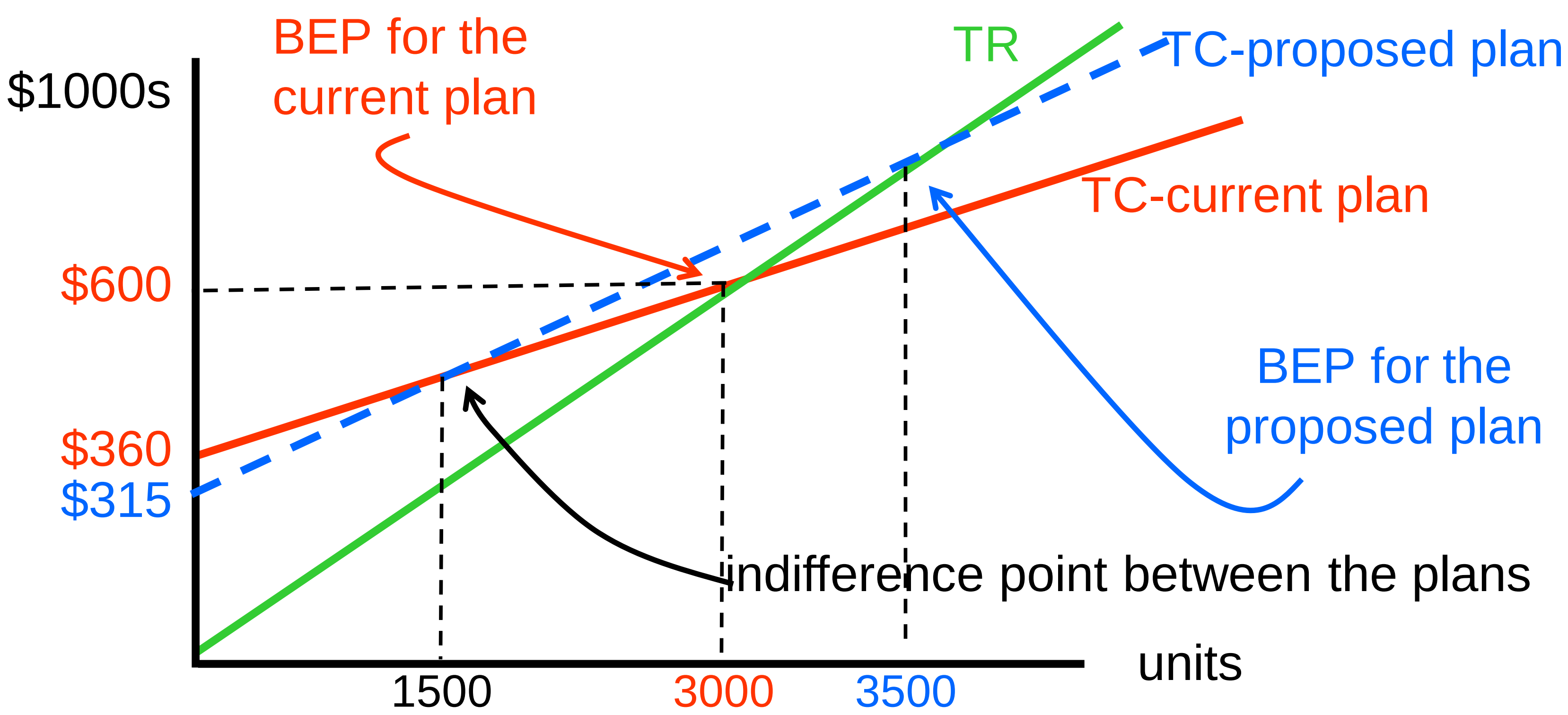
$$\text{Profit (proposed plan)} = \$90Q - \$315{,}000$$

$$\$120Q - \$360{,}000 = \$90Q - \$315{,}000$$

$$\$30Q = \$45{,}000 \longrightarrow Q = 1{,}500 \text{ units}$$

Q1,2: CVP Graphs of the Indifference Point

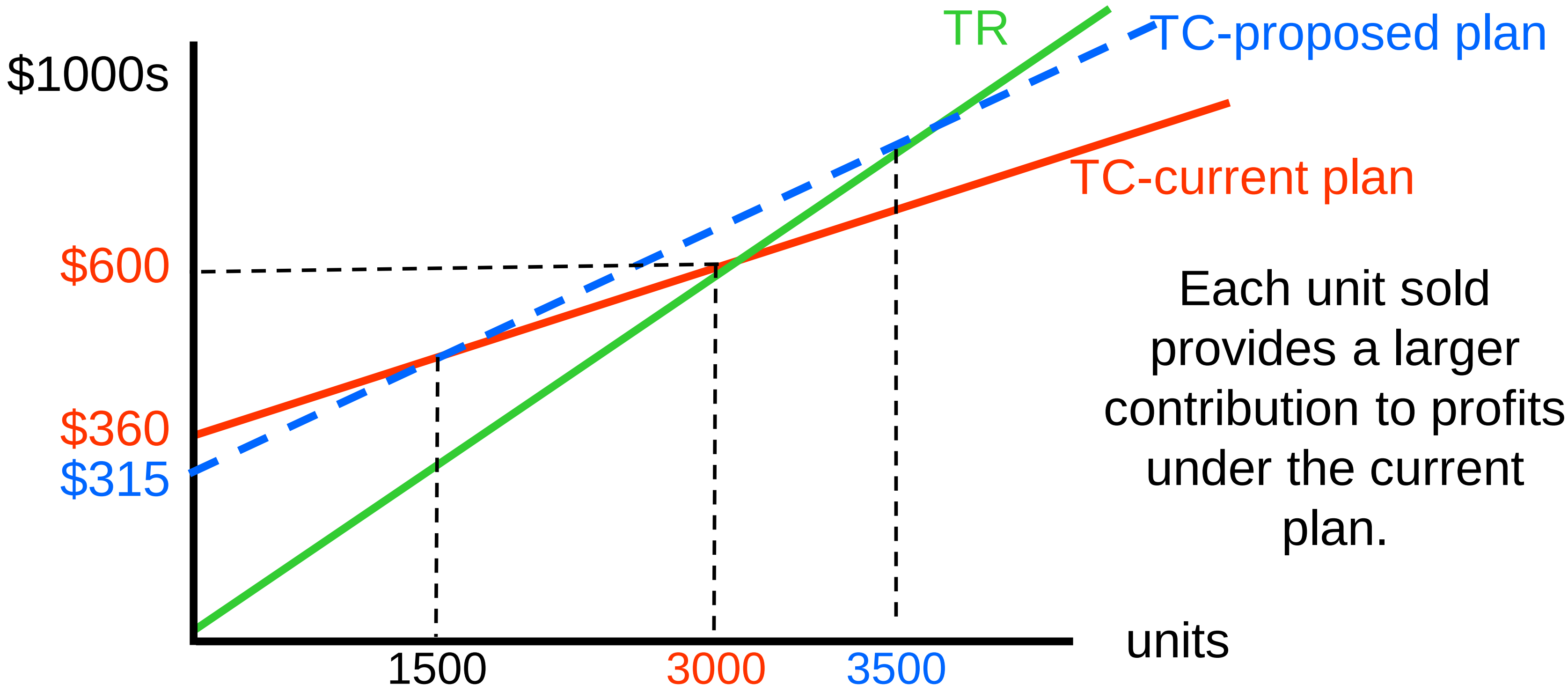
Draw a CVP graph for Bill's that displays the costs under both alternatives. Notice that the total revenue line for both alternatives is the same, but the total cost lines are different.



Q1,2: Comparing Alternatives

The current plan breaks even before the proposed plan.

At 1500 units, the plans have the same total cost.



Each unit sold provides a larger contribution to profits under the current plan.

Q4: Business Risk in Bill's Decision

- Hopefully Bill is currently selling more than 1500 briefcases, because profits are negative under BOTH plans at this point.
- The total costs of the current plan are less than the those of the proposed plan at sales levels past 1500 briefcases.
- Therefore, it seems the current plan is preferable to the proposed plan.

However, . . .

Q5: Business Risk in Bill's Decision

. . . this may not be true because the level of future sales is always uncertain.

- What if the briefcases were a new product line?
  - Estimates of sales levels may be highly uncertain.
  - The lower fixed costs of the proposed plan may be safer.
- The plans may create different estimates of the likelihood of various sales levels.
  - Salespersons may have an incentive to sell more units under the proposed plan.

Q3: CVP Analysis for Multiple Products

When a company sells more than one product the CVP calculations must be adjusted for the sales mix. The sales mix should be stated as a proportion

- of total units sold when performing CVP calculations for in units.

- of total revenues when performing CVP calculations in sales $.

Q3: Sales Mix Computations

- The weighted average contribution margin is the weighted sum of the products' contribution margins:

$$WACM = \sum_{i=1}^{n} \lambda_i CM_i$$

where λ_i is product i's % of total sales in units, CM_i is product i's contribution margin, and n= the number of products.

- The weighted average contribution margin ratio is the weighted sum of the products' contribution margin ratios:

$$WACMR = \sum_{i=1}^{n} \gamma_i CMR_i$$

where γ_i is product i's % of total sales revenues, CMR_i is product i's contribution margin ratio, and n= the number of products.

Q3: Multiple Product Breakeven Point

Peggy's Kitchen Wares sells three sizes of frying pans. Next year she hopes to sell a total of 10,000 pans. Peggy's total fixed costs are $40,800. Each product's selling price and variable costs is given below. Find the BEP in units for this company.

	Small	Medium	Large	Total
Expected sales in units	2,000	5,000	3,000	10,000
Selling price per unit	$10.00	$15.00	$18.00	
Variable costs per unit	$4.00	$8.00	$11.00	
Contribution margin per unit	$6.00	$7.00	$7.00	

First note the sales mix in units is 20%:50%:30%, respectively; then compute the weighted average contribution margin:

WACM = 20%x$6 + 50%x$7 + 30%x$7 = $6.80

Q3: Multiple Product Breakeven Point

Next, compute the BEP in terms of total units:

$$\text{Total units needed to breakeven} = Q = \frac{F+0}{P-V} = \frac{\$40{,}800}{\$6.80/\text{unit}} = 6{,}000 \text{ units}$$

But 6,000 units is not really the BEP in units; the BEP is only 6,000 units *if* the sales mix remains the same.

The BEP should be stated in terms of how many of each unit must be sold:

Units required to break even:		
Small pans	20%	1,200
Medium pans	50%	3,000
Large pans	30%	1,800
		6,000

Q3: Multiple Product Breakeven Point

Find the BEP in sales $ for Peggy's Kitchen Wares. The total revenue and total variable cost information below is based on the expected sales mix.

	Small	Medium	Large	Total
Expected sales in units	2,000	5,000	3,000	10,000
Total revenue	$20,000	$75,000	$54,000	$149,000
Total variable costs	$8,000	$40,000	$33,000	$81,000
Total contribution margin	$12,000	$35,000	$21,000	$68,000
Contribution margin ratio	60.0%	46.7%	38.9%	45.6%

First compute the weighted average contribution margin ratio:

WACMR = (20/149)x60% + (75/149)x46.7% + (54/149)x38.9% =

Q3: Multiple Product Breakeven Point

. . . = 45.6%, of course! Depending on how the given information is structured, it may be easier to compute the CMR as Total contribution margin/Total revenue.

Next compute the BEP in sales $:

$$\text{BEP in sales \$} = \frac{F + 0}{CMR} = \frac{\$40{,}800}{0.456} = \$89{,}474^{*}$$

* If you sum the number of units of each size pan required at breakeven times its selling price you get $89,400. The extra $74 in the answer above comes from rounding the contribution margin ratio to three decimals.

Q4: Assumptions in CVP Analysis

CVP analysis assumes that costs and revenues are linear within a relevant range of activity.

- Linear total revenues means that selling prices per unit are constant and the sales mix does not change.
  - Offering volume discounts to customers violates this assumption.
- Linear total costs means total fixed costs are constant and variable costs per unit are constant.
  - If volume discounts are received from suppliers, then variable costs per unit are not constant.
  - If worker productivity changes as activity levels change, then variable costs per unit are not constant.

Q4: Assumptions in CVP Analysis

- These assumptions may induce a small relevant range.
  - Results of CVP calculations must be checked to see if they fall within the relevant range.
- Linear CVP analysis may be inappropriate if the linearity assumptions hold only over small ranges of activity.
  - Nonlinear analysis techniques are available.
  - For example, regression analysis, along with nonlinear transformations of the data, can be used to estimate nonlinear cost and revenue functions.

Q5: Margin of Safety

The margin of safety is a measure of how far past the breakeven point a company is operating, or plans to operate. It can be measured 3 ways.

$$\text{margin of safety in units} = \text{actual or estimated units of activity} - \text{BEP in units}$$

$$\text{margin of safety in \$} = \text{actual or estimated sales \$} - \text{BEP in sales \$}$$

$$\text{margin of safety percentage} = \frac{\text{Margin of safety in units}}{\text{Actual or estimated units}}$$

$$= \frac{\text{Margin of safety in \$}}{\text{Actual or estimated sales \$}}$$

Q5: Margin of Safety

Suppose that Bill's Briefcases has budgeted next year's sales at 5,000 units. Compute all three measures of the margin of safety for Bill. Recall that *P* = \$200, *V* = \$80, *F* = \$360,000, the BEP in units = 3,000, and the BEP in sales \$ = \$600,000.

margin of safety in units = 5,000 units – 3,000 units = 2,000 units

margin of safety in \$ = \$200 x 5,000 - \$600,000 = \$400,000

$$\text{margin of safety percentage} = \frac{2{,}000 \text{ units}}{5{,}000 \text{ units}} = \frac{\$400{,}000}{\$200 \times 5{,}000} = 40\%$$

The margin of safety tells Bill how far sales can decrease before profits go to zero.

Q5: Degree of Operating Leverage

- The degree of operating leverage measures the extent to which the cost function is comprised of fixed costs.
- A high degree of operating leverage indicates a high proportion of fixed costs.
- Businesses operating at a high degree of operating leverage
  - face higher risk of loss when sales decrease,
  - but enjoy profits that rise more quickly when sales increase.

Q5: Degree of Operating Leverage

The degree of operating leverage can be computed 3 ways.

$$\text{degree of operating leverage} = \begin{cases} \dfrac{\text{Contribution margin}}{\text{Profit}} \\[2ex] \dfrac{\text{Fixed costs}}{\text{Profit}} + 1 \\[2ex] \dfrac{1}{\text{Margin of safety percentage}} \end{cases}$$

Q5: Degree of Operating Leverage

Suppose that Bill's Briefcases has budgeted next year's sales at 5,000 units. Compute Bill's degree of operating leverage. Recall that P = \$200, V = \$80, F = \$360,000, and the margin of safety percentage at 5,000 units is 40%.

First, compute contribution margin and profit at 5,000 units:

Contribution margin = (\$200 - \$80) x 5,000 = \$600,000

Profit = \$600,000 - \$360,000 = \$240,000

$$\text{Degree of operating leverage} = \frac{\$600{,}000}{\$240{,}000} = 2.5$$

$$\text{or, degree of operating leverage} = \frac{\$360{,}000}{\$240{,}000} + 1 = 2.5$$

$$\text{or, degree of operating leverage} = \frac{1}{40\%} = 2.5$$

Q5: Using the Degree of Operating Leverage

- The degree of operating leverage shows the sensitivity of profits to changes in sales.
- On the prior slide Bill's degree of operating leverage was 2.5 and profits were $240,000.
    - If expected sales were to increase to 6,000 units, a 20% increase, then profits would increase by 2.5 x 20%, or 50%, to $360,000.*
    - If expected sales were to decrease to 4,500 units, a 10% decrease, then profits would decrease by 2.5 x 10%, or 25%, to $180,000.**

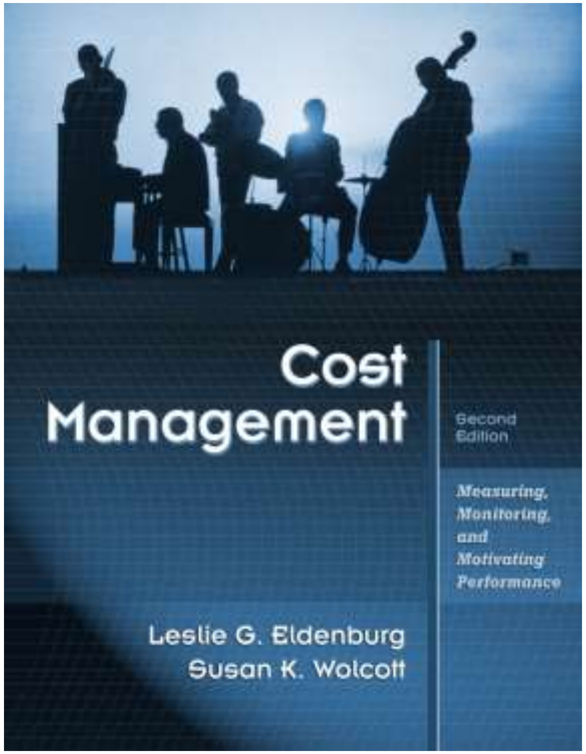
* $240,000 x 1.5 = $360,000

** $240,000 x 0.75 = $180,000

Cost Management
Measuring, Monitoring, and Motivating Performance

Chapter 4

Relevant Information for Decision Making



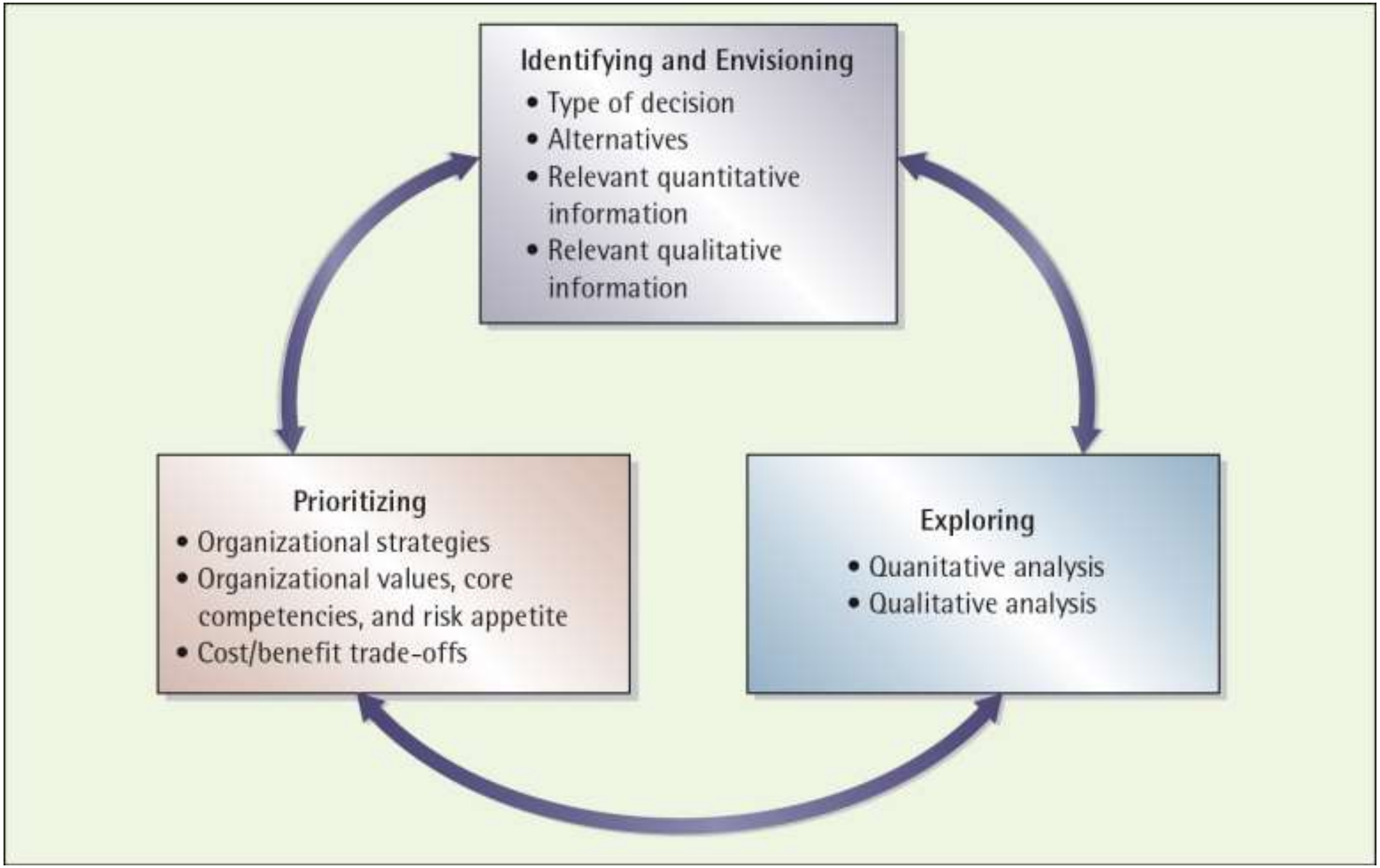
Learning objectives

- Q1: What is the process for identifying and using relevant information in decision making?
- Q2: How is relevant quantitative and qualitative information used in special order decisions?
- Q3: How is relevant quantitative and qualitative information used in keep or drop decisions?
- Q4: How is relevant quantitative and qualitative information used in outsourcing (make or buy) decisions?
- Q5: How is relevant quantitative and qualitative information used in product emphasis and constrained resource decisions?
- Q6: What factors affect the quality of operating decisions?

Q1: Nonroutine Operating Decisions

- Routine operating decisions are those made on a regular schedule. Examples include:
  - annual budgets and resource allocation decisions
  - monthly production planning
  - weekly work scheduling issues
- Nonroutine operating decisions are not made on a regular schedule. Examples include:
  - accept or reject a customer's special order
  - keep or drop business segments
  - insource or outsource a business activity
  - constrained (scarce) resource allocation issues

Q1: Nonroutine Operating Decisions



Q1: Process for Making Nonroutine Operating Decisions

1. Identify the type of decision to be made.
2. Identify the relevant quantitative analysis technique(s).
3. Identify and analyze the qualitative factors.
4. Perform quantitative and/or qualitative analyses
5. Prioritize issues and arrive at a decision.

Q1: Identify the Type of Decision

- Special order decisions
  - determine the pricing
  - accept or reject a customer's proposal for order quantity and pricing
  - identify if there is sufficient available capacity
- Keep or drop business segment decisions
  - examples of business segments include product lines, divisions, services, geographic regions, or other distinct segments of the business
  - eliminating segments with operating losses will not always improve profits

Q1: Identify the Type of Decision

- Outsourcing decisions
  - make or buy production components
  - perform business activities “in-house” or pay another business to perform the activity
- Constrained resource allocation decisions
  - determine which products (or business segments) should receive allocations of scarce resources
  - examples include allocating scarce machine hours or limited supplies of materials to products
- Other decisions may use similar analyses

Q1: Identify and Apply the Relevant Quantitative Analysis Technique(s)

- Regression, CVP, and linear programming are examples of quantitative analysis techniques.
- Analysis techniques require input data.
  - Data for some input variables will be known and for other input variables estimates will be required.
- Many nonroutine decisions have a general decision rule to apply to the data.
- The results of the general rule need to be interpreted.
  - The quality of the information used must be considered when interpreting the results of the general rule.

Q2-Q5 : Identify and Analyze Qualitative Factors

- Qualitative information cannot easily be valued in dollars.
  - can be difficult to identify
  - can be every bit as important as the quantitative information
- Examples of qualitative information that may be relevant in some nonroutine decisions include:
  - quality of inputs available from a supplier
  - effects of decision on regular customers
  - effects of decision on employee morale
  - effects of production on the environment or the community

Q1: Consider All Information and Make a Decision

- Before making a decision:
  - Consider all quantitative and qualitative information.
    - Judgment is required when interpreting the effects of qualitative information.
  - Consider the quality of the information.
    - Judgment is also required when user lower-quality information.

Q2: Special Order Decisions

- A new customer (or an existing customer) may sometimes request a special order with a lower selling price per unit.
- The general rule for special order decisions is:
  - accept the order if incremental revenues exceed incremental costs.
  - subject to qualitative considerations.

Price >=	**Relevant Variable Costs +**	**Relevant Fixed Costs +**	**Opportunity Cost**

- If the special order replaces a portion of normal operations, then the opportunity cost of accepting the order must be included in incremental costs.

Q2: Special Order Decisions

RobotBits, Inc. makes sensory input devices for robot manufacturers. The normal selling price is $38.00 per unit. RobotBits was approached by a large robot manufacturer, U.S. Robots, Inc. USR wants to buy 8,000 units at $24, and USR will pay the shipping costs. The per-unit costs traceable to the product (based on normal capacity of 94,000 units) are listed below. Which costs are relevant to this decision?

Direct materials	yes	$6.20	Relevant?
Direct labor	yes	8.00	Relevant?
Variable mfg. overhead	yes	5.80	Relevant?
Fixed mfg. overhead	no	3.50	Relevant?
Shipping/handling	yes no	2.50	Relevant?
Fixed administrative costs	no	0.88	Relevant?
Fixed selling costs	no	0.36	Relevant?
		$27.24	

$20.00

Q2: Special Order Decisions

Suppose that the capacity of RobotBits is 107,000 units and projected sales to regular customers this year total 94,000 units. Does the quantitative analysis suggest that the company should accept the special order?

First determine if there is sufficient idle capacity to accept this order without disrupting normal operations:

Projected sales to regular customers	94,000	units
Special order	8,000	units
	102,000	units

RobotBits still has 5,000 units of idle capacity if the order is accepted. Compare incremental revenue to incremental cost:

Incremental profit if accept special order =

($24 selling price - $20 relevant costs) x 8,000 units = $32,000

Q2: Qualitative Factors in Special Order Decisions

What qualitative issues, in general, might RobotBits consider before finalizing its decision?

- Will USR expect the same selling price per unit on future orders?
- Will other regular customers be upset if they discover the lower selling price to one of their competitors?
- Will employee productivity change with the increase in production?
- Given the increase in production, will the incremental costs remain as predicted for this special order?
- Are materials available from its supplier to meet the increase in production?

Q2: Special Order Decisions and Capacity Issues

Suppose instead that the capacity of RobotBits is 100,000 units and projected sales to regular customers this year totals 94,000 units. Should the company accept the special order?

Here the company does not have enough idle capacity to accept the order:

Projected sales to regular customers	94,000	units
Special order	8,000	units
	102,000	units

If USR will not agree to a reduction of the order to 6,000 units, then the offer can only be accepted by denying sales of 2,000 units to regular customers.

Q2: Special Order Decisions and Capacity Issues

Suppose instead that the capacity of RobotBits is 100,000 units and projected sales to regular customers this year total 94,000 units. Does the quantitative analysis suggest that the company should accept the special order?

Direct materials	$6.20
Direct labor	8.00
Variable mfg. overhead	5.80
Fixed mfg. overhead	3.50
Shipping/handling	2.50
Fixed administrative costs	0.88
Fixed selling costs	0.36
	$27.24

Variable cost/unit for regular sales = $22.50.

CM/unit on regular sales = $38.00 - $22.50 = $15.50.

The opportunity cost of accepting this order is the lost contribution margin on 2,000 units of regular sales.

Incremental profit if accept special order =
$32,000 incremental profit under idle capacity – opportunity cost =
$32,000 - $15.50 x 2,000 = $1,000

Q2: Qualitative Factors in Special Order Decisions

What additional qualitative issues, in this case of a capacity constraint, might RobotBits consider before finalizing its decision?

- What will be the effect on the regular customer(s) that do not receive their order(s) of 2,000 units?
- What is the effect on the company's reputation of leaving orders from regular customers of 2,000 units unfilled?
- Will any of the projected costs change if the company operates at 100% capacity?
- Are there any methods to increase capacity? What effects do these methods have on employees and on the community?
- Notice that the small incremental profit of $1,000 will probably be outweighed by the qualitative considerations.

Q3: Keep or Drop Decisions

- Managers must determine whether to keep or eliminate business segments that appear to be unprofitable.
- The general rule for keep or drop decisions is:
  - keep the business segment if its contribution margin covers its avoidable fixed costs,
  - subject to qualitative considerations.

Drop if: Contribution Margin < Relevant Fixed Costs + Opportunity Cost

- If the business segment's elimination will affect continuing operations, the opportunity costs of its discontinuation must be included in the analysis.

Q3: Keep or Drop Decisions

Starz, Inc. has 3 divisions. The Gibson and Quaid Divisions have recently been operating at a loss. Management is considering the elimination of these divisions. Divisional income statements (in 1000s of dollars) are given below. According to the quantitative analysis, should Starz eliminate Gibson or Quaid or both?

	Gibson	Quaid	Russell	Total
Revenues	$390	$433	$837	$1,660
Variable costs	247	335	472	1,054
Contribution margin	143	98	365	606
Traceable fixed costs	166	114	175	455
Division operating income	($23)	($16)	$190	151
Unallocated fixed costs				81
Operating income				$70

Breakdown of traceable fixed costs:			
Avoidable	$154	$96	$139
Unavoidable	12	18	36
	$166	$114	$175

Q3: Keep or Drop Decisions

	Gibson	Quaid	Russell	Total
Revenues	$390	$433	$837	$1,660
Variable costs	247	335	472	1,054
Contribution margin	143	98	365	606
Traceable fixed costs	166	114	175	455
Division operating income	($23)	($16)	$190	151
Unallocated fixed costs				81
Operating income				$70
Breakdown of traceable fixed costs:				
Avoidable	$154	$96	$139	
Unavoidable	12	18	36	
	$166	$114	$175	

Use the general rule to determine if Gibson and/or Quaid should be eliminated.

	Gibson	Quaid
Contribution margin	$143	$98
Avoidable fixed costs	154	96
Effect on profit if keep	($11)	$2

The general rule shows that we should keep Quaid and drop Gibson.

Q3: Keep or Drop Decisions

	Gibson	Quaid	Russell	Total
Revenues	$390	$433	$837	$1,660
Variable costs	247	335	472	1,054
Contribution margin	143	98	365	606
Traceable fixed costs	166	114	175	455
Division operating income	($23)	($16)	$190	151
Unallocated fixed costs				81
Operating income				$70

Breakdown of traceable fixed costs:			
Avoidable	$154	$96	$139
Unavoidable	12	18	36
	$166	$114	$175

Using the general rule is easier than recasting the income statements:

Quaid & Russell only

	Gibson	Quaid	Russell	Total
Revenues	$390	$433	$837	$1,270
Variable costs	247	335	472	807
Contribution margin	143	98	365	$463
Traceable fixed costs	166	114	175	289
Division operating income	($23)	($16)	$190	$174
Unallocated fixed costs				81
Gibson's unavoidable fixed costs				12
Operating income				$81

Profits increase by $11 when Gibson is eliminated.

Q3: Keep or Drop Decisions

Suppose that the Gibson & Quaid Divisions use the same supplier for a particular production input. If the Gibson Division is dropped, the decrease in purchases from this supplier means that Quaid will no longer receive volume discounts on this input. This will increase the costs of production for Quaid by $14,000 per year. In this scenario, should Starz still eliminate the Gibson Division?

Effect on profit if drop Gibson before considering impact on Quaid's production costs	$11
Opportunity cost of eliminating Gibson	(14)
Revised effect on profit if drop Gibson	($3)

Profits decrease by $3 when Gibson is eliminated.

Q3: Qualitative Factors in Keep or Drop Decisions

What qualitative issues should Starz consider before finalizing its decision?

- What will be the effect on the customers of Gibson if it is eliminated? What is the effect on the company's reputation?
- What will be the effect on the employees of Gibson? Can any of them be reassigned to other divisions?
- What will be the effect on the community where Gibson is located if the decision is made to drop Gibson?
- What will be the effect on the morale of the employees of the remaining divisions?

Q4: Insource or Outsource (Make or Buy) Decisions

- Managers often must determine whether to
  - make or buy a production input
  - keep a business activity in house or outsource the activity
- The general rule for make or buy decisions is:
  - choose the alternative with the lowest relevant (incremental cost), subject to qualitative considerations
- If the decision will affect other aspects of operations, these costs (or lost revenues) must be included in the analysis.

Outsource if: Cost to Outsource < Cost to Insource

Where: Cost to Insource = Relevant FC + Relevant VC + Opportunity Cost

Q4: Make or Buy Decisions

Graham Co. currently of our main product manufactures a part called a gasker used in the manufacture of its main product. Graham makes and uses 60,000 gaskers per year. The production costs are detailed below. An outside supplier has offered to supply Graham 60,000 gaskers per year at $1.55 each. Fixed production costs of $30,000 associated with the gaskers are unavoidable. Should Graham make or buy the gaskers?

The production costs per unit for manufacturing a gasker are:

Direct materials	yes	$0.65	Relevant?
Direct labor	yes	0.45	Relevant?
Variable manufacturing overhead	yes	0.40	Relevant?
Fixed manufacturing overhead*	no	0.50	Relevant?
		$2.00	

$1.50

*$30,000/60,000 units = $0.50/unit

Advantage of “make” over “buy” = [$1.55 - $1.50] x 60,000 = $3,000

Q4: Qualitative Factors in Make or Buy Decisions

The quantitative analysis indicates that Graham should continue to make the component. What qualitative issues should Graham consider before finalizing its decision?

- Is the quality of the manufactured component superior to the quality of the purchased component?
- Will purchasing the component result in more timely availability of the component?
- Would a relationship with the potential supplier benefit the company in any way?
- Are there any worker productivity issues that affect this decision?

Q3: Make or Buy Decisions

Suppose the potential supplier of the gasker offers Graham a discount for a different sub-unit required to manufacture Graham's main product if Graham purchases 60,000 gaskers annually. This discount is expected to save Graham $15,000 per year. Should Graham consider purchasing the gaskers?

Advantage of "make" over "buy" before considering discount (slide 23)	$3,000
Discount	15,000
Advantage of "buy" over "make"	$12,000

Profits increase by $12,000 when the gasker is purchased instead of manufactured.

Q5: Constrained Resource (Product Emphasis) Decisions

- Managers often face constraints such as
  - production capacity constraints such as machine hours or limits on availability of material inputs
  - limits on the quantities of outputs that customers demand
- Managers need to determine which products should first be allocated the scarce resources.
- The general rule for constrained resource allocation decisions with only one constraint is:
  - allocate scarce resources to products with the highest contribution margin <u>per unit of the constrained resource,</u>
  - subject to qualitative considerations.

Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

Urban's Umbrellas makes two types of patio umbrellas, regular and deluxe. Suppose there is unlimited customer demand for each product. The selling prices and variable costs of each product are listed below.

	Regular	Deluxe
Selling price per unit	$40	$110
Variable cost per unit	20	44
Contribution margin per unit	$20	$ 66
Contribution margin ratio	50%	60%
Required machine hours/unit	0.4	2.0

Urban has only 160,000 machine hours available per year.

Write Urban's machine hour constraint as an inequality.

$$0.4R + 2D \leq 160{,}000 \text{ machine hours}$$

Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

Suppose that Urban decides to make all Regular umbrellas. What is the total contribution margin? Recall that the CM/unit for R is $20.

The machine hour constraint is: $0.4R + 2D \leq 160{,}000$ machine hours

If D=0, this constraint becomes $0.4R \leq 160{,}000$ machine hours, or $R \leq 400{,}000$ units

Total contribution margin = $20*400,000 = $8 million

Suppose that Urban decides to make all Deluxe umbrellas. What is the total contribution margin? Recall that the CM/unit for D is $66.

If R=0, this constraint becomes $2D \leq 160{,}000$ machine hours, or $D \leq 80{,}000$ units

Total contribution margin = $66*80,000 = $5.28 million

Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

If the choice is between all Ds or all Rs, then clearly making all Rs is better. But how do we know that some combination of Rs and Ds won't yield an even higher contribution margin?

make all Ds; get $5.28 million

make all Rs; get $8 million

In a one constraint problem, a combination of Rs and Ds will yield a contribution margin between $5.28 and $8 million. Therefore, Urban will only make one product, and clearly R is the best choice.

Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

The general rule for constrained resource decisions with one scarce resource is to first make only the product with the highest contribution margin per unit of the constrained resource.

In Urban's case, the sole scarce resource was machine hours, so Urban should make only the product with the highest contribution margin per machine hour.

R: CM/mach hr = $20/0.4mach hrs = $50/mach hr

D: CM/mach hr = $66/2mach hrs = $33/mach hr

Notice that the total contribution margin from making all Rs is $50/mach hr x 160,000 machine hours to be used producing Rs = $8 million.

Q5: Constrained Resource Decisions (Multiple Scarce Resources)

- Usually managers face more than one constraint.
- Multiple constraints are easiest to analyze using a quantitative analysis technique known as linear programming.
- A problem formulated as a linear programming problem contains
  - an algebraic expression of the company's goal, known as the objective function
    - for example "maximize total contribution margin" or "minimize total costs"
  - a list of the constraints written as inequalities

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

Suppose Urban also need 2 and 6 hours of direct labor per unit of R and D, respectively. There are only 120,000 direct labor hours available per year. Formulate this as a linear programming problem.

$$\max_{R,D} \; 20R + 66D$$

subject to:

$0.4R+2D \leq 160{,}000$ mach hr constraint

$2R+6D \leq 120{,}000$ DL hr constraint

$R \geq 0$

$D \geq 0$

nonnegativity constraints (can't make a negative amount of R or D)

objective function

R, D are the choice variables

constraints

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

Draw a graph showing the possible production plans for Urban.

Every R, D ordered pair is a production plan.

But which ones are feasible, given the constraints?

To determine this, graph the constraints as inequalities.

$0.4R+2D \leq 160{,}000$ mach hr constraint

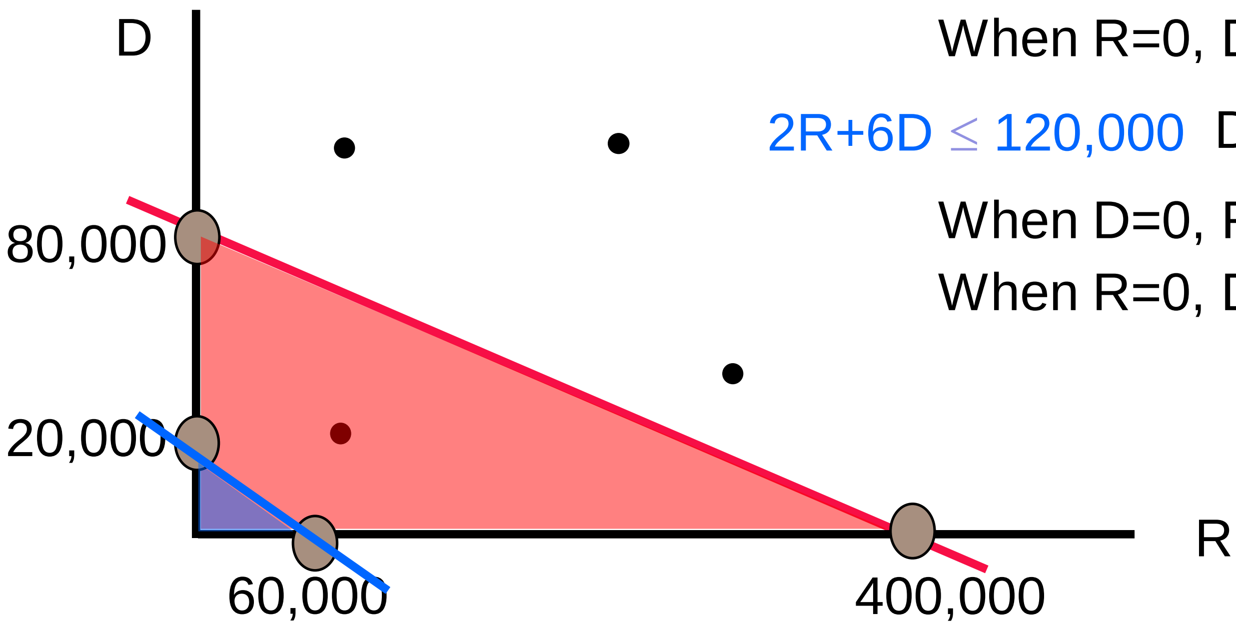
When D=0, R=400,000

When R=0, D=80,000

$2R+6D \leq 120{,}000$ DL hr constraint

When D=0, R=60,000

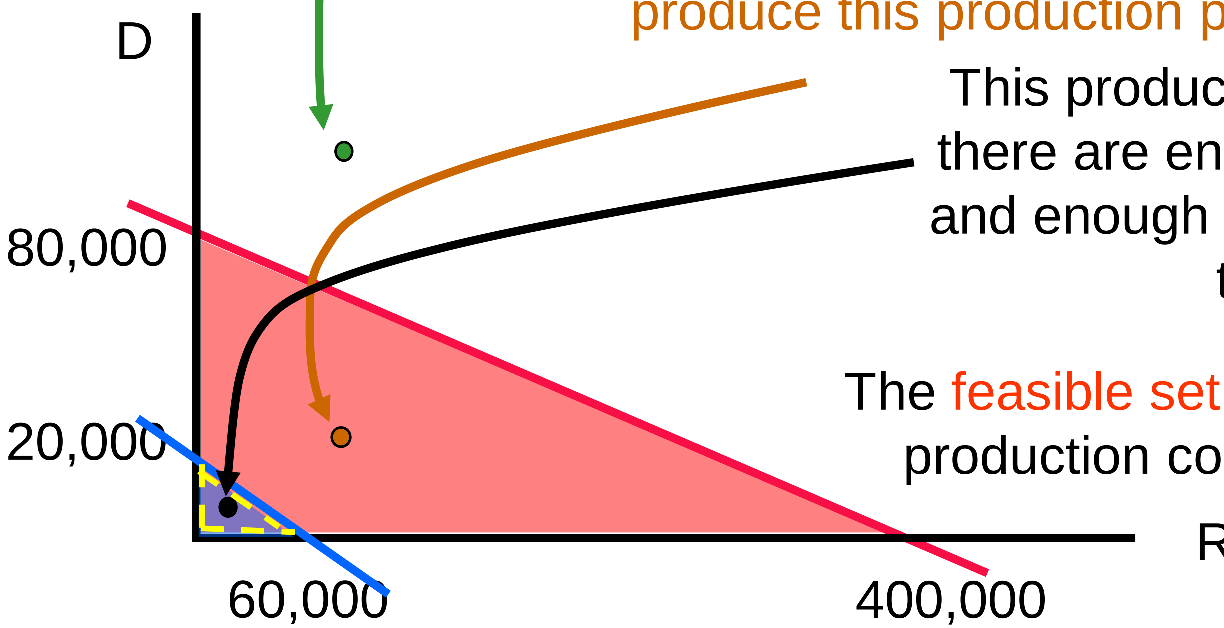
When R=0, D=20,000



Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

There are not enough machine hours or enough direct labor hours to produce this production plan.

There are enough machine hours, but not enough direct labor hours, to produce this production plan.



This production plan is feasible; there are enough machine hours and enough direct labor hours for this plan.

The feasible set is the area where all the production constraints are satisfied.

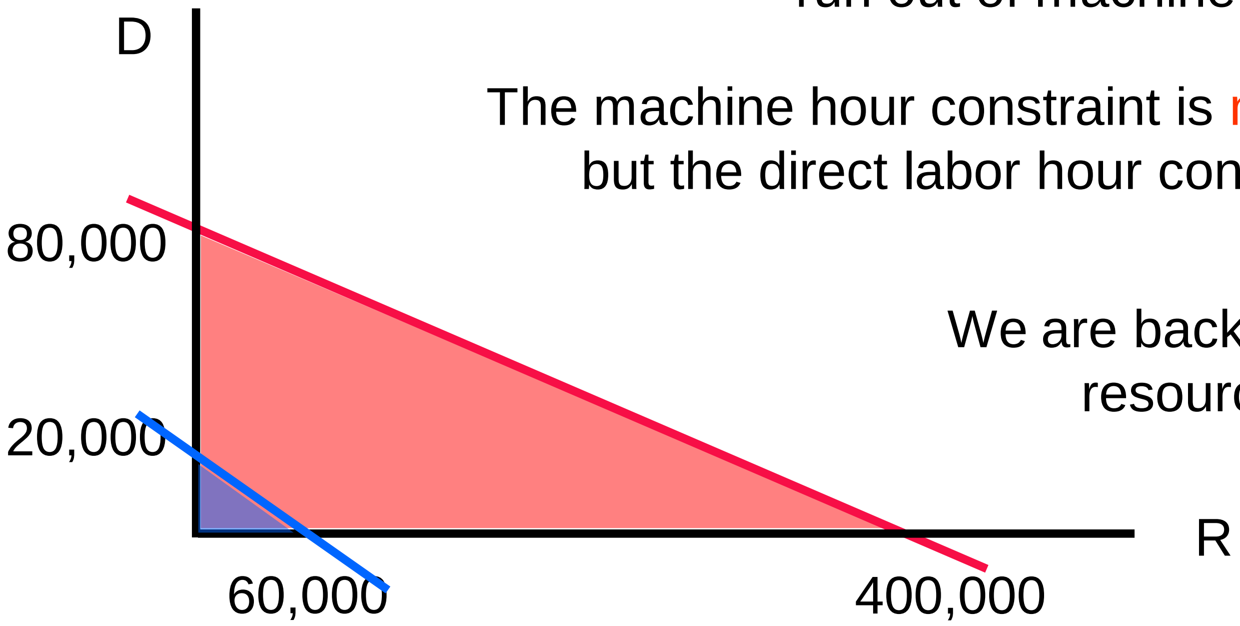
Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

The graph helped us realize an important aspect of this problem – we thought there were 2 constrained resources but in fact there is only one.

For every feasible production plan, Urban will never run out of machine hours.

The machine hour constraint is non-binding, or slack, but the direct labor hour constraint is binding.

We are back to a one-scarce-resource problem.



Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

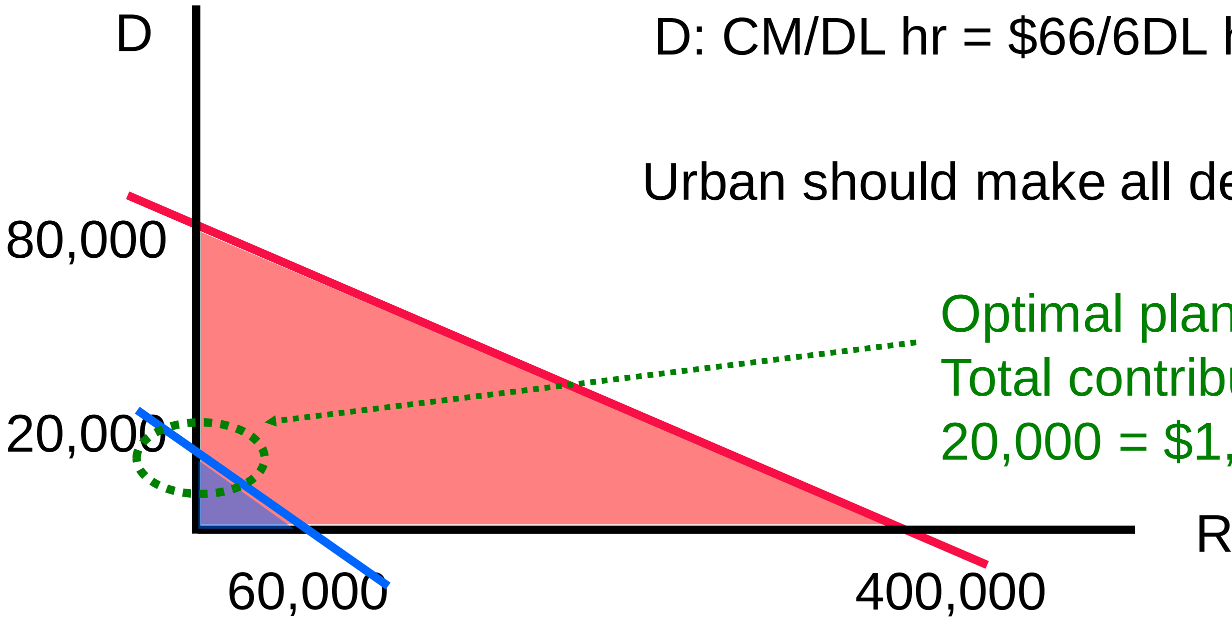
Here direct labor hours is the sole scarce resource.

We can use the general rule for one-constraint problems.

R: CM/DL hr = $20/2DL hrs = $10/DL hr

D: CM/DL hr = $66/6DL hrs = $11/DL hr

Urban should make all deluxe umbrellas.



Optimal plan is R=0, D=20,000.
Total contribution margin = $66 x 20,000 = $1,320,000

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

Suppose Urban has been able to train a new workforce and now there are 600,000 direct labor hours available per year. Formulate this as a linear programming problem, graph it, and find the feasible set.

$$\max_{R,D} \; 20R + 66D$$

<u>subject to:</u>

$0.4R+2D \leq 160{,}000$ mach hr constraint

$2R+6D \leq 600{,}000$ DL hr constraint

$R \geq 0$

$D \geq 0$

The formulation of the problem is the same as before; the only change is that the right hand side (RHS) of the DL hour constraint is larger.

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

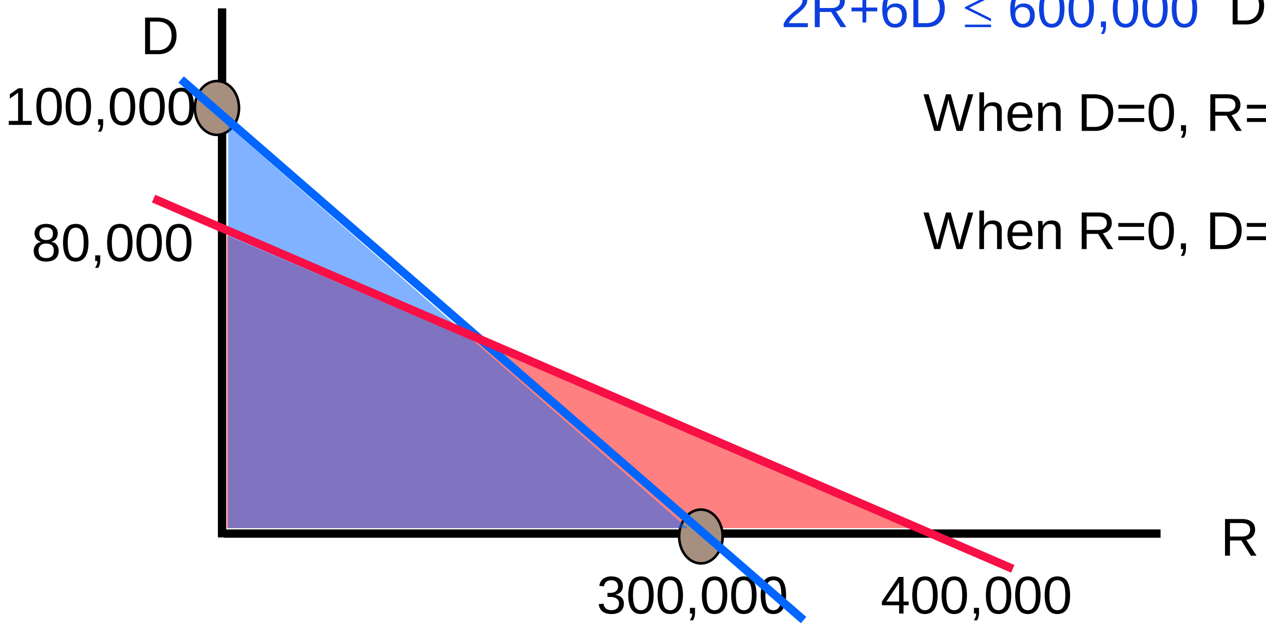
The machine hour constraint is the same as before.

$0.4R+2D \leq 160{,}000$ mach hr constraint

$2R+6D \leq 600{,}000$ DL hr constraint

When D=0, R=300,000

When R=0, D=100,000

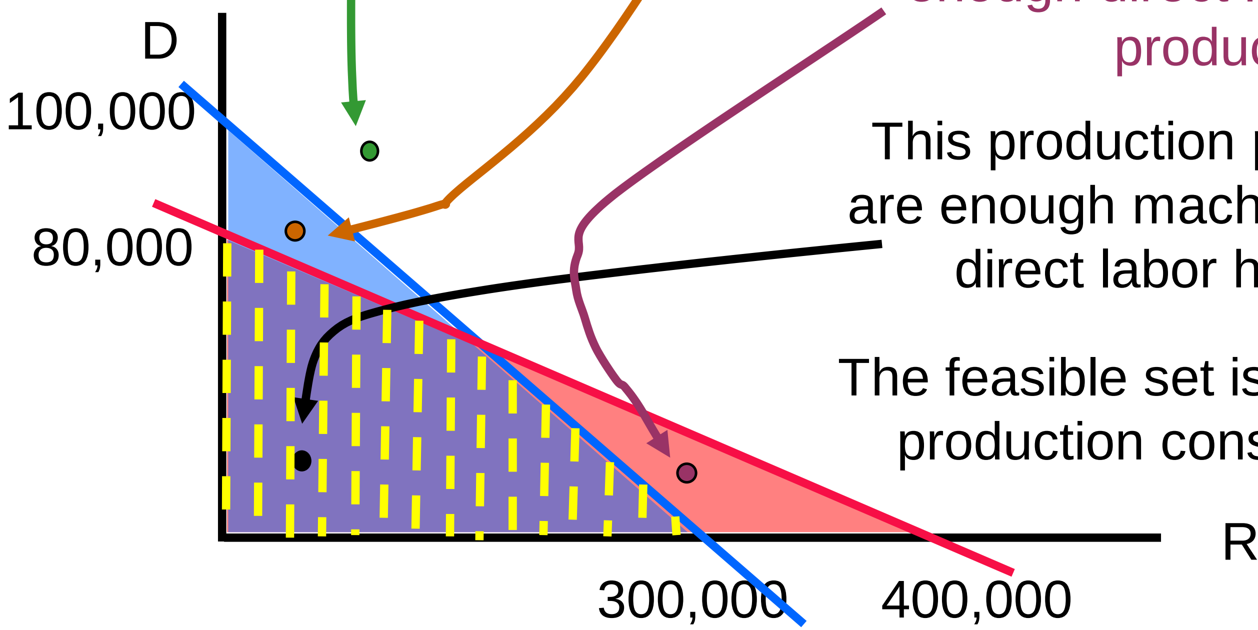


Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

There are not enough machine hours or enough direct labor hours for this production plan.

There are enough direct labor hours, but not enough machine hours, for this production plan.

There are enough machine hours, but not enough direct labor hours, for this production plan.



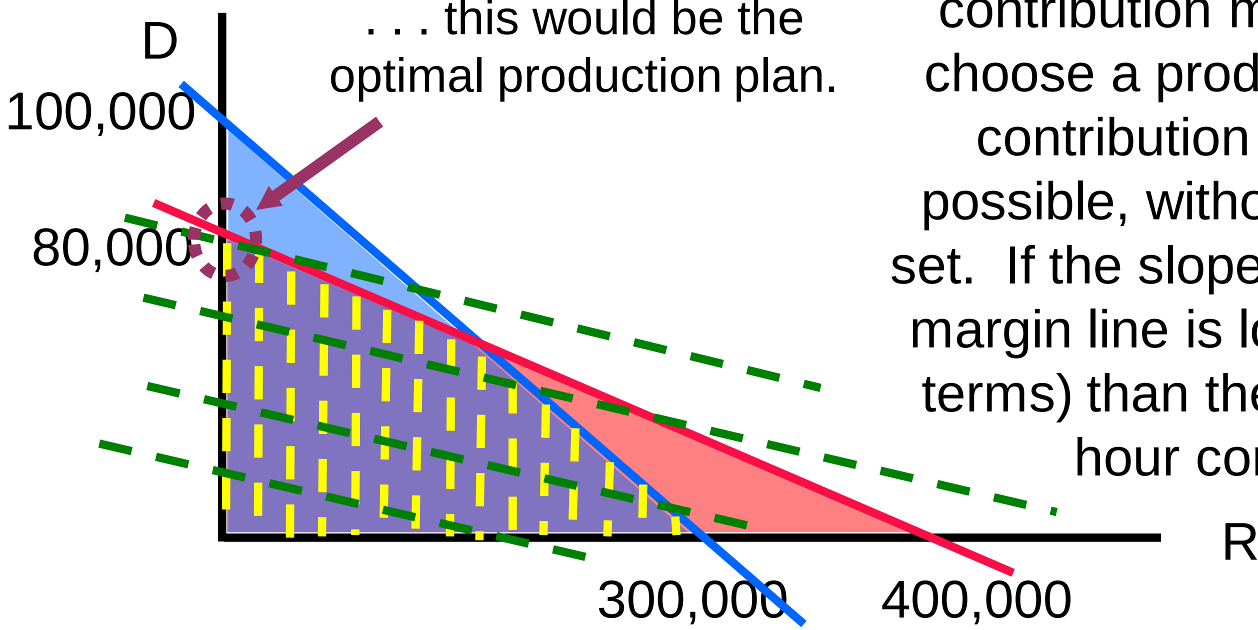
This production plan is feasible; there are enough machine hours and enough direct labor hours for this plan.

The feasible set is the area where all the production constraints are satisfied.

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

How do we know which of the feasible plans is optimal?
We can't use the general rule for one-constraint problems.

We can graph the total contribution margin line, because its slope will help us determine the optimal production plan.

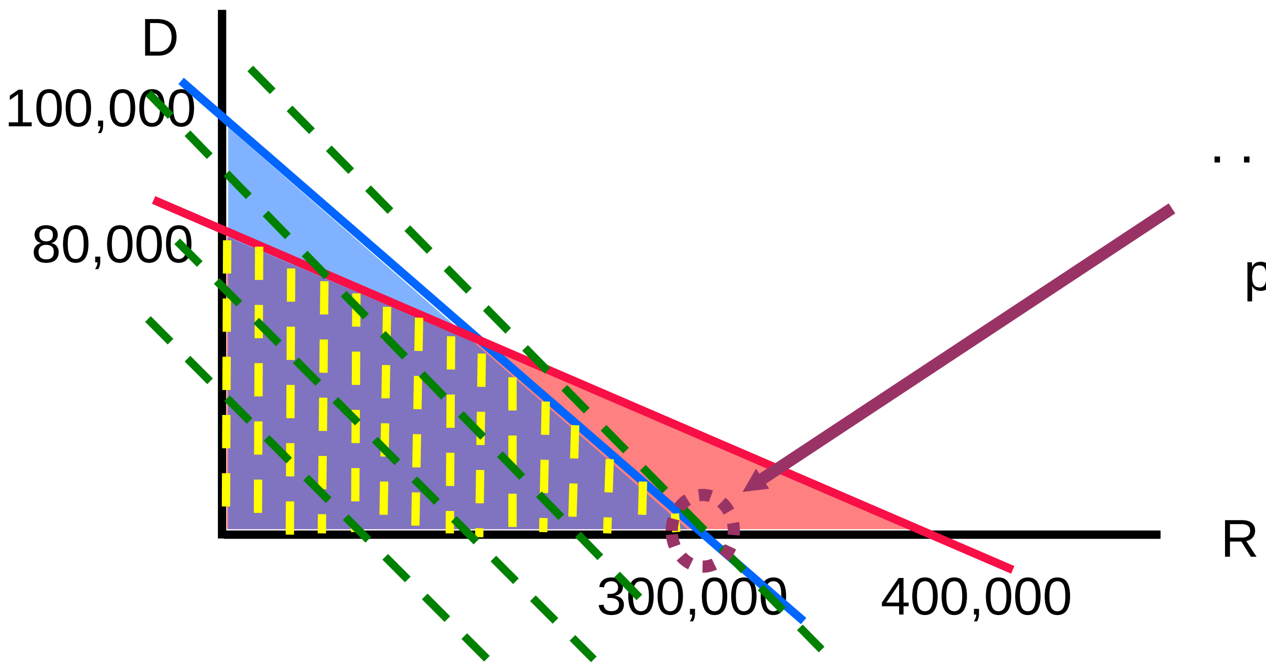


The objective "maximize total contribution margin" means that we choose a production plan so that the contribution margin is a large as possible, without leaving the feasible set. If the slope of the total contribution margin line is lower (in absolute value terms) than the slope of the machine hour constraint, then. . .

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

What if the slope of the total contribution margin line is higher (in absolute value terms) than the slope of the direct labor hour constraint?

If the total CM line had this steep slope, . .

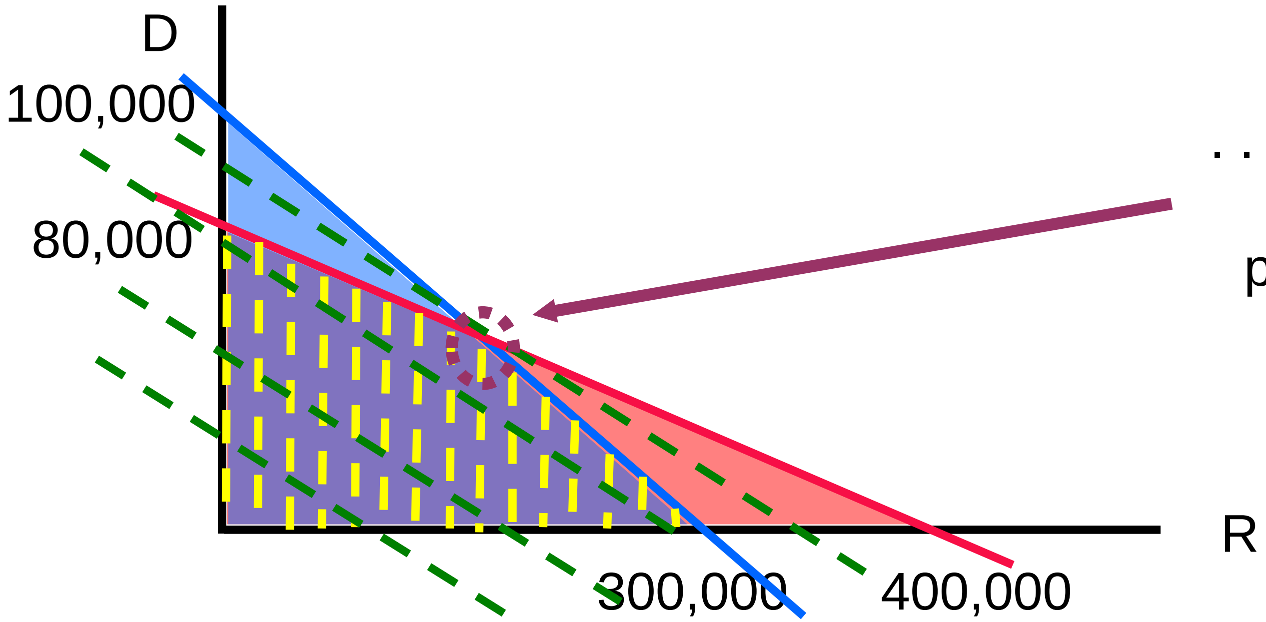


. . then this would be the optimal production plan.

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

What if the slope of the total contribution margin line is between the slopes of the two constraints?

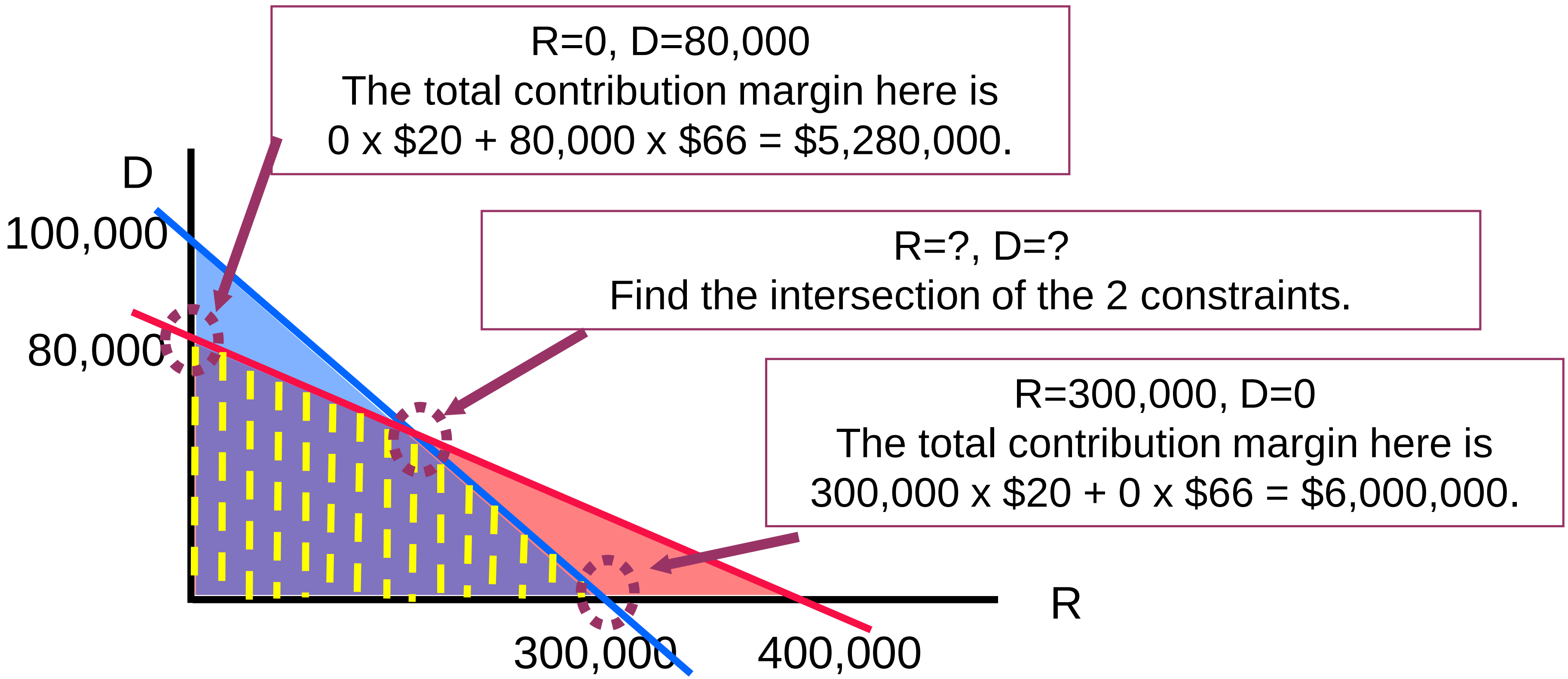
If the total CM line had this slope, . .



. . then this would be the optimal production plan.

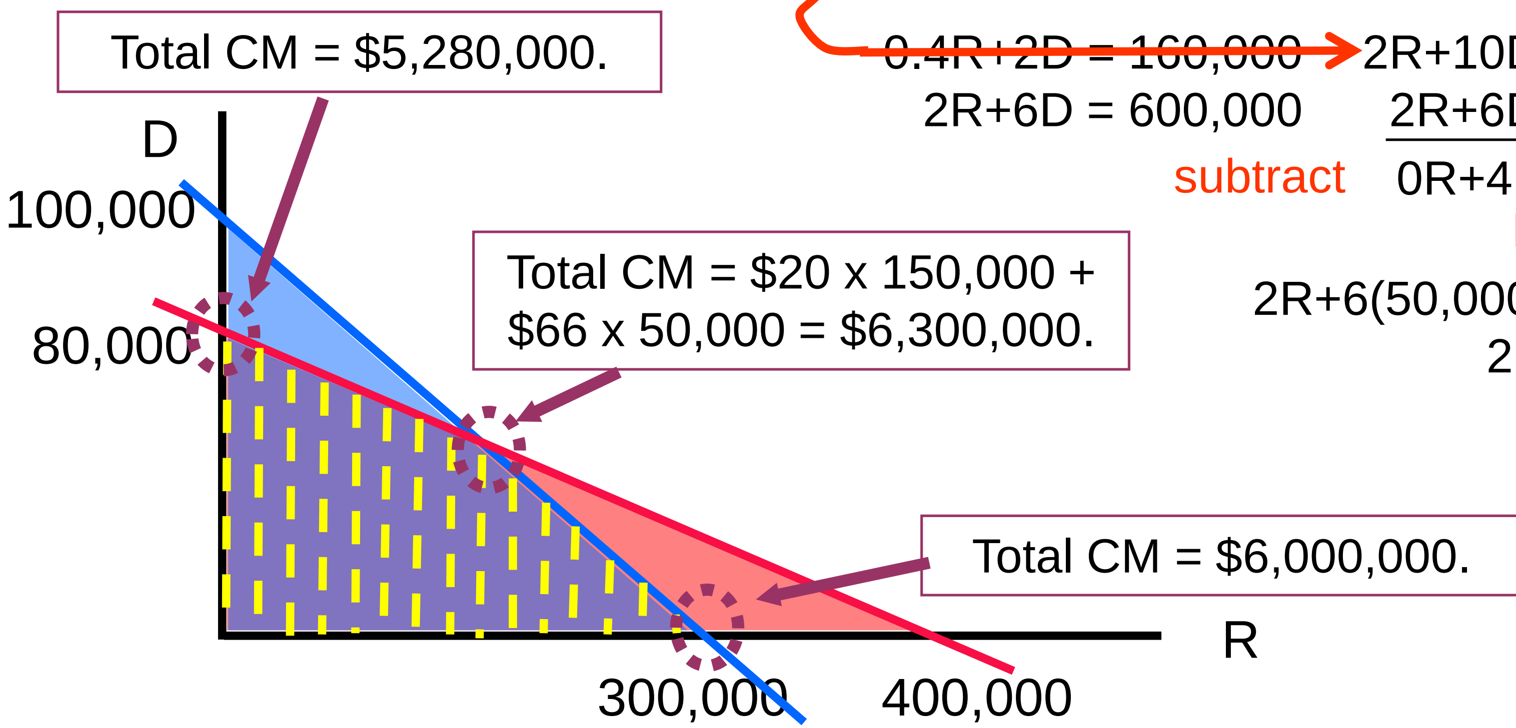
Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

The last 3 slides showed that the optimal production plan is always at a corner of the feasible set. This gives us an easy way to solve 2 product, 2 or more scarce resource problems.



Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

To find the intersection of the 2 constraints, use substitution or subtract one constraint from the other.



multiply each side by 5

$0.4R+2D = 160,000 \rightarrow 2R+10D = 800,000$

$2R+6D = 600,000 \qquad 2R+6D = 600,000$

subtract $\quad 0R+4D = 200,000$

$D = 50,000$

$2R+6(50,000) = 600,000$

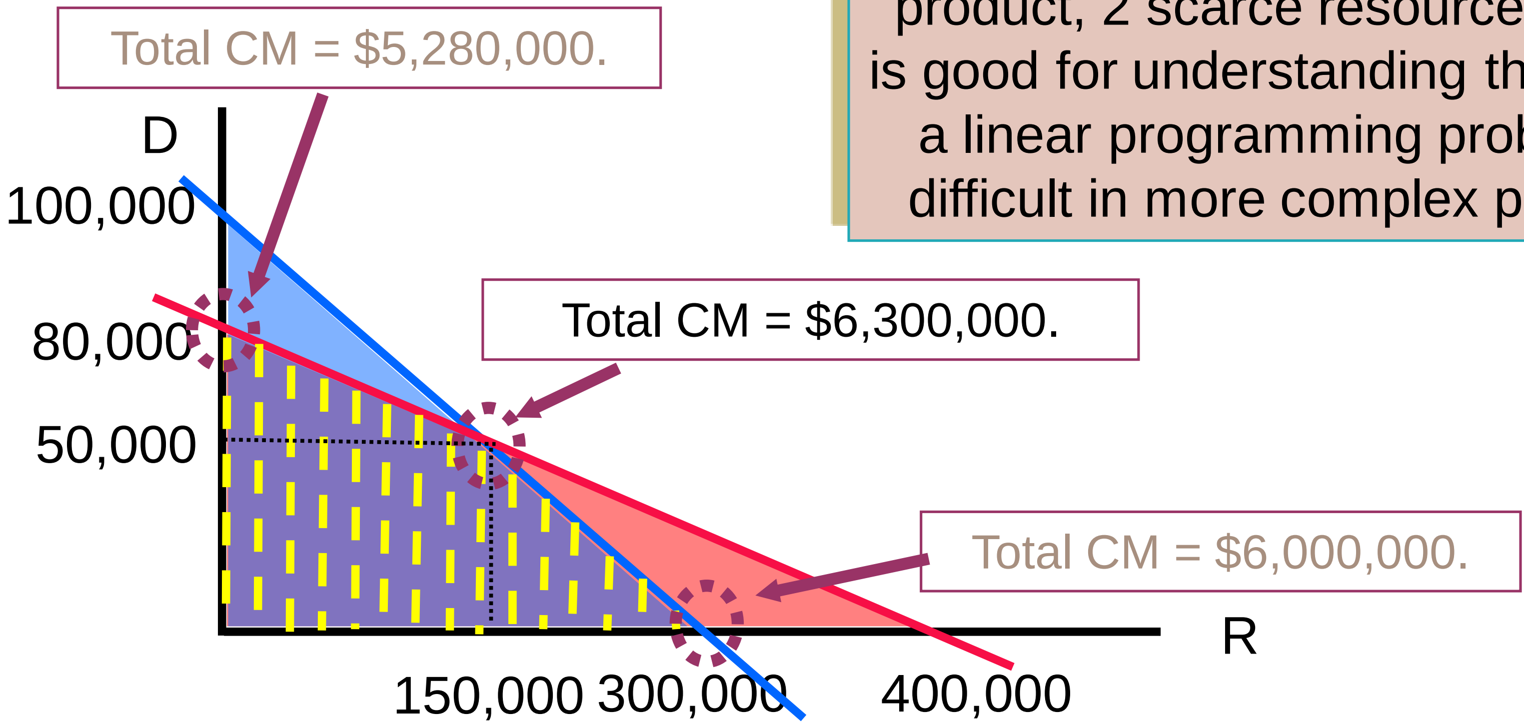
$2R = 300,000$

$R = 150,000$

Q5: Constrained Resource Decisions (Two Products; Two Scarce Resources)

By checking the total contribution margin at each corner of the feasible set (ignoring the origin), we can see that the optimal production plan is R=150,000, D=50,000.

Knowing how to graph and solve 2 product, 2 scarce resource problems is good for understanding the nature of a linear programming problem (but difficult in more complex problems).



Q5: Qualitative Factors in Scarce Resource Allocation Decisions

The quantitative analysis indicates that Urban should produce 150,000 regular umbrellas and 50,000 deluxe umbrellas. What qualitative issues should Urban consider before finalizing its decision?

- The assumption that customer demand is unlimited is unlikely; can this be investigated further?
- Are there any long-term strategic implications of minimizing production of the deluxe umbrellas?
- What would be the effects of attempting to relax the machine hour or DL hour constraints?
- Are there any worker productivity issues that affect this decision?

Q5: Constrained Resource Decisions (Multiple Products; Multiple Constraints)

- Problems with multiple products, one scarce resource, and one constraint on customer demand for each product are easy to solve.
- The general rule is to make the product with the highest contribution margin per unit of the scarce resource:
  - until its customer demand is satisfied
  - then move to the product with the next highest contribution margin per unit of the scarce resource, etc.
- Problems with multiple products and multiple scarce resources are too cumbersome to solve by hand – Excel solver is a useful tool here.

Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

Urban's Umbrellas makes two types of patio umbrellas, regular and deluxe. Suppose customer demand for regular umbrellas is 300,000 units and for deluxe umbrellas customer demand is limited to 60,000. Urban has only 160,000 machine hours available per year. What is his optimal production plan? How much would he pay (above his normal costs) for an extra machine hour?

	Regular	Deluxe
Selling price per unit	$40	$110
Variable cost per unit	20	44
Contribution margin per unit	$20	$ 66
Required machine hours/unit	0.4	2.0
CM/machine hour	$50	$33

Urban should first concentrate on making Rs. He can make enough to satisfy customer demand for Rs: 300,000 Rs x 0.4 mach hr/R = 120,000 mach hrs.

Q5: Constrained Resource Decisions (Two Products; One Scarce Resource)

	Regular	Deluxe
Selling price per unit	$40	$110
Variable cost per unit	20	44
Contribution margin per unit	$20	$ 66
Required machine hours/unit	0.4	2.0
CM/machine hour	$50	$33

The 40,000 remaining hours will make 20,000 Ds.

The optimal plan is 300,000 Rs and 20,000 Ds. The CM/mach hr shows how much Urban would be willing to pay, above his normal costs, for an additional machine hour.

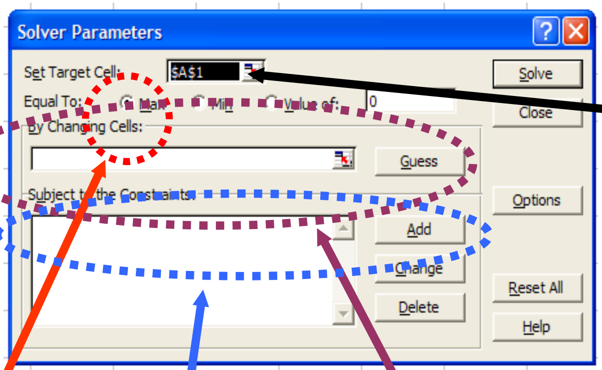
Here Urban will be producing Ds when he runs out of machine hours so he'd be willing to pay up to $33 for an additional machine hour.

If customer demand for Rs exceeded 400,000 units, Urban would be willing to pay up to an additional $50 for a machine hour.

If customer demand for Rs and Ds could be satisfied with the 160,000 available machine hours, then Urban would not be willing to pay anything to acquire an additional machine hour.

Q5: Constrained Resource Decisions Using Excel Solver

To obtain the solver dialog box, choose "Solver" from the Tools pull-down menu.



The "target cell" will contain the maximized value for the objective (or "target") function.

Choose "max" for the types of problems in this chapter.

Choose one cell for each choice variable (product). It's helpful to "name" these cells.

Add constraint formulas by clicking "add".

Click "solve" to obtain the next dialog box.

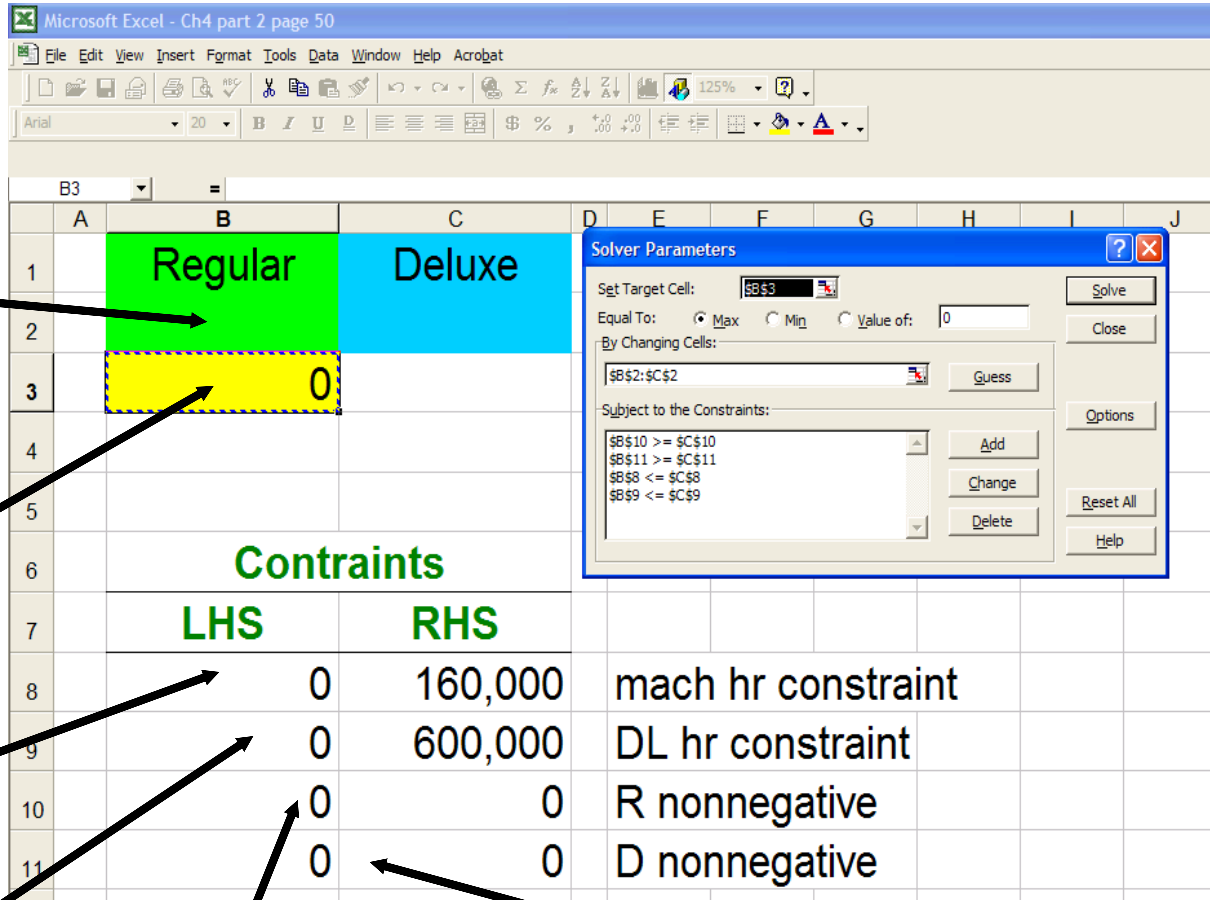
Q5: Constrained Resource Decisions Using Excel Solver

Cell B2 was named "Regular" and cell C2 was named Deluxe.

=20*Regular + 66*Deluxe

=0.4*Regular+ 2*Deluxe

=2*Regular+ 6*Deluxe



=Regular (cell B2)

=Deluxe (cell C2)

Then click "solve" and choose all 3 reports.

Q5: Excel Solver Answer Report

Microsoft Excel 9.0 Answer Report

Target Cell (Max)

Cell	Name	Original Value	Final Value
$B$3	Regular	0	6,300,000

Adjustable Cells

Cell	Name	Original Value	Final Value
$B$2	Regular	0	150,000
$C$2	Deluxe	0	50000

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$B$9	DL hr	600,000	$B$9<=$C$9	Binding	0
$B$8	mach hr	160,000	$B$8<=$C$8	Binding	0
$B$11	D>0	50,000	$B$11>=$C$11	Not Binding	50,000
$B$10	R>0	150,000	$B$10>=$C$10	Not Binding	150,000

Refer to the problem on Slide #50.

The total contribution margin for the optimal plan was $6.3 million.

The optimal production plan was 150,000 Rs and 50,000 Ds.

The machine and DL hour constraints are binding – the plan uses all available machine and DL hours.

The nonnegativity constraints for R and D are not binding; the slack is 50,000 and 150,000 units respectively.

Q5: Excel Solver Sensitivity Report

Microsoft Excel 9.0 Sensitivity Report

Refer to the problem on Slide #50.

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$B$2	Regular	150,000	0	20	2	6.8
$C$2	Deluxe	50000	0	66	34	6

This shows how much the slope of the total CM line can change before the optimal production plan will change.

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$B$9	DL hr	600,000	9	600000	200000	120000
$B$8	mach hr	160,000	8	160000	40000	40000
$B$11	D>0	50,000	0	0	50000	1E+30
$B$10	R>0	150,000	0	0	150000	1E+30

The CM per unit for Regular can drop to $13.20 or increase to $22 (all else equal) before the optimal plan will change. The CM per unit for Deluxe can drop to $60 or increase to $100 (all else equal) before the optimal plan will change.

Q5: Excel Solver Sensitivity Report

Microsoft Excel 9.0 Sensitivity Report

Refer to the problem on Slide #50.

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$B$2	Regular	150,000	0	20	2	6.8
$C$2	Deluxe	50000	0	66	34	6

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$B$9	DL hr	600,000	8.50	600000	200000	120000
$B$8	mach hr	160,000	7.50	160000	40000	40000
$B$11	D>0	50,000	0.00	0	50000	1E+30
$B$10	R>0	150,000	0.00	0	150000	1E+30

This shows how much the RHS of each constraint can change before the shadow price will change.

The available DL hours could decrease to 480,000 or increase to 800,000 (all else equal) before the shadow price for DL would change. The available machine hours could decrease to 120,000 or increase to 200,000 (all else equal) before the shadow price for machine hours would change.

Q5: Excel Solver Sensitivity Report

Microsoft Excel 9.0 Sensitivity Report

Refer to the problem on Slide #50.

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$B$2	Regular	150,000	0	20	2	6.8
$C$2	Deluxe	50000	0	66	34	6

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$B$9	DL hr	600,000	8.50	600000	200000	120000
$B$8	mach hr	160,000	7.50	160000	40000	40000
$B$11	D>0	50,000	0.00	0	50000	1E+30
$B$10	R>0	150,000	0.00	0	150000	1E+30

The shadow price shows how much a one unit increase in the RHS of a constraint will improve the total contribution margin.

Urban would be willing to pay up to $8.50 to obtain one more DL hour and up to $7.50 to obtain one more machine hour.

Q7: Impacts to Quality of Nonroutine Operating Decisions

- The quality of the information used in nonroutine operating decisions must be assessed.
  - There may be more information quality issues (and more uncertainty) in nonroutine decisions because of the irregularity of the decisions.
- Three aspects of the quality of information available can affect decision quality.
  - Business risk (changes in economic condition, consumer demand, regulation, competitors, etc.)
  - Information timeliness
  - Assumptions in the quantitative and qualitative analyses

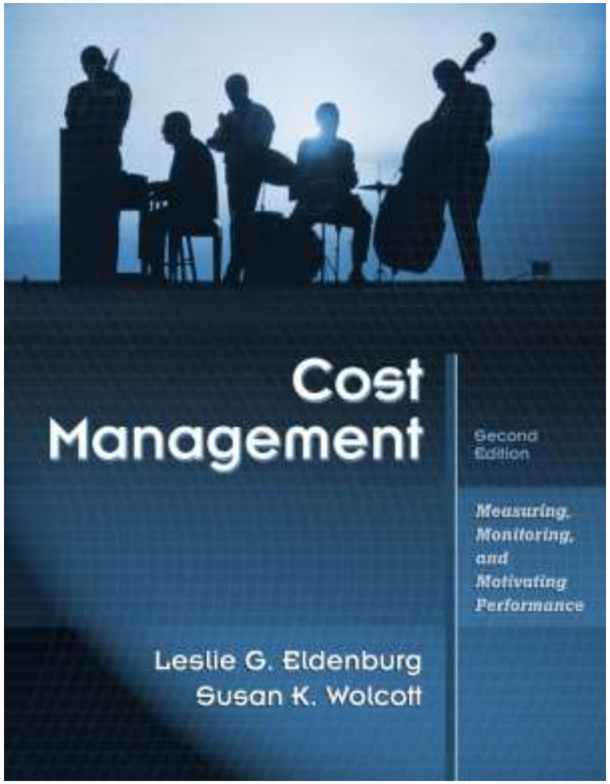
Q7: Impacts to Quality of Nonroutine Operating Decisions

- Short term decision must align to company's overall strategic plans
- Must watch for decision maker bias
  - Predisposition for specific outcome
  - Preference for one type of analysis without considering other options
- Opportunity costs are often overlooked
- Performing sensitivity analysis can help assess and minimize business risk
- Established control system incentives (performance bonuses, etc.) can encourage sub-obtimal decision making

Cost Management
Measuring, Monitoring, and Motivating Performance

Chapter 5

Job Costing



Learning objectives

- Q1: How are costs assigned to customized goods and services?
- Q2: How is overhead allocated to individual jobs?
- Q3: How does job costing information affect managers' incentives and decisions?
- Q4: How are spoilage, rework, and scrap handled in job costing?
- Q5: What are the quality and behavioral implications of spoilage?

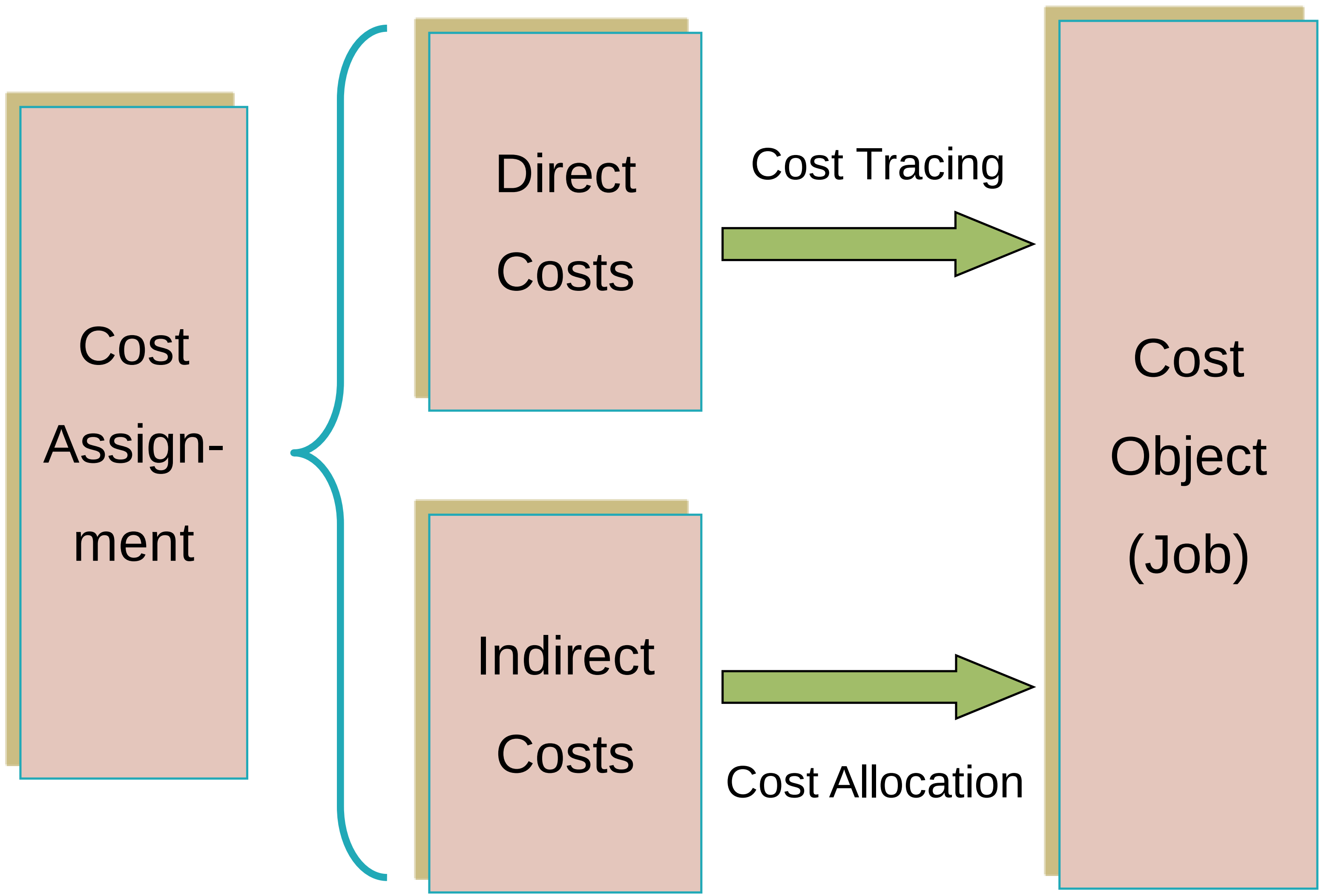
Q1: Job Costing versus Process Costing

Job Costing	• Used when products can be distinguished from one another
Process Costing	• Used when similar products are mass produced
Hybrid Costing	• Includes characteristics of both job and process costing

Q1: Job Costing versus Process Costing

	Job Costing	Process Costing
Operations	Discrete	Continuous
Product	Fewer units	Many units
Units	Readily identifiable	Fungible
Cost object	Job or batch	Processing department
# of WIP accounts	One	Same as the # of processing departments

Q1: Assigning Costs to Jobs



Q1: Job Cost Records

Each job's costs are maintained on a job cost record.

The job cost records form the subsidiary ledger for Work in process inventory.

Date	Dir. Materials	Dir. Labor	Overhead	Total

This information comes from Materials Requisition Forms

This information comes from Labor Time Reports

Overhead costs must be allocated to each job

Q2: Allocating Overhead Costs to Jobs

- Direct costs are traced to the individual jobs using source documents.

- Overhead costs are indirect and cannot be traced to individual jobs; they must be allocated.

- An overhead allocation base must be chosen.

- The overhead allocation base should be some measure of activity; it should be a reasonably good cost driver for overhead costs.

Q2: Steps in Allocating Overhead

1. Identify the relevant cost object.
2. Identify one or more overhead cost pools and allocation bases.
3. For each overhead cost pool, calculate an overhead allocation rate.
4. For each overhead cost pool, allocate costs to the cost object.

Q2: Overhead Allocation Rates

- Companies may use an actual or an estimated overhead allocation rate.

$$\text{Actual allocation rate} = \frac{\text{Actual overhead cost}}{\text{Actual quantity of the allocation base}}$$

  - The actual allocation rate cannot be computed until the accounting period is over.

$$\text{Estimated allocation rate} = \frac{\text{Estimated overhead cost}}{\text{Estimated quantity of the allocation base}}$$

- The estimated allocation rate can be computed at the beginning of the accounting period (normal costing).

Q2: Overhead Allocation Rates

Chausse Manufacturing makes road paving equipment. At the beginning of the year, overhead costs were estimated to be $450,000. However, actual overhead was $504,000. Chausse uses direct labor hours as the cost allocation base. At the beginning of the year, total direct labor hours were estimated at 10,000 hours, but actual direct labor hours for the year totaled 12,000 hours. Compute the actual overhead rate and the estimated overhead rate.

$$\text{Actual allocation rate} = \frac{\$504{,}000}{12{,}000 \text{ hours}} = \$42/\text{hr}$$

$$\text{Estimated allocation rate} = \frac{\$450{,}000}{10{,}000 \text{ hours}} = \$45/\text{hr}$$

Q2: Actual and Normal Costing

	Actual Costing	Normal Costing
Direct costs	Actual costs	Actual costs
Indirect costs	Actual rate x actual usage of cost allocation base	Estimated rate x actual usage of cost allocation base

In normal costing, annual budgeted rates are used

- smoothing effect on numerator
- smoothing effect on denominator

Q2: Job Costing Example (Service Sector)

Serena-Sturm is an architectural firm with a professional staff of 5 architects and a support staff of 7. Some projects are done for a fixed fee, while others are billed for the actual hours spent on the project. You are given the following information for Serena-Sturm (SS) for 2005. What is the estimated indirect cost rate if # of projects is used as the cost allocation base? Is this a good choice for the cost allocation base?

	BUDGETED	ACTUAL
Direct Costs:		
Professional labor costs	$400,000	$420,000
Professional labor hours	10,000	12,000
Professional labor rate/hour	$40	$35
Indirect Costs:		
Designers, drafters	$360,000	$360,000
Office costs	40,000	80,000
Office salaries & wages	45,000	56,800
Travel & entertainment	5,000	7,200
Total indirect costs	$450,000	$504,000
Other Information:		
Number of projects	1,000	1,200
Number of blueprints prepared	3,600	4,000

Estimated indirect cost rate =

$450,000/1,000 projects =

$450/project

Terrible choice for a cost allocation base; ignores resource consumption of the projects.

Q2: Job Costing Example (Service Sector)

SS has a costing system with a single direct cost pool. If SS uses a single indirect cost pool, determine both the estimated and actual indirect cost rates using (a) number of professional labor hours and (b) number of blueprints prepared as cost allocation bases.

	BUDGETED	ACTUAL
Direct Costs:		
Professional labor costs	$400,000	$420,000
Professional labor hours	10,000	12,000
Professional labor rate/hour	$40	$35
Indirect Costs:		
Designers, drafters	$360,000	$360,000
Office costs	40,000	80,000
Office salaries & wages	45,000	56,800
Travel & entertainment	5,000	7,200
Total indirect costs	$450,000	$504,000
Other Information:		
Number of projects	1,000	1,200
Number of blueprints prepared	3,600	4,000

Potential Cost Allocation Base	Actual Rate	Estimated Rate
Professional labor hours	$\frac{\$504{,}000}{12{,}000 \text{ hrs}}$ = $42/hr	$\frac{\$450{,}000}{10{,}000 \text{ hrs}}$ = $45/hr
Number of blueprints	$\frac{\$504{,}000}{4{,}000 \text{ bpts}}$ = $126/bpt	$\frac{\$450{,}000}{3{,}600 \text{ bpts}}$ = $125/bpt

Q2: Job Costing Example (Service Sector)

SS was asked to prepare a fixed fee bid for an out-of-town project called The Culebra Complex. The budgeted professional hours for this project was 400, and the job is expected to require the preparation of 7 blueprints. Compute the budgeted project cost using (a) professional labor hours and (b) number of blue prints prepared as a cost driver for indirect costs.

Potential Cost Allocation Base	Estimated Rate
Professional labor hours	$45/hr
Number of blueprints	$125/bpt

	Cost Allocation Base	
Costs	Professional labor hours	Number of blueprints
Direct costs	$40/hr x 400 hrs = $16,000	$40/hr x 400 hrs = $16,000
Indirect costs	$45/hr x 400 hrs = $18,000	$125/bpt x 7 bpts = $875
Total	$34,000	$16,875

Q2: Why Are Costs so Different?

Why do the different cost allocation bases yield vastly different project costs?

	BUDGETED
Direct Costs:	
Professional labor costs	$400,000
Professional labor hours	10,000
Professional labor rate/hour	$40
Indirect Costs:	
Designers, drafters	$360,000
Office costs	40,000
Office salaries & wages	45,000
Travel & entertainment	5,000
Total indirect costs	$450,000
Other Information:	
Number of projects	1,000
Number of blueprints prepared	3,600

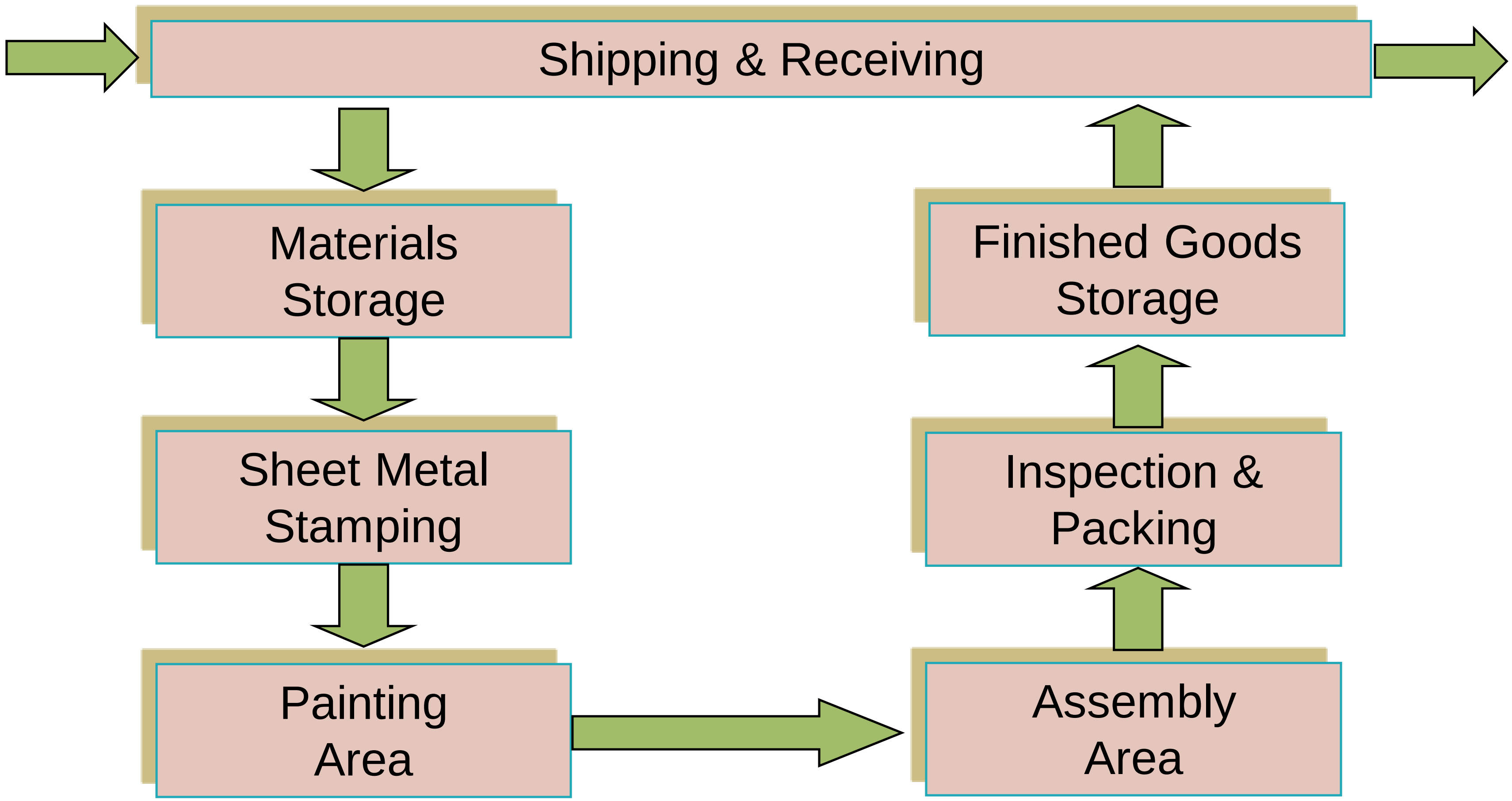
	Cost Allocation Base	
Costs	Professional labor hours	Number of blueprints
Direct costs	$16,000	$16,000
Indirect costs	$18,000	$875
Total	$34,000	$16,875

If professional labor hours is a good measure of activity, then this project is expected to be 400 hrs/10,000 hrs, or 4% of the year's activity.

If # of blueprints is a good measure of activity, then this project is expected to be 7 bpts/3,600 bpts, or less than 0.2% of the year's activity.

Q2: Job Costing in Manufacturing

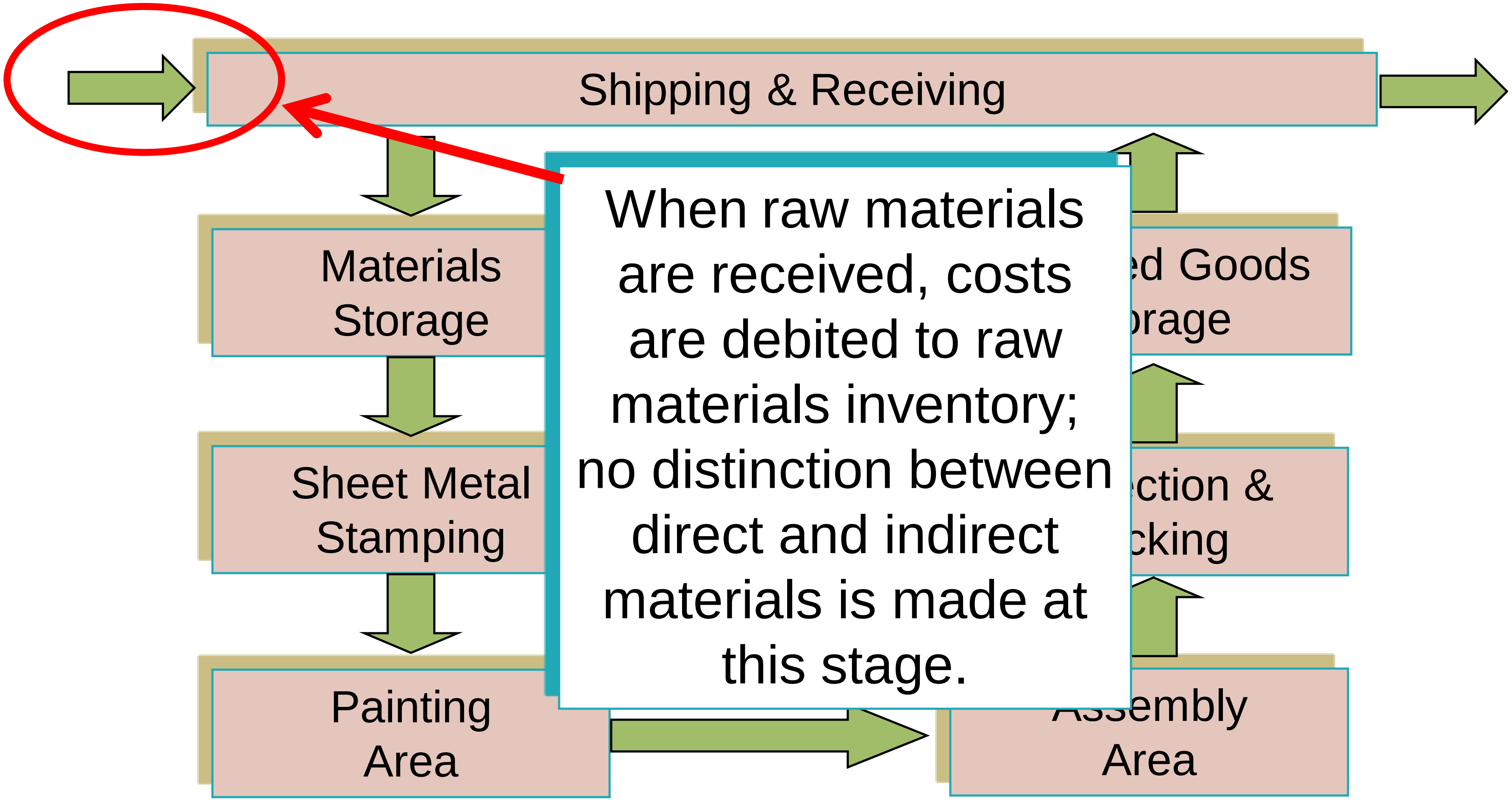
Logo lamps makes desk lamps stamped with the customer's logo.



Q2: Journal Entries in Job Costing

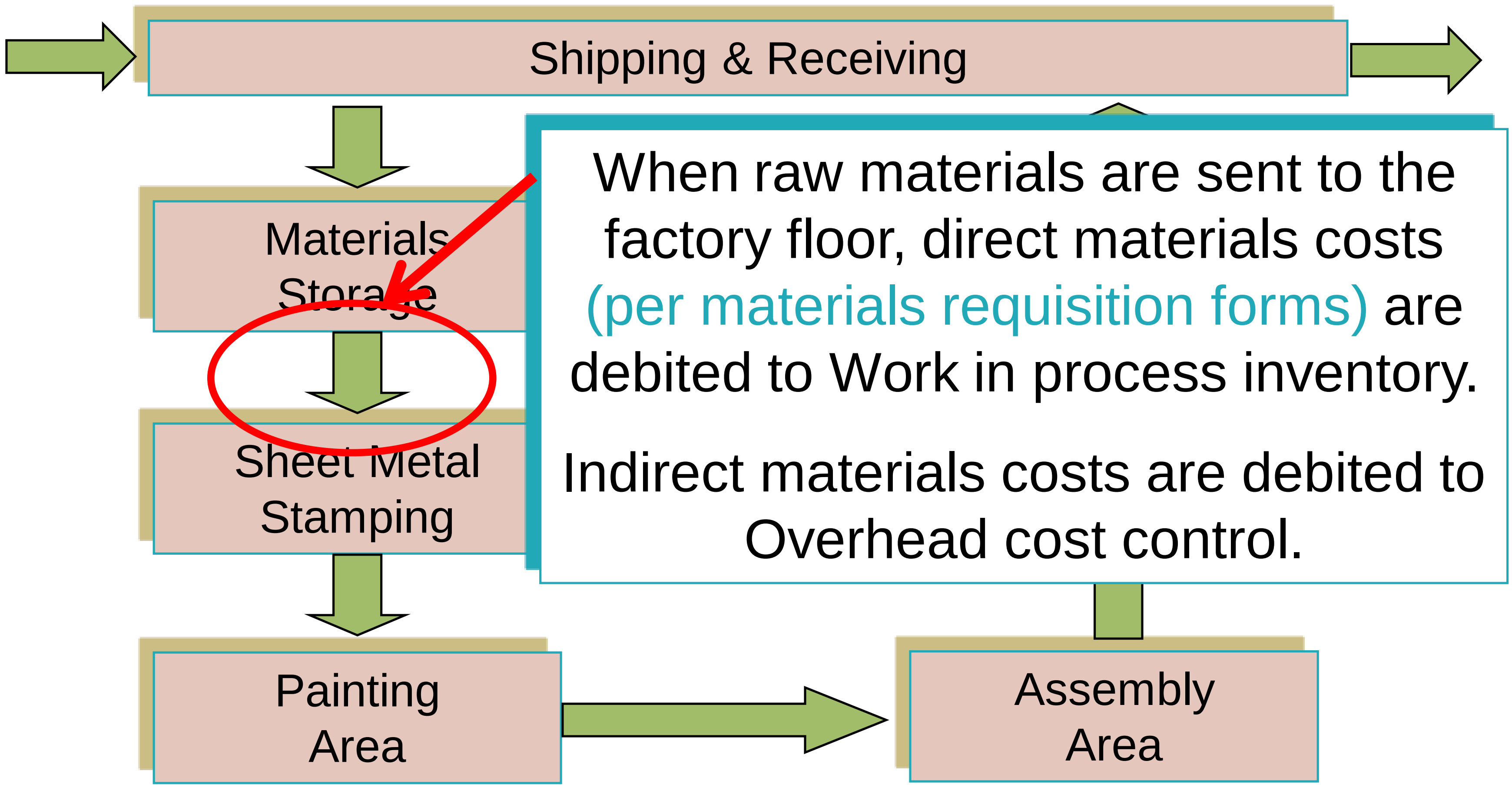
- Flow of costs matches flow of the goods through the factory
- Source documents used to update accounts for direct costs
- Normal costing is used, so overhead is charged to jobs based on estimated overhead rates
- Overhead cost control is a temporary account used in normal costing
    - debit Overhead cost control for actual overhead costs
    - credit Overhead cost control when overhead allocated to WIP

Q2: Flow of Costs in Job Costing



When raw materials are received, costs are debited to raw materials inventory; no distinction between direct and indirect materials is made at this stage.

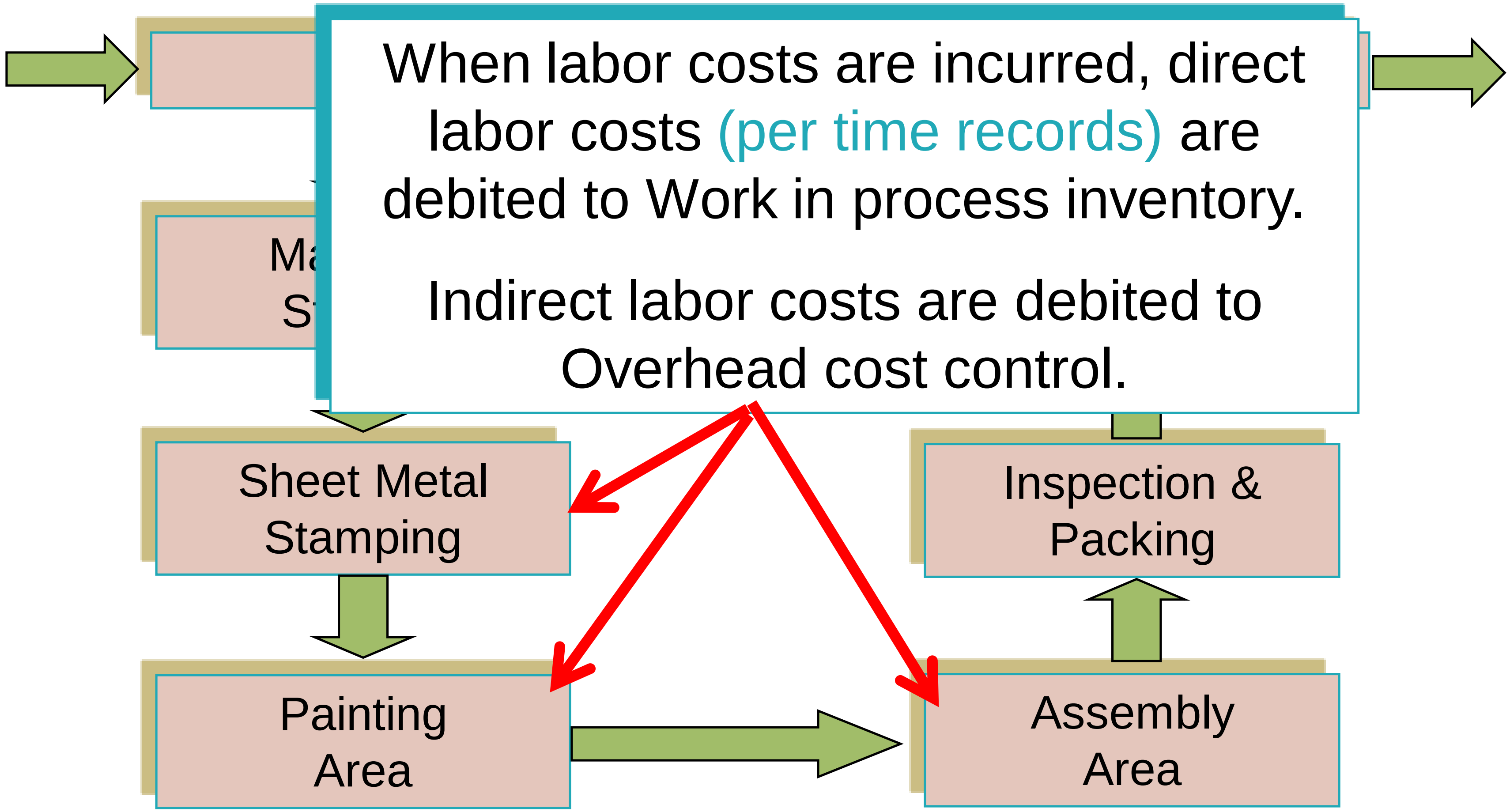
Q2: Flow of Costs in Job Costing



When raw materials are sent to the factory floor, direct materials costs (per materials requisition forms) are debited to Work in process inventory.

Indirect materials costs are debited to Overhead cost control.

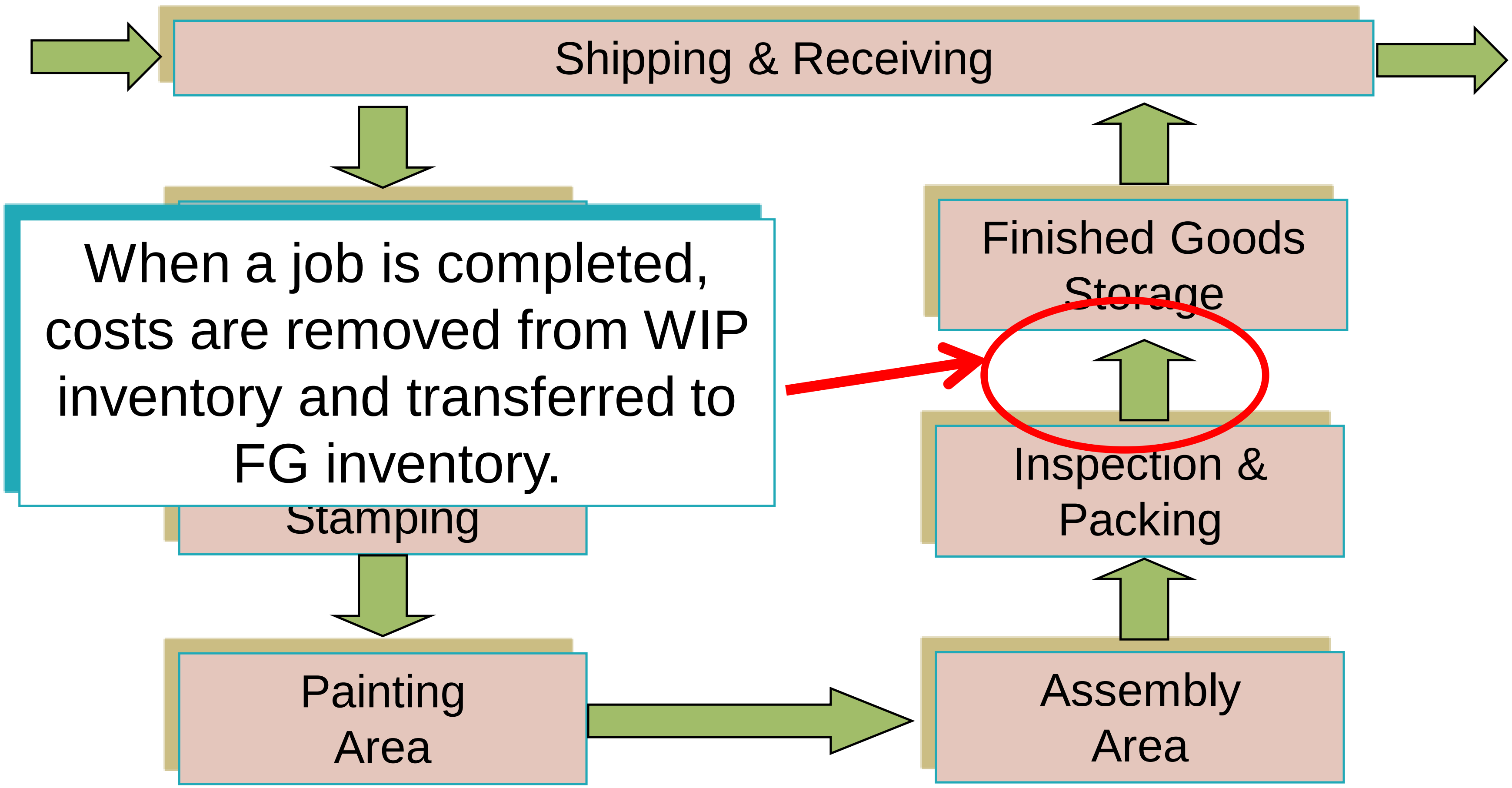
Q2: Flow of Costs in Job Costing



When labor costs are incurred, direct labor costs (per time records) are debited to Work in process inventory.

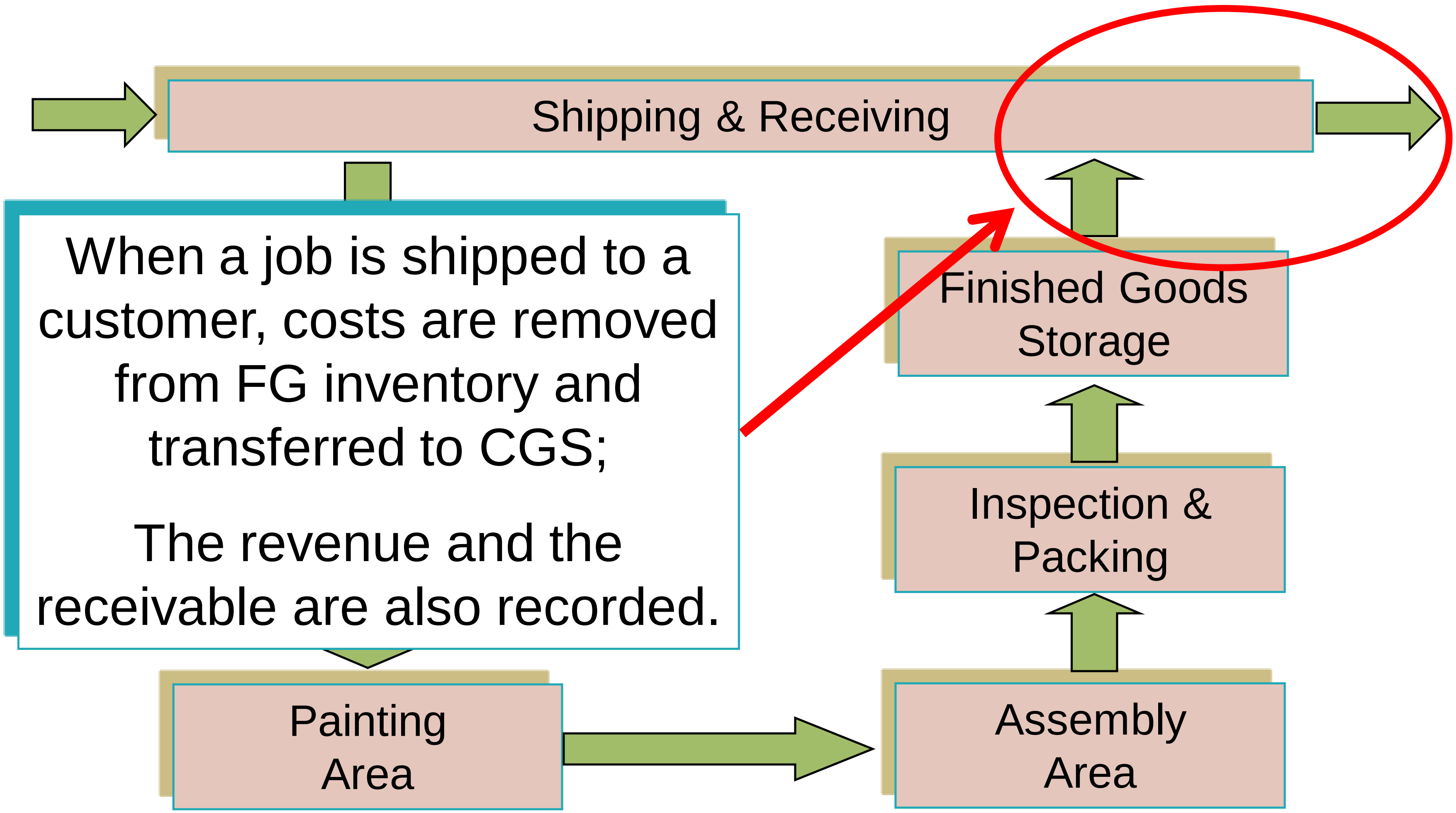
Indirect labor costs are debited to Overhead cost control.

Q2: Flow of Costs in Job Costing



When a job is completed, costs are removed from WIP inventory and transferred to FG inventory.

Q2: Flow of Costs in Job Costing



When a job is shipped to a customer, costs are removed from FG inventory and transferred to CGS;

The revenue and the receivable are also recorded.

Q2: Journal Entries in Job Costing

The materials storeroom receives a shipment of direct and indirect materials that cost $12,500. Prepare the journal entry.

Raw materials inventory	12,500	
Accounts payable		12,500

Materials are sent to the stamping and assembly areas. The cost of the direct materials is $1,400 and the cost of the indirect materials is $800. Prepare the journal entry.

Work in process inventory	1,400	
Overhead cost control	800	
Raw materials inventory		2,200

Q2: Journal Entries in Job Costing

Wages totaling $2,000 are accrued; 75% of these costs are direct labor and 25% are indirect labor. Prepare the journal entry.

Work in process inventory	1,500	
Overhead cost control	500	
Wages Payable		2,000

Overhead costs are allocated to work in process using an allocation rate of 200% of direct labor costs. Prepare the journal entry.

Work in process inventory	3,000	
Overhead cost control		3,000

Q2: Journal Entries in Job Costing

Job #1208, with a total cost of $2,200 is completed. Prepare the journal entry.

Finished goods inventory	2,200	
Work in process inventory		2,200

Job #1208 is shipped to the customer, who is billed for $4,000. Prepare the journal entry.

Accounts receivable	4,000	
Cost of goods sold	2,200	
Sales		4,000
Finished goods inventory		2,200

Q2: Disposition of Misallocated Overhead

- Under normal costing, actual overhead is different from allocated overhead.
- Misallocated overhead is the difference between actual and allocated overhead.
- At the end of the year, the Overhead cost control account is closed out to WIP, FG & CGS.
- Misallocated overhead (if material) is prorated to the 3 accounts based on a ratio of their account balances; if immaterial it is closed to CGS.

Q2: Disposition of Misallocated Overhead

Suppose budgeted overhead was $100,000 fixed overhead plus variable overhead of $10/DL hour. Expected DL hours were 50,00, so that the estimated overhead rate was $12/DL hour. Actual DL hours totaled 40,000 for the year and actual overhead was $550,000. At the end of the year, WIP, FG & CGS had the account balances shown below. Prepare the year-end entry to close the Overhead cost control account.

WIP	$ 100,000	5%
FG	200,000	10%
CGS	1,700,000	85%
	$2,000,000	

Work in process inventory	3,000	
Finished goods inventory	7,000	
Cost of goods sold	59,500	
Overhead cost control		70,000

Overhead cost control

$550,000	$480,000 ($12/DL hr x 40,000 DL hrs)
$70,000	

Q3: Uses & Limitations of Job Costing Information

- Job cost information is used for
  - Financial statement preparation
  - Income tax returns
  - Bidding for jobs
  - Comparing expected to actual costs (diagnostic control)
- Job cost information may not be useful for non-routine short term decision making as allocated fixed costs may not be relevant
- Accountant's judgment is used to determine:
  - Direct vs. allocated costs
  - Type and number of overhead pools
  - Type of cost driver

Q4: Job Costing and Spoilage - Terminology

- Spoilage – unacceptable units that are discarded or sold for disposal costs
  - Normal spoilage arises under efficient operating conditions & is treated as an inventoriable cost
  - Abormal spoilage is not part of normal operations & is treated as a period cost
- Reworked units - unacceptable units that are reprocessed and sold
- Scrap – left over direct materials that are discarded or sold for a minimal amount

Q4: Job Costing and Spoilage

In job costing, spoilage could be normal spoilage that coincidentally occurred on this job, but was not due to any demanding aspects of this job

- spoilage costs removed from Work in process inventory
- spoilage costs are debited to Overhead cost control
- in this case a job without spoilage has the same manufacturing cost per unit as a job where spoilage occurred

Q4: Job Costing and Spoilage

In job costing, spoilage could be abnormal spoilage that coincidentally occurred on this job, but was not due to any demanding aspects of this job

– spoilage costs removed from Work in process inventory

– spoilage costs are debited to Loss from abnormal spoilage

– in this case a job without spoilage has the same manufacturing cost per unit as a job where spoilage occurred

Q4: Job Costing and Spoilage

In job costing, spoilage could be spoilage that occurred on this job due to the job's demanding specifications

- spoilage costs are not removed from Work in process inventory

- in this case a job without spoilage has a lower manufacturing cost per unit than a job where this type of spoilage occurred

Q4: Job Costing and Spoilage Example

On January 1 Leia Corp. budgeted the following factory overhead:

Factory rent	$40,000
Utilities	10,000
Normal spoilage	6,000
	$56,000

Leia expected to use 28,000 DL hours this year; overhead is allocated to WIP using DL hours. Job #3 shows total costs of $12,200. An inspection reveals that 20% of Job #3 must be scrapped and sold for $100. Prepare the journal entry to record the spoilage and the sale of the scrap if the spoilage is considered normal and is not due to the demanding specifications of Job #3. If Job #3 was originally a batch of 10,000 units, what is the manufacturing cost per unit for the good units in Job #3?

Overhead cost control	2,340		
Cash	100		
Work in process inventory		2,440	(20% x $12,200)

Mfg cost/unit = ($12,200 - $2,440)/8,000 good units = $1.22/unit.

Q4: Job Costing and Spoilage Example

On January 1 Leia Corp. budgeted the following factory overhead:

Factory rent	$40,000
Utilities	10,000
Normal spoilage	6,000
	$56,000

Leia expected to use 28,000 DL hours this year; overhead is allocated to WIP using DL hours. Job #3 shows total costs of $12,200. An inspection reveals that 20% of Job #3 must be scrapped and sold for $100. Prepare the journal entry to record the spoilage and the sale of the scrap if the spoilage is considered abnormal. If Job #3 was originally a batch of 10,000 units, what is the manufacturing cost per unit for the good units in Job #3?

Loss from abnormal spoilage	2,340		
Cash	100		
Work in process inventory		2,440	(20% x $12,200)

Mfg cost/unit = ($12,200 - $2,440)/8,000 good units = $1.22/unit.

Q4: Job Costing and Spoilage Example

On January 1 Leia Corp. budgeted the following factory overhead:

Factory rent	$40,000
Utilities	10,000
Normal spoilage	6,000
	$56,000

Leia expected to use 28,000 DL hours this year; overhead is allocated to WIP using DL hours. Job #3 shows total costs of $12,200. An inspection reveals that 20% of Job #3 must be scrapped and sold for $100. Prepare the journal entry to record the spoilage and the sale of the scrap if the spoilage occurred to the demanding specifications of Job #3. If Job #3 was originally a batch of 10,000 units, what is the manufacturing cost per unit for the good units in Job #3?

	Debit	Credit
Cash	100	
Work in process inventory		100

Mfg cost/unit = ($12,200 - $100)/8,000 good units = $1.5125/unit.

Q5: Effect of Spoilage Accounting on Manager Behavior

- If spoilage costs are ignored, there is no incentive for managers to control these costs.

- If company has a zero defect policy, all spoilage is considered abnormal; the loss on the income statement may force managers to control spoilage.

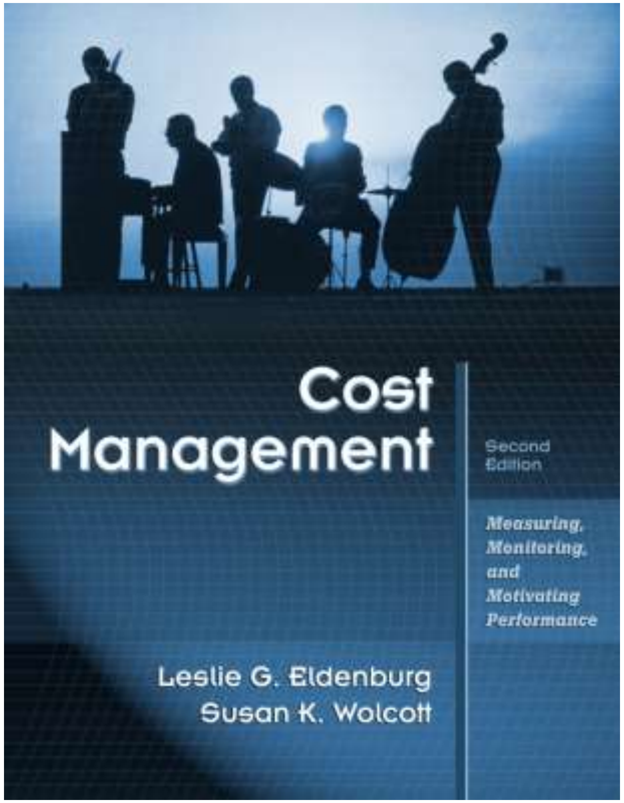
- If rework costs are not accounted for separately, managers may rework units that should be scrapped.

Cost Management

Measuring, Monitoring, and Motivating Performance

Chapter 6

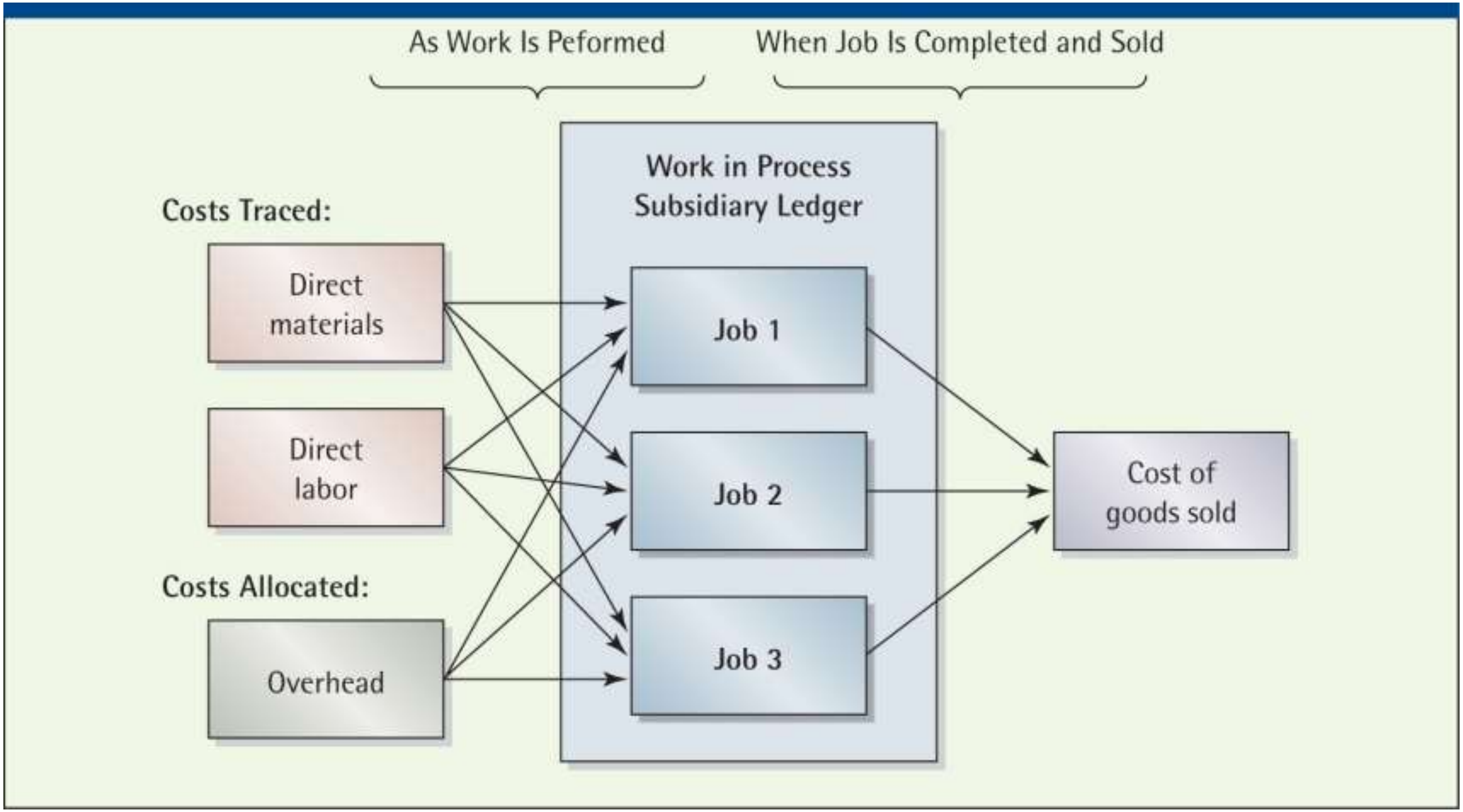
Process Costing



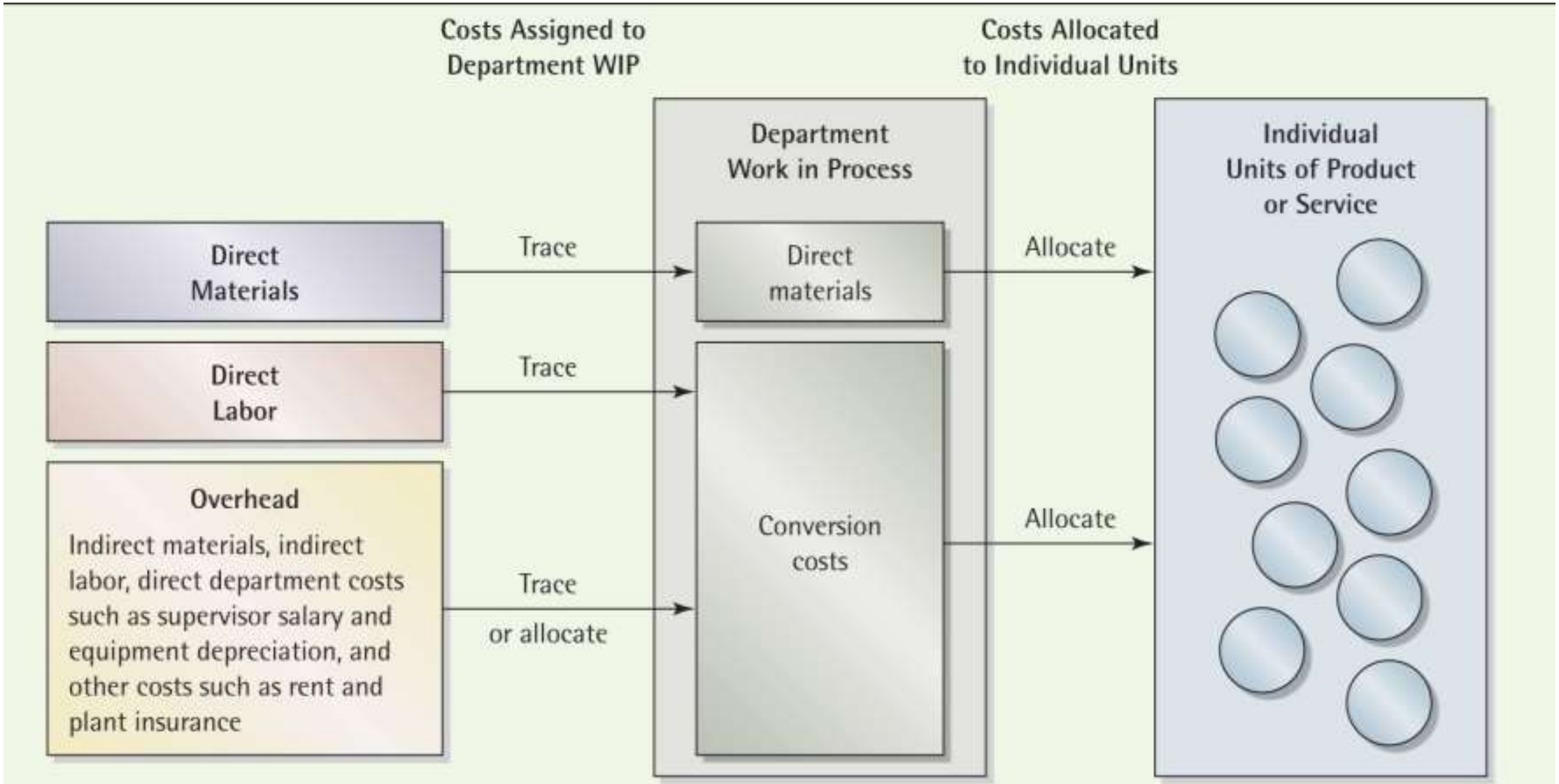
Learning objectives

- Q1: How are costs assigned to mass-produced products?
- Q2: What are equivalent units & how do they relate to the production process?
- Q3: How is the weighted average method used in process costing?
- Q4: How is the FIFO method used in process costing?
- Q5: What alternative methods are used for mass production?
- Q6: How is process costing performed for multiple production departments?
- Q7: How are spoilage costs handled in process costing?
- Q8: How does process costing information affect managers' incentives and decisions?

Q1: Job Order versus Process Costing

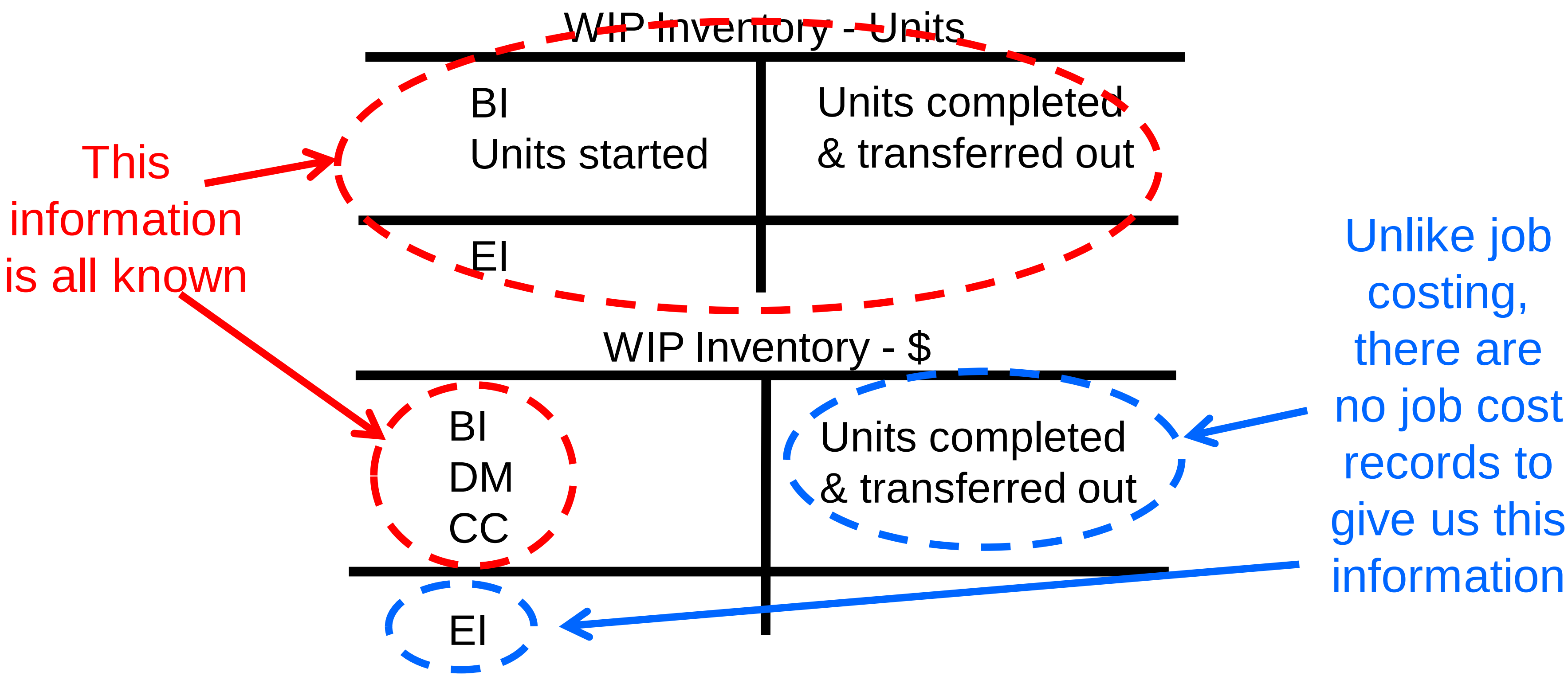


Q1: Job Order versus Process Costing



Q1: Introduction to Process Costing

Process costing is a method of averaging costs over the units of production. This is necessary to determine the cost of the units transferred out of a department, as well as the cost of the department's ending WIP inventory.



Q1: Process Costing with all Units Completed

Riker Co. had June costs for Department 1 as follows:

DM	$60,000
CC	30,000
	$90,000

There were no units in beginning or ending WIP inventory in June. During June Department 1 started 45,000 units, and all 45,000 were completed in June. What is the manufacturing cost/unit?

WIP Inventory - Units

0	
45,000	45,000
0	

WIP Inventory - $

0	
90,000	90,000
0	

The manufacturing cost/unit is $90,000/45,000 units = $2/unit.

Q2: The Concept of Equivalent Units

In order to value partially complete units of inventory, we measure units in equivalent whole units rather than actual units.

Suppose that 30,000 units were completed in June, and the units in ending WIP were 1/3 complete. What is the manufacturing cost/unit?

WIP Inventory - Units

0	
45,000	30,000
15,000	

WIP Inventory - $

0	
90,000	

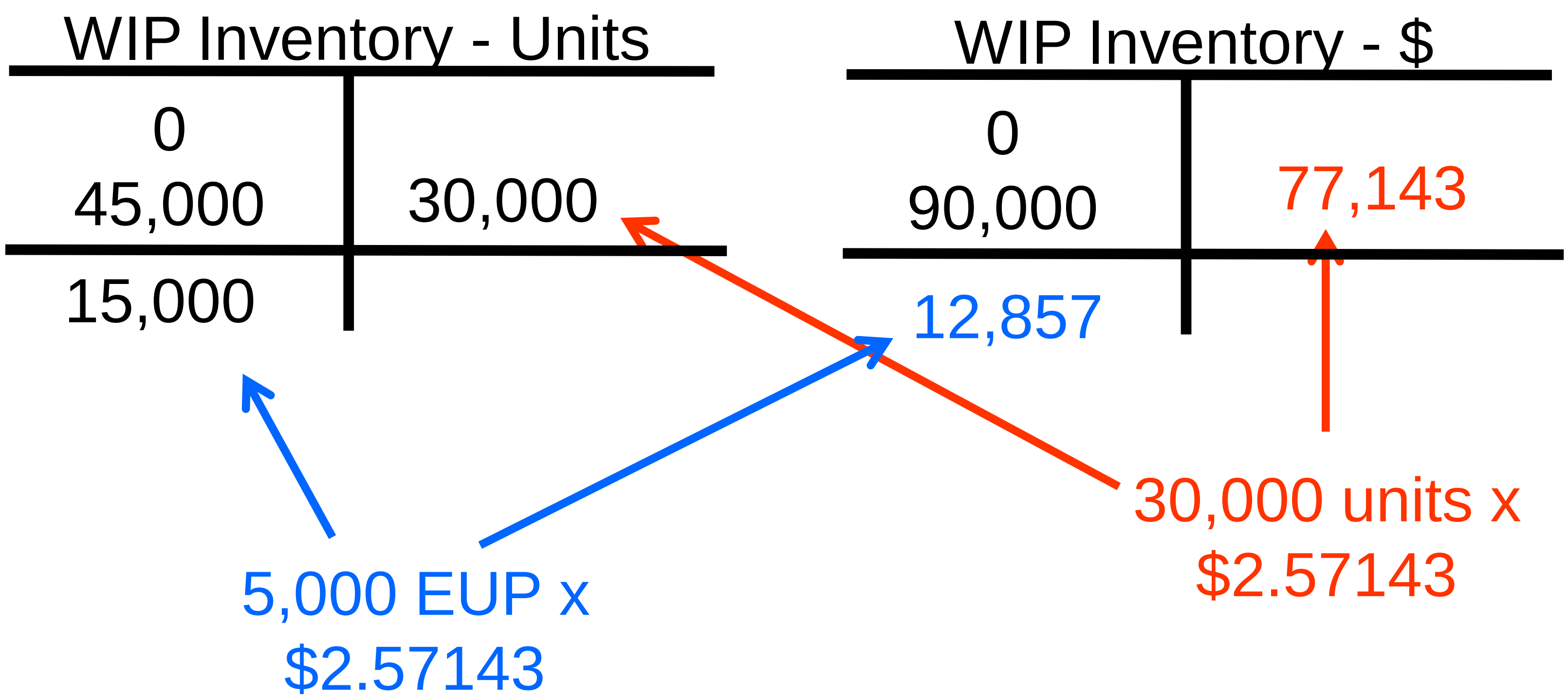
The 15,000 units taken to 1/3 completion are counted as 5,000 equivalent whole units, or 5,000 equivalent units of production (EUP).

The manufacturing cost/unit =

$90,000/[30,000 + 5,000]EUP = $2.57143/EUP.

Q2: The Concept of Equivalent Units

Using the cost/EUP of $2.57143 from the prior slide, compute the costs attached to the 30,000 completed units and the costs attached to the 15,000 units in ending WIP inventory.

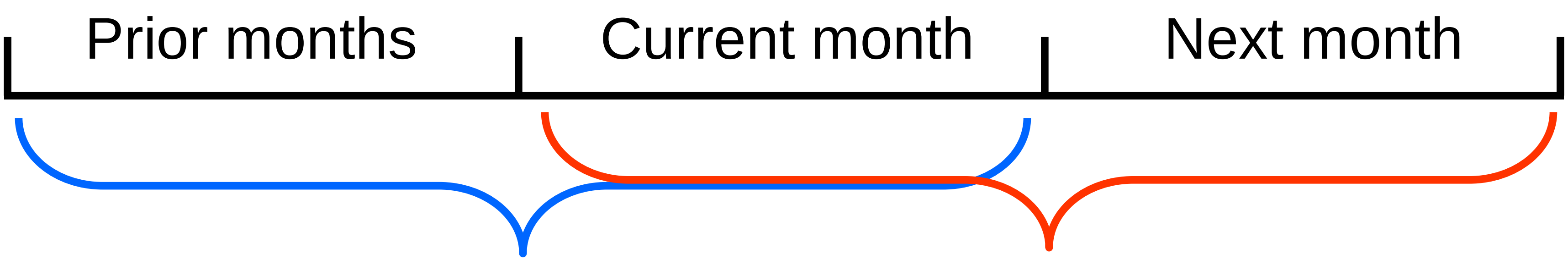


Q2-Q4: Equivalent Units & Process Costing Methods

- The prior slide simplified the computation of EUP.
  - 15,000 units taken to 1/3 completion is equivalent to 5,000 whole units only if costs are incurred evenly.
  - We will return to this later.
- The prior slide ignored the different methods of computing EUP.
  - The weighted average and FIFO methods compute EUP differently.

Q2-Q4: Three Categories of Units

In process costing we categorize units according to the time period(s) they were produced.

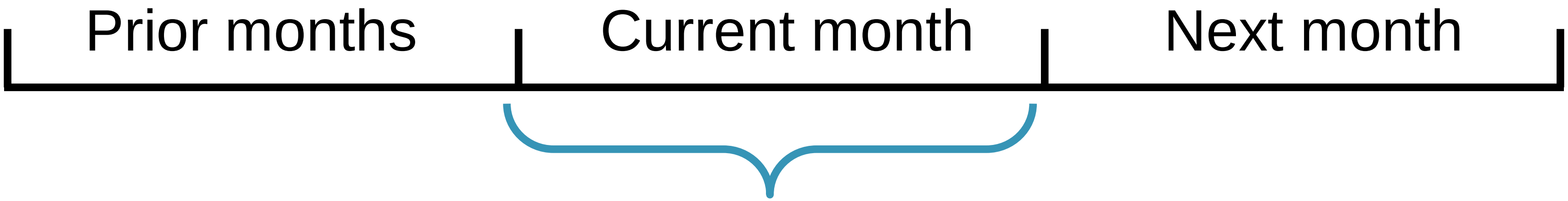


BI units: The units in beginning Work in process inventory were worked on in prior months and (we assume) they will be completed in the current month.

EI units: The units in ending Work in process inventory are started (we assume) in the current month and (we assume) they will be completed in the current month.

Q2-Q4: Three Categories of Units

In process costing we categorize units according to the time period(s) they were produced.



S&C units: Any units that are started in the current month and are totally complete by month end are called **started & completed** units.

Q2-Q4: Summarizing the Physical Flow of Production

The number of S&C units can be computed as the number of units transferred out less the number of BI units.

For example, suppose a department had 5,000 units in beginning WIP and started 50,000 units this month. If 35,000 units were completed, what is the number of S&C units?

WIP Inventory - Units

5,000	
50,000	35,000
20,000	

BI units	5,000
S&C units	30,000
Completed units	35,000

Q2-Q4: Two Process Costing Methods

The weighted average and FIFO methods of process costing methods compute EUP differently.

Prior months | Current month | Next month

The weighted average (WA) method gives credit for work performed in the current & prior months.

This means that under the WA method, the EUP for BI units and S&C units is the same as the physical number of units in each category.

Q2-Q4: Two Process Costing Methods

The weighted average and FIFO methods of process costing methods compute EUP differently.

Prior months | Current month | Next month

The weighted average (WA) method gives credit for work performed in the current & prior months.

The EUP for EI units and is based on the stage of completion of the EI units – only the portion of the work done in the current month is included.

Q2-Q4: Two Process Costing Methods

The weighted average and FIFO methods of process costing methods compute EUP differently.

Prior months | Current month | Next month

The FIFO method gives credit only for work performed in the current month.

This means that the EUP for BI units is based on the completion of these units during the current month.

Q2-Q4: Two Process Costing Methods

The weighted average and FIFO methods of process costing methods compute EUP differently.

Prior months | Current month | Next month

The FIFO method gives credit only for work performed in the current month.

The EUP for EI units and is based on the stage of completion of the EI units – only the portion of the work done in the current month is included.

Q2-Q4: Equivalent Units of Production Example

In July, Rita Corp. had 30,000 units in beginning WIP that were 60% complete and 20,000 units in ending WIP that were 80% complete. There were 100,000 units completed and transferred to FG inventory. Compute EUP for July using both the weighted average and FIFO methods.

First, summarize the physical flow of the units and compute S&C.

WIP Inventory - Units

Debit	Credit
30,000	
90,000	100,000
20,000	

BI units	30,000
S&C units	70,000
Completed units	100,000

Q2-Q4: Equivalent Units of Production Example

In July, Rita Corp. had 30,000 units in beginning WIP that were 60% complete and 20,000 units in ending WIP that were 80% complete. There were 100,000 units completed and transferred to FG inventory. Compute EUP for July using both the weighted average and FIFO methods.

Then, convert the physical units to EUP.

WIP Inventory - Units

30,000	
90,000	100,000
20,000	

BI units	30,000
S&C units	70,000
Completed units	100,000

Units Summary	Physical Units	Equivalent Units (WA)		Equivalent Units (FIFO)	
Beginning WIP	30,000	18,000	60%		
This Period's Work					
Complete Beg WIP	30,000	12,000	40%	12,000	40%
Start & Complete	70,000	70,000	100%	70,000	100%
Ending WIP	20,000	16,000	80%	16,000	80%
Total Work	120,000	116,000		98,000	

Q2-Q4: Equivalent Units of Production Example

In July, Rita Corp. had 30,000 units in beginning WIP that were 60% complete and 20,000 units in ending WIP that were 80% complete. There were 100,000 units completed and transferred to FG inventory. Compute EUP for July using both the weighted average and FIFO methods.

Then, convert the physical units to EUP.

WIP Inventory - Units

30,000	
90,000	100,000
20,000	

BI units	30,000
S&C units	70,000
Completed units	100,000

(1-60%)

Units Summary	Physical Units	Equivalent Units (WA)		Equivalent Units (FIFO)	
Beginning WIP	30,000	18,000	60%		
This Period's Work					
Complete Beg WIP	30,000	12,000	40%	12,000	40%
Start & Complete	70,000	70,000	100%	70,000	100%
Ending WIP	20,000	16,000	80%	16,000	80%
Total Work	120,000	116,000		98,000	

Q2-Q4: Equivalent Units & Process Costing Methods

- The prior slides simplified the computation of EUP
  - 20,000 units started and taken to 80% completion is equivalent to 16,000 whole units only if costs are incurred evenly.
  - We usually assume that conversion costs are incurred evenly throughout production, but direct materials costs may not be incurred evenly.
  - Direct materials costs may be incurred at the beginning of processing or in some other uneven manner.
  - Because costs are incurred at different times, separate EUP computations are done for DM & CC.

Q2-Q4: Separate EUP for DM & CC

You are given the information below about the physical flow of the units in Department 1. The BI units were 25% complete and the EI units were 40% complete. Compute EUP for DM and CC if DM costs are incurred at the beginning of production.

WIP Inventory - Units

5,000	
20,000	17,000
8,000	

BI units	5,000
S&C units	12,000
Completed units	17,000

(1-25%)

Units Summary	Physical Units	Equivalent Units (DM)		Equivalent Units (CC)	
Beginning WIP	5,000	5,000	100%	1,250	25%
This Period's Work					
Complete Beg WIP	5,000	-	0%	3,750	75%
Start & Complete	12,000	12,000	100%	12,000	100%
Ending WIP	8,000	8,000	100%	3,200	40%
FIFO Equivalent Units		20,000		18,950	
WA Equivalent Units (with Beg WIP)		25,000		20,200	

Q2-Q4: Separate EUP for DM & CC

Use the same information from the prior slide; recall that the BI units were 25% complete and the EI units were 40% complete. Compute EUP for DM and CC if 20% of DM costs are incurred at the beginning of processing and the rest of the DM costs are incurred when the units pass the 60% stage of completion.

No Change

(1-20%)

Units Summary	Physical Units	Equivalent Units (DM)		Equivalent Units (CC)	
Beginning WIP	5,000	1,000	20%	1,250	25%
This Period's Work					
Complete Beg WIP	5,000	4,000	80%	3,750	75%
Start & Complete	12,000	12,000	100%	12,000	100%
Ending WIP	8,000	1,600	20%	3,200	40%
FIFO Equivalent Units		17,600		18,950	
WA Equivalent Units (with Beg WIP)		18,600		20,200	

Q2-Q4: Cost per Equivalent Unit

- The EUP calculations provide the denominator in the cost per EUP computation.
- A cost per EUP is computed for each cost category.
- The WA and FIFO methods use different numerators in the cost per EUP computation.
  - The numerator for the WA cost per EUP includes total costs (current costs plus the BI costs).
  - The numerator for the FIFO cost per EUP includes only current costs.

Q3&4: Process Costing Example, no BI

You are given the information below about May's production and costs for Slocik Co. The units in ending WIP were 1/3 complete. Direct materials are added at the beginning of processing. What is the manufacturing cost per EUP under both methods?

WIP Inventory - Units

0	
	30,000
45,000	
15,000	

WIP Inventory - $

0	
DM 65,250	
CC 28,000	

First, compute the EUP for DM & CC.

Q3&4: Process Costing Example, no BI

WIP Inventory - Units

0	
	30,000
45,000	
15,000	

WIP Inventory - $

0	
DM 65,250	
CC 28,000	

When there is no BI, WA and FIFO have the same EUP, and hence the same costs/EUP.

Units Summary	**Physical Units**	**Equivalent Units (DM)**		**Equivalent Units (CC)**	
Beginning WIP	-	-		-	
This Period's Work					
Complete Beg WIP	-	-		-	
Start & Complete	30,000	30,000	100%	30,000	100%
Ending WIP	15,000	15,000	100%	5,000	33%
FIFO Equivalent Units		45,000		35,000	
WA Equivalent Units (with Beg WIP)		45,000		35,000	

Q3&4: Process Costing Example, no BI

WIP Inventory - Units

0	
	30,000
45,000	
15,000	

WIP Inventory - $

0	
DM 65,250	
CC 28,000	

Now, compute the costs/EUP for DM & CC.

DM cost/EUP = $65,250/45,000 EUP = $1.45/EUP

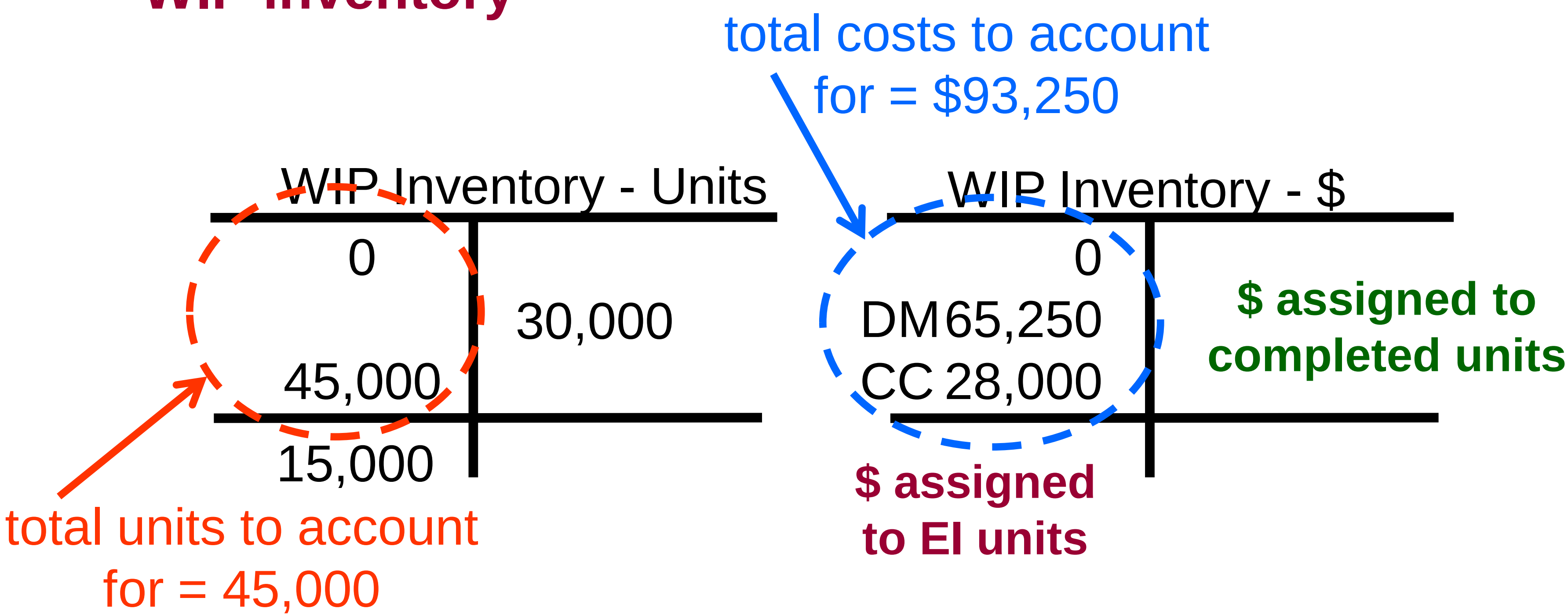
CC/EUP = $28,000/35,000 EUP = 0.80/EUP

Total manufacturing cost/EUP $2.25/EUP

Q3&4: Process Costing Example, no BI

The last step is a process cost report that breaks the “total costs to account for” into:

- **the portion that is assigned to the completed units, and**
- **the portion that is assigned to the units in ending WIP inventory**



Q3&4: Process Costing Example, no BI

The journal entry to record the costs transferred out is:

FG inventory	67,500	
WIP inventory		67,500

BI			
Cost to complete BI			
DM			
CC			
Total costs added			
Total cost of BI		0	0
S&C	30,000 x $2.25	30,000	67,500
Total costs tr'd out		30,000	67,500
EI:		15,000	
DM	15,000 x $1.45		21,750
CC	5,000 x $0.80		4,000
Total EI costs			25,750
Total acctd for		45,000	93,250

Q3&4: Process Costing Example, with BI

Colors R Us, Inc. uses a process costing system for its sole processing department. There were 6,200 units in beginning WIP inventory for February and 57,500 units were started in February. The beginning WIP units were 60% complete and the 5,000 units in ending WIP were 45% complete. All materials are added at the start of processing. Compute the EUP for DM and CC using both methods.

First, compute the # of units started & completed:

WIP Inventory - Units

6,200	
57,500	58,700
5,000	

BI units	6,200
S&C units	52,500
Completed units	58,700

Q3&4: Process Costing Example, with BI

WIP Inventory - Units

6,200	
57,500	58,700
5,000	

BI units	6,200
S&C units	52,500
Completed units	58,700

Now, compute the EUP for DM & CC (recall that BI & EI were 60% & 45% complete, respectively, and all DM are added at the start of processing).

Units Summary	Physical Units	Equivalent Units (DM)		Equivalent Units (CC)	
Beginning WIP	6,200	6,200	100%	3,720	60%
This Period's Work					
Complete Beg WIP	6,200	-	0%	2,480	40%
Start & Complete	52,500	52,500	100%	52,500	100%
Ending WIP	5,000	5,000	100%	2,250	45%
FIFO Equivalent Units	63,700	57,500		57,230	
WA Equivalent Units (with Beg WIP)		63,700		60,950	

Q3&4: Process Costing Example, with BI

Beginning WIP inventory was valued at $42,896 [DM costs of $12,850 plus CC of $30,046]. During February Colors incurred DM costs of $178,250, and CC of $274,704. Compute the cost of the goods transferred out the the costs assigned to ending WIP inventory for February, using both methods.

WIP Inventory - $

BI	42,896	
DM	178,250	
CC	274,704	

The EUP from the prior slide:

Equiv units	WA EUP	FIFO EUP
DM	63,700	57,500
CC	60,950	57,230

Under FIFO, the numerator includes only current costs:

DM cost/EUP = $178,250/57,500 EUP =	$3.10/EUP
CC/EUP = $274,704/57,230 EUP =	4.80/EUP
Total manufacturing cost/EUP	$7.90/EUP

Q3&4: Process Costing Example, with BI

Beginning WIP inventory was valued at $42,896 [DM costs of $12,850 plus CC of $30,046]. During February Colors incurred DM costs of $178,250, and CC of $274,704. Compute the cost of the goods transferred out the the costs assigned to ending WIP inventory for February, using both methods.

WIP Inventory - $

BI	42,896	
DM	178,250	
CC	274,704	

The EUP from the prior slide:

Equiv units	WA EUP	FIFO EUP
DM	63,700	57,500
CC	60,950	57,230

Under WA, the numerator includes BI and current costs:

DM cost/EUP = $191,100/63,700 EUP = $3.00/EUP

CC/EUP = $307,750/60,950 EUP = 5.00/EUP

Total manufacturing cost/EUP $8.00/EUP

Q3&4: Process Costing Example, with BI

The last step is a process cost report that breaks the “total costs to account for” into:

- **the portion that is assigned to the completed units, and**
- **the portion that is assigned to the units in ending WIP inventory**

total costs to account for = $495,850

WIP Inventory - Units

6,200	58,700
57,500	
5,000	

WIP Inventory - $

42,896	
DM 178,250	
CC 274,704	

$ assigned to completed units

$ assigned to EI units

total units to account for = 63,700

Q3&4: WA Process Costing Example, with BI

Under the WA method, there is no distinction between the 6,200 BI units and the 52,500 S&C units.

Cost Assignment		Units		Cost
	Units Completed	58,700		$ 469,600
	Ending WIP	5,000		
	Direct Materials			15,000
	Conversion Costs			11,250
	Total Ending WIP Cost	-		26,250
Total Units and Cost Accounted For		**63,700**		**$ 495,850**

Q3&4: FIFO Process Costing Example, with BI

Under the FIFO method, the cost assigned to the 6,200 BI units is computed separately from the cost of the 52,500 S&C units.

Cost Assignment	Units	Cost	
Beginning WIP	6,200	$ 42,896	
Direct Materials		-	
Conversion Costs		11,904	= 2,480 * $4.80
Units Completed		54,800	
Units Started & Completed	52,500	414,750	= 52,500 * $7.90
Total Transferred Out	58,700	469,550	
Ending WIP	5,000		
Direct Materials		15,500	= 5,000 * $3.10
Conversion Costs		10,800	= 2,250 * $4.80
Total Ending WIP Cost	-	26,300	
Total Units and Cost Accounted	**63,700**	**$ 495,850**	

Q6: Accounting for Transferred-in Costs

- "Transferred-in costs" (TI) is merely another cost category like DM or CC
- All processing departments except the first will account for TI costs
- When preparing a process cost report for a department with TI costs:
  - Compute EUP for TI costs; all TI costs are incurred at the start of processing
  - Compute cost/EUP for TI costs
  - Assign TI costs to EI units

Q6: Process Costing Example, with TI Costs

Crusher Drugs manufactures a pain medication in a two-process cycle. In Department 2, direct materials are added as follows: 20% are added at the beginning of processing, and the rest at the 60% stage. There were 5,000 units in Dep't 2's beginning WIP inventory that were 40% complete, and 20,000 units were transferred in to Dep't 2 in May. The Dep't 2 ending WIP inventory of 6,000 units was 55% complete. Compute the May EUP for all cost categories for Department 2 using both methods.

First, compute the # of units started & completed:

Dep't 2 WIP Inventory - Units

5,000	
20,000	19,000
6,000	

BI units	5,000
S&C units	14,000
Completed units	19,000

Q6: Process Costing Example, with TI Costs

Dep't 2WIP Inventory - Units

5,000	
20,000	19,000
6,000	

BI units	5,000
S&C units	14,000
Completed units	19,000

Now, compute the EUP for DM & CC (recall that BI & EI were 40% & 55% complete, respectively; 20% of DM costs are incurred at the start of processing, and the rest are incurred at the 60% stage).

Units Summary	**Physical Units**	**Equivalent Units (DM)**		**Equivalent Units (CC)**		**Equivalent Units (TI)**	
Beginning WIP	5,000	1,000	20%	2,000	40%	5,000	100%
This Period's Work							
Complete Beg WIP	5,000	4,000	80%	3,000	60%	-	0%
Start & Complete	14,000	14,000	100%	14,000	100%	14,000	100%
Ending WIP	6,000	1,200	20%	3,300	55%	6,000	100%
FIFO Equivalent Units	25,000	19,200		20,300		20,000	
WA Equivalent Units (with Beg WIP)		20,200		22,300		25,000	

Q6: Process Costing Example, with TI Costs

You are given the cost information below. Compute the cost per EUP under both methods.

	DM	CC	TI	Total
Work in process, May 1	$7,297.50	$3,860.50	$19,250.00	$30,408.00
Costs added in May	72,240.00	31,262.00	112,000.00	215,502.00
Total	$79,537.50	$35,122.50	$131,250.00	$245,910.00

Under WA, the numerator includes BI and current costs:

DM cost/EUP = $79,537.50/20,200 EUP =	$3.9375/EUP
CC/EUP = $35,122.50/22,300 EUP =	1.5750/EUP
TI cost/EUP = $131,250/25,000 EUP =	5.2500/EUP
Total manufacturing cost/EUP	$10.7625/EUP

Q6: Process Costing Example, with TI Costs

You are given the cost information below. Compute the cost per EUP under both methods.

	DM	CC	TI	Total
Work in process, May 1	$7,297.50	$3,860.50	$19,250.00	$30,408.00
Costs added in May	72,240.00	31,262.00	112,000.00	215,502.00
Total	$79,537.50	$35,122.50	$131,250.00	$245,910.00

Under FIFO, the numerator includes only current costs:

DM cost/EUP = $72,240/19,200 EUP =	$3.7625/EUP
CC/EUP = $31,262/20,300 EUP =	1.5400/EUP
TI cost/EUP = $112,000/20,000 EUP =	5.6000/EUP
Total manufacturing cost/EUP	$10.9025/EUP

Next, complete the process cost report using both methods….

Q6: Process Costing Example, with TI Costs

Equivalent Unit Cost		FIFO	WA	
Direct Materials	4,000 *	$ 3.7625	$ 3.9375	
Conversion Costs	3,000 *	1.5400	1.5750	
Transfer In Costs		5.6000	5.2500	Given $
Total Cost per Equivalent Unit	14,000 *	$ 10.9025	$ 10.7625	* 19,000

Cost Assignment	Units	FIFO Cost	Units	WA Cost
Beginning WIP	5,000	$ 30,408		
Cost to Complete BI				
Direct Materials		15,050		
Conversion Costs		4,620		
Total Cost BI		50,078		
Units Started & Completed	14,000	152,635		
Total Transferred Out	19,000	$ 202,713	19,000	$204,488
Ending WIP	6,000		6,000	
Direct Materials		1,200 * $3.7625 = 4,515	1,200 * $3.9375 =	4,725
Conversion Costs		3,300 * $1.5400 = 5,082	3,300 * $1.5750 =	5,198
Transfer In Costs		6,000 * $5.6000 = 33,600	6,000 * $5.2500 =	31,500
Total Ending WIP Cost	-	$ 43,197		$ 41,423
Total Units and Cost Accounted	**25,000**	**$ 245,910**	**25,000**	**$245,910**

Q5: What Alternative Methods are Used for Mass Production?

- Adaptations to Traditional Process Costing
  - Match equivalent units calculations more closely to actual production processes
  - Separate conversion costs into multiple pools
- Standard costs simplify the accounting
- Just-in-time production
- Hybrid costing, or operation costing

Q7: Accounting for Spoilage in Process Costing

- Costs of normal spoilage are absorbed by the good units transferred out.
- Costs of abnormal spoilage are charged to a Loss from abnormal spoilage account.
- Costs attach to spoilage depending on when spoilage is detected.

Q7: Process Costing & Spoilage Example

Hollidaze makes molded plastic party decorations. In June, there were 800 units in beginning WIP inventory that were 40% complete and the 500 units in ending WIP were 30% complete. The company completed 3,000 units in June, but 200 of these were defective and were discarded. The defective units are located upon inspection before transfer to finished goods. It was determined that 50 of these defective units should be considered normal spoilage. The remaining spoilage occurred because of a rare machine malfunction and should be considered abnormal spoilage. All direct materials are added at the beginning of processing.
Compute the June EUP for DM and CC using both methods.

First, compute the # of units started & completed:

WIP Inventory - Units

800	
2,700	3,000
500	

BI units	800
S&C units	2,200
Completed units	3,000

this includes 200 defective units

Q7: Process Costing & Spoilage Example

WIP Inventory - Units

Debit	Credit
800	
2,700	3,000
500	

BI units	800
S&C units	2,200
Completed units	3,000

Now, compute the EUP for DM & CC (recall that BI & EI were 40% & 30% complete, respectively; DM costs are incurred at the start of processing).

Units Summary	Physical Units	Equivalent Units (DM)		Equivalent Units (CC)	
Beginning WIP	800	800	100%	320	40%
This Period's Work					
Complete Beg WIP	800	-	0%	480	60%
Good Units Start & Complete	2,000	2,000	100%	2,000	100%
Ending WIP	500	500	100%	150	30%
Spoiled Units:					
Normal Spoilage	50	50	100%	50	100%
Abnormal Spoilage	150	150	100%	150	100%
FIFO Equivalent Units	**3,500**	**2,700**		**2,830**	
Less Spoilage:	(200)				
Total Good Units	3,300				
WA Equivalent Units (with Beg WIP)		**3,500**		**3,150**	

Q7: Process Costing & Spoilage Example

You are given the cost information below. Compute the cost per EUP under both methods.

	DM	CC	Total
Work in process, June	$2,735	$1,302	$4,037
Costs added in June	$8,640	$5,943	$14,583
Total	$11,375	$7,245	$18,620

Under WA, the numerator includes BI and current costs:

DM cost/EUP = $11,375/3,500 EUP =	$3.25/EUP
CC/EUP = $7,245/3,150 EUP =	2.30/EUP
Total manufacturing cost/EUP	$5.55/EUP

Q7: Process Costing & Spoilage Example

You are given the cost information below. Compute the cost per EUP under both methods.

	DM	CC	Total
Work in process, June	$2,735	$1,302	$4,037
Costs added in June	$8,640	$5,943	$14,583
Total	$11,375	$7,245	$18,620

Under FIFO, the numerator includes only current costs:

DM cost/EUP = $8,640/2,700 EUP =	$3.20/EUP
CC/EUP = $5,943/2,830 EUP =	2.10/EUP
Total manufacturing cost/EUP	$5.30/EUP

Next, complete the process cost report using both methods….

Q7: WA Process Costing & Spoilage Example

The WA journal entry to record the costs transferred out is:

FG inventory	15,81.50	
Loss from abnormal spoilage	832.50	
WIP inventory		16,650.00

Note the total good units accounted for is the total units to account for less the spoiled units.

Cost		
Be		
Co		
D		
Conversion Costs		
Total Cost BI		
Normal Sp		278
Good Units	2,800	$ 15,540
Total Tr	2,800	$ 15,818
Abnormal S		833
Ending WI	500	
Direct Ma		1,625
Conversion Costs		345
Total Ending WIP Cost		$ 1,970
Total Units and Cost Accounted For	**3,300**	**$ 18,620**

Q7: FIFO Process Costing & Spoilage Example

The FIFO journal entry to record the costs transferred out is:

FG inventory	15,910	
Loss from abnormal spoilage	795	
WIP inventory		16,705

Cost Assignmen			
Beginning WIP			
Cost to Compl			
Direct Mater			
Conversion			
Total Cost BI			
Normal Spoilage			265
Good Units Started & Completed	2,000		10,600
Total Transferred Out	2,800	$	15,910
Abnormal Spoilage			795
Ending WIP	500		
Direct Materials			1,600
Conversion Costs			315
Total Ending WIP Cost		$	1,915
Total Units and Cost Accounted For	**3,300**	**$**	**18,620**

Q8: Process Costing Uses for Decision Making

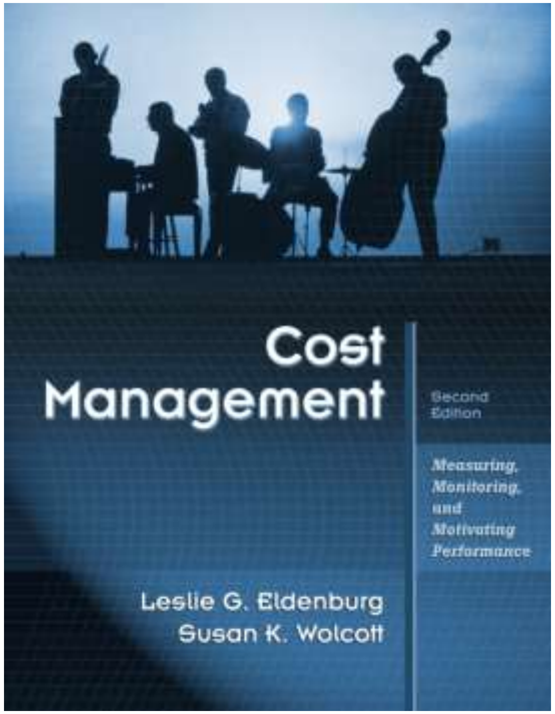
- Used to determine valuation for inventory and cost of goods sold at the end of each period
  - Required for financial statements and income tax returns
- Helps managers evaluate if the production processes are operating as expected
  - Compare actual results to budget, standards, or prior periods
- Identify areas for process improvements
- Analyze benefits of quality improvements

Q8: Process Costing Limitations & Impacts on Managers' Decision Making

- Process cost information is generally not useful for many short-term decisions because unavoidable fixed costs are allocated to the products.
  - Need to determine incremental or marginal costs
  - Separating conversion costs into fixed and variable pools would help
- Requires use of estimates:
  - The point of the production process when DM costs or CC are incurred.
  - Stage of completion for all units in beginning and ending WIP inventories

Chapter 7

Activity-Based Costing and Management



Learning objectives

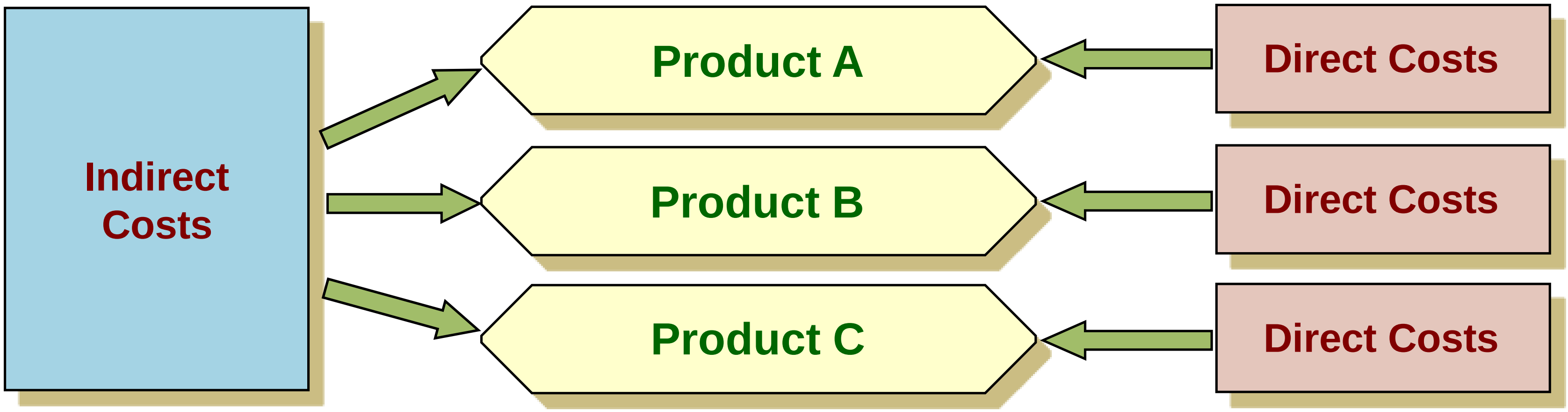
- Q1: What is activity-based costing (ABC)?
- Q2: What are activities and how are they identified?
- Q3: What process is used to assign costs in an ABC system?
- Q4: What is activity-based management?
- Q5: What are GPK and RCA?
- Q6: How does information from ABC, GPK, and RCA affect managers' incentives and decisions?

Q1: Activity-Based Costing (ABC)

- ABC is a method of cost system refinement.
- Indirect costs are divided into "sub-pools" of costs of activities.
- Activity costs are then allocated to the final cost objects using a cost allocation base (more commonly called cost drivers in ABC).
- Activities are measurable, making it more likely that cost drivers can be found so that a final cost object will absorb indirect costs in proportion to its use of the activity.

Q1: Traditional Costing vs. ABC

Traditional costing systems:

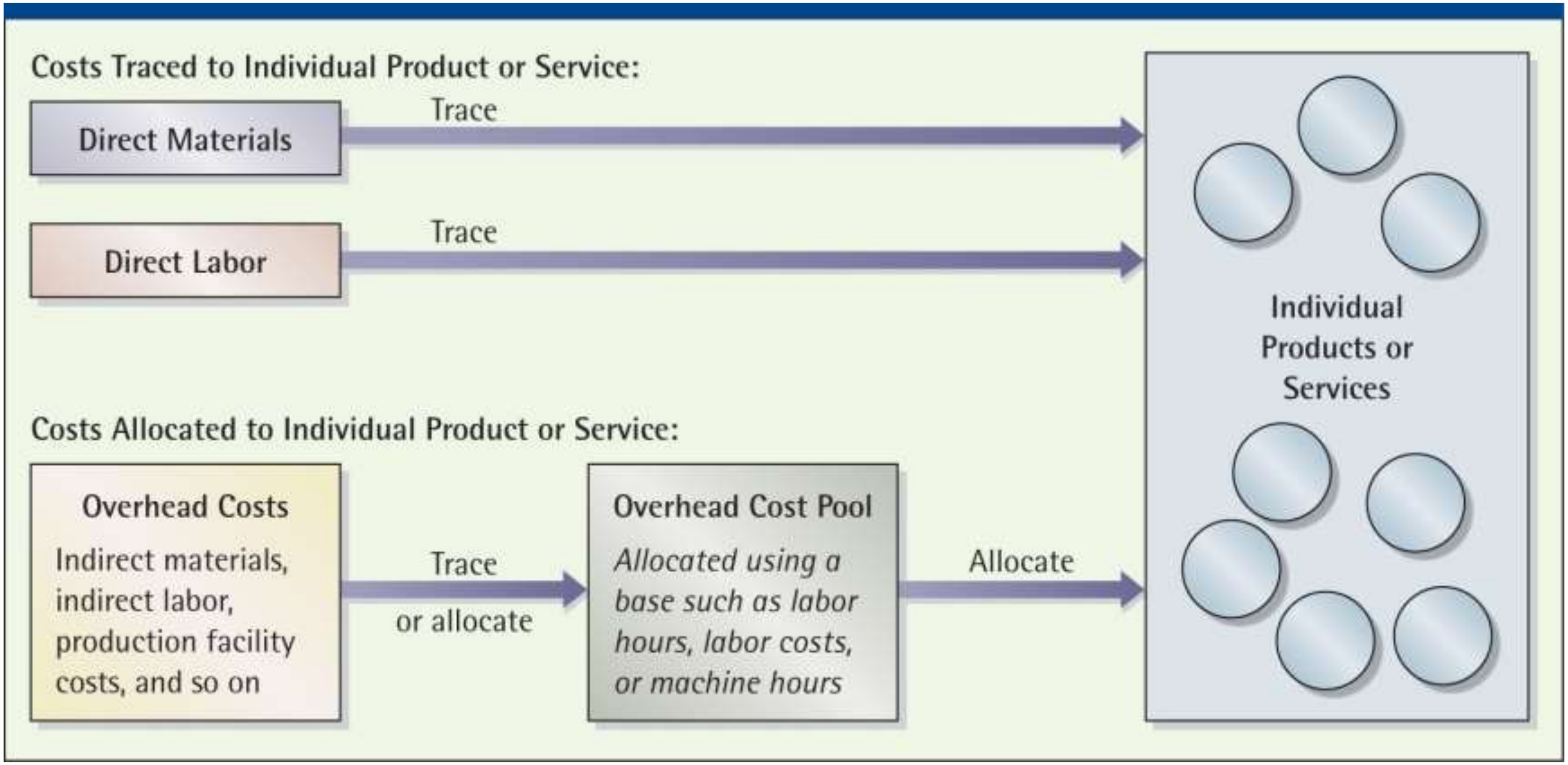


Indirect costs are grouped into one (or a small number) of cost pools; a cost allocation base assigns costs to the individual products

The individual products are the final cost objects.

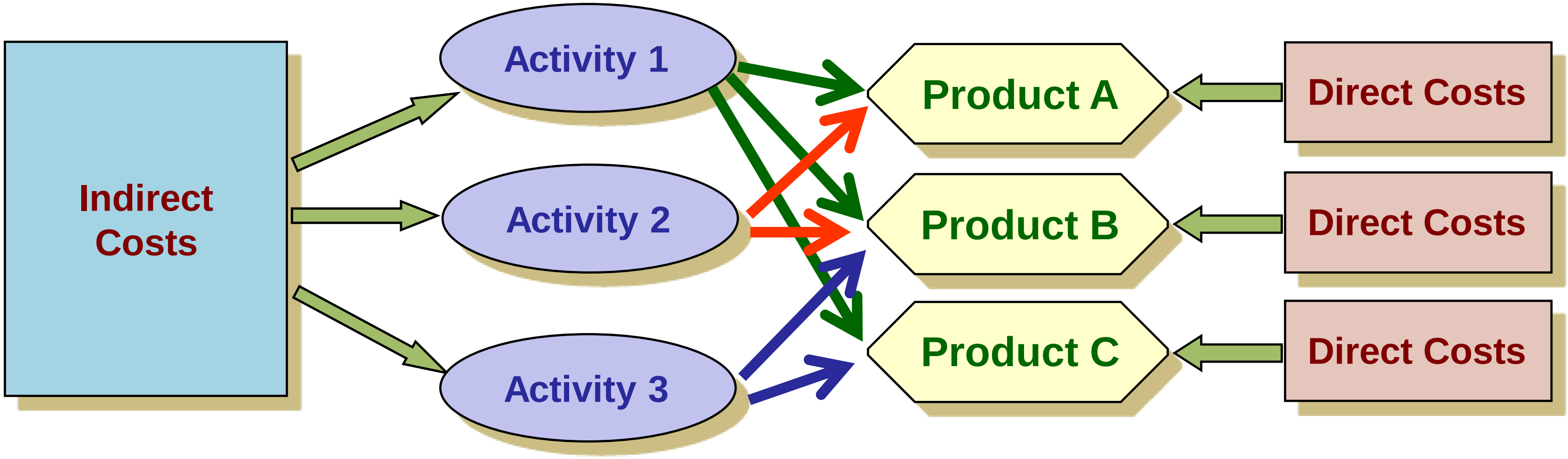
Direct costs are traced to the individual products.

Q1: Traditional Costing Systems



Q1: Traditional Costing vs. ABC

Activity-based costing systems:

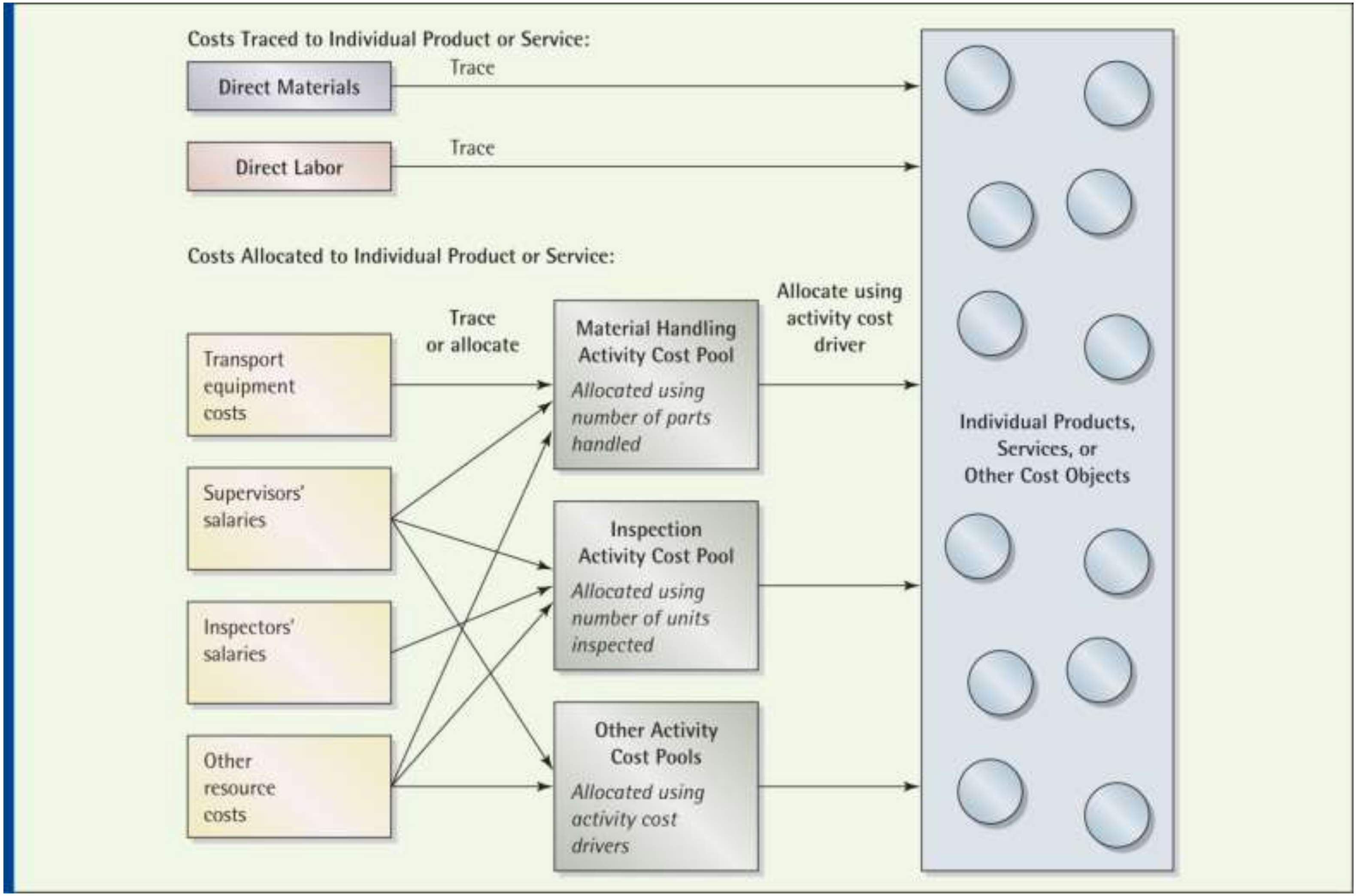


Indirect costs are assigned (traced & allocated) to various pools of activity costs.

Activity costs are allocated to products

The individual products are the final cost objects & direct costs are traced to the individual products.

Q1: ABC Costing Systems



Q2: What are Activities and How are They Identified?

The ABC cost hierarchy includes the following activities:

- organization-sustaining – associated with overall organization
- facility-sustaining – associated with single manufacturing plant or service facility
- customer-sustaining – associated with a single customer
- product-sustaining – associated with product lien or single product
- batch-level – associated with each batch of product
- unit-level – associated with each unit produced

Q2: ABC Cost Hierarchy Example

Some of the costs incurred by the Dewey Chargem law firm are listed below. This firm specializes in immigration issues and family law. For each cost, identify whether the cost most likely relates to a(n) (1) organiz-ation-sustaining, (2) facility-sustaining, (3) customer-sustaining, (4) product-sustaining, (5) batch-level, or (6) unit-level activity and explain your choice.

Cost	Cost Hierarchy Level
Bookkeeping software	
Salary for partner in charge of family law	
Office supplies	
Subscription to family law update journal	
Telephone charges for local calls	
Long distance telephone charges	
Window washing service	
Salary of receptionist	

Q3: What Process is Used to Assign Costs in an ABC system?

1. Identify the relevant cost object.
2. Identify activities and group *homogeneous activities*.
3. Assign costs to the activity cost pools.
4. Choose a cost driver for each activity cost pool.
5. Calculate an allocation rate for each activity cost pool.
6. Allocate activity costs to the final cost object.

Q3: How Are Cost Drivers Selected for Activities?

- For each activity, determine its place in the ABC cost hierarchy.
- Look for drivers that have a good cause-and-effect relationship with the activities' costs.
- Use a reasonable driver when there is no cause-and-effect relationship.

Q3: ABC in Manufacturing Example

Alphabet Co. makes products A & B. Product A is a low-volume specialty item and B is a high-volume item. Estimated factory- wide overhead is $800,000, and the number of DL hours for the year is estimated to be 50,000 hours. DL costs are $10/hour. Each product uses 2 DL hours. Compute the traditional cost of each product if Products A & B use $25 and $10 in direct materials, respectively.

First, compute the estimated overhead rate:

Estimated overhead rate = $800,000/50,000 hours = $16/hour.

	Product A	Product B
Direct materials	$25	$10
Direct labor (2hrs @ $10)	20	20
Overhead (2 hrs @ $16)	32	32
	$77	$62

Q3: ABC in Manufacturing Example

Alphabet Co. is implementing an ABC system. It estimated the costs and activity levels for the upcoming year shown below.

	Estimated Costs	Estimated Activity Levels Prod. A	Prod. B	Total	Cost Driver
Machine set-ups	$200,000	3,000	2,000	5,000	# set-ups
Inspections	140,000	500	300	800	# inspections
Materials handling	80,000	400	400	800	# mat'l requistions
Machining dep't	320,000	12,000	28,000	40,000	# machine hours
Quality control dep't	60,000	600	150	750	# tests
	$800,000				

First, compute the estimated overhead rate for each activity:

Q3: ABC in Manufacturing Example

	Estimated Costs	Estimated Activity		Overhead Rate	
Machine set-ups	$200,000	5,000	set-ups	$40	/setup
Inspections	140,000	800	inspections	$175	/inspection
Materials handling	80,000	800	mat'l requistions	$100	/requisition
Machining dep't	320,000	40,000	machine hours	$8	/mach hr
Quality control dep't	60,000	750	tests	$80	/test
	$800,000				

Q3: ABC in Manufacturing Example

Alphabet recently completed a batch of 100 As and a batch of 100 Bs. Direct material and labor costs were as budgeted. Information about each batch's use of the cost drivers is given below. Compute the overhead allocated to each unit of A and B.

	100 As	100 Bs
Machine set-ups	60	10
Inspections	10	2
Materials handling	4	2
Machining dep't	240	120
Quality control dep't	3	1

Overhead allocated:	100 As	100 Bs
Machine set-ups	$2,400	$400
Inspections	1,750	350
Materials handling	400	200
Machining dep't	1,920	960
Quality control dep't	240	80
Overhead for batch	$6,710	$1,990
Overhead per unit	$67.10	$19.90

Q3: ABC in Manufacturing Example

Compute the total cost of each product and compare it to the costs computed under traditional costing.

	Prod A	Prod B
Direct material	$25.00	$10.00
Direct labor	20.00	20.00
Overhead	67.10	19.90
Total	$112.10	$49.90

Traditional costing assigned $77 to a unit of Product A and $62 to a unit of Product B.

- The only difference between the two costing systems is that Product A is assigned more overhead costs under ABC.
- The additional overhead assigned to Product A reflects Product A's consumption of resources.

Q4: Activity-Based Management (ABM)

- ABM is the process of using ABC information to evaluate opportunities for improvements in an organization.
- Examples include managing & monitoring
  - customer profitability
  - product and process design
  - environmental costs
  - quality
  - constrained resources

Q4: ABM & Customer Profitability

- Activities can be defined so that different costs of servicing customers are accumulated.

- Examples include
  - analyzing the types of bank transactions used by various categories of customers
  - comparing the costs of servicing insurance contracts sold to married versus single individuals
  - comparing the costs of different distribution channels

Q4: ABM & Product/Process Improvements

- Activities can be defined so that the costs of stages of production or of a business process are accumulated.
- Examples include
  - determining the costs of non-value-added activities so the most costly can be reduced or eliminated
  - changing the steps in the accounts payable function to reduce the number of personnel
  - determining the most costly stages of product development so that the time to market is reduced

Q4: ABM & Environmental Costs

- Activities can be defined so that types of environmental costs are accumulated.
- Examples include
  - capturing the costs of contingent liabilities for waste disposal site remediation
  - comparing the cost of recycling packaging to the cost of disposal
  - computing the costs of treating different kinds of emissions

Q4: ABM & Quality Costs

- Activities can be defined so that categories of costs of managing quality are accumulated.
- Common categories of quality costs are
  - costs of prevention activities
  - costs of appraisal activities
  - costs of production activities
  - costs of postsales activities

Q5: What are GPK and RCA?

- Costing approaches similar to ABC because they involve multiple pools and multiple drivers
- GPK can be described as marginal planning and cost accounting
  - Each cost is traced to a cost center (smaller than a department) which performs a single repetitive activity, and is the responsibility of one manager)
  - Output measures tracks the volume of resource use
  - Costs are segregated into proportional (change with volume in resource use) and fixed
  - *Practical* capacity is used for estimated allocation rate volumes

Q5: Capacity Definitions

- Theoretical capacity – maximum assuming continuous, uninterrupted operations 365 days/year
- Practical capacity – typical operating conditions
- Budgeted capacity – expected volume for the upcoming time period
- Idle/excess capacity – difference between activity capacity used and one of the above measures of capacity

Q5: What are GPK and RCA?

- Resource Consumption Accounting (RCA)
- Builds on GPK and ABC principles
- Each cost is assigned to a resource cost pool
  - Labor and machinery are often placed in different cost pools since they are different types of resources
  - RCA involves a significantly larger number of cost pools than traditional accounting
  - Like GPK, segregates proportional and fixed costs
  - Utilizes *theoretical* rather than practical capacity for allocating fixed costs
    - More likely to focus manager attention on reducing idle and non-productive resource time

Q5: Benefits/Drawbacks to GPK/RCA

- Benefits
  - Generates multi-level internal income statements useful for short terms decisions because it focuses on marginal cost
  - Increases cause & effect awareness among managers
  - Categorizes costs (and generates profit margin) at the product, product group, division, and company level
  - Avoids arbitrary allocations of fixed costs
- Drawbacks
  - Can be costly to implement
  - Can result in a large number of variances to analyze

Q5: Comparison of ABC, GPK, and RCA

	ABC	GPK	RCA
Character of cost accounting system	Full costing	Marginal costing	Full and marginal costing
Location of data	Database separate from general ledger	Comprehensive accounting system	Comprehensive accounting system
Primary decision relevance	Mid- to long-term	Short-term	Short-, Mid-, and Long term
Allocation of overhead based on	Activities	Cost Centers	Resources and/or activities
Cost Drivers	Activity –Based	Resource Output related	Resource output or activity related
Fixed cost allocation rate denominator	Actual, budgeted, or practical capacity	Budgeted or practical capacity	Theoretical capacity

Q6: Decision Making with ABC, GPK, and RCA

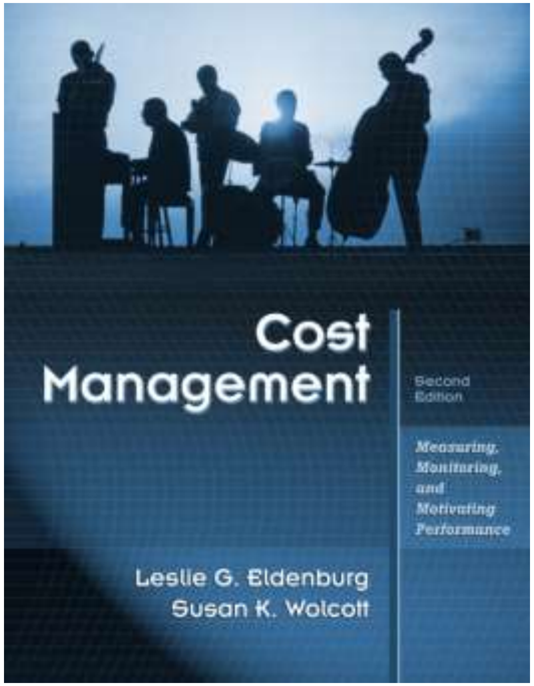
- Benefits
  - more accurate and relevant product cost information
  - employees focus attention on activities
  - measurement of the costs of activities and business processes
  - identify non-value-added activities and reduce costs
- Costs
  - systems can be difficult to design and maintain
  - more information must be captured
  - decision makers may not use the information appropriately

Q6: Uncertainties in ABC and ABM Implementation

- Judgment is required when determining activities.
- Judgment is required when selecting cost drivers.
- Denominator levels for cost drivers are estimates.
- ABC information includes unitized fixed costs, so decision makers must use ABC information correctly.

Chapter 8

Measuring and Assigning Support Department Costs



Chapter 8: Measuring and Assigning Support Department Costs

Learning objectives

- Q1: What are support departments, and why are their costs allocated to other departments?
- Q2: What process is used to allocate support department costs?
- Q3: How is the direct method used to allocate support costs to operating departments?
- Q4: How is the step-down method used to allocate support costs to operating departments?
- Q5: How is the reciprocal method used to allocate support costs to operating departments?
- Q6: What is the difference between single- and dual-rate allocations?
- Q7: How do support cost allocations affect decisions and managerial incentives?

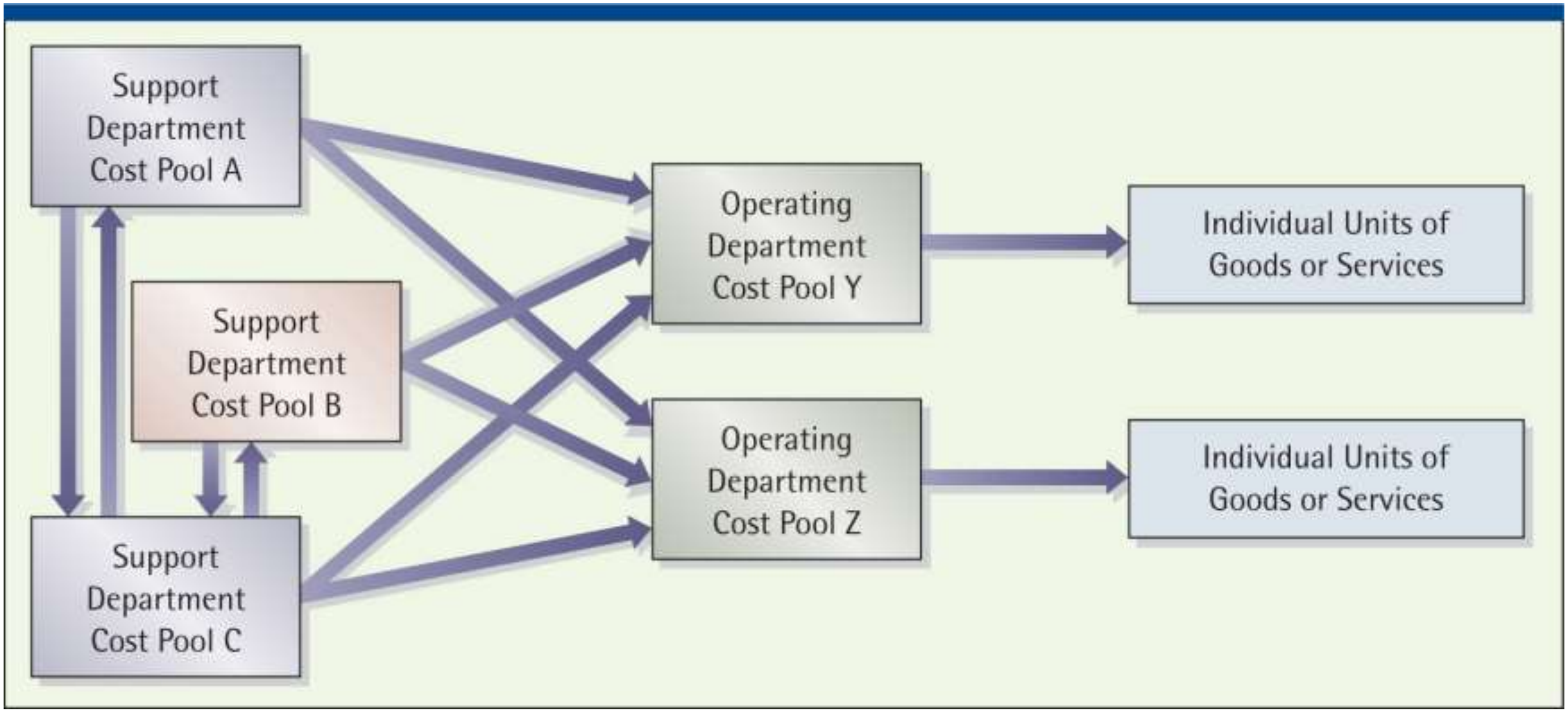
Q1: Support versus Operating Departments

- The operating departments of an organization produce products or services that generate revenue.
- The support departments of an organization produce products or provide services to the operating and other support departments.
- The support department costs are common costs that are shared between two or more other departments.

Q1: Reasons for Allocating Support Department Costs

- External reporting
- Motivation
  - appropriate consumption of support department resources
  - efficiency of support department
  - monitor consumption of support department services
- Decision making
  - product pricing
  - make or buy decisions

Q1: Support Department Allocation Process



Q2: Process for Allocating Support Department Costs

1. Clarify allocation purpose
2. Identify cost pools
3. Assign costs to cost pools
4. Choose allocation bases for each cost pool
5. Choose allocation method; allocate support department costs
6. Allocate updated operating department costs to units of goods or services, if relevant

Q2: Process for Allocating Support Department Costs

1. Clarify allocation purpose

   - if the purpose is to motivate the use of the services of a newly formed department, perhaps no costs should be allocated

   - if the purpose is to discourage operating department managers from over-use of the services of support departments, then a rate per unit of service might be large and not based on actual costs

   - if the purpose is to determine the full cost of products or services for long-term pricing decisions, then all support costs should be allocated

Q2: Process for Allocating Support Department Costs

2. Identify cost pools

- the purpose will determine whether both fixed and variable support department costs should be allocated

- the purpose will determine which costs should be allocated

Q2: Process for Allocating Support Department Costs

3. Assign costs to cost pools

- some costs will be direct to the cost pool (e.g. toner cartridge costs would be direct to the "variable copying costs" cost pool)

- some costs will be indirect to the cost pool (e.g. rent costs for an entire facility would be indirect to the "information technology costs" cost pool)

Q2: Process for Allocating Support Department Costs

4. Choose allocation bases for each cost pool

   - an allocation base with a good cause-and-effect relationship with the cost pool provides a reasonable allocation rate

   - users of support department services will carefully monitor their consumption of the allocation base

Q2: Process for Allocating Support Department Costs

5. Choose allocation method and allocate support department costs

- in this chapter we cover three allocation methods
- each of these three methods could be implemented using
  - a single- or dual-rate approach (covered later)
  - actual or budgeted costs and allocation bases (covered later)

Q2: Process for Allocating Support Department Costs

6. Allocate updated operating department costs to units of goods or services, if relevant

   - for some decisions, this may not be relevant
   - for long-term pricing decisions, this is likely to be relevant

Q3: The Direct Method of Allocating Support Department Costs

- The direct method ignores the fact that support departments use each others' services.
- Each support department's costs are allocated only to operating departments.
- This method is the easiest computationally and the easiest to explain.

Q3: The Direct Method Example

Philco Toys makes metal and plastic toys in separate departments. It has two support departments, Accounting and Information Systems. Philco has decided to allocate Accounting department costs based on the number of employees in each department and Information Systems costs based on the number of computers in each department. Given the information below, use the direct method to allocate support department costs.

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(48,000)		27,789	20,211	$0
Information Systems		(72,000)	36,000	36,000	$0
Totals	$0	$0	$449,789	$238,211	$688,000

Q3: The Direct Method Example

Plastic Products is allocated 22/(22+16) of Accounting department costs, and Metal Products is allocated 16/(22+16). Notice that the number of employees in the support departments is ignored under the direct method.

Plastic and Metal Product share Info Systems costs equally because they have the same number of computers in each department. Notice that the number of computers in the support departments is ignored under the direct method.

	Acc-ounting	In Systems	Products	Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(48,000)		27,789	20,211	$0
Information Systems		(72,000)	36,000	36,000	$0
Totals	$0	$0	$449,789	$238,211	$688,000

Q4: The Step-Down Method of Allocating Support Department Costs

- The step-down method allocates some (but not all) support department costs to other support departments.
- The first support department's costs are allocated to all operating and support departments that use its services.
- Each subsequent support department's costs are allocated to all operating and support departments that use its services, except any support department whose costs were already allocated.
- Allocation order must be determined.

Q4: The Step-Down Method Example

Given the information for Philco, use the step-down method to allocate support department costs. Allocate the costs of the support department that provides the largest percentage of its services to the other support department first.

First determine allocation order:

Accounting provided 4/(4+22+16) = 4/42 = 9.5% of its services to Info Systems.

Information Systems provided 4/(4+3+3) = 4/10 = 40% of its services to Accounting, so Information Systems goes first.

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Q4: The Step-Down Method Example

Given the information for Philco, use the step-down method to allocate support department costs.

Now perform the allocation:

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(76,800)		44,463	32,337	$0
Information Systems	28,800	(72,000)	21,600	21,600	$0
Totals	$0	$0	$452,063	$235,937	$688,000

Q4: The Step-Down Method Example

Info Systems costs are allocated to Accounting, Plastic, & Metal based on each department's number of computers compared to total non-Info Systems computers: 4+3+3=10.

Accounting costs are allocated only to Plastic & Metal based on each department's number of employees compared to total non-Accounting and non-Info Systems employees: 22+16=38

	Dep'ts				
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(76,800)		44,463	32,337	$0
Information Systems	28,800	(72,000)	21,600	21,600	$0
Totals	$0	$0	$452,063	$235,937	$688,000

Total costs allocated out of Accounting are now higher because of the Info Systems costs allocated to Accounting.

Q4: The Step-Down Method Example

(22/38) x $76,800

(16/38) x $76,800

(4/10) x $72,000

(3/10) x $72,000

(3/10) x $72,000

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(76,800)		44,463	32,337	$0
Information Systems	28,800	(72,000)	21,600	21,600	$0
Totals	$0	$0	$452,063	$235,937	$688,000

Q5: The Reciprocal Method of Allocating Support Department Costs

- The reciprocal method allocates all support department costs to other support departments.
- The first step is to compute the total costs of each support department when its usage of other support department services is taken into consideration.
- Support department costs are then allocated to all other operating and support departments that consume its services.

Q5: The Reciprocal Method Example

Given the information for Philco, use the reciprocal method to allocate support department costs.

First determine total costs for each support department by writing an equation for its costs (use A and IS as abbreviations).

A = $48,000 + [4/(4+3+3)] x IS; IS = $72,000 + [4/(4+22+16)] x A

Then solve: A = $48,000 + (4/10) x [$72,000 + (4/42) x A]

A = $48,000 + $28,800 + (16/420) x A]

(404/420) x A = $76,800

A = $76,800 x (420/404) = $79,842

IS = $72,000 + (4/42) x $79,842 = $79,604

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Q5: The Reciprocal Method Example

Given the information for Philco, use the reciprocal method to allocate support department costs.

Now perform the allocation:

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(79,842)	7,604	41,822	30,416	$0
Information Systems	31,842	(79,604)	23,881	23,881	$0
Totals	$0	$0	$451,703	$236,297	$688,000

Q5: The Reciprocal Method Example

These numbers are the solutions to the simultaneous equations.

(4/42) x $79,842

(22/42) x $79,842

(16/42) x $79,842

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(79,842)	7,604	41,822	30,416	$0
Information Systems	31,842	(79,604)	23,881	23,881	$0
Totals	$0	$0	$451,703	$236,297	$688,000

Q5: The Reciprocal Method Example

(4/10) x $79,604

(3/10) x $79,604

(3/10) x $79,604

	Support Dep'ts		Operating Departments		
	Acc-ounting	Info Systems	Plastic Products	Metal Products	Total
Total department costs	$48,000	$72,000	$386,000	$182,000	$688,000
Number of employees	3	4	22	16	45
Number of computers	4	6	3	3	16

Allocate costs:

Accounting	(79,842)	7,604	41,822	30,416	$0
Information Systems	31,842	(79,604)	23,881	23,881	$0
Totals	$0	$0	$451,703	$236,297	$688,000

Q6: Single- versus Dual-Rate Allocation

- In single-rate allocation, each cost pool includes fixed and variable costs.
- In dual-rate allocation, fixed and variable costs are in separate cost pools.
- Both methods can be employed with the direct, step-down, or reciprocal methods.
- The prior three examples used the single-rate allocation method.

Q6: Single- versus Dual-Rate Example

Philco has decided to use the direct method and allocate variable Accounting costs based on the number of transactions and fixed Accounting costs based on the number of employees. The Info Systems variable costs will be allocated based on the number of service requests and fixed costs will be allocated based on the number of computers. The required information is presented below.

	Support Dep'ts		Operating Departments	
	Acc-ounting	Info Systems	Plastic Products	Metal Products
Total department variable costs	$20,000	$22,000	$186,000	$100,000
Total department fixed costs	$28,000	$50,000	$200,000	$82,000
Number of transactions	20	32	140	86
Number of employees	3	4	22	16
Number of service requests	18	5	12	8
Number of computers	4	6	3	3

Now perform the allocation…

Q6: Single- versus Dual-Rate Example

	Support Dep'ts		Operating Departments	
	Acc-ounting	Info Systems	Plastic Products	Metal Products
Total department variable costs	$20,000	$22,000	$186,000	$100,000
Total department fixed costs	$28,000	$50,000	$200,000	$82,000
Number of transactions	20	32	140	86
Number of employees	3	4	22	16
Number of service requests	18	5	12	8
Number of computers	4	6	3	3

Allocate variable costs:

Accounting	(20,000)		12,389	7,611
Information Systems		(22,000)	13,200	8,800
Total variable costs	$0	$0	$211,589	$116,411

Allocate fixed costs:

Accounting	(28,000)		16,211	11,789
Information Systems		(50,000)	25,000	25,000
Total fixed costs	$0	$0	$241,211	$118,789

Total fixed and variable costs	$0	$0	$452,800	$235,200

Q7: Decision Making with Support Costs

- Support costs need to be considered when evaluating decisions such as make/buy, keep/drop, special order, and constrained resource
- Necessary to isolate relevant support costs
  - This may not be the same as the allocated support costs
  - For example, outsourcing an operating department may not result in a reduction in support department costs

Q7: Establishing Transfer Prices for Support Departments

- Transfer prices should be set to motivate efficient use of the support department resources
  - If transfer price is set too high, user departments may outsource the service
  - If transfer price is set too low, user departments may utilize the support department inefficiently
- The best transfer pricing approach is the Opportunity Cost approach
  - Each department is charged an amount that reflects the value of any opportunities forgone by not using the service for its next best alternative use.
  - This is often difficult in practice so most companies use a cost based or market based transfer pricing policy

Q7: Estimated versus Actual Support Costs and Rates

A department's allocation

of support department costs

= the allocation rate x the department's consumption of the allocation base

Either of these could be estimated or actual.

Q7: Estimated versus Actual Support Costs and Rates

the allocation rate × the department's consumption of the allocation base

Using actual rates and actual consumption provides the best measure of the cost of support services; it is the most accurate but the least timely.

The purpose of the cost allocation will determine whether actual or estimated rates, and actual or estimated consumption, should be used.

Q7: Estimated versus Actual Support Costs and Rates

- Actual rates and consumption may be required for some types of government contracts.
- Most federal grants to educational institutions allow the use of estimates.
- Using an actual rate means that support service users are affected by
  - inefficiencies of support department managers
  - changes in the consumption of support services by other users

Q7: Other Common Cost Allocation Methods

- Other cost allocation purposes may require the allocation to
  - be perceived as “fair”
  - be based on the user’s “ability to bear” the cost
- Under the stand-alone method, a common cost is allocated based on information about the users’ consumption of the cost.
- Under the incremental cost allocation method, a “primary user” is allocated the bulk of the common cost and the secondary user is allocated only the increment in cost that it caused.

Q7: Stand-Alone versus Incremental Cost Allocation Methods Example

Leslie has a job interview with Big Co. next month in New York City. Her plane ticket cost $300, and she will need to spend $125/night for 2 nights in a hotel. She estimates that she will spend $50 in cab fares and $50 for food. Big Co. has promised to reimburse her actual costs. After this trip was arranged, Small Co., also located in New York City, called her for an interview. If she interviews with Small Co. while she's there, she will spend an additional $125 for another night at a hotel, and another estimated $40 in cab fares and food. Think of at least two ways to allocate Leslie's travel costs using the stand-alone method. Discuss the merits of each.

1. Compute the total cost of the trip and divide it by 2, since there are 2 interviews.
2. Compute the total cost of the trip and allocate 2/3 of it to Big Co. and 1/3 to Small Co. since she is spending 2 of the 3 nights in NYC for the Big Co. interview.

Q7: Stand-Alone versus Incremental Cost Allocation Methods Example

Perform the calculations for your two versions of the cost allocation under the stand-alone method. Then allocate the travel costs using the incremental cost allocation method. Which is more appropriate? Why?

Estimated total costs:	
Plane ticket	$300
Hotel	375
Cab fares & food	140
Total	$815

If shared equally, then this is $407.50 for each company; if Big Co. is allocated 2/3 of the cost then $543.33 is allocated to Big Co. and $271.67 is allocated to Small Co.

Under the incremental cost allocation method, Big Co. is most likely to be considered the primary user. Since Leslie's budgeted travel costs were $300 + $250 + $50 + $50 = $650 before she was offered the Small Co. interview, Big Co. is allocated $650 and Small Co. is allocated $815 - $650 = $165.

Q7: Fixed Price versus Cost-Based Contracts

- Under fixed price contracts, vendors provide products or services for a specified price.
- Under cost-based contracts, the price is computed based on the actual cost of the products or services.
  - may be necessary for research & new product development
  - vendors are not motivated to control costs
  - vendors may be motivated to inappropriately allocate common costs

Appendix 8A: Excel Solver and the Reciprocal Method

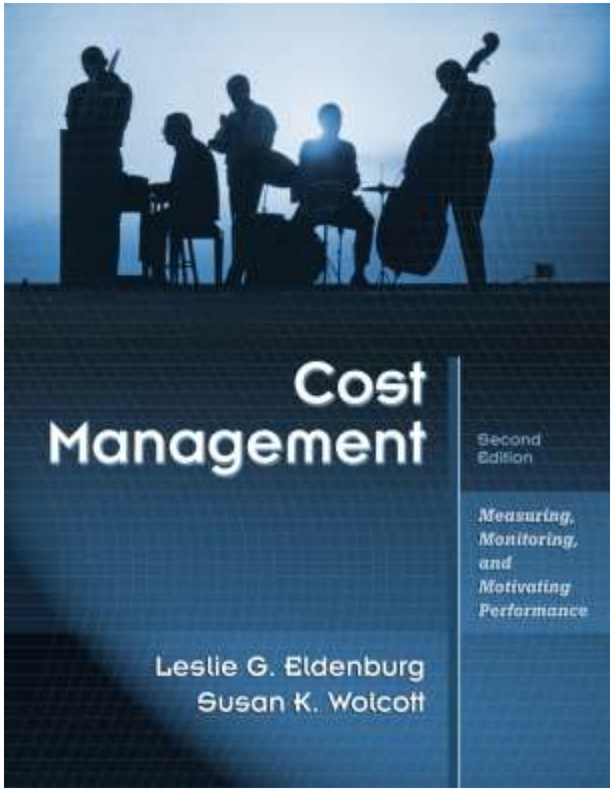
- Solving the simultaneous equations required for the reciprocal method can be tedious when there are 3 or more support departments.
- Excel Solver can be used to solve these equations.
- Refer to Appendix 4A for help with using Excel Solver.

Appendix 8A: Excel Solver and the Reciprocal Method

- Set up a “change cell” for each support department’s total costs.
- The target function is the sum of the change cells.
- The simultaneous equations are entered as constraints; one constraint per equation.

Chapter 9

JOINT PRODUCT AND BY-PRODUCT COSTING



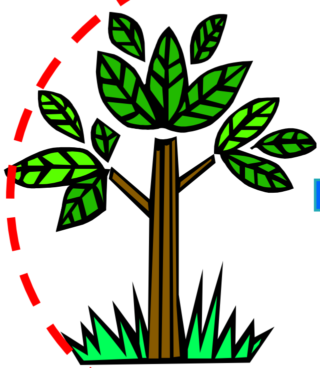
Learning objectives

- Q1: What is a joint process, and what is the difference between a by-product and a main product?
- Q2: How are joint costs allocated?
- Q3: What factors are considered in choosing a joint cost allocation method?
- Q4: What information is relevant for deciding whether to process a joint product beyond the split-off point?
- Q5: What methods are used to account for the sale of by-products?
- Q6: How does a sales mix affect joint cost allocation?
- Q7: How do joint cost allocations affect decisions and managerial incentives?

Q1: Joint Processes and Costs

- A process that yields one or more products is called a joint process.
  - The products are called joint products.
  - The costs of the process are called joint costs.
- The split-off point is the stage in the joint process where the separate products become identifiable.
  - Joints costs are incurred prior to the split-off point.
  - Costs incurred past split-off are separable costs.
- Joint products that have minimal sales value compared to the main product are called by-products.

Q1: Joint Processes and Costs



Sawdust

Bark

Planks

Wall paneling

If sawdust sells for a relatively minimal amount, it is a byproduct.

The costs of processing planks further are separable costs.

Joint costs include DM, DL & Overhead.

Joint products

Q2: Methods of Allocating Joint Costs

- Physical output methods
  - Can be used only when joint products are measured the same way (e.g. pounds or feet).

- Market-based methods
  - Sales value at split-off method
    - Often used when all products sold at split-off.
  - Net realizable value (NRV) method
    - NRV = Final selling price – Separable costs.
  - Constant gross margin (GM) NRV method
    - The two NRV methods can be used when some products are processed past split-off.

Q2: Physical Volume Method Example

Pleasing Peaches grows peaches and processes three different peach products that are sold to a canning company. The pounds produced for each product, and the selling price per pound, is given below. The joint costs of processing the 280,000 pounds of products were $70,000. Allocate the joint costs to each product using the physical volume method.

Product	Pounds Produced	Selling Price per Pound	Total Sales Value at Split-Off	Relative Weight	Allocated Joint Costs
Peach halves	160,000	$0.50	$80,000	57.1%	$40,000
Peach slices	80,000	$0.40	$32,000	28.6%	$20,000
Peach purée	40,000	$0.30	$12,000	14.3%	$10,000
	280,000		$124,000	100.0%	$70,000

Q2: Sales Value at Split-Off Method Example

Allocate the joint costs of $70,000 to each of Pleasing Peaches products using the sales value at split-off method.

Product	Pounds Produced	Selling Price per Pound	Total Sales Value at Split-Off	Relative Sales Value	Allocated Joint Costs
Peach halves	160,000	$0.50	$80,000	64.5%	$45,161
Peach slices	80,000	$0.40	$32,000	25.8%	$18,065
Peach purée	40,000	$0.30	$12,000	9.7%	$6,774
	280,000		$124,000	100.0%	$70,000

Q2, 6: Compare the Physical Volume and Sales Value at Split-Off Methods

Compute the gross margin for each product for each of the two allocation methods. Discuss the differences between the two methods.

		Allocated Joint Costs		Gross Margin	
Product	Total Sales Value at Split-Off	Physical Volume Method	Sales Value at Split-Off Method	Physical Volume Method	Sales Value at Split-Off Method
Peach halves	$80,000	$40,000	$45,161	$40,000	$34,839
Peach slices	$32,000	$20,000	$18,065	$12,000	$13,935
Peach purée	$12,000	$10,000	$6,774	$2,000	$5,226
	$124,000	$70,000	$70,000	$54,000	$54,000

Q2, 6: Compare the Physical Volume and Sales Value at Split-Off Methods

Compute the gross margin ratio (GM/Sales) for each product under both of the methods and discuss.

		Gross Margin		Gross Margin Ratio	
Product	Total Sales Value at Split-Off	Physical Volume Method	Sales Value at Split-Off Method	Physical Volume Method	Sales Value at Split-Off Method
Peach halves	$80,000	$40,000	$34,839	50.0%	43.5%
Peach slices	$32,000	$12,000	$13,935	37.5%	43.5%
Peach purée	$12,000	$2,000	$5,226	16.7%	43.5%
	$124,000	$54,000	$54,000	43.5%	43.5%

Q2: Net Realizable Value (NRV) Method Example

Pleasing Peaches could process each of its three products beyond split off. It could can the peach halves itself, make the peach slices into frozen peach pie, and make juice out of the peach purée. The retail value of the new products and the separable costs for the additional processing are given below. Compute the joint costs allocated to each of the products using the NRV method.

Product	Final Sales Value	Separable Costs	NRV	Relative NRV	Allocated Joint Costs
Canned peaches	$180,000	$60,000	$120,000	64.2%	$44,920
Peach pie	$120,000	$70,000	$50,000	26.7%	$18,717
Peach juice	$50,000	$33,000	$17,000	9.1%	$6,364
	$350,000	$163,000	$187,000	100.0%	$70,000

Q2: Constant GM NRV Method

- Under the constant GM NRV method, all products are allocated joint costs to achieve the same gross margin ratio (GM%).
- First compute overall gross margin and GM%:

  GM = Revenue – Joint costs – Separable costs

  GM% = GM/Sales
- Then compute the GM for each product:

  GM = Final sales value x GM%
- All products end up with the same gross margin ratio; for each product solve for allocated joint costs:

  Final sales value – joint costs – separable costs = GM

Q2: Constant GM NRV Method Example

Compute the joint costs that Pleasing Peaches would allocate to each of the products using the constant GM NRV method.

First compute the overall GM and GM ratio:

GM = $350,000 - $163,000 - $70,000 = $117,000

GM% = $117,000/$350,000 = 33.43%

Product	Final Sales Value	Separable Costs	Allocated Joint Costs	Gross Margin	Gross Margin Ratio
Canned peaches	$180,000	$60,000	$59,829	$60,171	33.4%
Peach pie	$120,000	$70,000	$9,886	$40,114	33.4%
Peach juice	$50,000	$33,000	$286	$16,714	33.4%
	$350,000	$163,000	$70,000	$117,000	

Values are rounded as appropriate.

Q2, 6: Compare the NRV and Constant GM NRV Methods

Compute the gross margin (GM) and the gross margin ratio (GM%) for each product under NRV method. Compare this to the results of the constant GM NRV method and discuss.

		Gross Margin		Gross Margin Ratio	
Product	Final Sales Value	NRV Method	Constant GM NRV Method	NRV Method	Constant GM NRV Method
Peach halves	$180,000	$75,080	$60,171	41.7%	33.4%
Peach slices	$120,000	$31,283	$40,114	26.1%	33.4%
Peach purée	$50,000	$10,636	$16,714	21.3%	33.4%
	$350,000	$117,000	$117,000	33.4%	33.4%

Values are rounded as appropriate.

Q3: Choosing a Joint Cost Allocation Method

- Allocated joint costs should not be used in decision making.
- Still, avoid a method that shows one product to be unprofitable.
  - Under the physical volume method, the product with the greatest relative physical volume is allocated the most joint costs, regardless of product’s sales value.
  - Both of the NRV methods allocate joint costs based on the products’ “ability to bear the cost”.

Q4: Sell or Process Further Decisions

- Companies often can choose to sell a product at the split-off point or to process it further.
- Compare the incremental revenue of processing further to the product's separable costs.
  - Incremental revenue of processing further = Final sales value – Sales value at split-off
- Process further only when the incremental revenue exceeds the separable costs.

Q4: Sell or Process Further Example

Peg's Plastic Products makes the molded plastic parts for three model car kits, A, B & C from a joint production process. The joint costs of this process are $150,000. In each case, Peg could decide to make the entire kit rather than just the plastic parts. Information about the sales values and separable costs for each kit is given below. Determine which kits Peg should sell at the split-off point and which she should process further.

Kit	Final Sales Value	Sales Value at Split-Off	Sep-arable Costs	Incre-mental Revenue	Incre-mental Profit if Process Further	Sell at Split-Off or Process Further?
A	$200,000	$180,000	$25,000	$20,000	($5,000)	Sell
B	$120,000	$60,000	$40,000	$60,000	$20,000	Process
C	$80,000	$40,000	$10,000	$40,000	$30,000	Process

Q5: Accounting for By-Products

- When by-products have no sales value, there is no reason to account for them.

- Otherwise, there are two accounting methods available:
  - Recognize by-product value at time of production
  - Recognize by-product value at time of by-product sale

Q5: Recognize By-Product Value at Time of Production

- This method is also known as the offset approach or the NRV approach.
- Joint cost of the main products is reduced by the NRV of the by-products, even if by-products are not yet sold.
  - NRV of the by-products is kept in ending inventory until sold.
  - At sale of by-product, ending inventory is reduced; there is no gain/loss on sale.
- This method allows managers to control by-products.

Q5: By-Product Value Recognized at Time of Production Example

SJ Enterprises produces a main product and one by-product in a joint process. The joint costs totaled $480,000. The main product sells for $10/unit and the by-product sells for $1/unit. Information about the production and sales of the 2 products is given below. Use the NRV method to compute the production cost per unit for the main product.

	Information in Units of Each Product			
	Beginning Inventory	Production	Sales	Ending Inventory
Main product	0	100,000	95,000	5,000
By-product	0	10,000	3,000	7,000

Production costs	$480,000
Less: NRV of by-product	10,000
Net joint product cost	$470,000
Net product cost per unit	$4.70

Q5: By-Product Value Recognized at Time of Production Example

Prepare an income statement for SJ Enterprises and compute the costs attached to ending inventory using the NRV method, assuming that non-manufacturing costs totaled $250,000.

Revenue: 95,000 units at $10/unit	$950,000
Cost of goods sold: 95,000 units at $4.70/ur	446,500
Gross margin	503,500
Less: nonmanufacturing expenses	250,000
Operating income	$253,500

Ending inventory:	
Main product: 5,000 units at $4.70	$23,500
By-product: 7,000 units at $1	7,000
Value of ending inventory for balance sheet	$30,500

Q5: Recognize By-Product Value at Time of Sale

- This method is also known as the Realized Value Approach or the RV Approach.
- Joint cost of the main products is not reduced by the NRV of the by-products, regardless if by-products are sold.
  - NRV of the by-products is not kept in ending inventory.
  - At sale of by-product, either Other Income is recorded or Cost of Goods Sold is reduced.

Q5: By-Product Value Recognized at Time of Sale Example

SJ Enterprises produces a main product and one by-product in a joint process. The joint costs totaled $480,000. The main product sells for $10/unit and the by-product sells for $1/unit. Information about the production and sales of the 2 products is given below. Use the RV method to compute the production cost per unit for the main product.

	Information in Units of Each Product			
	Beginning Inventory	Prod-uction	Sales	Ending Inventory
Main product	0	100,000	95,000	5,000
By-product	0	10,000	3,000	7,000

Production costs	$480,000
Net product cost per unit	$4.80

Q5: By-Product Value Recognized at Time of Sale Example

Prepare an income statement for SJ Enterprises and compute the costs attached to ending inventory using the RV method, assuming that non-manufacturing costs totaled $250,000. By-product sales is recorded as other income.

Revenue: 95,000 units at $10/unit	$950,000
By-product sales: 3,000 units at $1/unit	3,000
Total revenue	953,000
Cost of goods sold: 95,000 units at $4.80/ur	456,000
Gross margin	497,000
Less: nonmanufacturing expenses	250,000
Operating income	$247,000

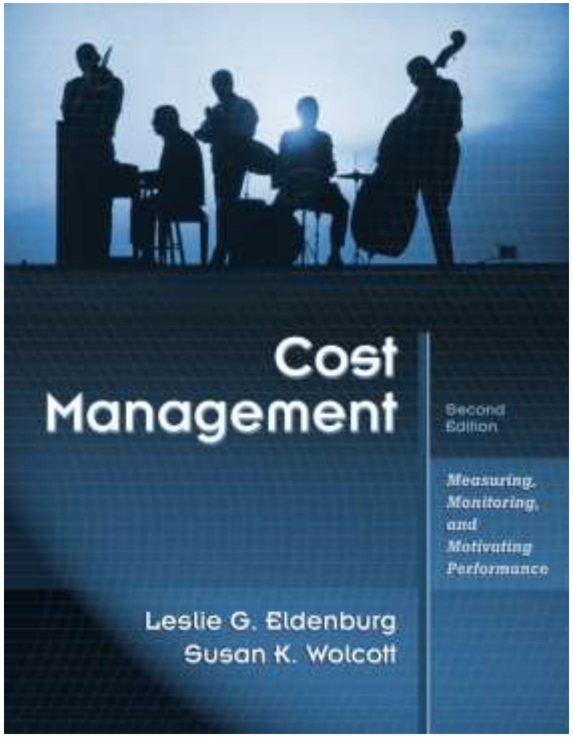
Ending inventory:	
Main product: 5,000 units at $4.80	$24,000

Q7: Decision Making & Joint Cost

- Joint cost information is required for financial statement & tax return preparation when production does not equal sales (inventory and cost of goods sold).
- Allocated joint costs are irrelevant for most decisions, especially regarding individual products
  - Joint cost information should not be used to make product mix decisions.

Chapter 10

Static and Flexible Budgets



Learning objectives

- Q1: How do budgets contribute to the strategic management process?
- Q2: What is a master budget and how is it prepared?
- Q3: What are flexible budgets and how can they be used for sensitivity analysis?
- Q4: How are budget variances calculated and used as performance measures?
- Q5: How do behavioral tensions influence the budgeting process?
- Q6: What approaches exist for addressing the problems of traditional budgeting?

Q1: Budgets & Strategic Management Process

- A budget is
  - A formalized financial plan.
  - A translation of an organization's strategies.
  - A method of communicating.
  - A way to define areas of responsibility and decision rights.

- The budget cycle is the series of sequential steps followed to create and use budgets.

Q1: Budgets & Strategic Management Process

- Budgeting process begins with the organizational vision, core competencies, and risk appetite
- Organizational strategies designed to achieve the vision will drive the capital expenditures and long term financing plans
- Operating plans are then created in line with the organizational strategies
- Actual results must be monitored, measured, and analyzed compared to budgeted plans

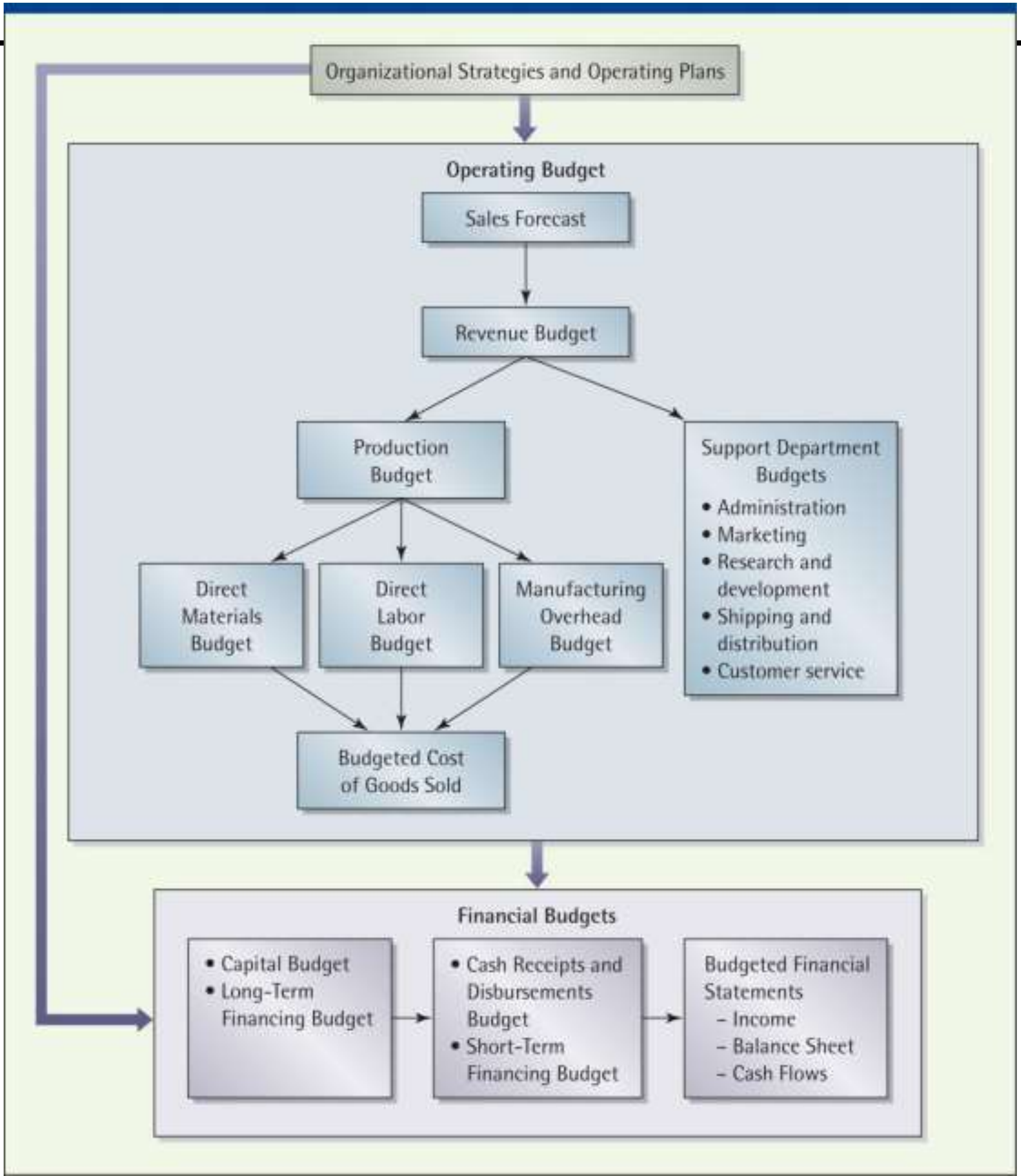
Q1: Budgets & Levers of Control

Belief Systems	Boundary Systems	Interactive Control Systems	Diagnostic Control Systems
• Communicates organizational strategies and goals • Motivates managers to plan in advance and coordinate activities	• Authorizes employees to engage in planned activities and spend within budget limits • Ensures sufficient cash flow for financial viability	• Utilize variances to identify opportunities and threats to the business • Revaluate strategies and operating plans as conditions changes	• Assign responsibility and reward employees for achieving budget targets • Motivate managers to provide good estimates and use resources appropriately

Q2: Master Budgets

- A master budget is
  - A comprehensive plan for the upcoming accounting period.
  - Usually prepared for a one-year period.
  - Is based on a series of budget assumptions.
- The master budget consists of several subsidiary budgets, in two categories:
  - Operating budgets.
  - Financial budgets.

Q2: Operating Budgets



Q2: Operating Budgets

The operating budget is created by preparing the following individual budgets, in this order:

- Revenue budget
- Production budget
- Direct materials budget
- Direct labor budget
- Manufacturing overhead budget
- Inventory and cost of goods sold budget
- Support department budgets
- Budgeted income statement

Q2: Financial Budgets

The financial budget is created by preparing the following individual budgets, in this order:

- Capital budget
- Long-term financing budget
- Cash budget
- Budgeted balance sheet
- Budgeted statement of cash flows

Q2: Operating Budget Example

Stanley J, Inc., makes a tool used by auto mechanics that sells for $68/unit. It expects to sell 6,000 units in April and 7,000 units in May. Stanley J prefers to end each period with a finished goods inventory equal to 10% of the next period's sales in units and a direct materials inventory equal to 20% of the direct materials required for the next period's production. The company never has any beginning or ending work-in-process inventories. There were 400 units in finished goods inventory on April 1. Prepare the revenue and production budgets for April.

Revenue budget

Budgeted sales in units in April	6,000
Budgeted selling price per unit	$68.00
Budgeted revenues	$408,000

Production budget

Budgeted sales in units in April	6,000
Desired ending FG inventory	700
Total units required	6,700
Less: beginning FG inventory	(400)
Required production in units	6,300

Q2: Operating Budget Example

Stanley J's product uses 0.3 pounds of direct material per unit, at a cost of $4/lb. There were 220 lbs. of direct material on hand on April 1. Assume that budgeted production for May is 6,500 units. Prepare the direct materials purchases and usage budget for April.

Direct materials budget	
Required production in units	6,300
DM required per unit, in pounds	0.3
Total DM required, in pounds	1,890
Less: Beginning DM inventory	(220)
Plus: Desired ending DM inventory	390
Required DM purchases in pounds	2,060
Budgeted DM cost per pound	$4.00
Budgeted cost of DM	$8,240

Usage Budget = 1,890 pounds * $4 per pound = $7,560

Q2: Operating Budget Example

Stanley J's product uses 0.2 hours of direct labor at a cost of $12/hr. Prepare the direct labor budget for April.

Direct labor budget	
Required production in units	6,300
DL required per unit, in hours	0.2
Total DL hours required	1,260
Budgeted cost per DL hour	$12.00
Budgeted cost of DL	$15,120

Q2: Operating Budget Example

Stanley J's budgeted fixed manufacturing overhead for April is $167,000, and variable manufacturing overhead is budgeted at $6 per direct labor hour. Prepare the manufacturing overhead budget for April.

Manufacturing overhead budget	
Total DL hours required	1,260
Budgeted variable overhead per DL hour	$6.00
Total budgeted variable overhead	$7,560
Budgeted fixed overhead	$167,000
Total budgeted overhead	$174,560

Q2: Operating Budget Example

Assume that Stanley J's April 1 direct materials inventory had a cost of $1,560. Prepare the April ending inventories budget for direct materials.

Ending inventories budgets	
Budgeted cost of DM purchases	$8,240
Beginning DM inventory	$854
DM available for use	$9,094
Budgeted cost of desired ending DM inventory:	
[6,500 units x 0.3 lbs/unit] x 20% x $4/lb	$1,560
Budgeted cost of DM to be used	$7,534

Q2: Operating Budget Example

Prepare the April ending inventories budget for finished goods.

Budgeted cost of DM to be used	$7,534
Budgeted cost of DL	$15,120
Total budgeted overhead	$174,560
Total budgeted manufacturing costs	$197,214
Required production in units	6,300
Budgeted manufacturing cost per unit	$31.3037
Budgeted ending FG inventory in units	700
Budgeted cost of ending FG inventory	$21,913

Q2: Operating Budget Example

Assume that Stanley J's April 1 finished goods inventory had a cost of $12,146. Prepare the cost of goods sold budget for April.

Cost of goods sold budget	
Beginning FG inventory	$12,146
Total budgeted manufacturing costs	$197,214
Cost of goods available for sale	$209,359
Less: budgeted ending FG inventory	$21,913
Budgeted cost of goods sold	$187,447

Q2: Operating Budget Example

Stanley J's budget for April includes $22,000 for administrative costs, $34,000 for fixed distribution costs, $18,000 for research and development, and $13,000 for fixed marketing costs. Additionally, the budgeted variable costs for distribution are $0.75/unit sold and the budgeted variable costs for marketing are 4% of sales revenue. Prepare the support department budget for April.

Support department budget		
Administration		$22,000
Distribution: Fixed costs	$34,000	
Variable costs	$4,500	$38,500
Research & development		$18,000
Marketing: Fixed costs	$13,000	
Variable costs	$16,320	$29,320
Total budgeted support department costs		$107,820

Q2: Operating Budget Example

Suppose that Stanley J's income tax rate is 28%. Prepare the budgeted income statement for April.

Budgeted income statement		
Sales revenue		$408,000
Cost of goods sold		$187,447
Gross margin		$220,553
Operating costs:		
Administration	$22,000	
Distribution	$38,500	
Research & development	$18,000	
Marketing	$29,320	$107,820
Net income before taxes		$112,733
Income taxes		$31,565
Net income		$81,168

Q4: Budget Variances

- Managers compare actual results to budgeted results in order to
  - Monitor operations, and
  - Motivate appropriate performance.
- Differences between budgeted and actual results are called budget variances.
  - Variances are stated in absolute value terms, and labeled as Favorable or Unfavorable.

Q4: Budget Variances

- Reasons for budget variances are investigated.
- The investigation may find:
  - Inefficiencies in actual operations that can be corrected.
  - Efficiencies in actual operations that can be replicated in other areas of the organization.
  - Uncontrollable outside factors that require changes to the budgeting process.

Q3: Static Budgets

- A budget prepared for a single level of sales volume is called a static budget.
- Static budgets are prepared at the beginning of the year.
- Differences between actual results and the static budget are called static budget variances.

Q3: Flexible Budgets

- A budget prepared for a multiple levels of sales volume is called a flexible budget.
- Flexible budgets are prepared at the beginning of the year for planning purposes and at the end of the year for performance evaluation.
- Flexible budgets are also used for sensitivity analysis and to manage risk due to uncertainty.
- Differences between actual results and the flexible budget are called flexible budget variances.

Q3, Q4: Flexible Budget Example

Tina's Trinkets is preparing a budget for 2006. The budgeted selling price per unit is $10, and total fixed costs for 2006 are estimated to be $5,000. Variable costs are budgeted at $3/unit. Prepare a flexible budget for the volume levels 1,000, 1,100, and 1,200 units.

	Volume Levels		
Sales in units	1,000	1,100	1,200
Revenues	$10,000	$11,000	$12,000
Variable costs	$3,000	$3,300	$3,600
Contribution margin	$7,000	$7,700	$8,400
Fixed costs	$5,000	$5,000	$5,000
Operating income	$2,000	$2,700	$3,400

Q3, Q4: Static Budget Variances Example

Suppose that Tina's 2006 static budget was for 1,100 units of sales. The actual results are given below. Compute the static budget variances for each row and discuss.

	Static Budget	Actual Results	Static Budget Variance	
Sales in units	1,100	980		
Revenues	$11,000	$9,604	$1,396	Unfavorable
Variable costs	$3,300	$2,989	$311	Favorable
Contribution margin	$7,700	$6,615	$1,085	Unfavorable
Fixed costs	$5,000	$4,520	$480	Favorable
Operating income	$2,700	$2,095	$605	Unfavorable

Q3, Q4: Flexible Budget Variances Example

Compute the flexible budget variances for Tina and discuss the results. Compare the flexible budget variances to the static budget variances on the prior page.

	Year-end Flexible Budget	Actual Results	Flexible Budget Variance	
Sales in units	980	980		
Revenues	$9,800	$9,604	$196	Unfavorable
Variable costs	$2,940	$2,989	$49	Unfavorable
Contribution margin	$6,860	$6,615	$245	Unfavorable
Fixed costs	$5,000	$4,520	$480	Favorable
Operating income	$1,860	$2,095	$235	Unfavorable

Q3, Q4: Performance Evaluation

- A static budget variance includes effects from output volume.
- A flexible budget variance removes these output volume effects.
- Other adjustments to the year-end flexible budget may be made for a fair performance evaluation, such as
  - Input price changes outside the control of the manager under evaluation
  - Fixed cost increases outside the control of the manager under evaluation

Q5: Behavior Tensions in Budgeting

- Budgets used to evaluate performance and compensation can create behavioral tension
- Participative budgeting – when managers who are responsible for the budgets prepare the budget forecasts
  - Can result in budgetary slack – when managers set targets so low that goals can be met easily (and bonuses achieved)
- Budget ratcheting – when top managers set targets
  - If targets unachievable, this can result in employees having little motivation to meet targets
- Organizations must watch for budget manipulation

Q6: Other Budgeting Approaches

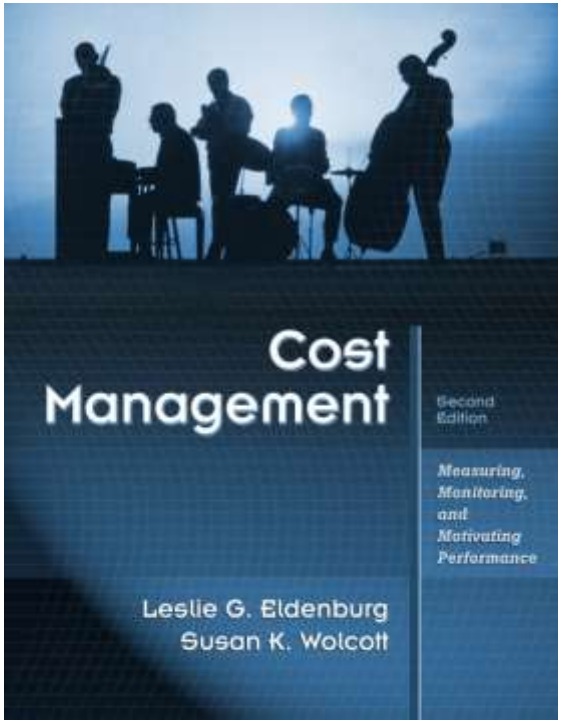
- Zero based budgets are prepared without using past information as justification.
- Rolling budgets are prepared frequently for overlapping time periods and actual results may be used to update the budget for the next period.
- Kaizen budgets plan cost reductions over time.
- Activity based budgets use more cost pools and cost drivers.
- GPK and RCA budgets identify fixed and variable cost functions at the resource center level.
- Beyond budgeting uses external benchmarks to evaluate managers' performance

Cost Management

Measuring, Monitoring, and Motivating Performance

Chapter 11

Standard Costs and Variance Analysis



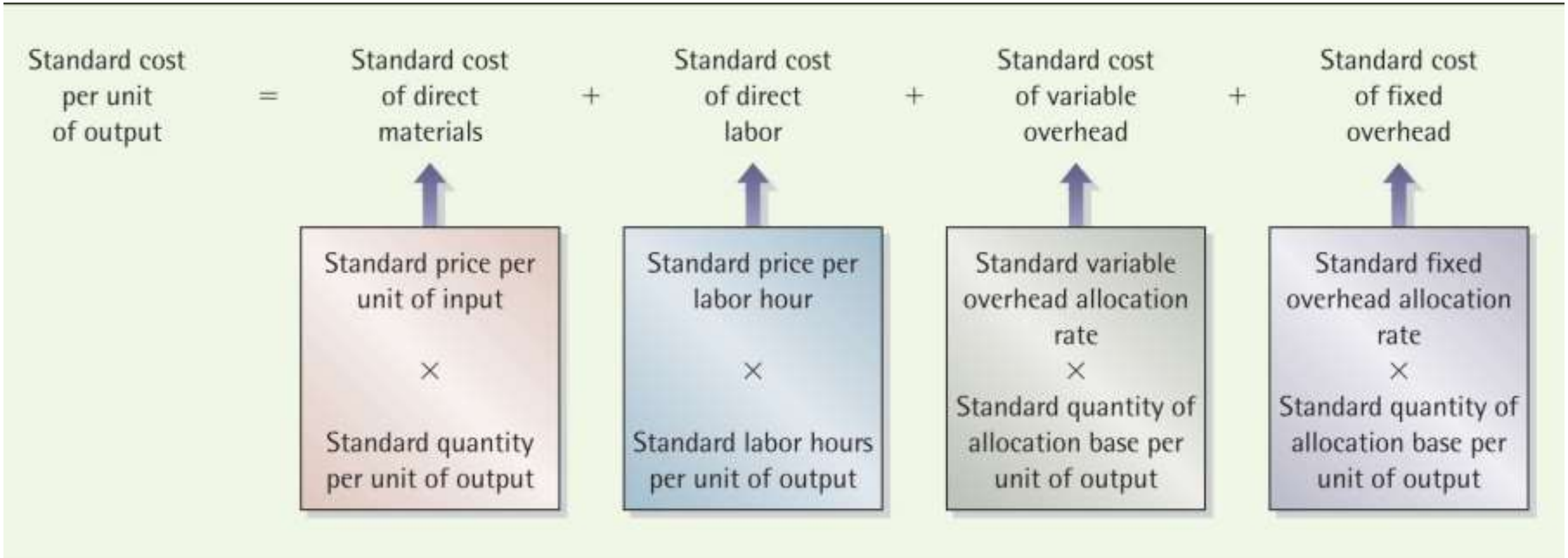
Learning objectives

- Q1: How does variance analysis contribute to the strategic management process?
- Q2: What is a standard costing system and how is it used?
- Q3: How are direct cost variances calculated?
- Q4: How is direct cost variance information analyzed and used?
- Q5: How are variable and fixed overhead variances calculated?
- Q6: How is overhead variance information analyzed and used?
- Q7: How are manufacturing cost variances closed?
- Q8: Which profit-related variances are commonly analyzed?

Q2: Standard Costs

- Organizations set standards to help plan operations.
- A standard cost is the expected cost of providing a good or service.
- In manufacturing, the standard cost of a unit of output is comprised of:
  - the standard price (SP) of the input, and
  - the standard quantity of the input expected to be consumed in the production of one output unit.

Q2: Standard Costs



Q2: Establishing & Using Standard Costs

- Standards can be set using:
  - Information from the prior year
  - Engineered estimates
  - New information available
- Standards can be used for:
  - Planning future operations
  - Monitoring current operations
  - Motivating manager and employee behavior
  - Evaluating performance

Q2: Standard Costing Systems

Advantages

- Information can be used to quickly estimate job or project costs
- Monitor resources to measure efficiency
- Communicates targets (goals) to employeess
- Provides information to analyze operations

Disadvantages

- May reduce employee motivation if the standards are too high or low
- Time involved in setting standards and analyzing variances
- Incorrect standards could result in inappropriate employee rewards or penalties

Q1: Variance Analysis

- The difference between an actual cost and the standard cost of producing goods or services at the *actual volume level* is called a standard cost variance.

- Managers investigate the reasons for standard cost variances so that:
  - efficiencies can be rewarded and replicated,
  - inefficiencies can be minimized, and
  - the validity of the standards can be assessed.

Q1: Variance Analysis in Diagnostic Control System

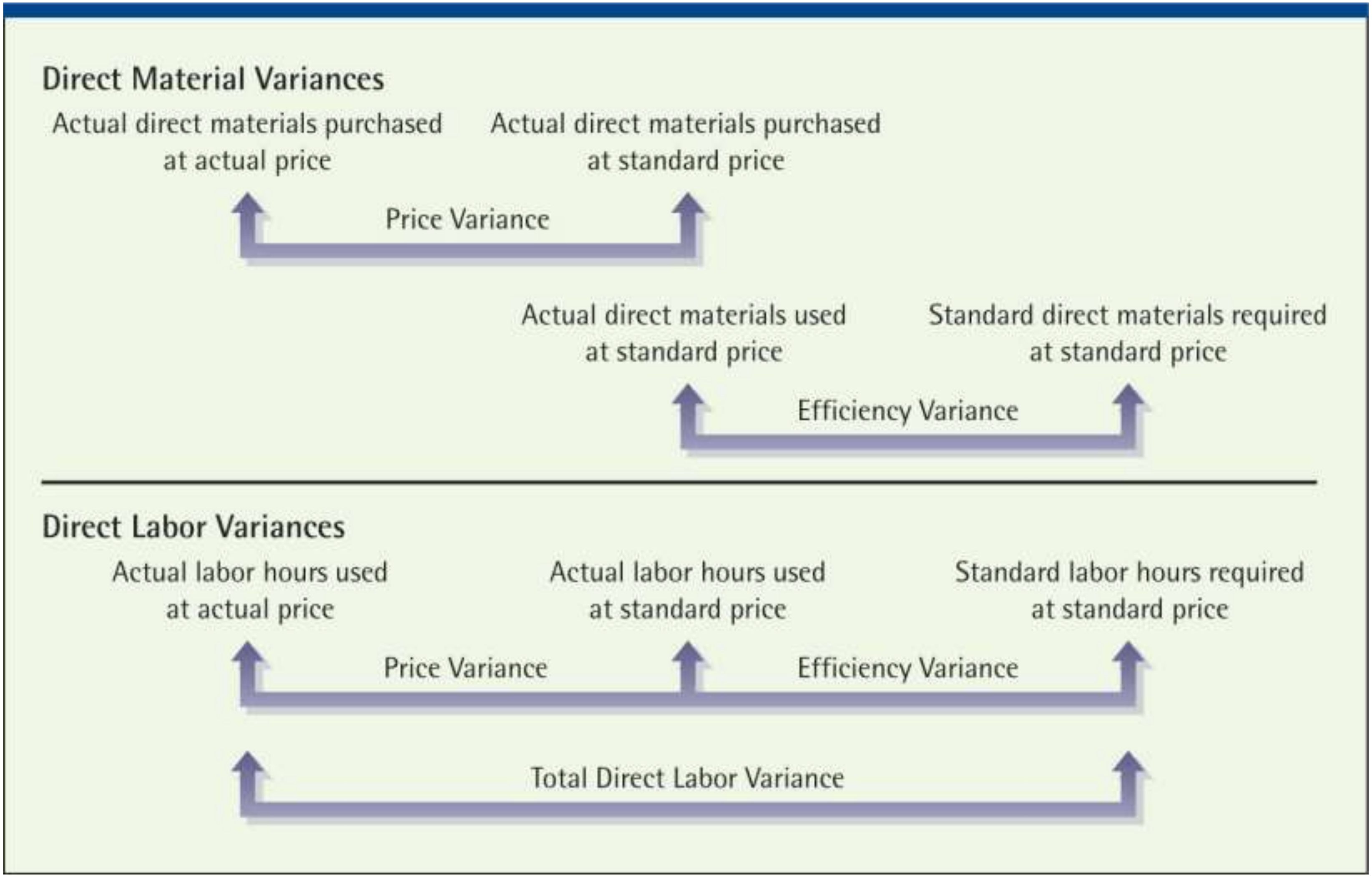
- Investigating Variances
  - Must decide what amount of variance needs to be investigated (% of budget, given $ amount)
  - Trends in variances should also be considered
  - Separating variances into component parts improves analysis
- Conclusions and Actions
  - After determining reasons for variances, managers need to draw conclusions about what happened
  - Determine if corrective action is required
  - Must consider behavioral implications and employee incentives to ensure standards are promoting overall success

Q3: Direct Cost Variances

- A price variance is the difference between the standard cost of resources purchased (or that should have been consumed) and the actual cost.

- An efficiency variance measures whether inputs were used efficiently.
  - It is the difference between the inputs used and the inputs that should have been used, times the standard price of the input

Q3: Direct Cost Variances



Q3: Direct Labor Cost Variances

- The direct labor price and efficiency variances are a decomposition of the direct labor flexible budget variance.

- The year-end flexible budget direct labor cost is based on the standard direct labor hours for the actual output, or standard quantity allowed (SQA).

- Other abbreviations used:
  - SP = standard price of the input
  - AP = actual price of the input
  - AQ = actual quantity of the input used

Q3: Direct Labor Cost Variances

The direct labor price and efficiency variances are a decomposition of the direct labor flexible budget variance.

Year-end flexible budget		Year-end actual results
SQA x SP	AQ x SP	AQ x AP

DLEV = [SQA – AQ] x SP

DLPV = [SP – AP] x AQ

DL efficiency variance

DL price variance

DL flexible budget variance

Q3: Direct Labor Cost Variances Example

Matthews Manufacturing makes a product that is expected to use ¼ hour of direct labor to produce. At the beginning of the year Matthews expected to produce 10,000 units. Actual production, however, was 9,800 units. The standard price of direct labor is $10/hour. Actual direct labor costs were $24,696 for the 2,520 labor hours used. Compute the direct labor cost variances.

First compute SQA for direct labor:

SQA = 9,800 units x ¼ hour/unit = 2,450 hours

Then compute AP for direct labor:

AP = $24,696/2,520 hours = $9.80/hour

DLPV = [SP – AP] x AQ = [$10/hour - $9.80/hour] x 2,520 hours = $504F

DLEV = [SQA – AQ] x SP = [2,450 hours - 2,520 hours] x $10/hour = $700U

Note that the DL FBV = $504F + $700U = $196U

Q4: Direct Labor Cost Variances Example

What are some possible explanations for the direct labor cost variances of Matthews Manufacturing?

- The favorable price variance could be due to:
  - an incorrect standard price,
  - using a higher percentage of lower-paid workers than expected, or
  - a favorable renegotiation of a labor contract.
- The unfavorable efficiency variance could be due to:
  - an incorrect standard quantity for labor,
  - inefficiency of direct labor personnel,
  - unexpected problems with machinery, or
  - lower quality of inputs that were more difficult to use.

Q3: Direct Material Cost Variances

- The direct materials and direct labor efficiency variances are computed in the same fashion.
- The direct material price variance is computed slightly differently than the direct labor price variance.
- Direct materials can be purchased and stored, and direct labor is consumed as it is purchased.
- The direct materials price and efficiency variances do not sum to the direct material flexible budget variance when there are any direct materials inventories.

Q3: Direct Material Cost Variances

The direct material price variance is based on the actual quantity of direct materials purchased, not the actual quantity of direct materials used.

Year-end flexible budget

SQA x SP | AQ x SP

DMEV = [SQA – AQ] x SP

DM efficiency variance

Remember that AQ=Actual quantity used, not actual quantity purchased.

Actual Quantity Purchased x SP | Actual Quantity Purchased x AP

DMPV = [SP – AP] x Actual Quantity Purchased

DM price variance

Q3: Direct Material Cost Variances Example

Matthews Manufacturing makes a product that is expected to use 2 pounds of direct material to produce. At the beginning of the year Matthews expected to produce 10,000 units. Actual production, however, was 9,800 units. The standard price of direct materials is $3/pound. Matthews purchased 20,500 pounds of direct material at $3.10/pound, and used 19,400 pounds. Compute the direct material cost variances.

First compute SQA for direct materials:

SQA = 9,800 units x 2 pounds/unit = 19,600 pounds

DMPV = [SP – AP] x Actual Quantity Purchased =

[$3/pound - $3.10/pound] x 20,500 pounds = $2,050U

DMEV = [SQA – AQ] x SP =

[19,600 pounds - 19,400 pounds] x $3/pound = $600F

Q4: Direct Material Cost Variances Example

What are some possible explanations for the direct material cost variances of Matthews Manufacturing?

- The unfavorable price variance could be due to:
  - an incorrect standard price,
  - an unexpected price increase from a supplier, or
  - the purchase of higher quality materials.
- The favorable efficiency variance could be due to:
  - an incorrect standard quantity for material,
  - efficient use of direct materials during production, or
  - less waste of direct materials due to higher material quality.

Q3: Recording Direct Cost Variances

- The direct material price variance is recorded when the materials are purchased.
- The direct material efficiency variance is recorded when the materials are used in production.
- The direct labor price and efficiency variances are recorded when labor is used in production.
- Work in process inventory is debited for the standard cost of the inputs that should have been used to produce the actual quantity of outputs (SP x SQA).

Q3: Recording Direct Labor Cost Variances

The journal entry to record the use of direct labor is:

dr. Work in process inventory	SP x SQA
dr. or cr. DLEV	[SQA-AQ] x SP
dr. or cr. DLPV	[SP-AP] x AQ
cr. Accrued payroll	AP x AQ

Unfavorable variances are debited to the variance accounts and favorable variances are credited to the variance accounts.

Q3: Recording Direct Labor Cost Variances Example

Prepare a summary journal entry to record the direct labor costs for Matthews Manufacturing, including the direct labor cost variances. Refer to slide #8.

dr. Work in process inventory	24,500	
[2,450 hrs x $10/hr]		
dr. DLEV	700	
[(2,450 hrs – 2,520 hrs) x $10/hr]		
cr. DLPV		504
[($10/hr - $9.80/hr) x 2,520 hrs]		
cr. Accrued payroll		24,696
[given]		

Q3: Recording Direct Material Cost Variances

The journal entry to record the purchase of direct materials is:

dr. Raw materials inventory	SP x Actual Qty Purch'd
dr. or cr. DMPV	[SP–AP] x Actual Qty Purch'd
cr. Accounts payable	AP x Actual Qty Purch'd

The journal entry to record the use of direct materials is:

dr. Work in process inventory	SP x SQA
dr. or cr. DMEV	[SQA-AQ] x SP
cr. Raw materials inventory	SP x AQ

Q3: Recording Direct Material Cost Variances Example

Prepare summary journal entries to record the purchase and the use of direct material for Matthews Manufacturing, including the direct material cost variances. Refer to slide #12.

The journal entry to record the purchase of direct materials is:

dr. Raw materials inventory [$3/lb x 20,500 lbs]	61,500	
dr. DMPV [($3/lb –$3.10/lb) x 20,500 lbs]	2,050	
cr. Accounts payable [$3.10/lb x 20,500 lbs]		63,550

The journal entry to record the use of direct materials is:

dr. Work in process inventory [$3/lb X 19,600 lbs]	58,800	
cr. DMEV [(19,600 lbs – 19,400 lbs) x $3/lb]		600
cr. Raw materials inventory [19,400 lbs x $3/lb]		58,200

Q5: Allocating Overhead Costs

- Chapter 5 covered the allocation of overhead to units of production.
- Estimated overhead rates are calculated for both fixed and variable overhead.

$$\text{Standard variable overhead allocation rate} = \frac{\text{Estimated variable overhead costs}}{\text{Estimated volume of an overhead allocation base}}$$

$$\text{Standard fixed overhead allocation rate} = \frac{\text{Estimated fixed overhead costs}}{\text{Estimated volume of an overhead allocation base}}$$

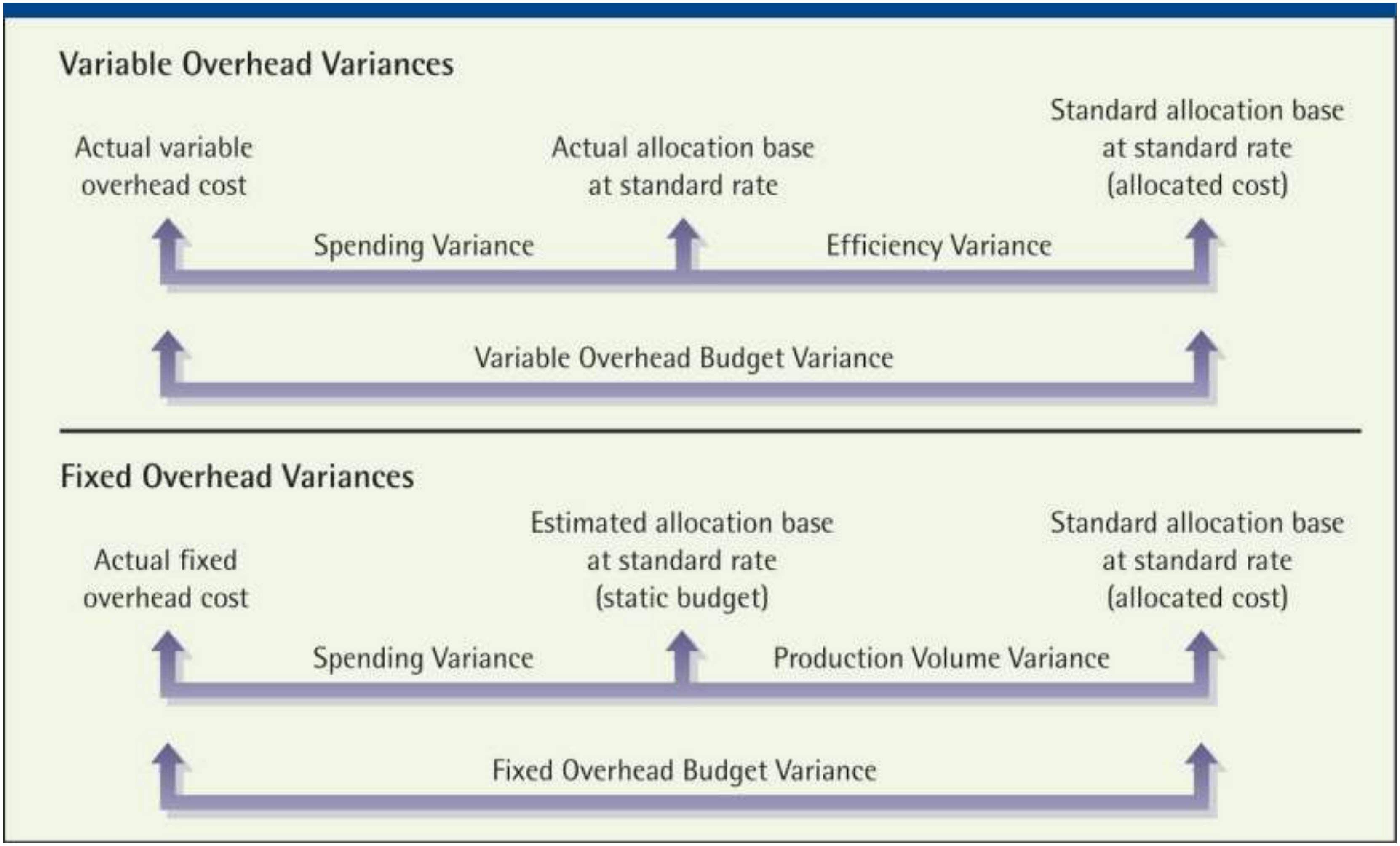
Q5: Overhead Cost Management

- For both variable and fixed overhead, cost management includes reducing non-value-added costs.

- For each variable overhead cost pool, cost management includes reducing the consumption of the related cost allocation base.

- For fixed overhead, cost management involves a trade-off between insufficient and excess capacity.

Q5: Overhead Cost Variances



Q5: Variable Overhead Cost Variances

- The variable overhead cost variances are computed in the same fashion as the direct labor cost variances.
- The variable overhead spending variance is similar to the direct labor price variance.
- The variable overhead efficiency variance is similar to the direct labor efficiency variance.
- The variable overhead (flexible) budget variance is the sum of these two variable overhead variances.

Q5: Variable Overhead Cost Variances

The standard quantity allowed (SQA) in the variable overhead cost variance calculations is the quantity of the variable overhead allocation base that should have been used to produce the actual output. SR is the standard variable overhead allocation rate.

Year-end flexible budget		Year-end actual results
SQA x SR	AQ x SR	Total actual VO

VOEV = [SQA – AQ] x SR

VOSV = [AQ x SR] – actual VO

VO efficiency variance

VO spending variance

VO flexible budget variance

Q5: Variable Overhead Cost Variances Example

Matthews Manufacturing makes a product that is expected to use ¼ hour of direct labor to produce. At the beginning of the year Matthews expected to produce 10,000 units. Actual production, however, was 9,800 units. The estimated variable overhead allocation rate is $4 per direct labor hour, actual variable overhead costs were $10,450, and actual direct labor hours were 2,520. Compute the variable overhead cost variances.

First compute SQA for direct labor, the VO cost allocation base:

SQA = 9,800 units x ¼ hour/unit = 2,450 hours

VOEV = [SQA – AQ] x SR = [2,450 hours - 2,520 hours] x $4/hour = $280U

VOSV = AQ x SR – actual VO = 2,520 hrs x $4/hr - $10,450 = $370U

Note that the VO FBV = $280U + $370U = $650U

Q6: Variable Overhead Cost Variances Example

What are some possible explanations for the variable overhead cost variances of Matthews Manufacturing?

- The favorable spending variance could be due to:
  - an incorrect standard variable overhead rate per direct labor hour,
  - lower prices than expected for the components of the variable overhead cost pool (e.g. a lower price per quart of machine oil), or
  - lower consumption than expected of the components of the variable overhead cost pool (e.g. less indirect labor used per direct labor hour).
- The unfavorable efficiency variance could be due to:
  - an incorrect standard quantity for labor,
  - inefficiency of direct labor personnel,
  - unexpected problems with machinery, or
  - lower quality of inputs that were more difficult to use.

Q5: Recording Variable Overhead Cost Variances

The summary entry to record the incurrence of variable overhead costs is:

dr. Variable overhead cost control	Actual VO costs
cr. Various accounts	Actual VO costs

The summary entry to record the allocation of variable overhead costs is:

dr. Work in process inventory	SR x SQA
cr. Variable overhead cost control	SR x SQA

The year-end entry to close the Variable overhead cost control and record the variable overhead cost variances will:

- close the Variable overhead cost control account with a debit or credit, whichever is required, and
- debit (credit) the Variable overhead spending variance and Variable overhead efficiency variance accounts for unfavorable (favorable) variances.

Q3: Recording Variable Overhead Cost Variances Example

Prepare summary journal entries to record the incurrence of and the allocation to work in process of variable overhead costs for Matthews Manufacturing. Also prepare the year-end entry to close variable overhead control and record the variances. Refer to slide #22.

The journal entry to record the incurrence of variable overhead costs is:

dr. Variable overhead cost control	10,450	
cr. Various accounts		10,450

The journal entry to record the allocation of variable overhead is:

dr. Work in process inventory [$4/hr X 2,450 hrs]	9,800	
cr. Variable overhead cost control		9,800

The year-end entry to close the Variable overhead cost control account is:

dr. VOSV	280	
dr. VOEV	370	
cr. Variable overhead cost control		650

Q5: Fixed Overhead Cost Variances

- The fixed overhead spending variance is the same as the fixed overhead (flexible) budget variance.
- There is no fixed overhead efficiency variance because changes in the quantity of the fixed overhead allocation base do not cause changes in actual total fixed overhead costs.
- The production volume variance occurs when actual volume is different than the static budget estimated volume.

Q5: The Production Volume Variance

- Allocating fixed overhead to production using a standard rate per unit of a cost allocation base treats fixed overhead as a variable cost for bookkeeping purposes.

- Since fixed overhead is not a variable cost, the fixed overhead allocated to production will differ from budgeted fixed overhead when actual volume differs from static budget estimated volume.

- The production volume variance is favorable (unfavorable) when actual volume exceeds (is less than) static budget estimated volume.

Q5: Fixed Overhead Cost Variances

The standard quantity allowed (SQA) in the fixed overhead cost variance calculations is the quantity of the fixed overhead allocation base that should have been used to produce the actual output. SR is the standard fixed overhead allocation rate.

Allocated fixed overhead	Static & year-end budget	Year-end actual results
SQA x SR	Estimated FO	Total actual FO

FOPVV = [SQA x SR] – estimated FO

FOSV = Estimated FO – actual FO

FO production volume variance

FO spending variance

Total FO budget variance

Q5: Fixed Overhead Cost Variances Example

Matthews Manufacturing makes a product that is expected to use 1.2 machine hours to produce. At the beginning of the year Matthews expected to produce 10,000 units. Actual production, however, was 9,800 units. Estimated fixed overhead at the beginning of the year was $60,000 and actual fixed overhead was $58,100. Actual machine hours for the year totaled 12,200 hours. Compute the fixed overhead cost variances.

First compute SQA for machine hours:

SQA = 9,800 units x 1.2 hours/unit = 11,760 hours

Next compute the estimated fixed overhead rate per machine hour:

SR = $60,000/[10,000 units x 1.2 hrs/unit] = $5/hr

FOSV = Estimated FO – actual FO = $60,000 - $58,100 = $1,900F

FOPVV = SQA x SR – estimated FO =

11,760 hours x $5/hr - $60,000 = $1,200U

Q6: Fixed Overhead Cost Variances Example

What are some possible explanations for the fixed overhead cost variances of Matthews Manufacturing?

- The favorable spending variance could be due to:
  - an incorrect estimate for fixed overhead costs,
  - a decision to forgo a budgeted discretionary fixed cost, or
  - a favorable renegotiation of leasing agreements.
- The unfavorable production volume variance is due to:
  - an actual volume level that is less than the static budget volume level.

Q5: Recording Fixed Overhead Cost Variances

The summary entry to record the incurrence of fixed overhead costs is:

dr. Fixed overhead cost control	Actual FO costs
cr. Various accounts	Actual FO costs

The summary entry to record the allocation of fixed overhead costs is:

dr. Work in process inventory	SR x SQA
cr. Fixed overhead cost control	SR x SQA

The year-end entry to close the fixed overhead cost control and record the fixed overhead cost variances will:

- close the Fixed overhead cost control account with a debit or credit, whichever is required, and
- debit (credit) the fixed overhead production volume variance and fixed overhead spending variance accounts for unfavorable (favorable) variances.

Q5: Recording Fixed Overhead Cost Variances Example

Prepare summary journal entries to record the incurrence of and the allocation to work in process of fixed overhead costs for Matthews Manufacturing. Also prepare the year-end entry to close Fixed overhead control and record the variances. Refer to slide #29.

The journal entry to record the incurrence of variable overhead costs is:

dr. Fixed overhead cost control	58,100	
cr. Various accounts		58,100

The journal entry to record the allocation of fixed overhead is:

dr. Work in process inventory [$5/hr x 11,760 hrs]	58,800	
cr. Fixed overhead cost control		58,800

The year-end entry to close the fixed overhead cost control account is:

dr. Fixed overhead cost control	700	
dr. Fixed overhead production volume variance	1,200	
cr. Fixed overhead spending variance		1,900

Q7: Closing Manufacturing Variances

- At the end of the year, all eight variance accounts are closed out to Work in process inventory, Finished goods inventory, and Cost of goods sold.

- The net of the variance accounts is generally prorated to the three accounts using a ratio of the accounts' ending balances.

- Technically, a portion of the direct materials price variance should also be allocated to Raw materials inventory, but this complication is ignored here.

Q8: Revenue Budget Variance

- The revenue budget variance measures the difference between actual revenues and static budget revenues, and has two components:
  - The sales price variance is due to the difference between actual average selling price and the budgeted selling price per unit.
  - The revenue sales quantity variance is due to the difference between the actual number and the budgeted number of units sold.

Q8: Revenue Budget Variance

ASP is the actual average selling price per unit; BSP is the budgeted selling price from the static budget.

Actual revenue		Static budget revenue
ASP x actual units sold	BSP x actual units sold	BSP x budgeted unit sales

[ASP – BSP] x actual units sold | [Actual – budgeted units] x BSP

Sales price variance

Revenue sales quantity variance

Revenue budget variance

Q7: Revenue Budget Variance Example

Matthews Manufacturing makes a product with a budgeted selling price of \$15/unit. At the beginning of the year Matthews expected to sell 10,000 units. Actual sales, however, were 9,800 units, and actual revenue was \$156,800. Compute the revenue budget variances.

First compute the actual average selling price per unit:

ASP = \$156,800/9,800 units = \$16/unit

Sales price variance = [\$16/unit - \$15/unit] x 9,800 units = \$9,800F

Revenue sales quantity variance =
[9,800 units – 10,000 units] x \$15/unit = \$3,000U

Note the revenue budget variance is \$9,800F + \$3,000U = \$6,800F

Q8: Contribution Margin Budget Variance

- The contribution margin budget variance measures the difference between actual contribution margin and the contribution margin budgeted at the beginning of the year. It has two components:
  - The contribution margin variance is the difference between the actual contribution margin and the budgeted contribution margin in in the year-end flexible budget (which is based on actual sales levels).
  - The contribution margin sales volume variance is difference budgeted contribution margin at the beginning of the year and the budgeted contribution margin in the year-end flexible budget.

Q8: Contribution Margin Sales Volume Variance

- When a company sells more than one product, the contribution margin sales volume variance itself has two components:
  - The contribution margin sales mix variance is the portion of the contribution margin sales volume variance caused by a change in the sales mix from the budgeted mix.
  - The contribution margin sales quantity variance is the portion of the contribution margin sales volume variance caused by the difference between budgeted total unit sales at the beginning of the year and actual total unit sales.

Q7: Profit-Related Variances Example

Matthews Manufacturing produces three products, Alpha, Beta, and Gamma. You are given the following information from Matthews' static budget:

Product	Budgeted Selling Price Per Unit	Budgeted CM per Unit	Static Budget Unit Sales	Static Budget Revenue	Static Budget Total CM	Static Budget Sales Mix
Alpha	$20.00	$12.00	3,000	$60,000	$36,000	30%
Beta	$15.00	$9.00	4,500	$67,500	$40,500	45%
Gamma	$12.00	$3.00	2,500	$30,000	$7,500	25%
			10,000	$157,500	$84,000	100%

Q7: Profit-Related Variances Example

You are given below the actual results for Matthews Manufacturing. Compute the revenue budget variances.

Product	Actual Selling Price Per Unit	Actual CM per Unit	Actual Unit Sales	Actual Revenue	Actual Total CM	Actual Sales Mix
Alpha	$22.00	$13.00	3,350	$73,700	$43,550	30.45%
Beta	$12.00	$5.00	6,000	$72,000	$30,000	54.55%
Gamma	$13.00	$3.00	1,650	$21,450	$4,950	15.00%
			11,000	$167,150	$78,500	100.00%

Total Actual Revenue	Actual Units Sold Times Budgeted Selling Price	Total Static Budget Revenue
$167,150	$176,800	$157,500

Sales Price Variance
$9,650 Favorable

Revenue Sales Quantity Variance
$19,300 Unfavorable

Revenue Budget Variance
$9,650 Unfavorable

Q7: Profit-Related Variances Example

Use the given information on the prior two slides to compute all of the contribution margin budget variances for Matthews Manufacturing.

Total Static Budget CM	Actual Total Units Sold Times Static Budget Sales Mix Times Static Budget CM per Unit	Actual Total Units Sold Times Actual Sales Mix Times Static Budget CM per Unit	Units Sold Times Actual Sales Mix Times Actual CM
$84,000	$92,400	$99,150	$78,500

CM Sales Quantity Variance: $8,400 Favorable

CM Sales Mix Variance: $6,750 Favorable

CM Sales Volume Variance: $15,150 Favorable

CM Variance: $20,650 Favorable

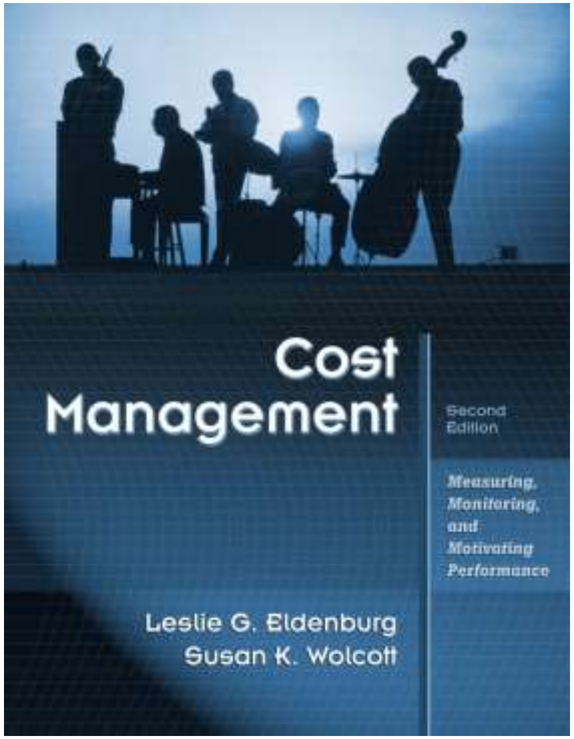
CM Budget Variance: $5,500 Unfavorable

Cost Management

Measuring, Monitoring, and Motivating Performance

Chapter 15

Performance Evaluation and Compensation



Learning objectives

- Q1: What is agency theory?
- Q2: How are decision-making responsibility and authority related to performance evaluation?
- Q3: How are responsibility centers used to measure, monitor, and motivate performance?
- Q4: How do return on investment, residual income, and economic value added affect managers' incentives and decisions?
- Q5: How is compensation used to motivate performance?
- Q6: What prices are used for transferring goods and services within an organization?
- Q7: How do transfer prices affect managers' incentives and decisions?

Q1: Agency Theory

- In agency theory, a principal contracts with an agent to act on his or her behalf.
- The principal can observe the outcome of the agent's actions, but cannot observe the agent's behavior or effort level.
- The costs or lost benefits the principal suffers when the agent does not act in the best interests of the principal are called agency costs.

Q1: Agency Costs

- Agency Costs include:
  - Losses from poor decisions
  - Losses from incongruent goals
  - Monitoring costs
  - Goal alignment costs
  - Contracting costs
- The principal must design plan to minimize agency costs.
  - Utilize well designed compensation schemes
  - Assign responsibility for decision making
  - Establish appropriate transfer prices

Q2: Decision Making Responsibility

- In a centralized organization, decision making authority and responsibility resides with top management.
- In a decentralized organization, decision making authority and responsibility is given to lower levels of management.
- Usually, top management has general knowledge about the operations of business segments and the business segment managers have specific knowledge.

Q2: Centralized Organizations

- The advantages of a centralized organizational structure include:
  - reduced monitoring costs, and
  - increased assurance that lower managers act in the best interests of the organization.
- The disadvantages of a centralized organizational structure include:
  - increased time to make decisions while top management gathers information about business segments, and
  - increased potential for lower quality decisions

Q2: Decentralized Organizations

- The advantages of a decentralized organizational structure include:
  - more timely decisions,
  - increased potential for higher quality decisions, and
  - top management is free to concentrate on organization's strategic goals.
- The disadvantages of a decentralized organizational structure include:
  - the possibility that the business segments are duplicating each others' efforts, and
  - segment managers may make decisions incongruent with the goals of the organization.

Q3: Responsibility Accounting

- Responsibility accounting assigns costs and revenues to business segments based on the areas over which the segment managers have decision making authority and responsibility.

- The revenues and costs assigned to a responsibility center are based on the elements over which the center's manager has control.

Q3: Cost Centers

- Managers of cost centers have responsibility only for managing the center's costs.
- Many support departments are cost centers, for example:
  - Human resource department
  - Accounting department
- These managers may only have responsibility for some of the center's costs and not for others.

Q3: Revenue Centers

- Managers of revenue centers have responsibility for generating revenues.
- These managers usually have the authority to determine the prices of goods sold.
- Revenue center managers are held responsible for the volume of sales.
- A marketing department or a geographical sales region are examples of revenue centers.

Q3: Profit Centers

- Managers of profit centers have responsibility for generating revenues and controlling costs.

- These managers usually have the authority to determine prices, the sales mix of goods sold, and the inputs used.

- A manufacturing division is an example of a profit center, and it will have both revenue and cost centers within the division.

Q3: Investment Centers

- Managers of investment centers have responsibility for generating revenues and controlling costs.
- These managers usually have the same authority as do profit center managers, in addition to the authority to make asset acquisition and disposition decisions.
- A manufacturing division with a manager allowed to purchase large machinery and perhaps build more factory space is an example of an investment center.

Q4: Performance Evaluation of Investment Centers

- Return on investment (ROI) shows the percentage return the center made on the investment level chosen.
- Residual income (RI) shows the dollar amount the center earned above the minimum required for the center's investment level.
- Economic value added (EVA®) is a specific type of residual income calculation.
- ROI can be used to compare the performance of different-sized business segments, but RI and EVA® can not.

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Q4: Return on Investment (ROI)

- ROI is simply calculated as “earnings” over “investment”.
- “Earnings” and “investment” must be defined; often, earnings is defined as operating income and investment is defined as average operating assets, so that

$$\text{ROI} = \frac{\text{Operating income}}{\text{Average operating assets}}$$

- Operating assets include cash, A/R, inventory, and the property and equipment used in producing the revenue.

Q4: DuPont Analysis

- DuPont analysis is a particularly useful decomposition of ROI.

ROI = Investment turnover x Return on sales

where: $$\text{Investment turnover} = \frac{\text{Revenue}}{\text{Average operating assets}}$$

and $$\text{Return on sales} = \frac{\text{Operating income}}{\text{Revenue}}$$

- DuPont analysis can be used to determine ways that ROI can be improved.

Q4: ROI Example

Altus Industries has two divisions, North and South. Given the information below, compute the ROI for each division.

	North	South
Operating income	$180,000	$40,000
After-tax operating income	120,000	24,000
Average operating assets	2,000,000	200,000
Average current liabilities	400,000	36,000
Net sales	2,600,000	100,000

North ROI = $180,000/$2,000,000 = 9%

South ROI = $40,000/$200,000 = 20%

Q4: ROI and DuPont Analysis Example

Altus Industries has two divisions, North and South. Use DuPont analysis to decompose the ROI for each divisions and discuss.

	North	South
Operating income	$180,000	$40,000
After-tax operating income	120,000	24,000
Average operating assets	2,000,000	200,000
Average current liabilities	400,000	36,000
Net sales	2,600,000	100,000

	North	South
Return on sales (ROS)	6.92%	40.00%
Investment turnover (ITO)	1.30	0.50
ROI (ROS x ITO)	9.0%	20.0%

North does a better job of using its asset base to generate sales than does South. However, South does a better job of turning sales dollars into operating income than does North.

Q4: ROI and New Projects Example

Suppose that Altus has a minimum required rate of return for all investments of 10%. Each division is considering a new project. The expected return and initial investment of each project is shown below. If ROI is used to evaluate division performance, will each division accept or reject the new project? Are these decisions in line with the best interests of Altus?

	North	South
Project income	$7,500	$2,250
Project investment	$80,000	$15,000
Project ROI	9.38%	15.00%

North will decide to accept the project because it will increase division ROI. However, this is not in line with the organization's best interests because investments with an ROI less than 10% should not be accepted.

South will decide to reject the project because it will decrease division ROI. However, this is not in line with the organization's best interests because investments with an ROI exceeding 10% should be accepted.

Q4: Residual Income (RI)

- RI is operating income less the minimum required operating income given the segment's investment in assets.

$$\text{RI} = \text{Operating income} - \left(\begin{array}{c}\text{Required} \\ \text{rate of} \\ \text{return}\end{array} \times \begin{array}{c}\text{Average} \\ \text{operating} \\ \text{assets}\end{array} \right)$$

- RI removes the incentive for business segment managers to make project investment decisions based on a comparison of segment ROI and project ROI.

Q4: RI Example

Altus Industries has two divisions, North and South. Given the information below, compute the RI for each division. Suppose that Altus has a minimum required rate of return of 10%. How is this related to ROI?

	North	South
Operating income	$180,000	$40,000
After-tax operating income	120,000	24,000
Average operating assets	2,000,000	200,000
Average current liabilities	400,000	36,000
Net sales	2,600,000	100,000

North RI = $180,000 – 10% x $2,000,000 = ($20,000)

South RI = $40,000 – 10% x $200,000 = $20,000

North had an ROI less than the 10% minimum required, which translates to a negative residual income. South's ROI exceeded the 10% minimum, so it had a positive RI.

Q4: RI and New Projects Example

If RI is used to evaluate division performance, will each division accept or reject the new project? Are these decisions in line with the best interests of Altus? The minimum required rate of return for all investments of 10%.

	North	South
Project income	$7,500	$2,250
Project investment	$80,000	$15,000
Project ROI	9.38%	15.00%

North would reject the project because $7,500 – 10% x $80,000 < 0. If North accepted the project, its new RI would be:

[$180,000 + $7,500] – 10% x [$2,000,000 + $80,000] = ($20,500).

South would accept the project because $2,250 – 10% x $15,000 > 0. If South accepted the project, its new RI would be:

[$40,000 + $2,250] – 10% x [$200,000 + $15,000] = $20,750.

Each division's decision is in line with Altus' best interest.

Q4: Economic Value Added (EVA®)

- EVA® is a residual income calculation with specific definitions of income, investment and rate of return.
- Income is defined as "adjusted" after-tax operating income.
- The required rate of return is defined as the weighted average cost of capital (WACC).
- Operating assets is defined as "adjusted" total assets less current liabilities.
- EVA®'s "adjustments" are specific to the organization's structure and goals.

Q4: Weighted Average Cost of Capital (WACC)

- WACC is a weighted average of the after-tax cost of debt and the cost of equity.
- WACC is the after-tax cost of all long-term financing for the business segment.
- Business segments in riskier industries will have a higher WACC.

Q4: EVA® Example

Altus Industries has two divisions, North and South. Given the information below, compute the EVA® for each division. Assume that the North Division has a WACC of 5% and that South Division has a WACC of 18%.

	North	South
Operating income	$180,000	$40,000
After-tax operating income	120,000	24,000
Average operating assets	2,000,000	200,000
Average current liabilities	400,000	36,000
Net sales	2,600,000	100,000

North EVA® = $120,000 – 5% x [$2,000,000 - $400,000] = $40,000

South EVA® = $24,000 – 18% x [$200,000 - $36,000] = ($5,520)

Q5: Using Compensation to Motivate Performance

- Base salaries plus bonuses based on operating income focuses manager attention on short-term goals.
- Base salaries plus stock options may focus manager attention on longer-term goals.
- Stock options are used frequently in the U.S. but are discouraged from use in some other countries.

Q6: Transfer Prices

- Goods or services transferred between the segments of an organization are known as intermediate products.
- Performance evaluation of the business segments can be affected.
- Organizations set transfer prices on these goods and services.
- Transfer prices are eliminated during the preparation of consolidated financial statements, so they have no effect on an organization's income.

Q6: Cost-Based Transfer Prices

- Cost-based transfer prices are based on a specific definition of the cost of the intermediate product.
- When the cost includes an allocation for fixed costs, and the transferring segment has the opportunity to sell to external customers, this may lead to suboptimal decisions for the organization.
- When the transferring segment does not have external customers, this reduces the transferring segment's incentives to reduce costs.

Q6: Activity-Based Transfer Prices

- Activity-based transfer prices are based on the unit-level and batch-level costs of the intermediate product plus a percentage of the producing department's facility-level costs.

- When the purchasing department's annual requirements for the intermediate product are known in advance, the transferring segment's planning is improved.

Q6: Market-Based Transfer Prices

- Market-based transfer prices are useful when there is a highly competitive market for the intermediate product.

- The producing department can opt to sell most or its entire intermediate product to external customers.

Q6: Dual-Rate Transfer Prices

- When dual-rate transfer prices are used, the producing department's selling price is different than the purchasing department's purchase price.

- Dual-rate transfer prices are useful to motivate appropriate manager behavior for both departments.

Q6: Negotiated Transfer Prices

- In some cases, managers of the producing and purchasing departments meet to exchange information and determine the transfer price.

- The resultant transfer price is called a negotiated transfer price.

Q6: Minimum Transfer Price

- From the standpoint of the producing division, the lowest acceptable transfer price is one that covers the variable costs plus any contribution margin that is lost when the goods are not sold to external customers:

$$\text{Transfer price} \geq \text{Variable cost per unit} + \frac{\text{Total contribution margin on lost external sales}}{\text{Number of units transferred}}$$

- The lost contribution margin depends on whether the producing department has sufficient external customers to use its entire capacity.

Q6: Transfer Price Example

Shepard, Inc. has two divisions, East and West. East makes a component called XW3 that West uses in its production. East's capacity is 100,000 units of XW3 each month. The variable costs of producing XW3 are \$4/unit and East's fixed costs are \$150,000 per month. East can sell XW3 to external customers for \$6 and West can buy it from another supplier for \$6. West needs 20,000 units of XW3 per month. Compute the transfer price if East charges the full absorption cost. Suppose that East can sell 70,000 units to external customers. Will East and West agree to the transfer? Is the transfer in the best interests of Shepard?

Cost-based transfer price = \$4.00 + \$150,000/100,000 = \$5.50

East's minimum transfer price = \$4.00 + \$0 = \$4.00, because it has sufficient capacity to cover West's demand for the product.

Both divisions will agree to the transfer. It is in the best interests of Shepard because it only costs \$4.00 x 20,000 = \$80,000 for East to produce the units, but it would cost West \$6.00 x 20,000 = \$120,000 to get the units from an outside supplier.

Q6: Transfer Price Example

Shepard, Inc. has two divisions, East and West. East makes a component called XW3 that West uses in its production. East's capacity is 100,000 units of XW3 each month. The variable costs of producing XW3 are $4/unit and East's fixed costs are $150,000 per month. East can sell XW3 to external customers for $6 and West can buy it from another supplier for $6. West needs 20,000 units of XW3 per month. Suppose that East can sell 97,000 units to external customers. Compute the minimum transfer price East will accept. Will West agree to the transfer? Is the transfer in the best interests of Shepard?

East will lose sales of 17,000 units to regular customer if it transfers the units to West. The contribution margin on a regular customer is $6 - $4 = $2.

East's minimum transfer price = $4 + ($2 x 17,000)/20,000 = $5.70.

West will agree to this because $5.70 < $6. It is in the best interests of Shepard because it only costs $4 x 20,000 + {lost contribution margin of $2 x 17,000} = $114,000 for East to produce the units, but it would cost West $6.00 x 20,000 = $120,000 to get the units from an outside supplier.

Q7: Transfer Price Uses

- Organizations set transfer prices for products and services transferred between business segments.
- Transfer prices can also be set for corporate overhead costs.
- International organizations set transfer prices so that total taxes are minimized for the organization, subject to IRS regulations.