Contabilidade de Gestão Avançada
Planeamento e Controlo Orçamental

Conceitos e Exemplos

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A. Cost Management and Strategy

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IMA's New Definition of Management Accounting: a Focus on Strategy

Management accounting is a profession that involves partnering in management decision making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organization's strategy.

Introduction to Strategy

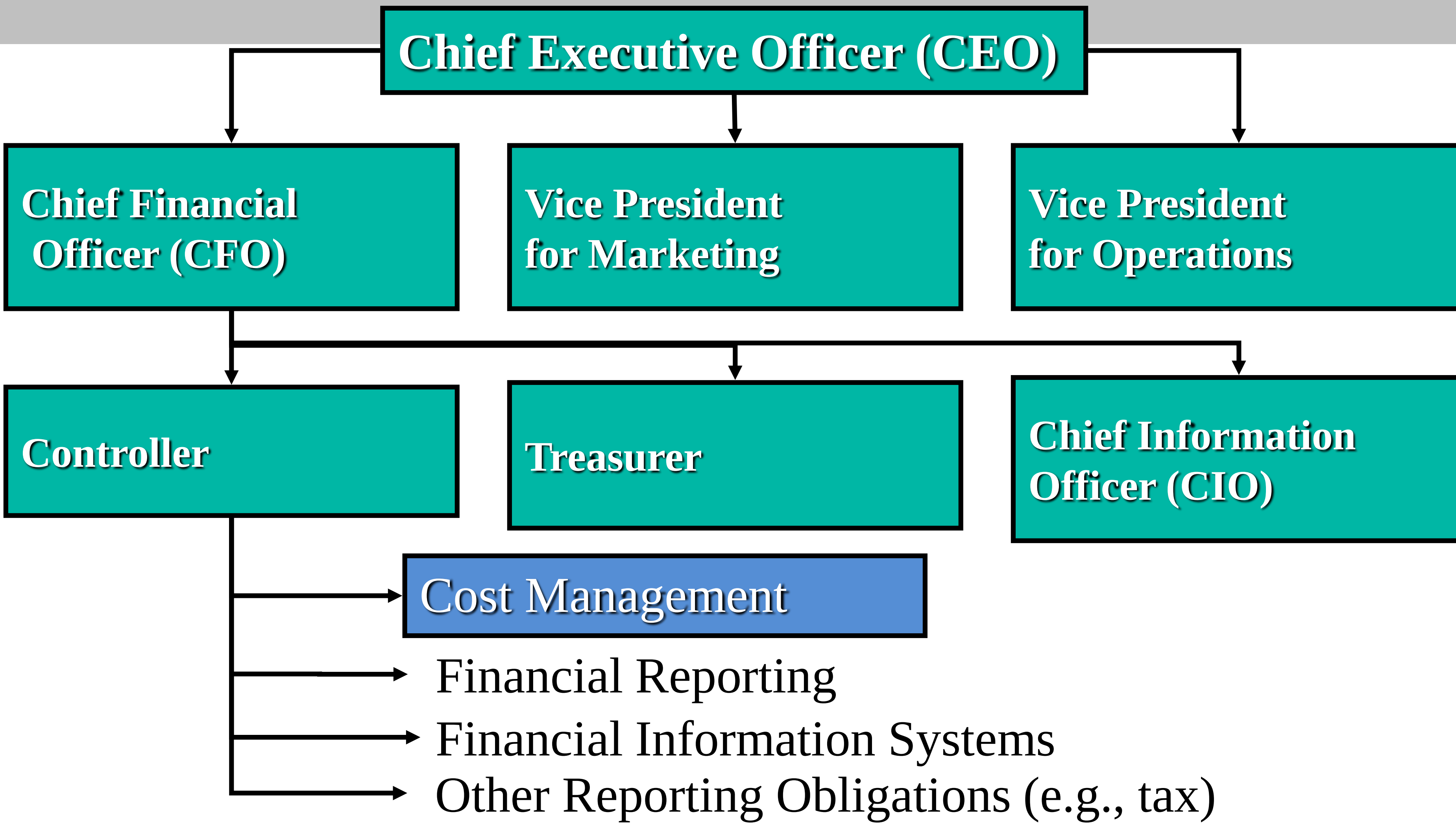
- **Success comes from developing and implementing an effective strategy aided by management accounting methods**
  – Clear mission statement
  – Strategy is a roadmap to achieve a company's mission
- **Management accountants can help a company be successful**
  – Key to success is having decision-relevant information

Cost Management Information

- **Serves all management functions**

- **Information a manager needs to manage effectively**
  - Financial and nonfinancial
    - Financial information alone shows a short-term focus
  - Developed under the direction of the controller for the Chief Financial Officer (CFO) of the organization

Typical Organization Chart



Cost Management vs. Financial Reporting

- **Financial reporting**
  - External users
  - Emphasis on accuracy and compliance
- **Cost management**
  - Internal users
  - Emphasis on usefulness and timeliness, key characteristics of decision-relevant information
- **Challenge for controller to reconcile these potentially conflicting roles**

Four Functions of Management

Cost management information is assembled to aid management in the following functions:

- Strategic management
- Planning and decision-making
- Management and operational control
- Preparation of financial statements

Management Functions

Strategic management

– Most important management function
– Involves identifying and implementing goals and action plans to maintain a competitive advantage
– Monitoring of Critical Success Factors (CSFs) is necessary
– Critical to a firm’s success due to global competition and rapidly changing markets

Management Functions (continued)

Planning and decision-making

- Information is needed to support recurring decisions such as scheduling production and pricing
- Information is needed for short-run planning (budgeting) and profit planning (Cost-Volume-Profit analysis)

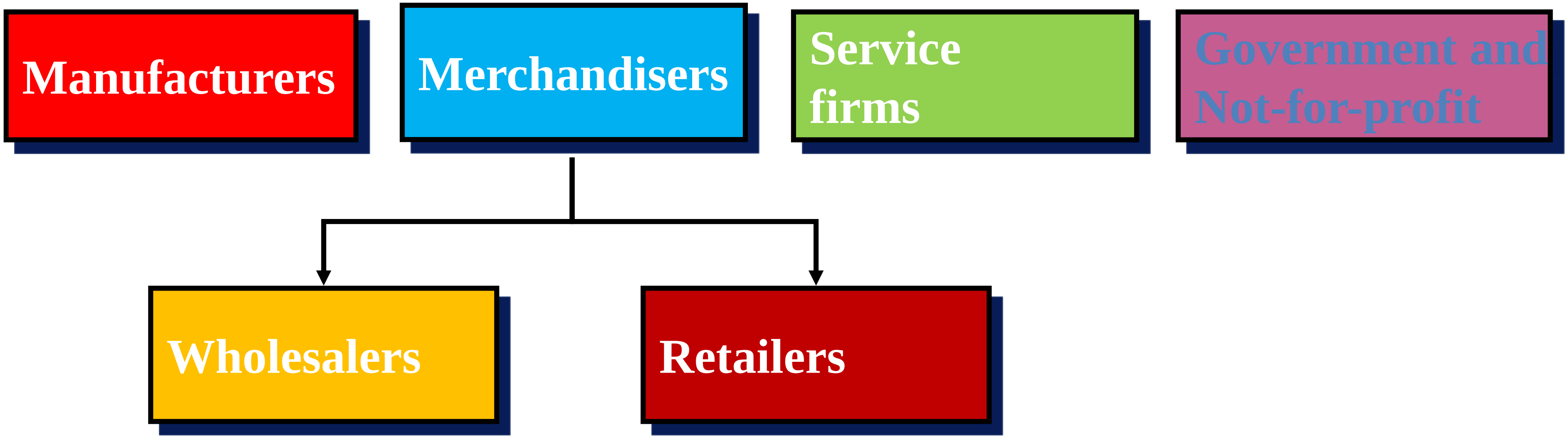
Management and operational control

- Information is needed to identify inefficient operations and reward effective management practices

Preparation of financial statements

- Information is needed to guarantee compliance with regulatory reporting requirements

Types of Organizations



Changes in the Contemporary Business Environment

1. **Shift to a global business environment**
   – Economic interdependence and increased competition
2. **Lean Manufacturing**
   – Just-in-time (JIT) inventory methods, inventory reduction and quality control
   – Emphasis on *speed-to-market* (i.e., time-based competition)
   – Flexible manufacturing systems

Changes in the Contemporary Business Environment (continued)

3. **Importance of information technology**
   – Increased use of the internet has reduced processing time and facilitated information exchange
4. **Focus on the customer**
   – Consumers expect functionality, quality and customization
   – Shorter product life-cycles have intensified competition

Changes in the Contemporary Business Environment (continued)

5. **Shifts in management organization**
   - The focus has shifted from financial measures and hierarchal command-and-control organizations to nonfinancial measures and flexible organizational structures
6. **Social, political, and cultural considerations**
   - Changes include a more diverse workforce, a renewed sense of ethical responsibility, and increased deregulation of business

The Strategic Focus of Cost Management: Kaplan's Phases for Developing Cost Management Systems

Stage One	Cost-management systems are basic transaction reporting systems
Stage Two	Cost-management systems focus on external reporting–decision-usefulness of cost-management data is limited
Stage Three	Cost-management systems track key operating data and relevant cost information for decision-making
Stage Four	Strategically relevant cost-management information is an integral part of the system

How do the Changes in The Contemporary Business Environment Affect Cost Management?

The management accountant's role:

- Provide strategically relevant cost management information to help the organization keep up with the ever-changing environment
- Thirteen Contemporary Management Techniques developed and employed by the management accountant

Contemporary Management Techniques

1. The Balanced Scorecard and Strategy Map
2. The Value Chain
3. Activity Based Costing and Management
4. Business Intelligence
5. Target Costing
6. Life Cycle Costing
7. Benchmarking
8. Business Process Improvement
9. Total Quality Management
10. Lean Accounting
11. The Theory of Constraints
12. Sustainability
13. Enterprise Risk Management

Contemporary Management Techniques (continued)

1. The Balanced Scorecard and the Strategy Map

- **The Balanced Scorecard (BSC)**
  - An accounting report that addresses a firm's performance in four areas: financial, customer, internal business processes, and innovation and learning
- **The Strategy Map**
  - The strategy map is a method, based on the balanced scorecard, which links the four perspectives in a cause-and-effect diagram.

Contemporary Management Techniques (continued)

2. The Value Chain

– An analysis tool used to identify the specific steps required to provide a competitive product

– Helps identify steps that can be eliminated or outsourced

3. Activity-Based Costing and Management

– Activity-Based Costing (ABC) improves the tracing of costs to individual products and customers

– Activity-Based Management (ABM) improves operational and management control

Contemporary Management Techniques (continued)

4. Business Intelligence

– an approach to strategy implementation in which the management accountant uses data to understand and analyze business performance.

5. Target Costing

– Target Cost = Market-determined price – Desired Profit

– A method that has resulted from intensely competitive markets

Contemporary Management Techniques (continued)

6. Life-Cycle Costing

- Costs should be monitored throughout a product's life cycle – from research and development to sales and service

7. Benchmarking

- Process by which a firm identifies its CSFs, studies the best practices of other firms in achieving these CSFs, and institutes change based on the assessment results

Contemporary Management Techniques (continued)

8. Business Process Improvement

– This technique involves managers and workers committing to a program of continuous improvement in quality and other CSFs

9. Total Quality Management (TQM)

– A technique by which management develops policies and practices to ensure the firm's products and services exceed customer's expectations

Contemporary Management Techniques (continued)

10. Lean accounting uses value streams to measure the financial benefits of a firm's progress in implementing lean manufacturing.

11. The Theory of Constraints (TOC)

– Helps firms improve *cycle-time* (i.e., the rate at which raw materials can be converted to finished products)

Contemporary Management Techniques (continued)

12. Sustainability means the balancing of the company's short and long term goals in all three dimensions of performance – social, environmental, and financial.

13. Enterprise risk management is a framework and process that firms use to managing the risks that could negatively or positively affect the company's competitiveness and success.

Competitive Strategies

- A firm succeeds by implementing a set of policies, procedures, and approaches to business called a strategy

- Strategy must have a long-term focus and adapt to the changing environment

- Cost management information should be used to develop and monitor strategic information

Michael Porter: Strategic Positioning

- **Cost Leadership**—outperform competitors by producing at the lowest cost, consistent with quality demanded by the consumer
- **Differentiation**—creating value for the customer through product innovation, product features, customer service, etc. that the customer is willing to pay for

Competitive Strategies (continued)

Aspect	Cost Leadership	Differentiation
Strategic Target	Broad cross section of the market	Focused cross section of the market
Basis of competitive advantage	Lowest cost in the industry	Unique product or service
Product line	Limited selection	Wide variety
Production emphasis	Lowest possible cost and essential features	Innovation in differentiating products
Marketing emphasis	Low price	Premium price and innovative features

The Five Steps of Strategic Decision Making

1. Determine the Strategic Issues Surrounding the Problem
2. Identify the Alternative Actions
3. Obtain Information and Conduct Analyses of the Alternatives
4. Based on Strategy and Analysis, Choose and Implement the Desired Alternative
5. Provide an On-going Evaluation of the Effectiveness of implementation in Step 4.

Professional Organizations

- **Organizations that provide guidelines and regulations:**
  - Internal Revenue Service (IRS), Federal Trade Commission (FTC), Securities and Exchange Commission (SEC), etc.
- **Organizations that promote professionalism and expertise:**
  - Institute of Management Accountants (IMA), Financial Executives Institute (FEI), and Institute of Internal Auditors (IIA)

Professional Certifications

There are three important certifications that are relevant for management accountants in the U.S. (other certifications worldwide):

- Certified Management Accountant (CMA)
- Certified Public Accountant (CPA)
- Certified Global Management Accountant(CGMA)

IMA Statement of Ethical Professional Practice

- Commitment to competence, integrity, confidentiality, and credibility is necessary for the management accountant to provide a useful service to management
- When presented with an ethical issue that cannot be resolved through the organization's established policies, the IMA suggests a three step process:
  - ❶ Discuss the situation with a superior not involved in the issue
  - ❷ Clarify the issue through discussion with an IMA Ethics Counselor or impartial advisor
  - ❸ Consult your own attorney as to your legal obligations and rights

B. Implementing Strategy: The Value Chain, the Balanced Scorecard, and the Strategy Map

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Implementing a Strategy

- **There are two main competitive strategies:**
  - cost leadership
  - differentiation
- **Once a firm chooses which strategy to follow, there are various means of implementation:**
  - SWOT Analysis
  - Focus on execution
  - Value-chain analysis
  - Balanced scorecard (BSC)

SWOT Analysis

- **Identification of critical success factors (CSFs) tied to strategy—for example:**
  - Product innovation
  - Quality
  - Skill development
- **Identification of quantitative measures for the specified CSFs—for example:**
  - Number of design changes or new patents
  - Number of defects or number of returns
  - Number of training hours or amount of skill performance improvement

SWOT Analysis (continued)

- **The SWOT analysis has four areas:**
  - **S** – strengths/internal
  - **W** – weaknesses/internal
  - **O** – opportunities/external
  - **T** – threats/external

Look at product lines, management, R&D, manufacturing, marketing, and strategy

Look at barriers to entry, intensity of rivalry among competitors, substitute goods, and customer/supplier bargaining power

Execution

- **The CSFs a manager executes depend on the chosen strategy**
  - Cost leadership: operational performance and quality
  - Differentiation: customer satisfaction and innovation
- **Differentiated firms must pay close attention to marketing and product development**
  - Management accountants assist by gathering, analyzing, and reporting on relevant information
- **Can be improved through benchmarking and total quality improvement**

Value-Chain Analysis

- **An analysis for better understanding the details of the organization's competitive strategy**
  - CSFs must be implemented in each and every phase of operations

- **Helps a firm better understand its competitive advantage by analyzing what processes add value (processes that do not add value can be deleted or outsourced)**

- **Will include upstream (prior to manufacturing or operations) and downstream activities**

Value-Chain Analysis

- **Value-chain analysis has two steps:**
  - Identify the value-chain activities at the smallest level possible
  - Develop a competitive advantage by reducing cost or adding value
- **To develop a competitive advantage, a firm must consider the following:**
  - What is our competitive advantage (strategy)?
  - Where can we add value for the customer?
  - Where can we reduce costs?
  - Are any of our processes linked (linkages exploited)?

Example: Value-Chain Analysis in Computer Manufacturing

- Computer Intelligence Company (CIC) manufactures computers for small businesses

- The company has an excellent reputation for service and reliability as well as a growing customer list: competes on differentiation

- Is there any way to add value for the customer while reducing costs?

Example: Value-Chain Analysis in Computer Manufacturing (continued)

- **The company is considering two options:**
  - **Option One** is to continue functioning as is
  - **Option Two** includes two separate outsourcing decisions: (a) the purchase or manufacture of parts, and (b) providing service internally or outsourcing it
- **It is important to consider company strategy in outsourcing decisions**

Value-Chain Analysis in Computer Manufacturing (continued)

Value Activity	Option One – Current	Option Two – Potential
Acquiring raw materials	CIC is not involved at this step	CIC is not involved at this step
Manufacturing computer chips and other parts	CIC is not involved at this step; cost is $200	CIC is not involved at this step; cost is $200
Manufacturing components, some of which CIC can make	CIC purchases $300 of parts for each unit	CIC manufactures these parts for $190 per unit plus $55,000 monthly
Assembling	CIC's costs are $250	CIC's costs are $250
Marketing, distributing, and servicing	CIC's costs are $175,000 per month	CIC contracts out these services for $130 per month

Results of Value-Chain Analysis

	Manufacturing	Marketing, distributing, and servicing
Option One	600 x $300 = $180,000	$175,000 per month
Option Two	600 x 190 + $55,000 = $169,000	$78,000 per month
Savings with Option Two	$11,000	$97,000 per month

Results of Value-Chain Analysis (continued)

CIC can save $108,000 ($11,000 + $97,000) per month by manufacturing the parts and contracting out marketing, distributing, and servicing

The main factor driving the decision is company strategy, which in this case is quality and customer service

- For a firm pursuing a differentiation strategy, the best option is not necessarily the one which provides the most savings (savings is a secondary consideration)
- From a strategic viewpoint, Option One is preferred over Option Two

The Five Steps of Strategic Decision Making for CIC

1. Determine the Strategic Issues Surrounding the Problem: CIC competes on differentiation
2. Identify the Alternative Actions: two options
3. Obtain Information and Conduct Analyses of the Alternatives: calculate the relevant costs
4. Based on Strategy and Analysis, Choose and Implement the Desired Alternative – support CIC's strategy, this is the key to the analysis
5. Provide an On-going Evaluation of the Effectiveness of implementation in Step 4.

The Balanced Scorecard (BSC)

- **A performance report** based on a broad set of financial and nonfinancial measures that is crucial to understanding and implementing a strategy

- **This report groups a firm's CSFs into four areas:**
  - Financial perspective (financial measures)
  - Customer perspective (customer satisfaction)
  - Internal process perspective (e.g., productivity and speed)
  - Learning and growth (e.g., training and number of new patents or products)

The Balanced Scorecard (continued)

- **Benefits**
  - Provides a means for implementing strategy
  - Provides a means to achieve a desired organizational change in strategy
  - Can be used to determine management's compensation and rewards
  - Aligns managers' efforts with strategy
  - Coordinates efforts within the firm to achieve CSFs

The Balanced Scorecard (continued)

- **A properly constructed BSC can be used to infer a company's strategy**

  – BSC → Strategy, and Strategy → BSC

- **The emphasis placed on each performance perspective reflects the strategy of the firm**

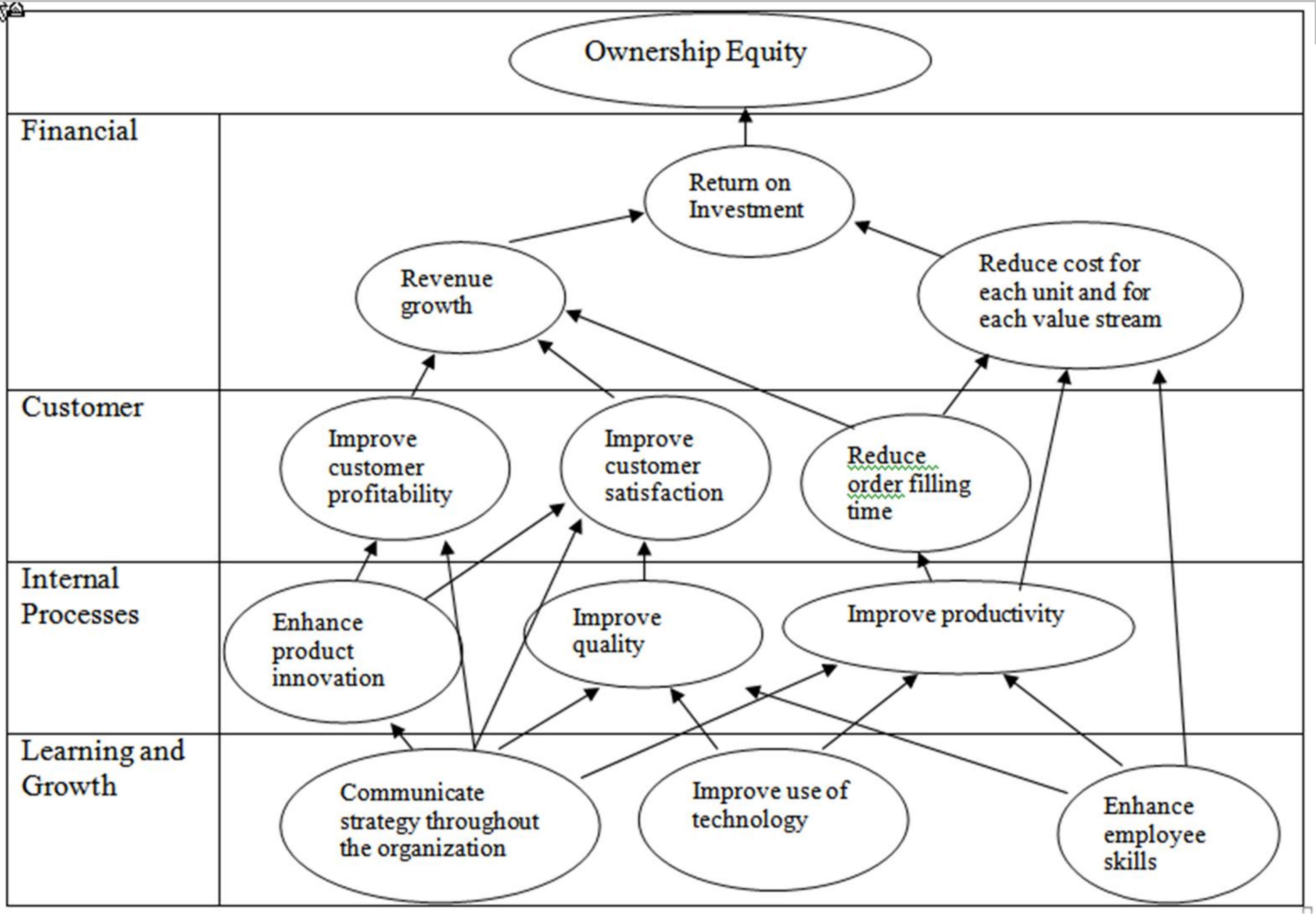
  – For a cost leader, the operations perspective might be the most important; for a differentiator, the customer perspective…

Strategy Map

A strategy map is a cause-and-effect diagram of the relationships embodied in a BSC:

- Shows how the achievement of CSFs in one perspective should affect the achievement of goals in another perspective
- The financial perspective is the target in the strategy map because financial performance is the ultimate goal for most profit-seeking organizations
- Success in the other perspectives leads directly to improved financial performance and shareholder value

An Example Strategy Map



Sustainability

- **The fifth perspective for many organizations**

- **The balancing of short-term and long-term goals in all three dimensions of the company's performance–financial, social, and environmental:**
  - Environmental reports use environmental performance indicators (EPIs) to measure sustainability
  - These indicators are in three areas:
    - Operational measures (stresses to the environment/regulatory compliance issues)
    - Management measures (efforts to reduce environmental effects)
    - Environmental measures (environmental quality)

Sustainability (continued)

- Sustainability reports also use social performance indicators (SPIs) to measure sustainability

- These indicators are in three areas:
  - Working conditions (worker safety and training)
  - Community involvement (for example, employees participation in community activities such as Habitat for Humanity)
  - Philanthropy (direct contributions)

C. Basic Cost Management Concepts

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Basic Definitions

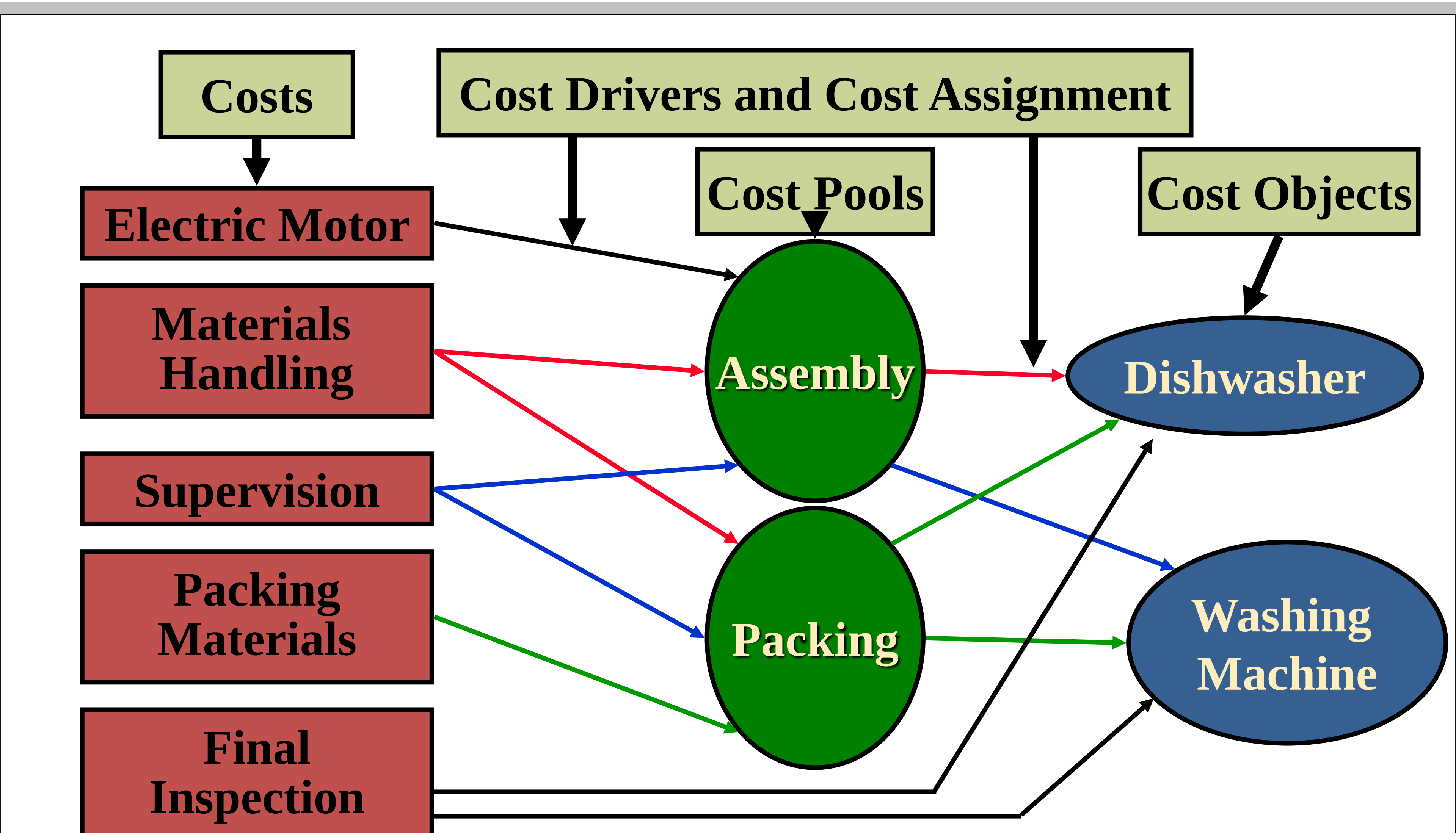
- A *cost* is incurred when a firm uses a resource for some purpose
- Costs are assembled into meaningful groups called *cost pools* (e.g., by type of cost or source)
- Any factor that has the effect of changing the level of total cost is called a *cost driver*
- A *cost object* is any product, service, customer, activity, or organizational unit to which costs are assigned for some management purpose

Product/Service Costing: Cost Assignment

The process of assigning costs to cost pools or from cost pools to cost objects

- *Direct costs* can be conveniently and economically traced to a cost pool or a cost object
- *Indirect costs* cannot be traced conveniently or economically to a cost pool or a cost object
- Because indirect costs cannot be traced, assignment is made through the use of cost drivers (*cost allocation*)
- These cost drivers are often called *allocation bases*

Cost Assignment: General Principles



Direct and Indirect Product Costs for a Manufacturer

- **Direct material costs** = cost of materials that can be readily traced to outputs = purchase price of materials + freight – purchase discounts + reasonable allowance for scrap and defective units

- **Indirect material costs** = cost of materials that cannot readily be traced to outputs (e.g., rags, lubricants, and small tools)

- **Direct labor costs** = labor that can be readily traced to outputs = wages paid plus a reasonable allowance for nonproductive time

- **Indirect labor costs** = labor costs that cannot be readily traced to outputs (i.e., they are manufacturing support costs)

Direct and Indirect Product Costs: (continued)

- **All indirect costs** for the manufacturer, including indirect materials, indirect labor, and other indirect items are often combined in a cost pool referred to as *overhead* (or, *factory overhead*, or *indirect manufacturing costs*)

- **The three main types of costs,** direct materials, direct labor, and overhead, are often condensed even further:
  - Direct materials + Direct labor = Prime costs
  - Direct labor + Overhead = Conversion costs

Cost Behavior: Cost Drivers

- ***Cost drivers* provide two roles for the management accountant**
  – Assigning costs to cost objects
  – Explaining cost behavior, i.e., how total cost changes as the cost driver changes
- **There are four types of *cost drivers*:**
  – Activity-based
  – Volume-based
  – Structural
  – Executional

Cost Drivers (continued)

- ***Activity-based* cost (ABC) drivers** are developed at a detailed level of operations using activity analysis–a cost driver is determined for each activity
- ***Volume-based* cost drivers** relate to the amount produced or quantity of service provided**:**
  - The relationship between the cost driver and total cost is approximately linear within the relevant range

Volume Based Cost Drivers: Classification by Behavior

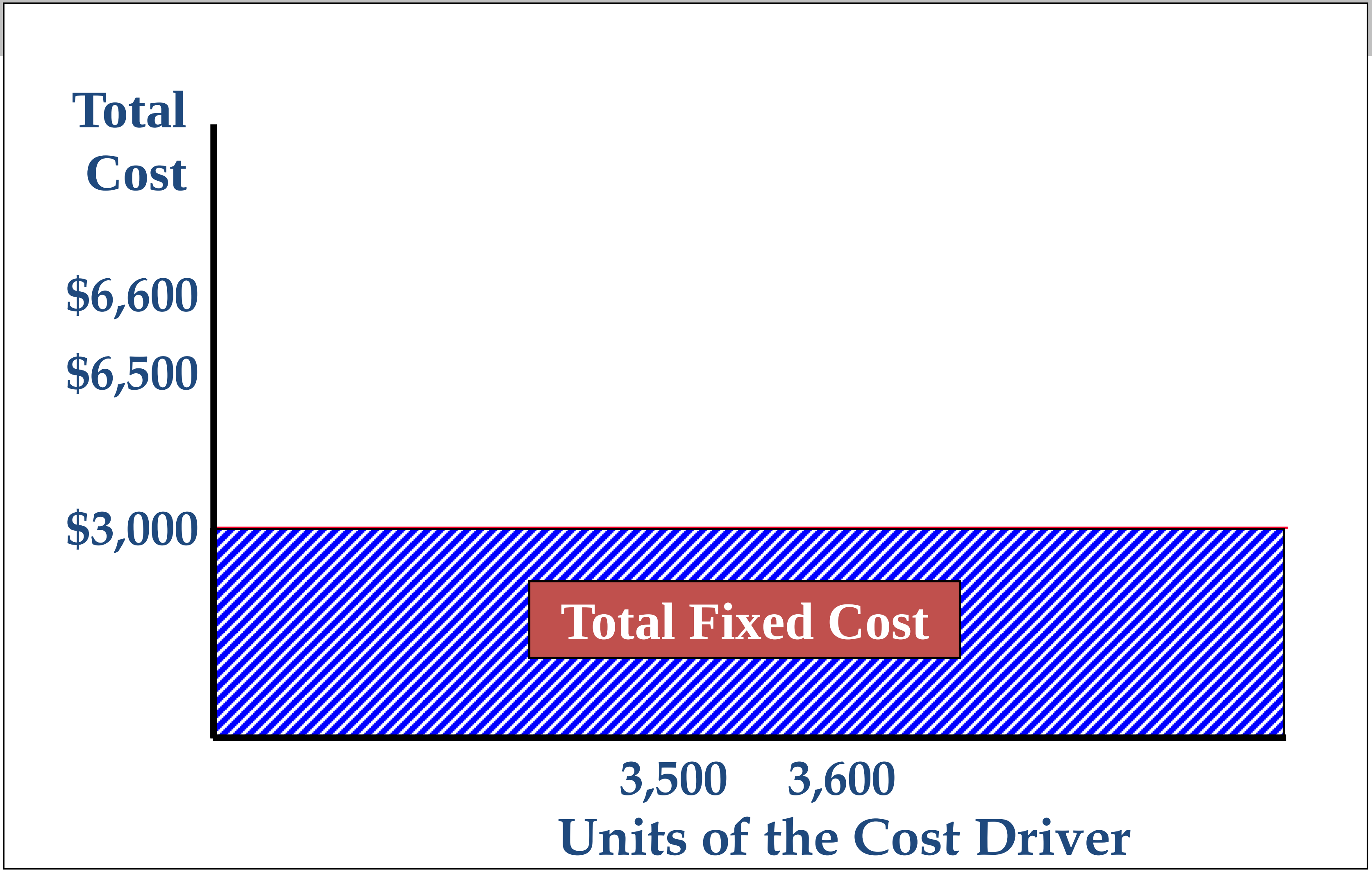
- *Fixed cost* is the portion of total cost that does not change with changes in output
- *Variable cost* is the change in total cost associated with each change in quantity of the cost driver
- *Mixed cost (semi-variable)* is used to refer to a total cost figure that includes both a fixed and variable component
- *Step costs (semi-fixed)* vary with the cost driver but do so in steps

Cost Drivers (continued)

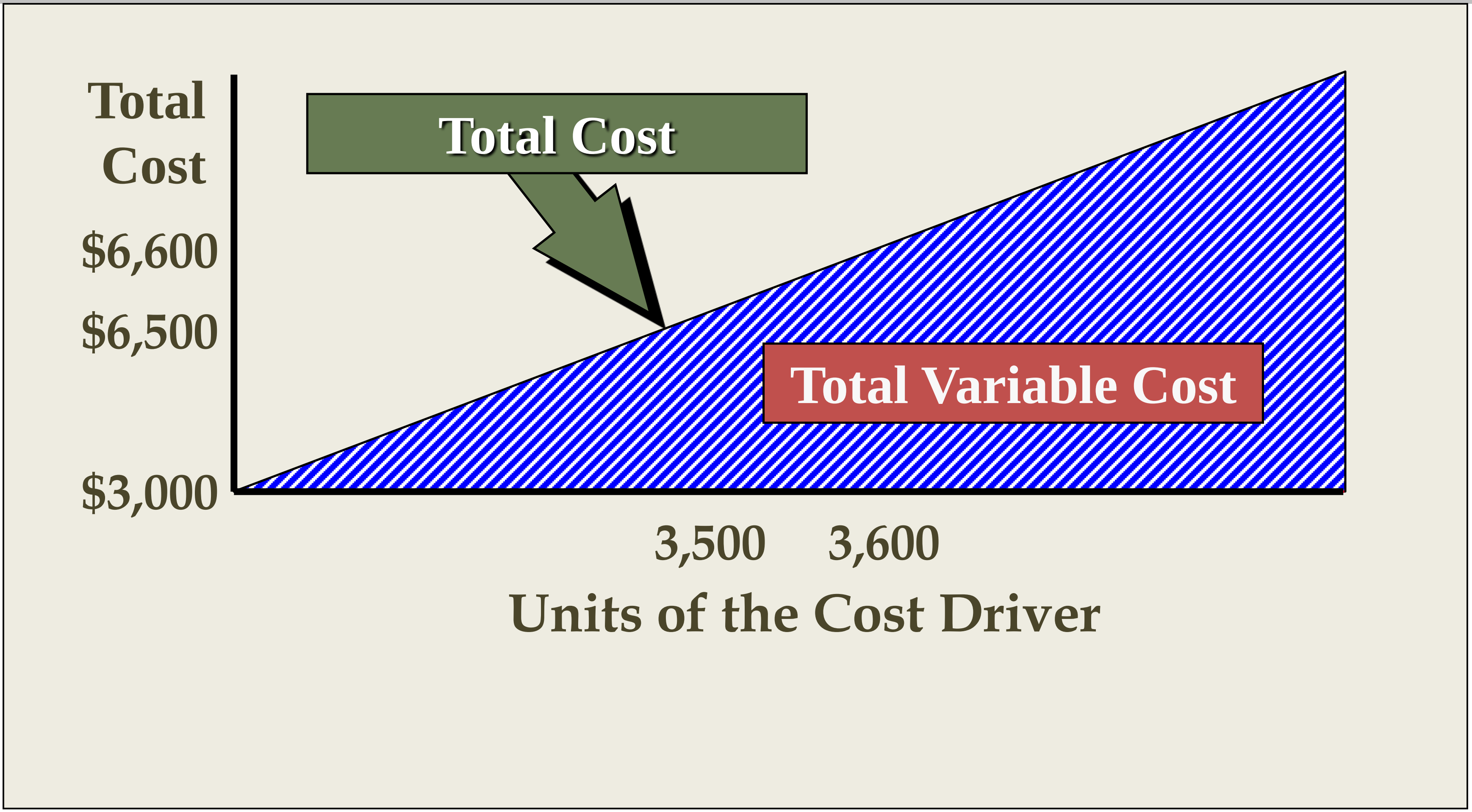
- ***Structural cost* drivers** facilitate strategic decision making because they involve plans and decisions that have long-term effects
  – Scale, experience, technology, and complexity are considered in hopes of improving competitive position

- ***Executional cost* drivers** facilitate operational decision making by focusing on short-term effects
  – Workforce involvement, design of the production process, and supplier relationships are considered in an attempt to reduce costs

Fixed Costs


Total
Cost
$6,600
$6,500
$3,000
Total Fixed Cost
3,500
3,600
Units of the Cost Driver

Variable Costs



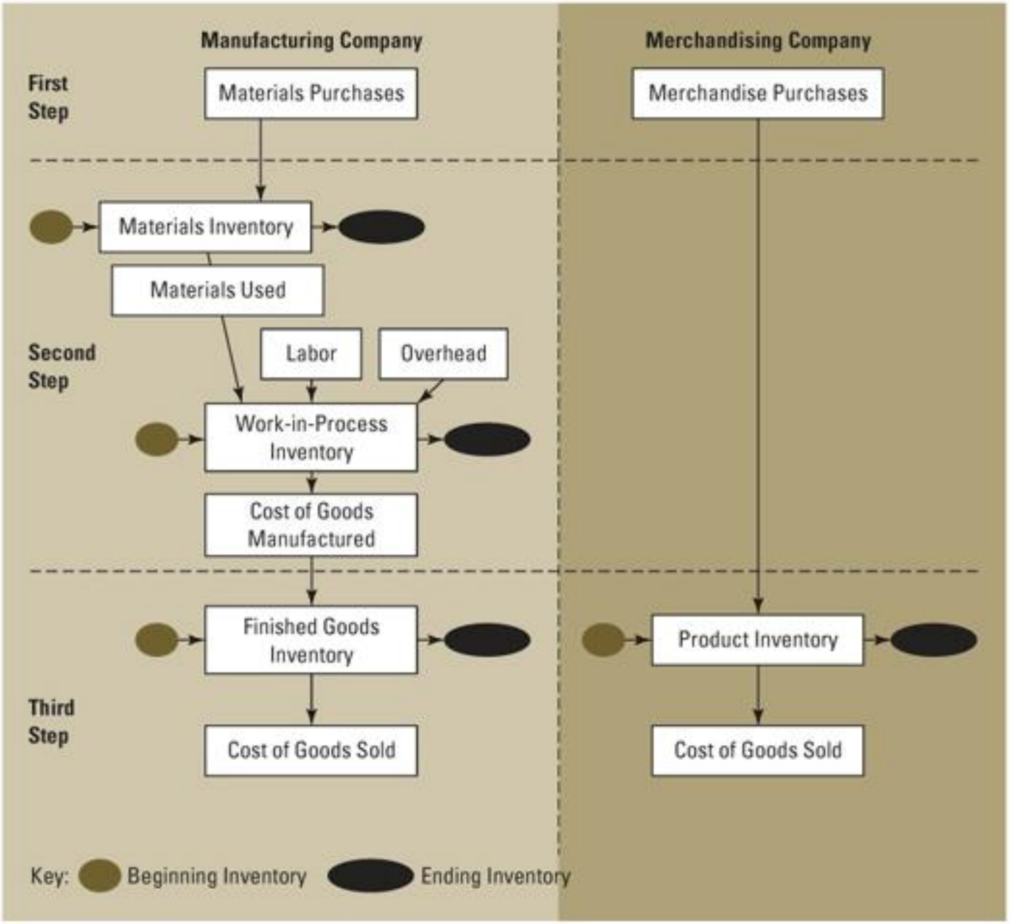
Product and Service Costing Concepts

- **Product costs** include only the costs necessary to complete the product at the manufacturing step in the value chain (manufacturing) or to purchase and transport the product to the location of sale (merchandising)

- **Period costs (also called non-product costs)** include all other costs incurred by the firm in managing or selling the product (indirect costs outside the manufacturing step of the value chain)

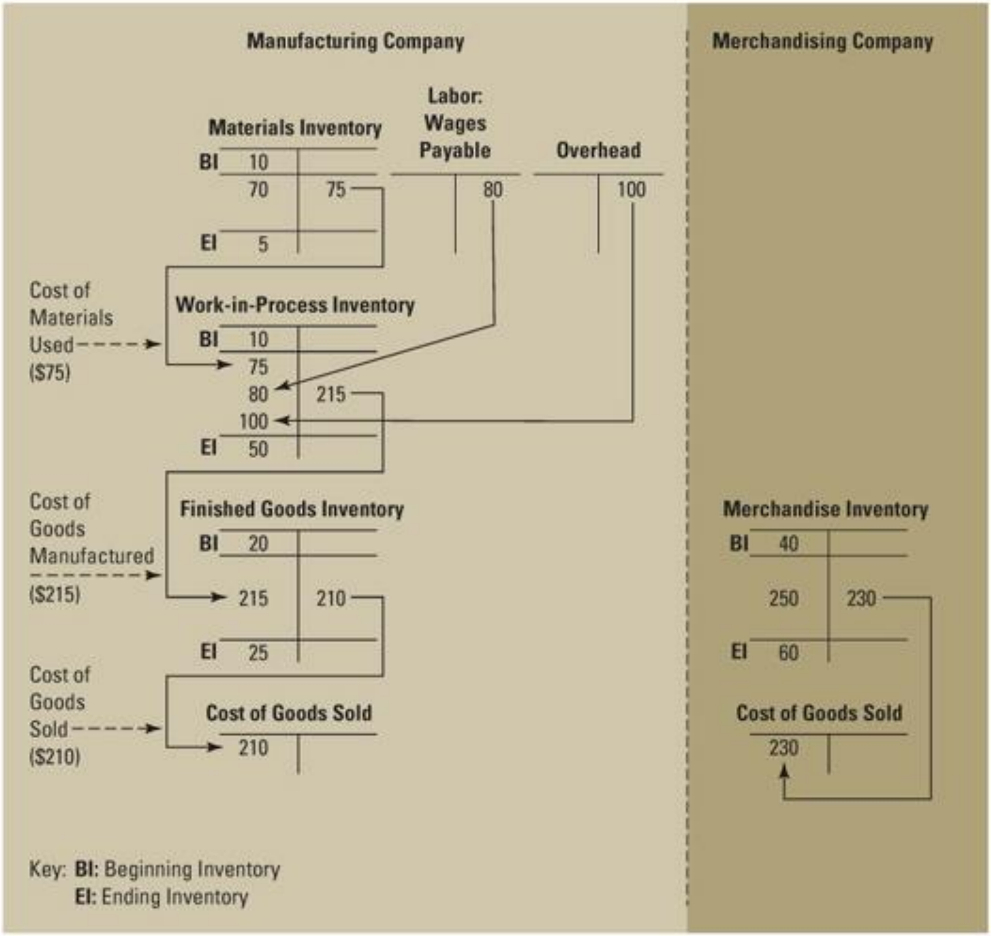
Manufacturing vs. Merchandising

EXHIBIT 3.13
Cost Flows in Manufacturing and Merchandising Firms



Inventory and Related Expense Accounts

EXHIBIT 3.14
Account Relationships for Manufacturing and Merchandising Companies



Qualitative Characteristics of Cost Information

– *Accuracy* (and the need to monitor internal accounting controls)
– *Cost and value of cost information* (the cost of information should be monitored by the management accountant to ensure that costs do not outweigh the associated benefits)
– *Timeliness* (often involves sacrificing in the other two areas)

Why Costing Systems?

- Costing *accuracy* is critical to a firm's success
- Costing systems help management estimate costs and accurately charge customers
- An accurate costing system can provide a *competitive advantage*

Developing a Costing System

- ***Product costing*** is a general term that refers to the process of assigning both direct and indirect costs to products or services:

  – Direct costs are *traced* to a cost object (e.g., a job)
  – Indirect costs are *allocated* to a cost object (using one or more cost-allocation bases/cost drivers)

- **A firm's choice of costing system** depends on the firm's industry and product or service, the firm's strategy and management information needs, and the costs and benefits of acquiring, designing, modifying, and operating a particular system

Developing a Costing System (continued)

- **When developing a product-costing system, there are three choices that must be made:**
  - Cost accumulation method (i.e., job or process costing)
  - Cost measurement method (i.e., actual, normal, or standard costing)
  - Overhead assignment method (i.e., volume-based or activity-based)
- **Each product-costing system will reflect these three choices**
  - For example, an organization’s cost system may be characterized by: job costing with normalized costs, and activity-based costing used to allocate indirect costs

Developing a Costing System (continued)

Cost accumulation: Job or Process Costing?

- **In a *job costing* system, all manufacturing costs incurred are assigned to jobs**
  - This type of system is appropriate when cost can be readily identified with specific customers, jobs, or projects
  - Often found in small or medium firms that produce customized products
- ***Process costing* is often found in large firms that produce one or a few homogeneous products through continuous mass production**

Developing a Costing System (continued)

The examples below show how certain industries tend to favor a particular cost accumulation method:

Job Costing	Construction, printing, special equipment manufacturing, shipbuilding, medical services, custom furniture manufacturers, advertising agencies, accounting firms, etc.
Process Costing	Chemical industry, bottling companies, plastics, food products, and paper products, cement manufacturing, brick production, etc.

Developing a Costing System (continued)

Cost measurement: actual, normal, or standard costing?

– An *actual costing system* uses actual costs incurred as the measure of product cost
  - This type of cost measurement is rarely used because unit costs fluctuate significantly, thereby increasing the possibility of error in pricing, adding/dropping product lines, and executing performance evaluations
  - Under actual costing, factory overhead costs are only known at or after the end of the period (thus, cost information is not available on a *timely* basis)

Developing a Costing System (continued)

- A ***normal costing system*** uses actual costs for direct materials and direct labor but normal costs for factory overhead:
  - Normal costing involves estimating a portion of overhead to be assigned to each product as it is produced providing a timely estimate of cost
  - Choice of an appropriate denominator activity level for allocating fixed overhead costs is a key consideration
- A ***standard costing system*** uses standard costs for all cost elements, direct and indirect:
  - Standard costs are costs a firm *should* attain under relatively efficient operating conditions
  - Standard costing systems provide a basis for cost control, performance evaluation, and process improvement

Developing a Costing System-Summary

Costing System	Type of Cost Used For: Direct Materials	Direct Labor	Factory Overhead
Actual Costing	Actual Cost	Actual Cost	Actual Cost
Normal Costing	Actual Cost	Actual Cost	Applied[1] Overhead Cost
Standard Costing	Standard Cost	Standard Cost	Standard Cost

[1]Also referred to as normal overhead cost.

Developing a Costing System (continued)

Overhead assignment under normal costing: volume-based or activity-based?

- *Volume-based costing systems* allocate overhead using a volume-based cost driver, such as direct labor-hours, direct labor costs, or machine-hours
  - This approach relies heavily on the assumption that overhead cost incurrence is related to output volume
- *Activity-based costing (ABC) systems* allocate factory overhead to products using a cause-and-effect criterion with multiple cost drivers, both volume-based and non-volume-based
  - This system allocates factory overhead more accurately based on resource consumption and activity consumption cost drivers

The Strategic Role of Product Costing

A firm's competitive strategy affects cost system design considerations:

- A commodity/cost leadership type of firm is likely to combine process costing, standard costing, and activity-based costing
  - Products are largely homogenous and produced in large production runs (process costing)
  - It is important for a cost leader to have accurate costs, and activity-based costing is generally more accurate than volume-based costing

The Strategic Role of Product Costing (continued)

A low-volume, highly-diversified firm pursuing a *differentiation strategy* is likely to use job costing

- This type of firm produces a wide variety of distinct products in low volume
- Costs are easily traced to each job

Many firms use a combination of job and process costing

– A manufacturer might use process costing for its common manufacturing processes and job costing for unique processes

D. Job Costing & Process Costing

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Job Costing

Job Costing is a product costing system that accumulates costs and assigns them to specific jobs, customers, projects, clients, or contracts

- The basic supporting document in a job costing system is the ***job-cost sheet,*** which records and summarizes the costs of direct materials, direct labor, and factory overhead for a particular job
- A job cost sheet is started when the production or processing of a job begins

Example Job Cost Sheet

THOMASVILLE FURNITURE
INDUSTRIES, INC.
Job Cost Sheet

Product End Table
Date Begun June 6, 2013
Date Complete June 15, 2013

Job No. 351
Quantity 20
Unit Cost $376.10

Direct Materials					Direct Labor					Factory Overhead			
Dept	Date	Requisition Number	Units	Cost	Date	Hrs	Rate	Ticket	Amount	Labor Hours	Application Rate	Amount	Total Cost
A	6/6	A-4204	20	$1,500.00	6/6 to 6/25	100	$10.00	A-1101 through A-1150	$1,000.00	100	$5.00	$500.00	$3,000.00
B	6/26	B-3105	15	$400.00	6/26 to 6/30	60	$15.00	B-308 through B-320	$900.00	60	$6.70	$402.00	$1,702.00
C	7/2	C-5051	10	$300.00	7/1 to 7/15	140	$12.00	C-515 through C-500	$1,680.00	140	$6.00	$840.00	$2,820.00
Total				$2,200.00					$3,580.00			$1,742.00	$7,522.00

Job Costing

– As a job goes through the production process, all costs for the job are accumulated on the job-cost sheet

– Upon its completion, overhead is allocated to the job

All the costs that appear on the job-cost sheet are recorded in the Work-in-Process (WIP) Inventory account

– The total of all the active job cost sheets should equal the debit side of the WIP Inventory

Cost Flows – Direct Materials

All costs recorded on the job cost sheets appear in WIP Inventory, but the process does not begin there

- **Direct materials**
  - Direct materials are first recorded in *Materials Inventory*
  - A *bill of materials*, a listing similar to a recipe, is used to decide the materials needed for a particular project
  - A request is made with a *materials requisition* for the supplies needed for a job
  - Upon issuance to production, the cost of the materials is then transferred to WIP Inventory
  - The materials requisitions are used to record the direct material costs on the job-cost sheets
  - Indirect materials, when issued to production, are taken out of Materials Inventory, but these costs are recorded to Factory Overhead rather than WIP Inventory

Bill of Materials

Thomasville Furniture Industries, Inc.
Bill of Materials

CHANGES FOR 14521–211

PLANT "T"

STYLE 14531–210 ARTICLE GEORGIAN END TABLE DATE 1–19–12 SHEET 1 OF 2

LINE		NO. PCS.	DESCRIPTION	FINISH SIZE L	FINISH SIZE W	FINISH SIZE T	FINISH SIZE BS	MULTI	ROUGH SIZE L	ROUGH SIZE W	ROUGH SIZE T	FOOTAGE	SKETCH
1	14531–210 ONLY	1	TOP	26	20	13/16		1	27	21	9/16		
2		1/2	TOP CORE					1	17	47 1/2	3/4		
3		1	TOP CORE SIDE BANDS	47 1/2	2	3/4		1	47 1/2	2	4/4		
4		2	TOP CORE FRT. & BK. BANDS	21	2	3/4		1	21	2	4/4		
5													
6		2	SIDE PANELS	22 3/8	4 15/16	3/4	21 3/8	4	23 7/8	21 3/4	5/8		4/4 POP CORE
7		2	SIDE APRON RAIL	22 3/8	1 7/8	1 7/16	21 3/8	1	23 3/8	2 1/8	8/4		
8		1	BACK PANEL	16 3/8	4 15/16	3/4	15 3/8	4	17 7/8	21 3/4	5/8		4/4 POP CORE
9		1	BACK APRON RAIL	16 3/8	1 7/8	1 7/16	15 3/8	1	17 3/8	2 1/8	8/4		
10		2	FRONT POST	22 3/4	2 1/2	2 1/2		1	23 3/4	2 3/4	3 pcs 5/4		
11		2	BACK POST	22 3/4	2 1/2	2 1/2		1	23 3/4	2 3/4	3 pcs 5/4		
12													
13	14531–210 ONLY	1	DRAWER FRONT	14 7/8	3 7/8	3/4		3	16 7/16	16 5/16	5/8		4/4 POP CORE
14		2	DWR. SIDES	20	3	7/16		1	21	3 1/4	5/8		
15		1	DWR. BACK	14 11/16	2 7/8	7/16							
16		1	DWR. BOTTOM	14 1/4	19 13/16	3/16		1	15 3/4	20 7/8	R.C.		
17		1	DWR. GUIDE—FEMALE	20 1/2	1 31/32	9/16	19 13/16	1	21 1/2	2 1/4	4/4		
18		1	DWR. GUIDE—MALE	22 1/2	1	1/2		1	23 1/2	1 1/4	4/4		
19		1	DWR. HOWE PULL										
20													

Materials Requisition

MATERIALS REQUISITION No. A–4024

Job Number 351 | Date June 6, 2013

Department A | Received by Tom Chan

Authorized by Juanita Perez | Issued by Ted Mercer

Item Number	Description	Quantity	Unit Cost	Total Cost
MJI 428	Drawer Pull	20	$.75	$15

Cost Flows – Direct Labor

- **Direct Labor**
  - Direct labor costs are recorded to the job-cost sheet from *time tickets,* which show the amount of time an employee worked on each job, the pay rate, and the total labor cost chargeable to each job
  - *Time cards* are also used for this purpose
  - *Indirect labor*, such as supervisors' and warehouse clerks' salaries, is recorded as Factory Overhead while Direct Labor is debited to the WIP Inventory

Cost Flows – Factory Overhead

Overhead application is the process of allocating overhead costs to individual jobs

- There are three approaches to allocating overhead: actual, normal, and standard costing
  - Under the *actual* application method, overhead costs are tracked for each job and are transferred to WIP and Finished Goods Inventory in the exact amounts incurred
  - Under the *normal* application method, overhead costs are applied to various jobs using a single *predetermined factory overhead rate*

Application of Factory Overhead

The *predetermined factory overhead rate* is an estimated factory overhead rate used to apply factory overhead cost to a job

– The amount of overhead assigned to a job using this rate is called *factory overhead applied*

Application of Factory Overhead (continued)

– The *predetermined factory overhead rate* is obtained using a four-step process:

❶ Estimate total factory overhead costs for the operating period, usually a year

❷ Select the appropriate cost driver(s) that will be used to apply factory overhead costs

❸ Estimate the total amount or activity level of the chosen cost drivers for the operating period (this is also referred to as the "denominator activity level")

❹For each overhead cost pool, compute the predetermined overhead rate by dividing budgeted overhead by the denominator activity level for the cost driver in question

Application of Factory Overhead (continued)

The predetermined factory overhead (OH) rate used to apply overhead to jobs is determined *before* the period begins.

$$\text{OH Rate} = \frac{\text{Estimated factory overhead amount for the year}}{\text{Estimated level of cost driver for the year}}$$

Some Possible Cost Drivers:

1. direct labor-hours
2. machine-hours
3. number of set-ups
4. number of orders
5. manufacturing cycle-time

The OH rate can be calculated on a firm-wide or a departmental basis.

Application of Factory Overhead (continued)

$$\text{OH Rate} = \frac{\text{Estimated factory overhead amount for the year}}{\text{Estimated level of cost driver for the year}}$$

Overhead applied = OH Rate × Actual activity

Based on **estimates**, and determined *before* the period begins

Actual amount of the allocation base, such as direct labor-hours, incurred during the period

Application of Factory Overhead (continued)

The *factory overhead applied* to jobs during a period is rarely exactly equal to actual factory overhead costs incurred during that period:

– If factory overhead applied > actual factory overhead, this excess is referred to as ***overapplied*** *overhead*

– If factory overhead applied < actual factory overhead, this shortage is referred to as ***underapplied*** *overhead*

– If the predetermined factory overhead rate is reasonably accurate (i.e., both the numerator and denominator in the OH rate are estimated with precision), these differences should be small

Disposition of Underapplied and Overapplied Factory Overhead

The factory overhead account is a *temporary* account and, as such, must be closed at the end of the year. Two treatments are possible:

- Adjust the Cost of Goods Sold (CGS) account , that is, the difference is simply added to (when underapplied) or subtracted from (when overapplied) the CGS account)
- Adjust the production costs of the period (i.e., *prorate* the difference to the ending balances of work in process inventory, Finished Goods Inventory, and the CGS account; proration is explained in chapter 15)

Potential Errors In Overhead Application

- **Aggregation error.**
  - An example is the use of an aggregate rate, such as a plantwide rate rather than a departmental rate
- **Specification error.**
  - Arises when the wrong cost driver is used, for example when a labor hours driver should be used rather than a machine hour driver
- **Measurement error.**
  - Arises from estimation and calculation error

Job Costing in Service Industries

Job costing is used extensively in service industries such as advertising agencies, construction companies, hospitals, accounting firms, and law firms

- The cost object is often a client, contract, or project rather than a job, but the approach is the same
- The major difference between manufacturing and service industries is the use of direct materials--service industries may use little or no direct materials
  - The main focus of a service industry's costing system is *direct labor*
- The OH rate is usually based on direct labor cost

Operation Costing

Operation costing **is a hybrid costing system** that uses job costing to assign direct material costs to jobs and a departmental approach to assign "conversion costs" to products or services:

- Common in manufacturing companies whose conversion activities are similar across several product lines, but whose direct materials vary significantly
- Direct material costs are traced directly to jobs while conversion costs are traced to departments and then to jobs
- This costing method is common in the following industries: clothing, food processing, textiles, shoes, furniture, metalworking, jewelry, and electronic equipment

Spoilage, Rework and Scrap in Job Costing

***Spoilage* refers to the unacceptable units that are discarded or sold for disposal value**

– *Normal* (occurs under normal conditions) vs. *abnormal spoilage* (excess over amount expected, thus “Loss from Abnormal Spoilage”)

– *Job-Specific normal* (cost of that job) vs. *common normal spoilage* (included as part of Factory Overhead cost)

Spoilage, Rework and Scrap in Job Costing (continued)

Rework **units are units produced that must be reworked into good units that can be sold in regular channels**

- On normal defective units for a specific job, rework costs are charged (debited) to work in process inventory
- On normal defective units common to all jobs, rework costs are charged (debited) to Factory Overhead
- On abnormal units, charge the costs to a "Loss from Abnormal Rework" account

Spoilage, Rework and Scrap in Job Costing (continued)

***Scrap* is the material left over from the manufacture of the product; it has little or no value**

- For a specific job, charge the WIP Inventory account
- Common to all jobs, charge to the Factory Overhead account

Process Costing

- *Process costing:* a product costing system that accumulates costs according to *processes* or *departments*

- Accumulated costs are spread over output of the period

- Used when outputs are standardized/ homogeneous

- **Examples:** chemicals, oil refining, textiles, paints, flour, canneries, rubber, steel, glass, cement, and sporting goods

Production Cost Report

- **Prepared each period (e.g., each month) for each department**
- **Each department has its own WIP Inventory account**
- **The production cost report summarizes:**
  - The number of physical and equivalent units
  - Costs incurred during the period
  - Cost per equivalent unit for each cost element (direct materials, direct labor, and factory overhead)
  - Costs assigned to units completed and to units in ending work-in-process inventory

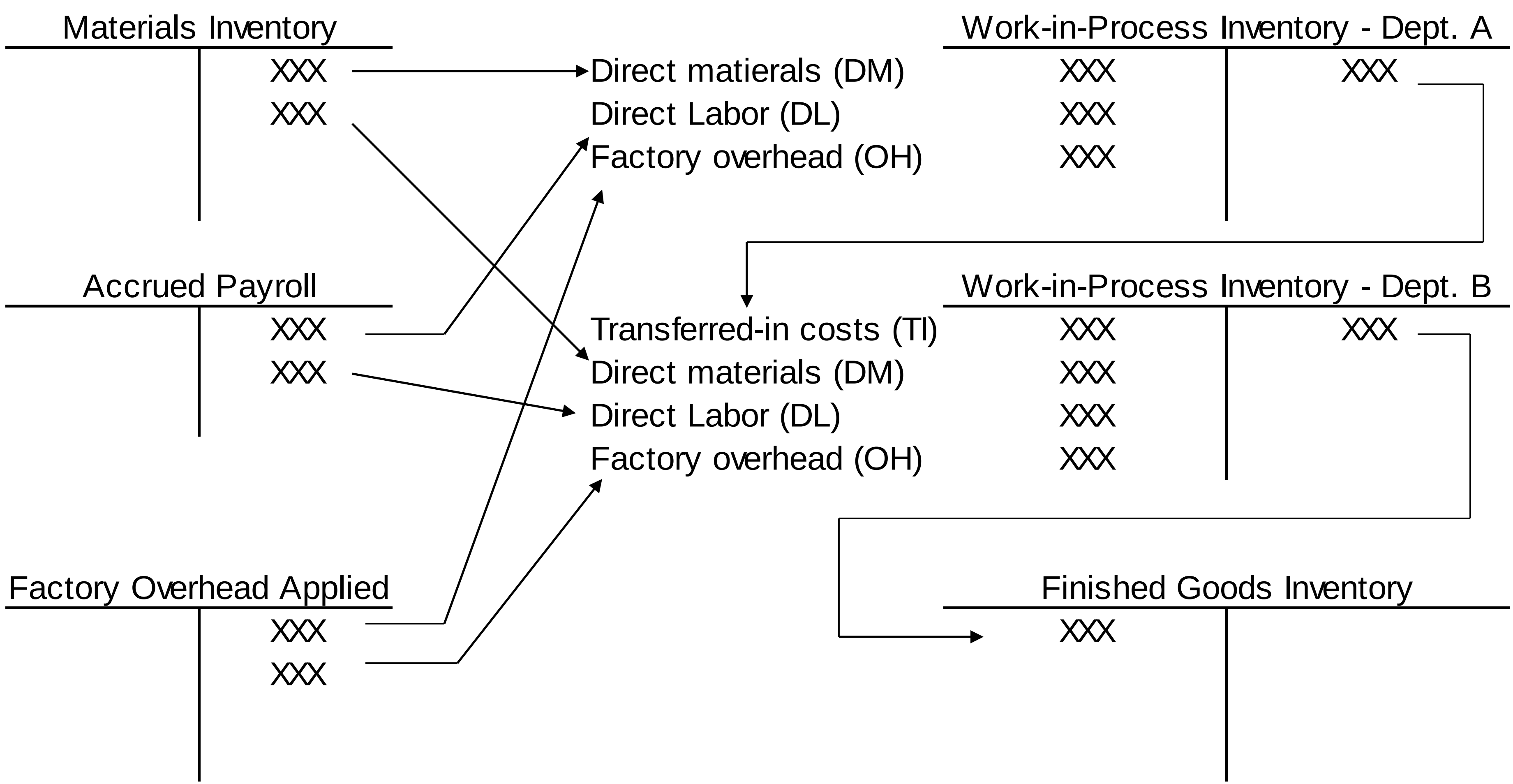
Production Cost Report (continued)

- ***Equivalent units:***
  - A measure of output for the period
    - Example:
      2 units 50% complete are “equivalent” to 1 unit fully complete
  - An expression of partially completed units in terms of fully completed units
- ***Cost per equivalent unit* = costs in each department for the period divided by the number of equivalent units produced during the period**
  - Definition of numerator and denominator depends on whether FIFO or weighted-average method is used…

Some Important Process Cost Issues

- Because of the relatively small direct labor content in many process industries, factory overhead and direct labor costs are often combined into a separate cost element and called *conversion costs*
- Many firms incur conversion costs uniformly throughout the production process
- Direct materials costs can be added at discrete points of manufacturing or continuously over production (in the latter case, direct materials for equivalent-unit purposes will be calculated using the same proportion as conversion costs)

Flow of Costs in Process Costing



Completing the Production Cost Report: 5 Steps

❶ Account for the physical units

❷ Calculate equivalent units for each manufacturing cost element (FIFO or weighted-average method)

❸ Determine total costs for each manufacturing cost element (FIFO or weighted-average method)

❹ Compute *cost per equivalent* unit for each manufacturing cost element

❺ Assign total manufacturing costs to units completed and ending work-in-process Inventory

Weighted-Average or FIFO?

- **The *weighted average method* includes all costs (beginning work-in-process inventory costs + current period manufacturing costs) in calculating cost per equivalent unit for each cost element the unit cost**
  - Thus, prior period and current period costs are averaged
- **The *FIFO method* includes only costs incurred during the current period**
  - Thus, FIFO costs represent the current period's cost per equivalent unit for each manufacturing cost element

Process Costing Example

Naftel Toy Company has two production departments, molding and finishing. Molding places direct materials into production at the beginning of the process. Direct labor and factory overhead costs are incurred gradually throughout the process with different proportions. The molding department’s units of production and costs for the month of June are provided.

Naftel uses the weighted-average method.

Process Costing Example (continued)

Work-in-process inventory, June 1:	10,000 units
Direct materials: 100% complete	$ 10,000
Direct labor: 30% complete	1,060
Factory overhead: 40% complete	1,620
Beginning work-in-process inventory	$ 12,680
Units started during June	40,000 units
Units completed during June	44,000 units
Work-in-process inventory, June 30:	6,000 units
Direct materials: 100% complete	?
Direct labor: 50% complete	?
Factory overhead: 60% complete	?
Costs added during June:	
Direct materials	$ 44,000
Direct labor	22,440
Factory overhead	43,600
Total costs incurred	$ 110,040

Step 1: Account for Physical Flow

Flow of Units in June	Physical Units
Input	
Work-in-Process Inventory, June 1	10,000
Units started in June	40,000
Total units to account for	50,000
Output	
Units completed and transferred out	44,000
Work-in-Process Inventory, June 30	6,000
Total units accounted for	50,000

Step 2: Calculate Equivalent Units (weighted-average method)

			EQUIVALENT UNITS		
	Physical Units	Completion Percentage	Direct Materials	Direct Labor	Factory Overhead
Work-in-process, June 1	10,000				
Direct materials		100%			
Direct labor		30			
Factory overhead		40			
Units started	40,000				
Units to account for	50,000				
Units completed	44,000	100%	44,000	44,000	44,000
Work-in-process, June 30	6,000				
Direct materials		100	6,000		
Direct labor		50		3,000	
Factory overhead		60			3,600
Units accounted for	50,000				
Total equivalent units			50,000	47,000	47,600

Step 3: Determine Total Cost for Each Cost Element

Total Costs for Each Manufacturing Cost Element are calculated below:

	Direct Materials	Direct Labor	Factory Overhead	Total
Costs (from Exhibit 6.7)				
Work-in-process, June 1	$10,000	$ 1,060	$ 1,620	$ 12,680
Costs added during June	44,000	22,440	43,600	110,040
Total costs to account for	$54,000	$23,500	$45,220	$122,720

Step 4: Calculate Cost per Equivalent Unit for Each Cost Element

	Direct Materials		Direct Labor		Factory Overhead		Total
Costs (from Exhibit 6.7)							
Work-in-process, June 1	$10,000		$ 1,060		$ 1,620		$ 12,680
Costs added during June	44,000		22,440		43,600		110,040
Total costs to account for	$54,000		$23,500		$45,220		$122,720
Divide by equivalent units (from Exhibit 6.6)	50,000		47,000		47,600		
Equivalent unit costs	$ 1.08	+	$ 0.50	+	$ 0.95	=	$ 2.53

Step 5: Cost Assignment

	Completed and Transferred out	Ending Work-in-Process	Total
Goods completed and transferred out (44,000 × \$2.53)	\$111,320		\$111,320
Ending work-in-process:			
Direct materials (6,000 × \$1.08)		\$ 6,480	6,480
Direct labor (3,000 × \$0.50)		1,500	1,500
Factory overhead (3,600 × \$0.95)		3,420	3,420
Total costs accounted for	\$111,320	\$11,400	\$122,720

FIFO Example: Step 1 (same as for weighted-average method)

Flow of Units in June	Physical Units
Input	
WIP Inventory, June 1	10,000
Units started in June	40,000
Total units to account for	50,000
Output	
Units completed and transferred out	44,000
WIP Inventory, June 30	6,000
Total units accounted for	50,000

Step 2, Alternative A: Calculate FIFO Equivalent Units

	Physical Units	Completion Percentage	Equivalent Units Direct Materials	Direct Labor	Factory Overhead
Input					
Work-in-process, June 1	10,000				
Direct materials		100%	10,000		
Direct labor		30		3,000	
Factory overhead		40			4,000
Units started	40,000				
Units to account for	50,000				
Output					
Units completed	44,000	100%	44,000	44,000	44,000
Work-in-process, June 30	6,000				
Direct materials		100	6,000		
Direct labor		50		3,000	
Factory overhead		60			3,600
Units accounted for	50,000				
Total equivalent units (weighted-average method)			50,000	47,000	47,600
Less: equivalent units in June 1 work-in-process			(10,000)	(3,000)	(4,000)
Equivalent units for work done in June only (FIFO method)			40,000	44,000	43,600

Step 2, Alternative B: Calculate FIFO Equivalent Units

	Physical Units	Completion Percentage	Equivalent Units (FIFO) Direct Materials	Direct Labor	Factory Overhead
Input					
Work-in-process, June 1	10,000				
Direct materials		100%	10,000		
Direct labor		30		3,000	
Factory overhead		40			4,000
Units started	40,000				
Units to account for	50,000				
Output					
Completed and transferred out from work-in-process, June 1	10,000				
Direct materials 10,000 × (1 - 100%)			0		
Direct labor 10,000 × (1 - 30%)				7,000	
Factory overhead 10,000 × (1 - 40%)					6,000
Started and completed (44,000 - 10,000)	34,000	100%	34,000	34,000	34,000
Work-in-process, June 30	6,000				
Direct materials		100	6,000		
Direct labor		50		3,000	
Factory overhead		60			3,600
Units accounted for	50,000				
Equivalent units of work for June (FIFO method)			40,000	44,000	43,600

Step 3: Calculate FIFO (i.e., Current Period) Costs

	Direct Materials	Direct Labor	Factory Overhead	Total
Costs (from Exhibit 6.7)				
Work-in-process, June 1				$ 12,680
Costs added during June	$44,000	$22,440	$43,600	110,040
Total costs to account for				$122,720

Step 4: Calculate FIFO Costs per Equivalent Unit

	Direct Materials		Direct Labor		Factory Overhead		Total
Costs (from Exhibit 6.7)							
Work-in-process, June 1							$ 12,680
Costs added during June	$44,000		$22,440		$43,600		110,040
Total costs to account for							$122,720
Divide by equivalent units (from Exhibit 6.11)	40,000		44,000		43,600		
Equivalent unit costs	$ 1.10	+	$ 0.51	+	$ 1.00	=	$ 2.61

Step 5, Part A: Assign Costs to Units Completed from Beginning WIP Inventory

<u>Analyze total completed units:</u>
44,000 = total units completed
10,000 = units in beginning inventory completed this period
34,000 = units started and completed this period

The cost for the 10,000 units in beginning WIP inventory completed this period:

Work-in-process inventory, June 1, 10,000 units	$12,680
Costs added during June to complete the beginning WIP inventory	
Direct labor 7,000 equivalent units × $0.51 per equivalent unit	3,570
Factory overhead 6,000 equivalent units × $1.00 per equivalent unit	6,000
Total for beginning inventory	$22,250

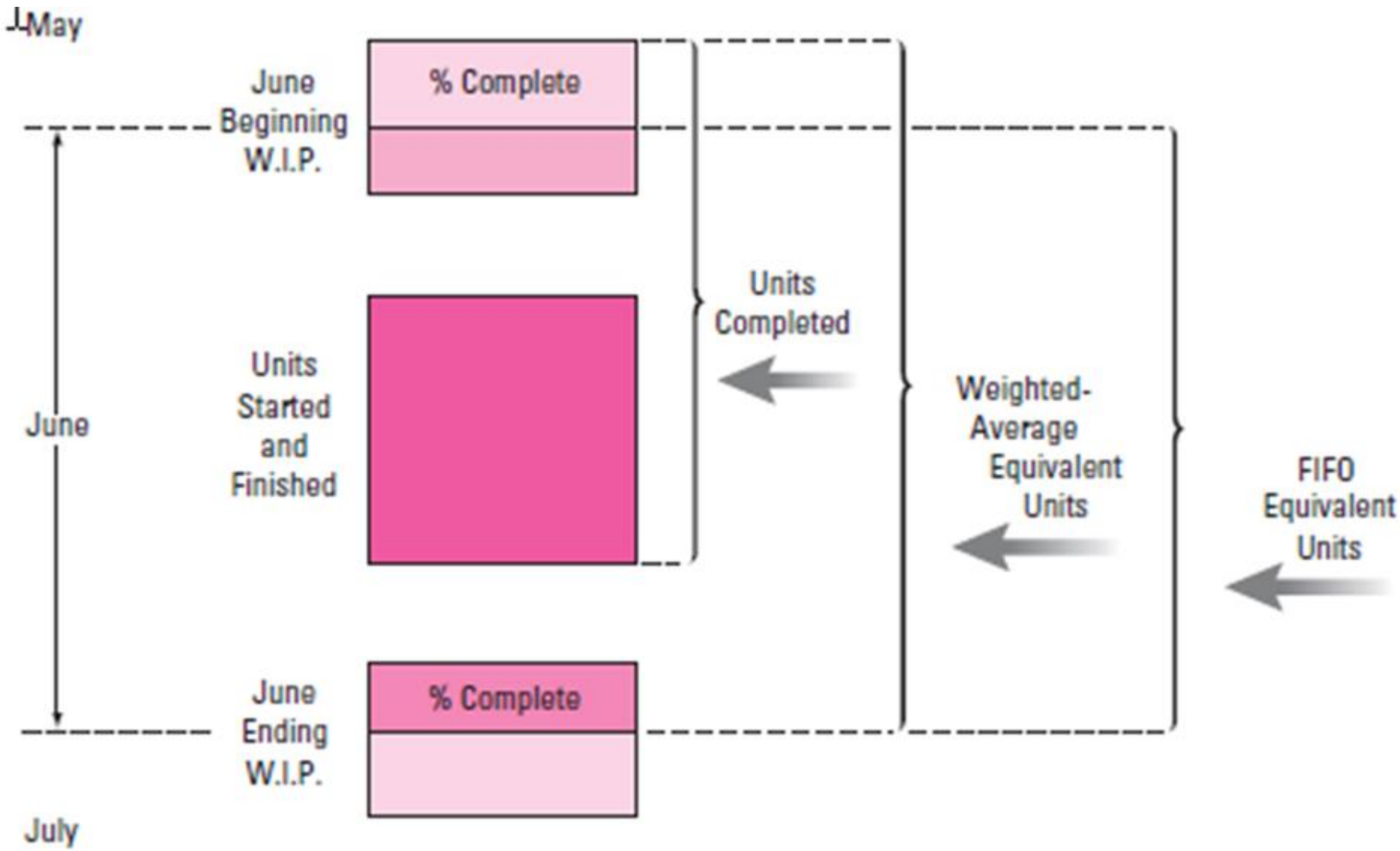
Step 5, Part B: Assign Costs to Units Started & Completed and Account for Total Costs

	Completed and Transferred out	Ending Work-in-Process	Total
Goods completed and transferred out			
Beginning work-in-process	$ 12,680		$ 12,680
Costs added during June			
Direct materials	0		0
Direct labor (7,000 × $0.51)	3,570		3,570
Factory overhead (6,000 × $1.00)	6,000		6,000
Total for beginning inventory	$ 22,250		$ 22,250
Started and completed (34,000 × $2.61)	88,740		88,740
Total costs completed and transferred out	$110,990		$110,990
Ending work-in-process			
Direct material (6,000 × $1.10)		$ 6,600	$ 6,600
Direct labor (3,000 × $0.51)		1,530	1,530
Factory overhead (3,600 × $1.00)		3,600	3,600
Total costs accounted for	$110,990	$11,730	$122,720

Weighted-Average vs. FIFO

	Weighted-Average	FIFO
Handling of partially completed beginning WIP	No separate treatment	Separates the units in the beginning WIP (and their costs) from the units started and completed during the period
Ease of calculation and appropriateness	Easier; best in situations where WIP is small and prices/costs are stable	More difficult; best in situations where prices/costs fluctuate; better for “control” purposes

Weighted-average vs. FIFO Equivalent Units



Process Costing with Multiple Departments: Transferred-in costs

- As a product passes from one department to another, the *accumulated cost* passes from department to department

- *Transferred-in costs*, or *prior department costs,* are costs of work performed in earlier departments that are transferred into the present department

- These costs are treated like an additional cost element

Illustration of Calculation of Equivalent units with Transferred-in Costs (weighted-average)

	Step 1		Step 2		
			Equivalent Units		
	Physical Units	Completion Percentage	Transferred in Costs	Direct Materials	Conversion Costs
Input					
Work-in-process, June 1	14,000				
Transferred-in		100%			
Direct materials		0			
Conversion		50			
Transferred-in	44,000				
Units to account for	58,000				
Output					
Units completed	50,000	100%	50,000	50,000	50,000
Work-in-process, June 30	8,000				
Transferred-in		100	8,000		
Direct materials		0			
Conversion		50			4,000
Units accounted for	58,000				
Total equivalent units			58,000	50,000	54,000

Transferred in equivalent units under weighted average = units to account for

Illustration of Calculation of Equivalent units with Transferred-in Costs (FIFO)

	Transferred-in Costs	Direct Materials	Conversion Costs
Total Equivalent Units (weighted average method)	58,000	50,000	54,000
Less: Equivalent units in beginning WIP inventory	14,000	-	7,000
Total Equivalent Units (FIFO)	44,000	50,000	47,000

Transferred-in equivalent units under FIFO = equivalent units under the weighted average method less equivalent units completed in beginning WIP inventory.

Steps 3,4 and 5 of the cost report for both weighted average and FIFO methods are determined in the same manner as for the case without transferred-in costs.

Implementation and Enhancement of Process Costing

- Sometimes process-based manufacturers have very different products going through different processes, making process costing by itself inadequate
- Activity-based costing (ABC) is an important enhancement to process costing when product and process variety arises
- Process costing also lacks the ability to identify the most profitable product mix--to remedy this shortcoming, the appropriate cost management methods are:
  - The contribution method
  - The theory of constraints

Implementation and Enhancement of Process Costing (continued)

- **Just-in-time** manufacturing processes and **backflush costing** represent an alternative to process costing in process systems where management has achieved a low level of materials, in-process, and finished goods inventory, through process engineering, process flow enhancements, lean manufacturing, and the use of theory of constraints.

- **Backflush costing** recognizes that in a system with low inventory levels there is no need to determine equivalent units, and instead current production costs are charged directly to finished goods inventory using standard costs. Backflush accounting is not accepted for generally accepted accounting principles (GAAP) because it does not value in-process inventory.

Normal Spoilage in Process Costing

There are two options to account for normal spoilage:

1. Count the number of spoiled units, prepare a separate equivalent unit computation with the cost per unit of the spoiled goods, and then allocate the cost of spoilage to the good units produced

2. Omit the spoiled units in computing the equivalent units of production; the spoilage cost is thus included as part of total manufacturing costs and is averaged over good units produced and ending work-in-process inventory

Option 1. is preferred since it shows the cost of normal spoilage

Abnormal Spoilage in Process Costing

When units are spoiled not under normal operating conditions, but instead is due to operator error or machine malfunction, or other preventable cause, it is accounted for as abnormal spoilage.

Abnormal spoilage is calculated as the cost of lost materials, labor and overhead up to the inspection point where it is determined that the units are spoiled. The cost of abnormal spoilage is calculated and reported separately in the cost report so that abnormal spoilage gets the desired management attention.

E. Cost Allocation: Departments, Joint Products, and By-Products

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The Strategic Role of Cost Allocation

❶ Determine accurate departmental and product costs as a basis for evaluating the cost efficiency of departments and the profitability of different products

❷ Motivate managers to exert a high level of effort to achieve the goals of top management

❸ Provide the right incentive for managers to make decisions that are consistent with the goals of top management

❹ Fairly determine the rewards earned by managers for their effort and skill and for the effectiveness of their decision-making

Cost Allocation Bases

– The most objective basis for cost allocation exists when a *cause-and-effect relationship* can be determined, such as the relationship between machine breakdowns and maintenance costs

– Other alternatives exist in the absence of cause-and-effect relationships, such as *ability-to-bear* and *benefit received*

Ethical Issues in Cost Allocation

- An ethical issue arises when costs are allocated to products or services that are produced for both a competitive market and a public or governmental entity
  - The latter often purchases on a cost-plus basis creating an incentive to shift costs from the competitive products to cost-plus-based products and contracts
- An equity or fair-share issue arises when a governmental unit reimburses the costs of a private institution or when it provides a service to the public for a fee–no single measure of equity exists

Ethical Issues in Cost Allocation (continued)

- A third ethical issue is the effect 0f the chosen allocation method on the costs of the products sold to or from foreign subsidiaries
  - By increasing the costs of products purchased in high-tax countries or in countries where the firm does not have favorable tax treatment, the firm can reduce its overall tax liability
  - International tax authorities watch the cost-allocation methods of multinational firms very closely for this reason

Overhead Allocations: Three General Approaches

Three general approaches for allocating overhead costs to products:

- The *volume-based approach* allocates overhead from a single cost pool
- The *departmental approach* allocates overhead to production departments, and then from production departments to products
- The *activity-based approach* allocates overhead to production activities, and then from production activities to products

The Departmental Approach

The departmental approach classifies manufacturing departments into production and service departments

This approach involves three phases:

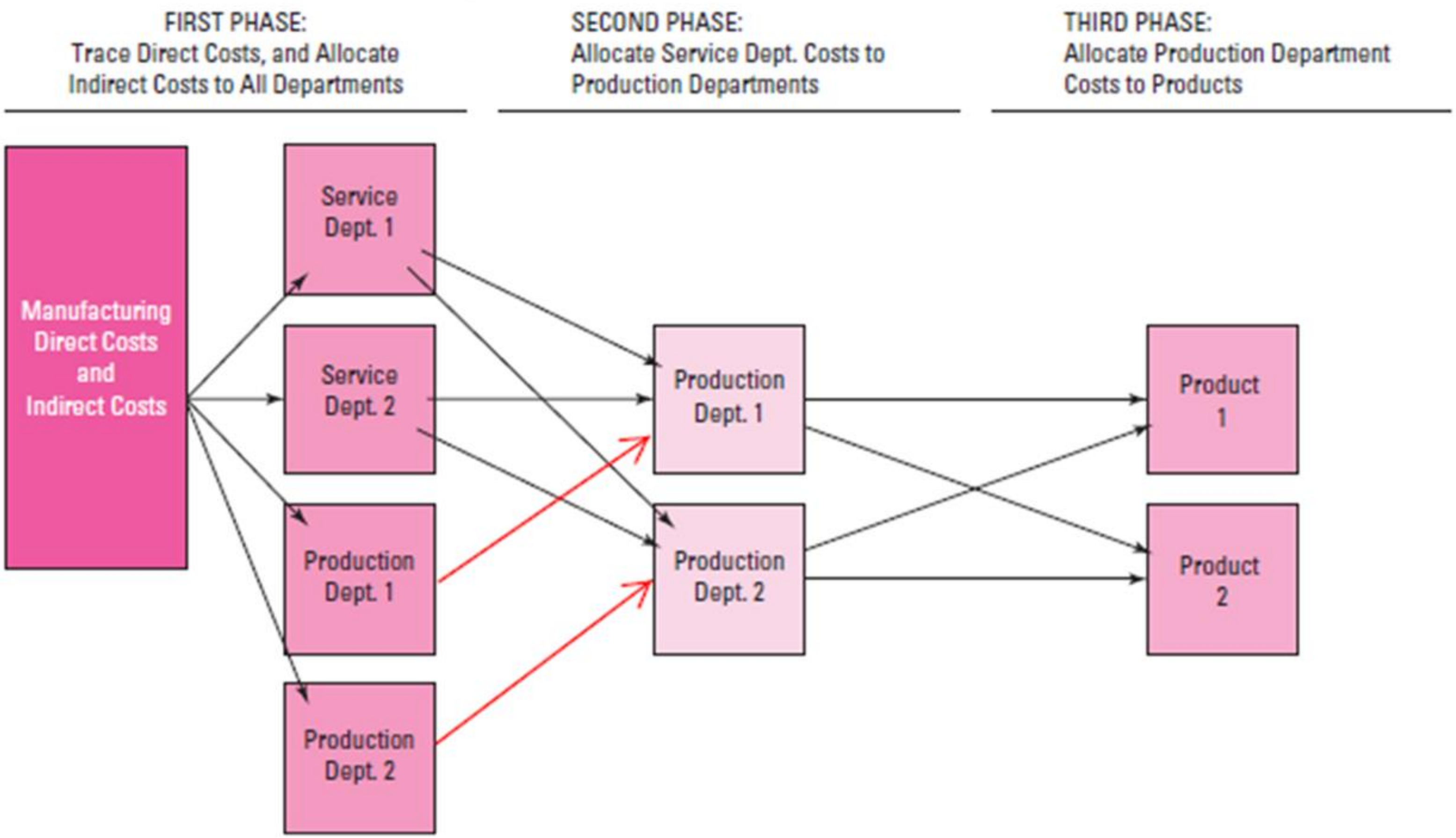
➊ Trace all direct overhead costs and allocate common overhead costs to both the various production and service departments

➋ Allocate the service department costs to the production departments

➌ Allocate production department costs to products

The Three Phases of Departmental Cost Allocation

EXHIBIT 7.2 **The Three Phases in Departmental Cost Allocation**



Departmental Approach Example

Beary Company manufactures two products and has two production departments (P-1 and P-2) and two service departments (S-1 and S-2). Beary uses labor-hours (DLH) to allocate indirect labor costs and machine-hours (MH) to allocate indirect materials costs.

	S-1	S-2	P-1	P-2	Total Hours	Total Amount
Labor-hours	1,800	1,200	3,600	5,400	12,000	
Machine-hours	320	160	1,120	1,600	3,200	
Direct costs	$ 1,600	$ 5,500	$ 15,500	$ 13,400		$ 36,000
Indirect labor						25,000
Indirect materials						5,000
						$ 66,000

Not Traceable

Departmental Approach: Phase 1

	S-1	S-2	P-1	P-2	Total
Direct labor-hours (DLH)	1,800	1,200	3,600	5,400	12,000
Percent	15%	10%	30%	45%	100%
Machine-hours	320	160	1,120	1,600	3,200
Percent	10%	5%	35%	50%	100%
Phase 1: Trace Direct Costs and Allocate Overhead Costs to Departments					
Direct costs	$ 1,600	$ 5,500	$15,500	$13,400	$ 36,000
OVH cost to departments:					
Indirect labor (DLH)	3,750	2,500	7,500	11,250	$ 25,000
Indirect materials (MH)	500	250	1,750	2,500	$ 5,000
Total for all departments	$ 5,850	$ 8,250	$24,750	$27,150	$ 66,000

Departmental Approach: Phase 2

Phase 2, allocation of service department costs: whether, and to what extent, **reciprocal cost flows** are recognized?

Three methods are used to allocate service department costs:

- The direct method
- The step method
- The reciprocal method

Phase 2: Direct Method

	P-1		P-2		Total	
S-1						
Service % to production departments		30%		30%		
Allocation % per direct method		50%		50%		
Allocation amount	$	2,925	$	2,925	$	5,850
S-2						
Service % to production departments		30%		60%		
Allocation % per direct method		33.33%		66.67%		
Allocation amount	$	2,750	$	5,500		8,250
Plus Phase 1 Allocation Amount	$	24,750	$	27,150		51,900
Total for Production Departments	$	30,425	$	35,575	$	66,000

Phase 3: Direct Method

	Product 1	Product 2	Total
Labor-hours			
Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	
P-1 (labor-hour basis)	$ 15,212.50	$ 15,212.50	$ 30,425
P-2 (mahine-hour basis)	8,893.75	26,681.25	35,575
Totals for each product	$ 24,106.25	$ 41,893.75	$ 66,000

Phase 2: Step Method

	S-2	P-1	P-2	Total
Step 1--Allocation of S-1:				
Service percent	40%	30%	30%	
Amount	$ 2,340	$ 1,755	$ 1,755	$ 5,850
Step 2--Allocation of S-2:				
Service percent		30%	60%	
Alloc. % per direct method		33.33%	66.67%	
Amount	$ 10,590	$ 3,530	$ 7,060	8,250
Plus: First-Phase Allocation		24,750	27,150	51,900
Totals		$ 30,035	$ 35,965	$ 66,000

Phase 3: Step Method

	Product 1	Product 2	Total
Labor-hours			
Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	
P-1 (labor-hour basis)	$ 15,017.50	$ 15,017.50	$ 30,035
P-2 (mahine-hour basis)	8,991.25	26,973.75	35,965
Totals for each product	$ 24,008.75	$ 41,991.25	$ 66,000

Phase 2: Reciprocal Method

Step 1: Set up and Solve Simultaneous Equations

Allocated S1 Costs = Traceable Costs + Cost allocated from S2

S1 = $5,850 + (10% x S2)

Allocated S2 Costs = Initial allocation + Cost allocated from S1

S2 = $8,250 + (40% x S1)

The second equation is substituted into the first as follows:

S1 = $5,850 + 10% x [$8250 + (40% x S1)]
S1 = $6,953.13

Then the S1 figure is substituted into the second equation:

S2 = $8,250 + [40% x ($6,953.13)]
S2 = $11,031.25

Phase 2: Reciprocal Method (continued)

Second Step: Allocation from Service Depts. To Prod. Departments

	P-1	P-2	Total
S-1			
Service % to prod. depts.	30%	30%	
Allocated amount	$ 2,086	$ 2,086	
S-2			
Service % to prod. depts.	30%	60%	
Allocated amount	$ 3,309	$ 6,619	
Plus Phase-1 Allocation	$ 24,750	$ 27,150	
Totals	$ 30,145	$ 35,855	$ 66,000

Phase 3: Reciprocal Method

	Product 1	Product 2	Total
Labor-hours			
Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	
P-1 (labor-hour basis)	$ 15,072.50	$ 15,072.50	$ 30,145
P-2 (mahine-hour basis)	8,963.75	26,891.25	35,855
Totals	$ 24,036.25	$ 41,963.75	$ 66,000

Key Implementation Issues

- **Choosing the most accurate method is key**
  - Wide variations can occur in the product allocation amounts

- **Determining an appropriate allocation base** and a percentage amount for service provided by the service departments is often difficult

- **Variable costs can be traced easily, but fixed costs are difficult to allocate to departments**
  - Ideally, firms would use *dual allocation*, which separates variable and fixed costs and traces the variable costs directly to the departments that caused the cost

Key Implementation Issues (continued)

- **Using budgeted vs. actual amounts?**
  - Budgeted (predetermined) amounts can be more difficult to determine but are more motivating for the allocation of fixed costs
  - Using budgeted amounts makes the allocation of fixed costs more predictable and less dependent upon the usage of other departments
- **Allocated costs can exceed external purchase cost**
  - Occasionally the cost a department is allocated exceeds the cost of purchasing that service from an outside supplier

Joint Product Costing

- Some manufacturing plants yield more than one product from a common resource input; this is called a joint production process

- *Joint products* are products from a joint production process that have relatively substantial sales values

- Products whose total sales values are minor in comparison to the sales value of the joint products are classified as *by-products*

Joint Product Costing (continued)

- **Joint products** and by-products start their manufacturing life as part of the same raw material, so up until a certain point, no distinction can be made between the products
  - **By-products** differ from joint products in that the sales value of the by-product is somewhat lower than that of the joint products
- The point in a joint production process at which individual products can be identified for the first time is called the *split-off point*
- *Joint costs* include all manufacturing costs incurred prior to the split-off point

Joint Product Costing (continued)

- **Costs incurred after the split-off point are called *separable processing costs***

- **Three methods are commonly used to allocate joint product costs**

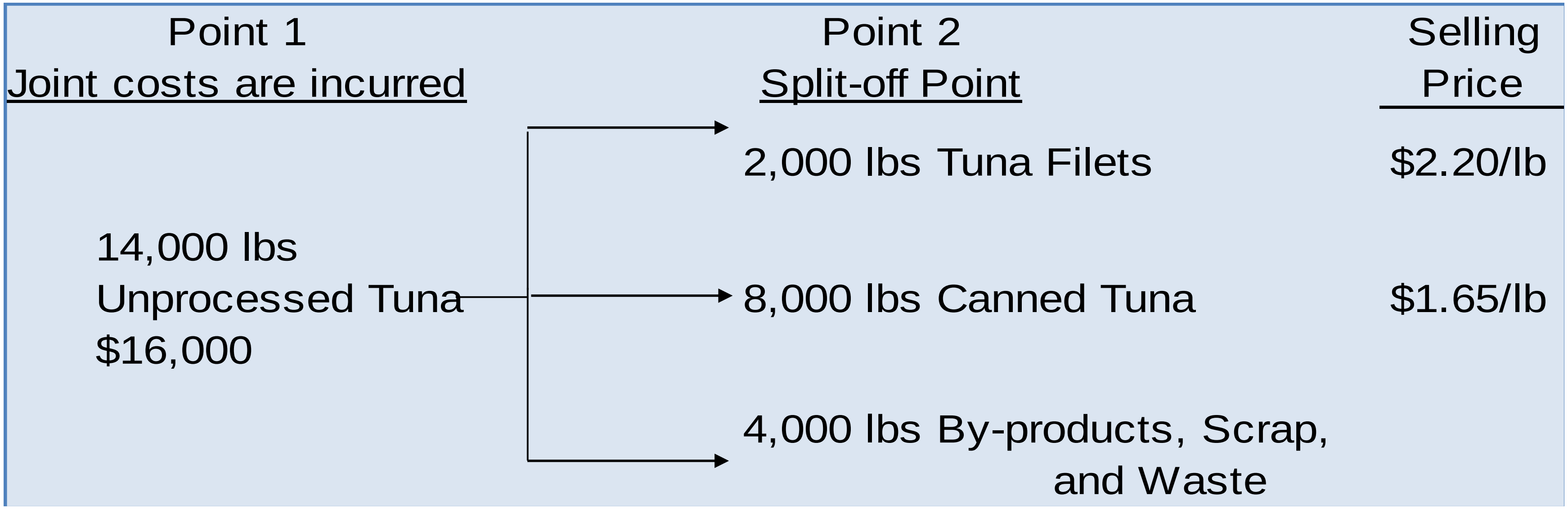
  – Relative physical units (measures) produced
  – Relative sales values of the products
  – Relative net realizable values (NRV) of the products

Cost Allocation Based on Relative Physical Units

- **The *physical units method* uses a physical measure such as pounds, gallons, or units or volume to allocate the joint costs to joint products**
  - The greater the output (however measured), the greater the share of joint costs allocated to the product
- **This method is also called the *average cost method* when units of output are used in the costing procedure**

The Physical Units Method: Example

Assume Johnson Seafood produces tuna filets and canned tuna for distribution to restaurants and supermarkets:



The Physical Units Method (continued)

Product	Phys. Units (lbs.)	Proportion	Allocation of Joint Cost	Cost per Pound
Tuna filets	2,000	20%	$ 3,200	$ 1.60
Canned tuna	8,000	80%	12,800	$ 1.60
Total	10,000	100%	$ 16,000	

The Physical Units Method: Summary

Advantages	Disadvantages
❶ Easy to use	❶ Ignores the revenue-producing capability of individual products
❷ The criterion for the allocation of the joint costs is objective	❷ Each product can have its own unique physical measure

Relative Sales Values at Split-off Method

- The sales value at split-off method allocates joint costs to joint products on the basis of their *relative sales values at the split-off point*

- This method can only be used when joint products can be sold at the split-off point

Sales Value at Split-off Point Method: Example

Using the same example, the sales value at split-off point method produces the following results:

Product	Units (in lbs.)	Price per unit	Sales Value	Proportion	Alloc. Of Joint Cost	Cost per Pound
Tuna filets	2,000	$2.20	$4,400	25%	$ 4,000	$ 2.00
Canned tuna	8,000	$1.65	$13,200	75%	12,000	$ 1.50
Total	10,000		$17,600	100%	$ 16,000	

Sales Values at Split-off Point Method: Summary

Advantages	Disadvantages
❶ Easy to calculate	❶ Market prices for some industries change constantly
❷ Costs are allocated according to the individual product's revenue	❷ Sales price at split-off might not be available because additional processing is necessary for sale

The Net Realizable Value (NRV) Method

- The NRV method can be used when joint products cannot be sold at split-off

- The net realizable value (NRV) of a product is the product's *estimated* sales value at the split-off point

- NRV is determined by subtracting additional processing and selling costs beyond the split-off point from the estimated ultimate sales value of the product

The Net Realizable Value (NRV) Method: Example

Assume Johnson Seafood also produces cat food from the raw, unprocessed tuna

Point 1 Joint costs are incurred	Point 2 Split-off Point		Point 3 Addt'l Processing
	2,000 lbs Tuna Filets @ $2.20/lb		
14,000 lbs Unprocessed Tuna $16,000	8,000 lbs Canned Tuna @$1.65/lb		
	3,000 lbs Cat Food	Processing Cost → $850	3,000 lbs Cat Food @$1.75/lb
	1,000 lbs By-products, Scrap, and Waste		

The NRV Method: Example (continued)

Product	Pounds	Price	Sales Value	Additional Processing	
Tuna filets	2000	$2.20	$4,400	$0.00	
Canned tuna	8000	$1.65	$13,200	$0.00	
Cat food	3000	$1.75	$5,250	$850.00	
Total	13,000		$22,850	$850.00	

Product	NRV	Percent of NRV	Allocated Cost	Total Cost	Cost per Pound
Tuna filets	$4,400	20%	$3,200	$3,200	$1.60
Canned tuna	$13,200	60%	$9,600	$9,600	$1.20
Cat food	$4,400	20%	$3,200	$4,050	$1.35
Total	$22,000	100%	$16,000	$16,850	

By-Product Costing

Four Methods: Two based on assets, two based on revenues:

- **Asset Recognition Methods:**
  - Net Realizable Value (NRV) Method
  - Other Income at Production Point Method
- **Revenue Methods:**
  - Other Income at Selling Point Method
  - Manufacturing Cost Reduction at Selling Point Method
- The main difference between these methods is the former grouping records by-product *produced* as inventory at NRV, while the latter grouping recognizes by-product revenue in the period *sold*

F. Activity-Based Costing and Customer Profitability Analysis

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Strategic Role of ABC

Activity-based costing (ABC) vs. volume-based costing:

- Volume-based costing results may be distorted because indirect costs do not always occur in proportion to output volume

- Volume-based costing generally causes cross-subsidization of outputs (i.e., some products will be overcosted and others undercosted)

- Activity-based costing uses detailed information about the activities that make up indirect costs so that outputs are charged only for resources consumed by the activities needed to perform them

Volume-Based Costing

- **May be a good strategic choice for some firms**
  - When the costs to be allocated are relatively small versus the directly traceable costs
  - When the activities supporting production are relatively homogeneous across different product/service lines
- **Volume-based costing is often used by paper product manufacturers, producers of agricultural products, other commodity firms, and professional service firms**

ABC Terms

- *Activity* - a specific task or action of work done, such as production set-up
- *Resource* - an economic element needed or consumed in performing activities, such as salaries and supplies
- Cost driver - either a *resource consumption cost driver* or an *activity consumption cost driver*

ABC Terms

- **Resource consumption cost drivers** measure the amount of resources consumed by an activity, such as the number of items in a purchase or sales order
- **Activity consumption cost drivers** measure the amount of activity performed for an object, such as the number of batches used to manufacture a product

Cost Assignment

- ***The two-stage cost assignment*** **approach for indirect (support) costs: resource costs such as factory overhead are assigned to activity cost pools and then to cost objects (jobs, clients, products, patients, etc.)**
  - Volume-based systems assign factory overhead to a single plant or departmental cost pool first and then to products or services using a volume-based rate
  - ABC systems assign factory overhead costs to activities or activity cost pools using resource consumption cost drivers and then assign these costs to cost objects using activity consumption cost drivers

Summary:
ABC vs. volume-based costing

ABC systems differ from volume-based costing systems in two ways:

- ABC system defines cost pools as activities rather than production plant or department cost centers
- Cost drivers
  - ABC systems use drivers based on an activity or activities performed for the cost object
  - Volume-based approaches use a volume-based cost driver that often bears little or no relationship to the consumption of resources by the cost objects

Activity Analysis

Through activity analysis, a firm identifies the work it performs to carry out its operations by

- Gathering data from existing documents and records
- Collecting additional data using questionnaires, observations, or interviews of key personnel
- Sample questions include:
  - What work or activities do you do?
  - How much time do you spend performing these activities?
  - What resources are required to perform these activities?
  - What value does the activity have for the product, service, customer, or organization?

Activity Analysis (continued)

To identify resource costs for various activities, a firm classifies all activities according to the way in which the activities consume resources

- A *unit-level* activity is performed on each individual unit of product or service of the firm (e.g., direct materials)
- A *batch-level* activity is performed for each batch or group of units of products or services (e.g., setting up machines or placing purchase orders)
- A *product-level* activity supports the production of a specific product or service (e.g., engineering changes to modify parts for a product)
- A f*acility-level* activity supports overall operations (e.g., property taxes and insurance)

Unit Level Costs

Performed for each unit of product or service

Examples include:

- Units of production related depreciation of factory machinery
- Energy costs for machinery used for individual units of production (e.g., A drill press that drills holes in pieces of metal)

Batch Level Costs

Performed for each batch of product or service produced

Examples include:

- Machine setup costs
- Quality control costs
- Wages for works that move products within the factory
- Energy costs for machinery that is used for multiple units of product at the same time (e.g., an oven that bakes a batch of cookies for a commercial baker)

Product Level Costs

Support production of a specific product or service line

Examples include:

- Salaries for product line purchasing managers
- Quality control costs
- Product development costs
- Depreciation and maintenance for specialized machinery dedicated to the production od a single product or service line

Facility Level Costs

Support overall operations

Examples include:

- Factory depreciation
- Security costs for the factory
- Insurance and property taxes for a factory
- Salary of a plant manager

Developing an ABC System

There are three steps in the development of an ABC system:

❶ Identify resource costs and activities

– An activity analysis is performed to identify key activities and the way in which the activities consume resources

❷ Assign resource costs to activities

– Use resource consumption cost drivers based on cause-and-effect relationships, such as the number of labor hours, setups, moves, machine-hours, employees, or square feet to assign resource costs

❸ Assign activity costs to cost objects

– Use activity consumption cost drivers, such as purchase orders, receiving reports, parts stored, direct labor-hours, or manufacturing cycle time to assign activity costs

Benefits of ABC Systems

❶ Better profitability measures due to more accurate costs

❷ Better decision making: identification of value-added vs. non-value-added activities and associated costs

❸ Information for process improvement

❹ Improved cost planning

❺ Helps identify and control the cost of unused capacity

Volume-Based vs. ABC Example

Haymarket BioTech, Inc. (HBT) produces and sells two secure communication systems, AW (Anywhere) and SZ (SecureZone). HBT has the following operating data for the two products:

	AW	SZ
Production volume	5,000	20,000
Selling price	$400.00	$200.00
Unit direct materials and labor	$200.00	$80.00
Direct labor-hours	25,000	75,000
Direct labor-hours per unit	5	3.75

Volume-Based vs. ABC (continued)

The **traditional volume-based costing system** assigns factory overhead (OH) based on direct labor-hours (DLH). The firm has a total budgeted overhead of $2,000,000. Since the firm budgeted 100,000 DLHs for the year, the overhead rate per DLH is $20 ($2,000,000÷100,000 DLH).

Therefore……

Volume-Based vs. ABC (continued)

The factory overhead assigned to AW is \$500,000 (25,000 DLH × \$20) in total and \$100 (\$500,000÷5,000 units) per unit, since the firm used 25,000 direct labor hours to manufacture 5,000 units of AW

and

The factory overhead assigned to SZ is \$1,500,000 (75,000 DLH × \$20) in total and \$75 (\$1,500,000÷20,000 units) per unit, since the firm used 75,000 direct labor hours to manufacture 20,000 units of SZ

Volume-Based vs. ABC (continued)

Product profitability analysis per unit using volume-based costing:

	AW		SZ	
Unit selling price		$400.00		$200.00
Unit-level manufacturing costs				
Direct materials and labor	$200.00		$80.00	
Factory overhead	100.00		75.00	
Cost per unit		300.00		155.00
Profit margin		100.00		45.00

Volume-Based vs. ABC (continued)

In an attempt to use an ABC system, HBT has identified the following activities, budgeted costs, and activity consumption cost drivers:

Activity	Budgeted Cost	Activity Consumption Cost Driver
Engineering	$ 125,000	Engineering hours
Setups	300,000	Number of setups
Machine operations	1,500,000	Machine hours
Packing	75,000	Number of packing orders
Total	$ 2,000,000	

Volume-Based vs. ABC (continued)

HBT also has gathered the following operating data pertaining to each of its products:

	AW	SZ	Total
Engineering hours	5,000	7,500	12,500
Number of setups	200	100	300
Machine hours	50,000	100,000	150,000
Number of packing orders	5,000	10,000	15,000

Volume-Based vs. ABC (continued)

Using the operating data, the activity rate for each activity consumption cost driver is calculated as follows:

(1)	(2)	(3)	(4) = (2) ÷ (3)
Consumption Cost Driver	Budgeted Cost	Budgeted Activity Consumption	Activity Consumption Rate
Engineering hours	$ 125,000	12,500	$ 10 per hour
Number of setups	300,000	300	1,000 per setup
Machine hours	1,500,000	150,000	10 per hour
Number of packing orders	75,000	15,000	5 per order

Volume-Based vs. ABC (continued)

Factory overhead costs for AW at 5,000 units of production:

(1) Consumption Cost Driver	(2) Activity Consumption Rate	(3) Activity Consumption	(4) = (2) × (3) Total Overhead	(5) Overhead per Unit
Engineering hours	$ 10	5,000	$ 50,000	$ 10
Number of setups	1,000	200	200,000	40
Machine hours	10	50,000	500,000	100
Number of packing orders	5	5,000	25,000	5
Total			$ 775,000	$ 155

Volume-Based vs. ABC (continued)

Factory overhead costs for SZ at 20,000 units of production:

(1)	(2)	(3)	(4)=(2)×(3)	(5)
Consumption Cost Driver	Activity Consumption Rate	Activity Consumption	Total Overhead	Overhead per Unit
Engineering hours	$ 10	7,500	$ 75,000	$ 3.75
Number of setups	1,000	100	100,000	5.00
Machine hours	10	100,000	1,000,000	50.00
Number of packing orders	5	10,000	50,000	2.50
Total			$ 1,225,000	$ 61.25

Volume-Based vs. ABC Example (continued)

Product profitability analysis per unit using ABC:

		AW			SZ	
Unit selling price			$ 400			$200.00
Unit-level manufacturing costs						
Direct materials and labor		$ 200			$ 80.00	
Engineering	$ 10			3.75		
Setups	40			5.00		
Machine running	100			50.00		
Packing	5			2.50		
Factory overhead		155.00			61.25	
Cost per unit			355.00			141.25
Profit margin			$ 45			$ 58.75

Volume-Based vs. ABC (continued)

The following chart compares the results of the two costing systems:

	AW		SZ	
Unit overhead cost				
Volume-based	$	100	$	75.00
Ativity-based		155		61.25
Difference	$	55	$	13.75
Profit margin				
Volume-based	$	100	$	45.00
Ativity-based		45		58.75
Difference	$	55	$	13.75

Can you guess which is the high-volume and which is the low-volume product?

Keep in mind that volume-based costing tends to undercost low-volume products and overcost high-volume products, a situation often referred to as product cost cross-subsidization

Cost of Capacity for the HBT Example

- Suppose that instead of a budgeted activity consumption of 12,500 hours, HBT were to use the practical capacity of the engineering staff, which is 15,625 hours.
- Using practical capacity, the activity consumption rate would be $8 per engineering hour (=$125,000÷15,625). If only 12,500 hours were used, as shown in the HBT example, then the overhead cost charged to AW and SZ would be reduced because of the lower rate ($8 instead of the original rate of $10).
- AW overhead would be reduced by $10,000 (5,000 hours × $2) and SZ overhead would be reduced by $15,000 (7,500 hours × $2).
- The total reduction for the two products, $25,000 (=$10,000 + $15,000) is the **cost of unused capacity.**

Five Steps of Strategic Decision Making in the HBT Example

1. **Determine the Strategic Issues Surrounding the Problem:** ***HBT competes on differentiation***
2. **Identify the Alternative Actions:** ***focus on AW or SZ?***
3. **Obtain Information and Conduct Analyses of the Alternatives:** ***cost analysis based on ABC costing***
4. **Based on Strategy and Analysis, Choose and Implement the Desired Alternative:** ***do not promote AW over SZ, but instead focus on SZ to improve overall profitability***
5. **Provide an On-going Evaluation of the Effectiveness of implementation in Step 4.**

Activity-Based Management (ABM)

ABM manages activities to improve the value of products or services to customers and increase the firm's competitiveness and profitability:

- Focuses on the efficiency and effectiveness of key business processes and activities
- Improves management's focus on the firm's critical success factors thereby enhancing the firm's competitive advantage
- ABC is its major source of information

Activity-Based Management (ABM) (continued)

ABM applications can be classified into two categories:

- ***Operational ABM*** enhances operational efficiency and asset utilization and lowers costs; it focuses on doing things right and performing activities more efficiently
- ***Strategic ABM*** attempts to alter the demand for activities and increases profitability through improved activity efficiency

ABC/M Tools

Some key ABC/M tools:

- In *activity analysis* an organization assesses each of its activities based on its need by the product or the customer, its efficiency, and its value content

- *Value-added analyses* are performed in an effort to eliminate activities that add little or no value to the customer; resource consumption can be reduced and the firm can focus on activities that increase customer satisfaction

ABC/M Tools (continued)

High-value-added activities:

- Increase significantly the value of the product or service
- Are necessary to meet customer requirements
- Enhance purchased materials or components
- Contribute to customer satisfaction
- Are critical steps in a business process

In short, removal would reduce the value of the product or service

ABC/M Tools (continued)

Low-value-added activities:

- Consume time, resources, or space but add little or nothing to satisfying customer needs
- Can be eliminated without affecting the form/fit/function of the product or service

Customer Profitability Analysis

ABC/M can be used to estimate customer-related costs and in therefore in assessing the profitability of a specific customer or group of customers

- *Customer profitability analysis* identifies customer service activities and cost drivers and determines profitability for each customer or group; this process allows the firm to chose its customer mix, determine an appropriate offering of after-sale services, decide what discounts to offer, etc.

- *Customer cost analysis* is the first step in a customer profitability analysis; it identifies activities and cost drivers to service customers before and after sales

Customer Profitability Analysis (continued)

Customer-related costs can be classified into the following categories:

- Customer unit-level costs - resources consumed for each unit sold to a customer, such as sales commissions and shipping costs based on units sold or shipped
- Customer batch-level costs - resources consumed for each sales transaction, such as order-processing costs or invoicing costs
- Customer-sustaining costs -resources consumed to service a customer regardless of the number of units or batches sold, such as monthly statement processing costs and collection costs for late payments

Customer Profitability Analysis (continued)

Customer costs can be classified into the following categories (continued):

- Distribution-channel costs are resources consumed in each distribution channel the firm uses to service customers, such as the cost of operating a regional warehouse or centralized distribution center

- Sales-sustaining costs are resources consumed to sustain sales and service activities that cannot be traced to an individual unit, batch, customer, or distribution channel, such as general corporate marketing expenditures

Customer Profitability Analysis (continued)

- **Customer Profitability Analysis** combines customer revenues and customer costs to assess customer profitability and helps identify actions to improve customer profitability
- Some companies quantify customer value in what is called **Customer Lifetime Value** (CLV), which is equal to the net present value (NPV) of all estimated future profits from the customer for a specified period of time

Customer Profitability Analysis (continued)

Customer profitability analysis helps to assess a customer's value to the company:

- What is the growth potential of the customer and the customer's industry?
- What is its "cross-selling" potential?
- What are the possible reactions of the customer to changes in sales terms or services?
- How important is this customer as a future sales reference?

ABC/M Implementation Issues

- A successful ABC/M implementation requires close cooperation among management accountants, engineers, and manufacturing and operating managers

- There are three important issues to consider in ABC/M implementation:
  - Multiple-Stage ABC
  - Time-Driven ABC (TDABC)
  - Resource Consumption Accounting

ABC/M Implementation Issues (continued)

- **Multiple-stage ABC** takes into account that some activities are cost objects for other activities

- **Time-driven ABC (TDABC)** simplifies some of the complexity involved in large ABC systems

ABC/M Implementation Issues (continued)

- Time-driven ABC (TDABC)
- Is based on the idea that the common element in the utilization of many activities is the unit of time
- Assigns resource costs directly to cost objects using the cost per time unit of supplying the resource
- Requires the total activity cost be divided by the number of minutes available to that activity to provide a cost per unit of time

Resource Consumption Accounting

- Emphasis is on being able to attribute costs, both fixed and proportional, to cost objects for decision support
- Three foundational concepts for RCA:
  - The view of resources – resources are the suppliers of capacity, meaning that capacity is a function of the resources available.
  - The quantity-based model – an operational view of the organization based on the concept that there is a causal relationship that can be expressed in terms of input and output units.
  - Cost behavior – the characteristics of the cost are inherent to the underlying resource and the consumption of those resources by value creating operations.

TDABC Example

- Assume 2 clerical workers paid $45,000 annually perform a certain activity that is expected to require 17 minutes. TDABC calculates the total cost as $45,000 × 2 = $90,000; TDABC then calculates the total time available for the activity as 180,000 minutes (assuming 30 hours per week with two weeks vacation: 2 workers × 50 weeks × 30 hours × 60 minutes per hour = 180,000 minutes per year).

- The TDAC rate for the activity is $0.50 per minute ($90,000 ÷ 180,000). The cost of a unit of activity is $0.50 × 17 min = $8.50.

G. Cost Estimation

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Strategic Role of Cost Estimation

- ***Cost estimation*** **is the development of the functional relationship between a cost object and its cost drivers for the purpose of predicting the cost**
- **Accurate cost estimates facilitate the strategic cost-management process in two ways:**
  - Cost estimates based on activity-based, volume-based, structural, and executional cost drivers facilitate effective planning, decision making, and performance measurement

Steps in Cost Estimation

There are six steps in the *cost estimation* process:

❶ **Define the cost object to be estimated**

❷ **Determine the cost driver(s)**

- The most important step: specification of underlying causal factors of a cost

❸ **Collect consistent and accurate data**

- *Consistent* means that the data are calculated on the same accounting basis and all transactions are recorded in the proper period
- *Accuracy* refers to the reliability of the data

Steps in Cost Estimation (continued)

❹ **Graph the data**

– To identify unusual patterns, possible nonlinearities, and any outlier observations

❺ **Select and employ a cost-estimation method (e.g., linear regression)**

❻ **Assess the accuracy of the cost estimate**

Cost Estimation Methods

- **There are two methods to collect and pre-analyze data**:
  – Engineering methods
  – Inspection of Accounts

- **Engineering Methods** – direct observation of activities. Suitable for repetitive processes with clear definition of input-output (direct labor; materials and machine hours).

- **Inspection of Accounts** – inputs from departmental manager and accountant regarding classification and cost pooling of items.

Cost Estimation Methods

- **There are two Quantitative *cost estimation methods*** discussed in this chapter:
  - The High-Low method
  - Regression analysis (both linear and nonlinear models)

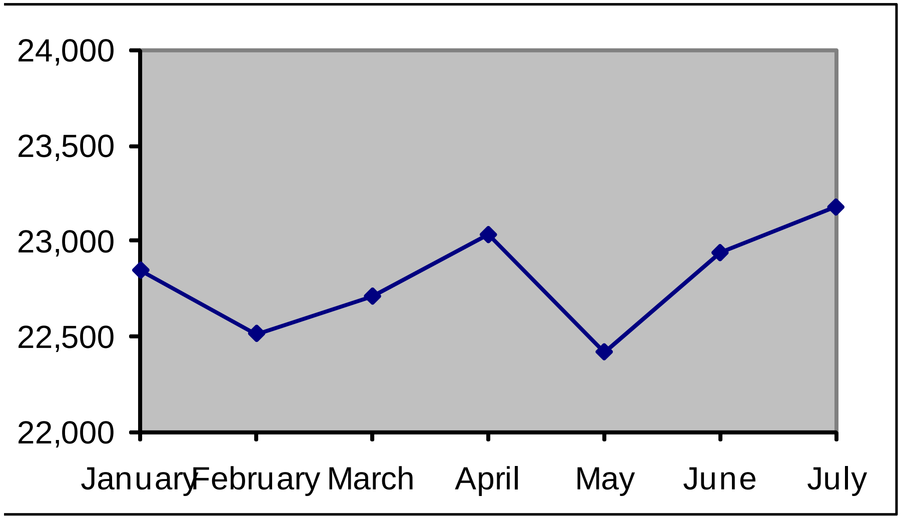
- **The High-Low method** is simpler but less accurate than the regression method.

- The method chosen by the cost analyst will depend on the level of accuracy desired and any limitations on cost, time, and effort

Cost Estimation: An Example

Bill Garcia, a management accountant, wants to estimate future maintenance costs for a large manufacturing company; recent monthly cost data are as follows:

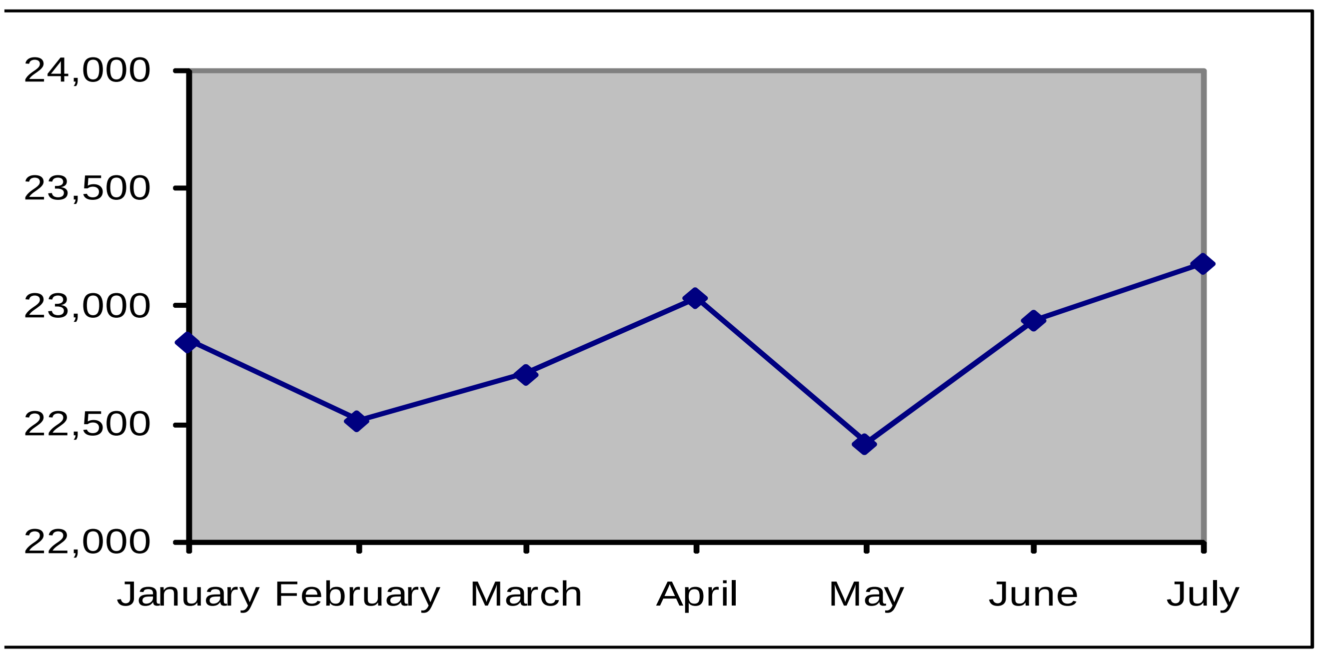
January	February	March	April	May	June	July
22,843	22,510	22,706	23,030	22,413	22,935	23,175



Cost Estimation Example (continued)

Based on above information, Garcia feels that maintenance costs for August will likely be between $22,500 and $23,500, but he wants to be accurate so he considers cost estimation.

January	February	March	April	May	June	July
22,843	22,510	22,706	23,030	22,413	22,935	23,175



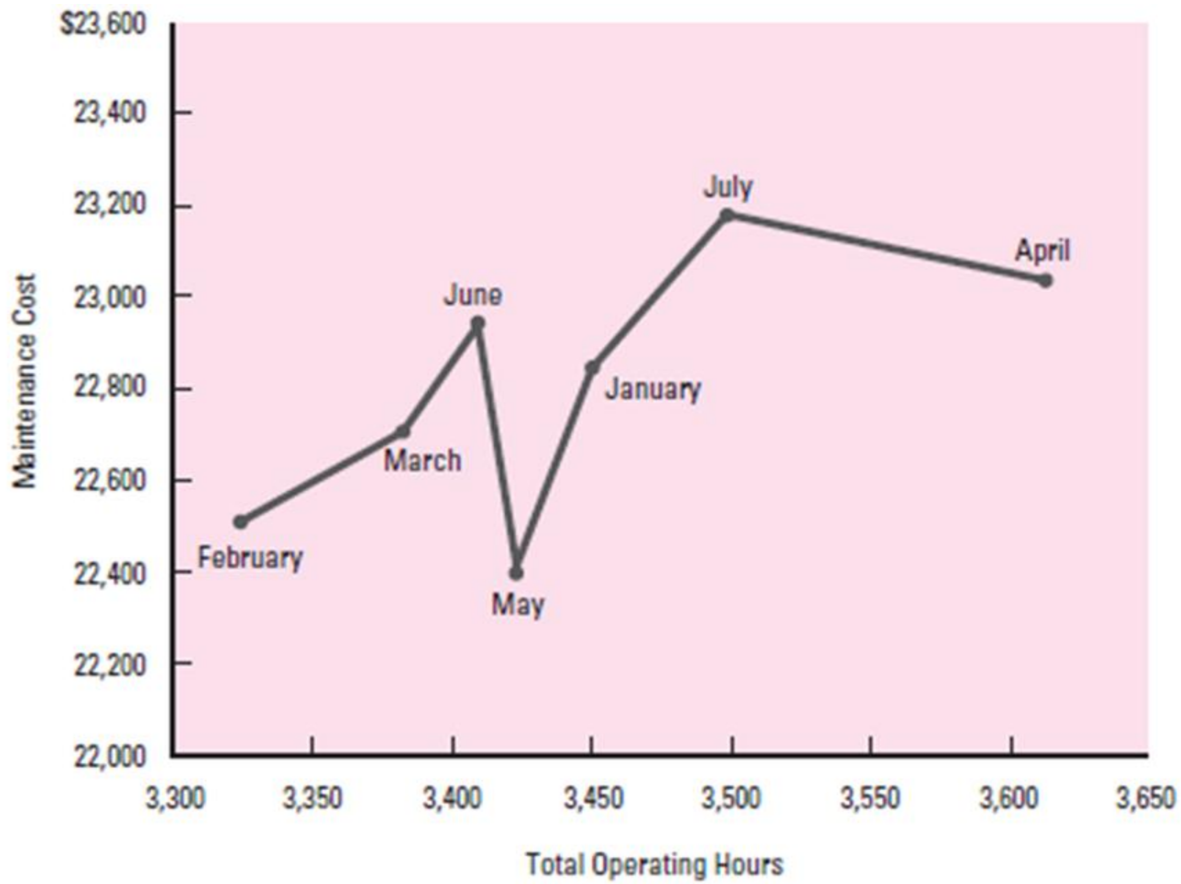
Cost Estimation Example (continued)

Garcia would like to estimate an underlying cost function for maintenance costs. Garcia feels there is an economic relationship between maintenance cost and monthly operating hours (a cost driver), so he collects the following monthly observations:

	January	February	March	April	May	June	July
Total operating hours	3,451	3,325	3,383	3,614	3,423	3,410	3,500
Maintenance costs ($)	22,843	22,510	22,706	23,030	22,413	22,935	23,175

Cost Estimation Example (continued)

Another graph is created to incorporate the new data:



The High-Low Method

The *high-low method* uses algebra to determine a unique estimation line (equation) between representative high and low points in the data

This method provides a unique cost line rather than a rough estimate based on a visual fitting of a cost function line through a set of data points

The high-low equation is as follows:

$$Y = a + (bX)$$

Where Y = the value of the estimated cost

X = the cost driver

a = a fixed quantity that represents Y when X is zero

b = the slope of the line (unit variable cost)

The High-Low Method (continued)

Using the graph, Garcia picks two data points, one representative of the lower points and one representative of the higher points (these points are often, but not necessarily, the highest and lowest points in the data set)

Let us assume that Garcia picks from the data set February (low point) and April (high point)

The next step is to calculate the equation of the line connecting these two points

	Hours	Cost
High Point (April)	3,614	$ 23,030
Low Point (February)	3,325	22,510
Change	289	$ 520

The High-Low Method (continued)

b = Unit variable cost = $520 ÷ 289 hours = $1.80/hour

a = Fixed cost = Total cost – Estimated variable cost

Fixed cost = $23,030 – ($1.80/hour × 3,614 hours)

Fixed cost = $23,030 – $6,505 = $16,525

Estimated cost function:

Total cost = Fixed cost + Variable cost

$$Y = a + (b \times X)$$

$$Y = \$16,525 + (\$1.80 \times X)$$

The High-Low Method (continued)

For values of the cost driver (operating hours) within the "relevant range," the preceding equation can be used to estimate monthly maintenance costs. For example, for the month of August:

Suppose that 3,600 operating hours are expected in August:

$$Y = 16{,}525 + (1.80 \times X)$$
$$Y = 16{,}525 + (1.80 \times 3{,}600)$$
$$Y = 16{,}525 + 6{,}480$$
$$Y = \$23{,}005 \text{ in maintenance costs}$$

The High-Low Method (continued)

Pros:

Requires less effort and cost than regression analysis

Provides a unique cost equation from which the management accountant can estimate future costs – useful in calculating total cost

Cons:

Relies on only two points, and the selection of those two points requires judgment (that is, it discards most of the data)

Regression analysis, based on statistical estimation, can provide more accurate estimates of cost; regression up next…

Regression Analysis

Regression analysis is a *statistical method* for obtaining the unique cost-estimating equation by minimizing, for a set of data points, the sum of the squares of the estimation errors:

An *error* is the distance measured from the regression line to the data point

Appropriately, this method of cost-estimation is referred to as *least-squares regression*

Regression Analysis (continued)

Regression analysis involves two types of variables:

– The *dependent variable* is the cost to be estimated

– The *independent variable* is the cost driver(s) used to estimate cost:

- When one cost driver is used, the regression model is referred to as a *simple regression* model
- When two or more cost drivers are used, the regression model is referred to as a *multiple regression* model

Regression Analysis (continued)

A simple (i.e., one independent variable), *linear* regression equation is as follows:

$Y = a + bX + e$

Where: Y = the amount of the *dependent variable*, the cost to be estimated

a = a *fixed quantity*, also called the *intercept* or *constant* term, which represents the amount of Y when X = 0

X = the value for the *independent variable*, the cost driver for the cost to be estimated (note: a multiple-regression model would include two or more cost drivers)

b = the *unit variable cost*, also called the *coefficient* of the independent variable, that is, the increase in Y (cost) for each unit increase in X (cost driver)

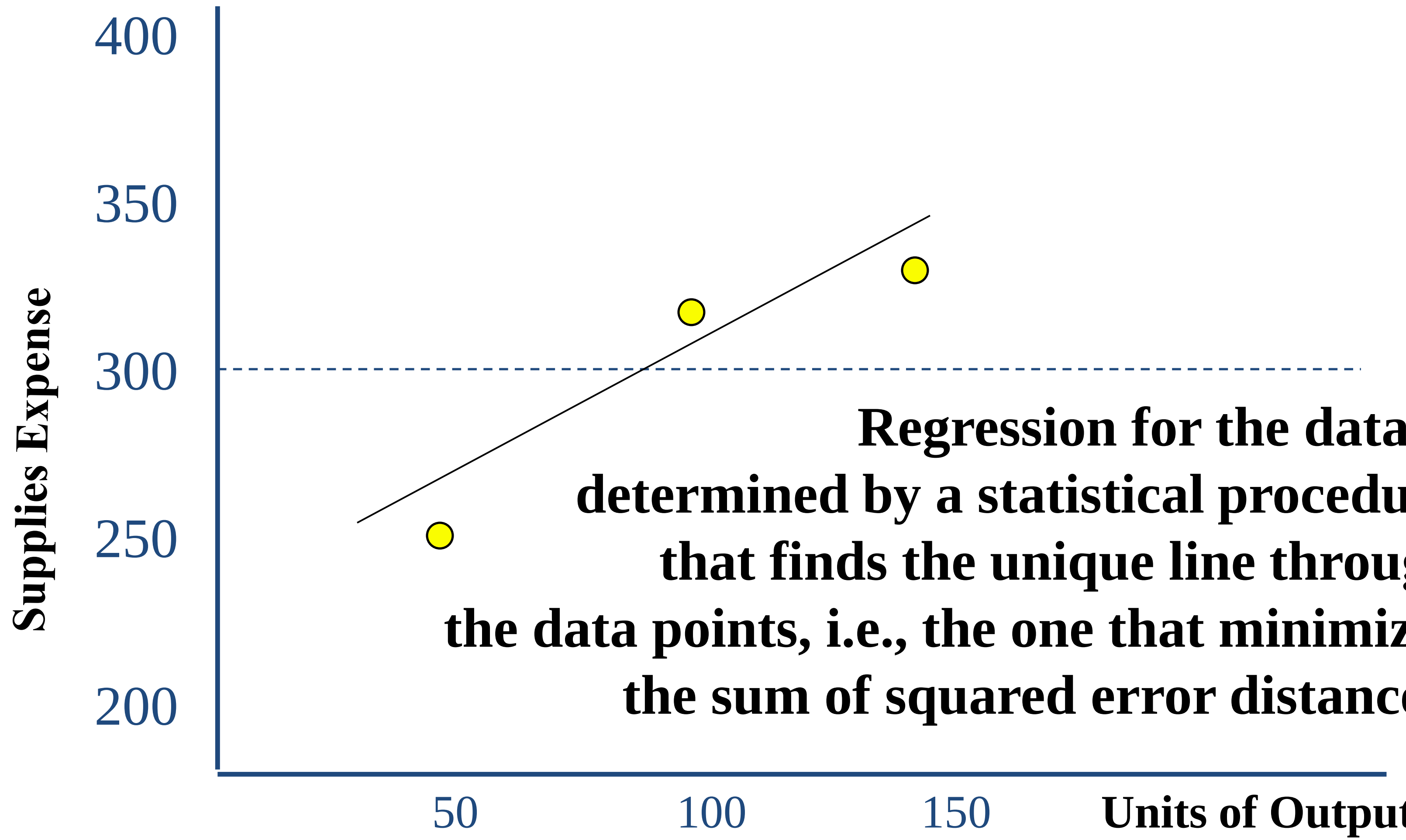
e = the *estimation error*, which (for each data point) is the distance between the regression line and the data point

Regression Analysis (continued)

To illustrate a simple, linear regression cost-estimation model, the following table contains three months of data on supplies expense and production levels (normally 12 or more points will be involved):

Month	Supplies Expense (Y)	Production Level (X)
1	$250	50 units
2	310	100 units
3	325	150 units
4	?	125 units

Regression Analysis (continued)



Regression for the data is determined by a statistical procedure that finds the unique line through the data points, i.e., the one that minimizes the sum of squared error distances.

Regression Analysis (continued)

Month	Supplies Expense (Y)	Production Level (X)
1	$250	50 units
2	310	100 units
3	325	150 units
4	?	125 units

Y = a + b x X

Y = $220 + ($0.75 per unit × 125 units)

Y = $313.75 = Estimated Cost, Month 4

Regression Analysis (continued)

Pros:

- Objective, statistically precise method of estimating future costs
- Provides quantitative measures of its *precision* (accuracy of the estimate, measured by the standard error of the estimate) and *reliability* (the statistical goodness of fit & validity of the regression, measured by R-squared, *t*-values, and *p*-values)
- Readily available software (such as Excel) to do the calculations

Cons:

- Can be influenced strongly by “outlier” data points resulting in a line that is not representative of all the data

Regression Analysis: Measuring Precision and Reliability

R-squared

- A number between zero and one that describes the explanatory power of the regression (the degree to which the change in Y can be explained by changes in X)
- A relative measure of "goodness-of-fit" (i.e., the percentage change in Y that can be explained by changes in X)
- The maximum value for R^2 is 1.00 (i.e., 100%)

t-value

- A measure of the statistical reliability of each independent variable in the cost function: does the independent variable have a valid, stable, relationship with dependent variable?
- Variables with a low *t*-value should be evaluated and possibly removed to improve cost estimation
- In a multiple-regression model, low *t*-values signal the possibility of *multicollinearity*, meaning two or more independent variables may be highly correlated with each other; removal of one or more of these variables may be desirable

Regression Analysis: Measuring Precision and Reliability (continued)

Standard error of the estimate (SE)

- A measure of the precision/accuracy of the regression's estimate
- Can be used to establish confidence intervals for cost estimation:
  - The range of +/- <u>one</u> SE around an estimate provides a confidence range of 67%; the unknown true value of the estimate should fall within this range of the amount predicted by the regression equation
  - The range of +/- <u>two</u> x SE around an estimate is interpreted as above except the confidence is 95%
- A regression with high precision will have an SE value that is relatively small compared to the average value of the dependent variable.

***P*-values**

– Measures the risk that the true value of a given cost coefficient is zero; low p-values imply rejection of the assumption of a relationship between the dependent and independent variables. Normally, p-values of 5% or less are expected in useable regression models.

Regression Analysis (example continued)

Continuing with the Garcia example, regression (using for example, Excel) produces the following output:

Y = \$15,843 + (\$2.02 x 3,600)

Y = \$23,115 in maintenance costs

The statistical measures are:

R-squared =	0.461
SE =	\$221.71
t -value =	2.07
p -value =	0.090

Regression Analysis (example continued)

Garcia reviews the results of his analysis:

R-squared is less than 0.50, which is lower than desired

However, the SE is approximately 1% of the mean of the dependent variable, which is good

The *t*-value on the estimated coefficient is slightly more than 2, which implies a low probability that there is no relationship between monthly maintenance costs and changes in units of output this

Regression Analysis (example continued)

But why is R squared relatively low?

Jan notices that the month of May's maintenance costs are unusually low compared to the other months and decides to use a dummy variable to potentially capture seasonal effects (therefore, she assigns a value of one for May and a value of zero for the other months)

After this addition to the model, the quantitative measures all improve: apparently, the seasonal fluctuation was distorting the results

Regression Analysis (example continued)

These are the results after inclusion of the dummy variable:

Y = \$16,467 + (\$1.856 X) - (\$408.638 x D)
Y = \$16,467 + (\$1.856 x 3,600) - (\$408.638 x 0)
Y = \$16,467 + \$6,682
Y = \$23,149 in maintenance costs

The statistical measures are:

R-squared =	0.772
SE =	\$161.27
t-values:	
Hours =	2.60
Dummy variable =	-2.33
p-values:	
Hours =	0.050
Dummy variable =	0.070

Cost Estimation Implementation: Nonlinearity

There are three main issues: trend & seasonality, outliers, and data shift:

- *Trend and Seasonality*: most cost and operating data have some trend or seasonality, which means the cost estimation is not linear; solution: transform the variables, use a trend variable, or a dummy variable

- *Outliers:* when a data point or points are far from the others, the data should be reviewed and the point removed or the model revised

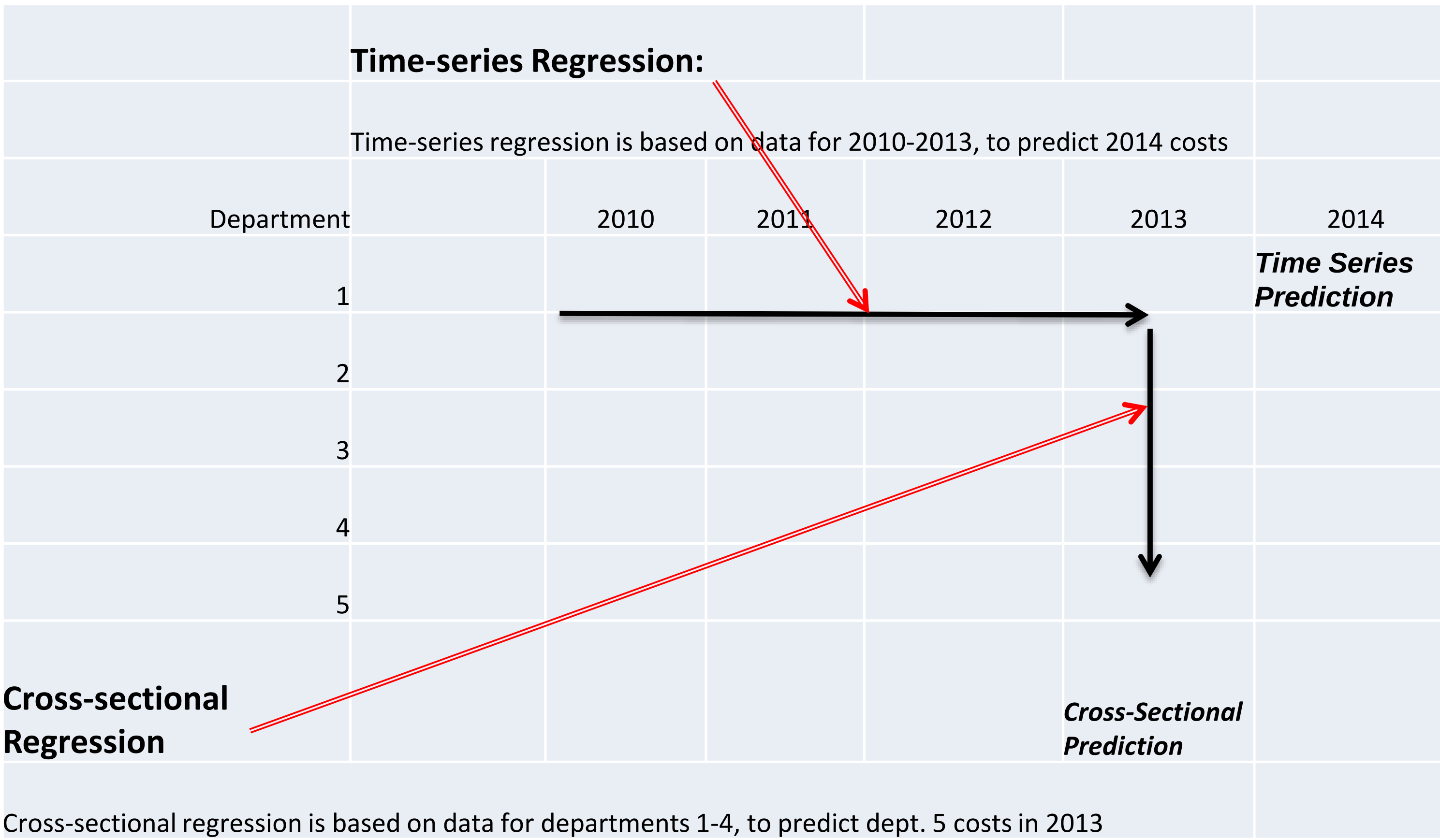
- *Data shift* can be the result of an unusual business condition that causes a shift to the data; often fixed with a dummy variable.

Time-Series and Cross-Sectional Regression

- **Time Series Regression**: used to predict future amounts, based on prior periods' data

- **Cross-Sectional Regression**: used to predict costs for a given cost object, based on costs of related cost objects, where the data for the regression is taken from the same period of time

Time-Series and Cross-Sectional Regression Illustrated



Learning Curve Analysis

- A cost whose amount is influenced by learning is an example of nonlinear cost behavior

- When an activity has a certain labor component and repetition of the same activity or operation makes the labor more proficient, the task *over time* is completed more quickly with the same or higher level of quality

Learning Curve Analysis (continued)

Learning curve analysis **is a systematic method for estimating costs when learning is present:**

- The *learning rate*, obtained by reviewing historical data, is the percentage by which average time (or total time) falls from previous levels as output doubles
- A learning rate ranges from one (no learning) to 0.5 (best possible; note, however, that a learning rate of 0.5 is not achievable in practice—it implies infinite learning wherein the total time for all units equals the time for the first unit)

Learning Curve Analysis (continued)

Below is the general equation used in learning-curve analysis:

$$Y = aX^b$$

Where:	Y = the average time per unit of output
	a = the time required for the first unit of output
	X = cumulative output
	b = the learning index

Learning Curve Analysis (continued)

- Learning curve analysis is useful in: life-cycle planning, cost-volume-profit analysis, budgeting production levels and labor needs, make-or-buy decisions, preparing bids for production contracts, developing standard product costs, management control, and capital budgeting, among other applications…

- Y/a is the ***learning rate***; for a learning rate of 80% and with the common assumption that that learning rate applies when output doubles, the learning index is b = -0.3219 = Ln (0,8)/Ln (2)

Learning Curve Analysis (continued)

Learning curve analysis has three inherent limitations:

❶ The approach is for labor-intensive contexts that involve repetitive tasks such as long production runs or repetitive operations, and this is becoming less common in organizations of all types

❷ The learning rate is assumed to be constant

❸ A carefully estimated learning curve might be unreliable because the observed change in productivity in the data used to fit the model was actually associated with factors other than learning

H. Short-Term Profit Planning: Cost-Volume-Profit (CVP) Analysis

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CVP Analysis

- CVP analysis is a planning tool for analyzing how operating decisions and marketing decisions affect short-term operating profit

- CVP relies on an understanding of the relationship between variable costs, fixed costs, unit selling price, and output level (volume)

CVP Analysis (continued)

CVP analysis can be used in:

- Setting prices for products and services
- Determining whether to introduce a new product or service
- Replacing a piece of equipment
- Determining breakeven point
- Making “Make-or-buy” (i.e., sourcing) decisions
- Determining the best product mix
- Performing strategic “what-if” (sensitivity) analysis

CVP Analysis (continued)

The CVP model is as follows:

Operating profit = Sales – Total costs

or

Sales = Fixed costs + Variable costs + Operating profit

or

Operating profit = (Units sold × selling price/unit) – (Units sold × variable cost/unit) – Fixed costs

CVP Analysis (continued)

For convenience, the (single-product) model is commonly shown in symbolic form:

$$\pi_{\mathrm{B}} = (p \times Q) - (v \times Q) - \mathrm{F}$$

Where:

$$Q = \text{units sold (i.e., sales volume)}$$
$$p = \text{selling price per unit}$$
$$F = \text{total fixed cost}$$
$$v = \text{variable cost per unit}$$
$$\pi_{\mathrm{B}} = \text{operating profit (before tax)}$$

CVP Analysis (continued)

Three additional concepts regarding the CVP model:

1. Contribution margin:

- *Unit contribution margin* (cm) = Unit sales price (p) – Unit variable cost (v)
- Unit contribution margin (cm) = the increase in operating profit for a unit increase in sales = (p – v)
- *Total contribution margin* (CM) = Unit contribution margin (cm) × Units sold (Q)

CVP Analysis (continued)

– *Contribution margin ratio* = Unit contribution margin (cm)÷ unit sales price (p)

$$= (p - v) \div p \quad = \quad cm/p$$

– The *contribution income statement*:
  - A useful way to show information developed in CVP analysis
  - Classifies costs based on cost *behavior* (fixed versus variable) rather than cost type (product versus period)
  - Provides an easy and accurate prediction of the effect of a change in sales on operating profit

Strategic Role of CVP Analysis

CVP analysis can help a firm choose its competitive position and execute its strategy by providing an understanding of how changes in sales volume affect costs and profits

- This process is most important for cost leadership firms during the manufacturing stage
- Differentiated firms use CVP analysis to assess profitability and desirability of new products and features

Strategic Role of CVP Analysis (continued)

CVP analysis is also important in life-cycle costing and target costing

- CVP analysis can assist in *life-cycle costing* by helping to determine whether a product is likely to achieve its desired profitability, the most cost-effective manufacturing process, the best marketing and distribution channels, the best compensation plan, whether to offer discounts, etc.
- CVP analysis can assist in *target costing* by showing the effect on profit of alternative product designs that have different target costs

Breakeven (B/E) Planning

Determining the “breakeven point” is the starting point of many business plans:

– *Breakeven* is the point at which revenues equal total costs and profit is zero

– The breakeven (B/E) point can be determined in either of two ways:

  – Based on Units Sold (Q)

  – Based on Sales Dollars (Y)

B/E Planning (continued)

Breakeven in Units, Q (@ B/E, π_B = $0)

$$\$0 = (p \times Q) - (v \times Q) - F$$

$$\$0 = (p - v)Q - F$$

$$F = (p - v)Q$$

$$Q = F/(p - v)$$

That is, Q = Fixed costs ÷ contribution margin per unit

B/E Planning (continued)

Breakeven in Sales Dollars, Y (@ B/E, π_B = \$0)

Operating profit = Sales − total variable costs − Fixed costs

$$\$0 = (p \times Q) - (v \times Q) - F$$

$$\$0 = [p \times (Y/p)] - [v \times (Y/p)] - F$$

$$p \times (Y/p) = [v \times (Y/p)] + F$$

$$Y = [(v/p) \times Y] + F$$

$$Y = F \div (p - v)/p$$

= fixed costs ÷ contribution margin ratio

Example: Breakeven Planning

Household Furnishings, Inc. (HFI) wants to perform a B/E analysis given the following expected results for 2013 and 2014:

	Per Unit	2013	2014
Fixed cost (per year)		$60,000	$60,000
Selling price	$75		
Variable cost	35		
Planned production		2,400 units	2,600 units
Planned sales volume		2,400 units	2,600 units

	2013		2014			
	Amount	Percent	Amount	Percent	Change	Notes
Sales	$180,000	100.00%	$195,000	100.00%	$15,000	
Variable costs	84,000	46.67	91,000	46.67	7,000	
Total contribution margin	$ 96,000	53.33%	$104,000	53.33%	$ 8,000	53.33% is the contribution margin ratio
Fixed costs	60,000		60,000		0	
Operating profit	$ 36,000		$ 44,000		$ 8,000	$8,000 = 0.5333 × $15,000

Breakeven Example (continued)

Breakeven in units, Q :

$$\text{Operating profit} = \text{Sales} - \text{Total variable costs} - \text{Fixed cost}$$

$$\begin{aligned}
\pi_B &= (p \times Q) - (v \times Q) - F \\
&= (\$75 \times Q) - (\$35 \times Q) - \$5{,}000/\text{month}
\end{aligned}$$

$$\begin{aligned}
0 &= [(\$75 - \$35) \times Q] - \$5{,}000/\text{month} \\
\$40 \times Q &= \$5{,}000/\text{month} \\
Q &= \$5{,}000/\text{month}/\$40 \text{ per unit} \\
Q &= 125 \text{ units/month}
\end{aligned}$$

Breakeven Example (continued)

Breakeven in dollars, Y:

1. Breakeven in units, *Q*, times selling price per unit, *p*
   = 125 units/month × \$75/unit = \$9,375/month

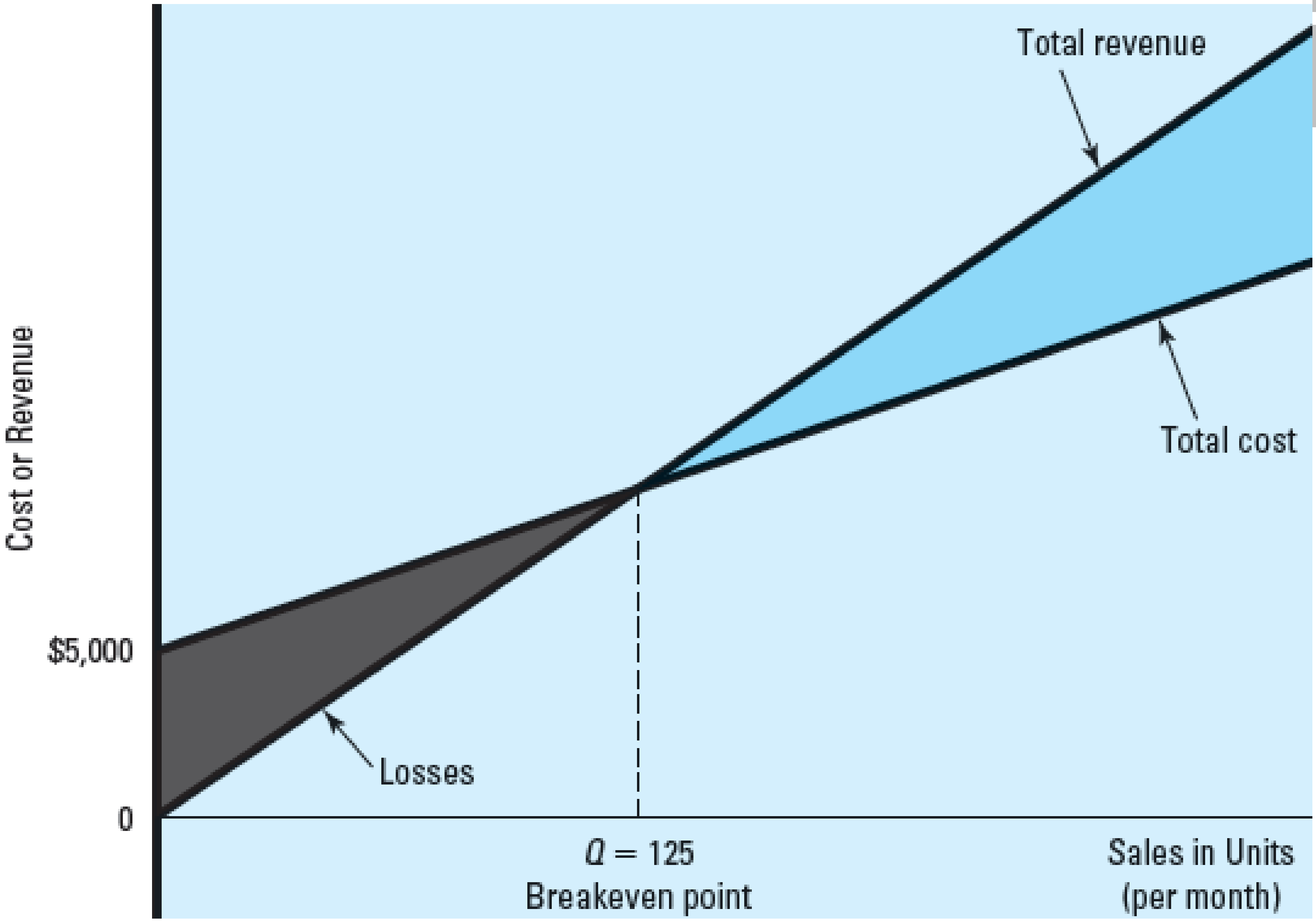
2. Alternatively, breakeven point in sales dollars, Y
   = Fixed cost/month ÷ contribution margin ratio
   = \$5,000/month ÷ (\$75 – \$35)/\$75
   = \$5,000/month ÷ 0.5333333= \$9,375/month

CVP Graph and Profit-Volume (PV) Graph

- The *CVP graph* illustrates how the levels of revenues and total costs change as output (sales volume) changes

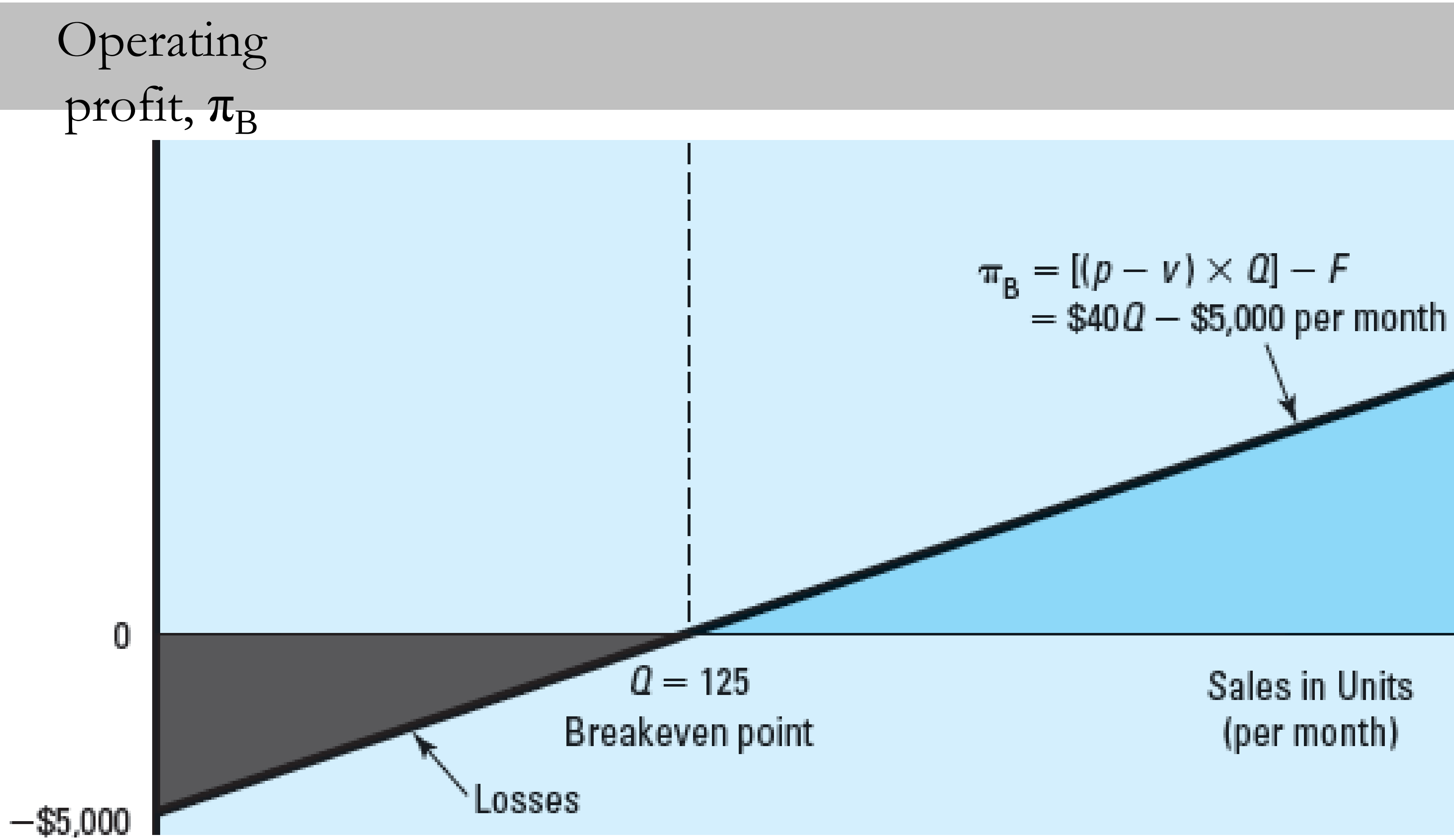
- A *profit-volume (PV) graph* illustrates how the level of operating profit changes as output (sales volume) changes
  - This graph allows a person to clearly see how total contribution margin, and therefore profit, changes as the output level (i.e., volume) changes

CVP Graph



Total revenue
Total cost
Cost or Revenue
$5,000
0
Losses
Q = 125
Breakeven point
Sales in Units
(per month)

PV Graph


Operating profit, π_B
$\pi_B = [(p - v) \times Q] - F$
$= \$40Q - \$5,000$ per month
0
−$5,000
$Q = 125$
Breakeven point
Losses
Sales in Units
(per month)

CVP Analysis in Profit Planning

CVP analysis can be used to determine the sales volume needed to achieve a desired level of before tax profit:

$$Q = \frac{F + \pi_B}{p - v}$$

$$Q = \frac{\$60{,}000 + \$48{,}000}{(\$75 - \$35)/\text{unit}}$$

$$Q = \quad 2{,}700 \text{ units per year}$$

CVP and Profit Planning (continued)

Assume that HFI has the option to choose between two machines that will complete the same operation with the same quality, but with different variable costs per unit (v) and different total fixed costs (F). B/E analysis can help HFI find the level of sales (called the "indifference point"), such that having sales > that this level will favor the option with the higher fixed costs, and having sales < this level will favor the low fixed cost option.

Which alternative should be chosen?

CVP and Profit Planning (continued)

Cost of Machine A	=	Cost of Machine B
$\$5{,}000 + (\$10 \times Q)$	=	$\$15{,}000 + (\$5 \times Q)$
Q	=	$\$10{,}000 \div \$5/\text{unit}$
Q	=	2,000 units

CVP and Profit Planning (continued)

Management decisions about costs and prices usually must include *income taxes* because taxes affect the amount of net profit at a given level of sales

In the HFI example, if we assume that the average income tax rate is 20 percent, to achieve the desired annual *after-tax* profit of $48,000, HFI must generate before-tax profits of ....

$$\text{Before-tax profit, } \pi_B = \text{After-tax profit, } \pi_A/(1 - \text{Tax Rate})$$

$$\pi_B = \pi_A \div (1 - t)$$

$$\pi_B = \$48{,}000 \div (1 - 0.2)$$

$$\pi_B = \$60{,}000$$

CVP and Profit Planning (continued)

Thus, when taxes are considered, the CVP model is as follows, with
t = average tax rate

$$Q = \frac{F + \dfrac{\text{After-Tax Profit}}{(1 - t)}}{(p - v)}$$

$$Q = \frac{\$60{,}000 + [\$48{,}000 \div (1 - 0.20)]}{(\$75 - \$35)/\text{unit}}$$

$$Q = 3{,}000 \text{ units}$$

CVP Analysis and Activity-Based Costing (ABC)

The conventional approach to CVP analysis is to use a volume-based measure to forecast costs, but an ABC approach is also possible:

- If the assumption is made that total batch-level costs are fixed relative to the number of batches, both approaches will produce the same result

- On the other hand, if the activity cost pool is a mixed cost, the ABC approach will provide a more accurate estimate of cost because the volume-based approach treats all activity costs that do not vary with output volume, such as machine setup, materials handling, inspection, and engineering, as fixed

CVP Analysis and ABC (continued)

In the ABC approach, additional terms are needed to define the fixed cost element (HFI's results are in parentheses below):

- F^{VB} = the level of *volume-based fixed costs*, or the portion of fixed costs that do not vary with the activity cost driver, \$50,000 (\$60,000 – \$10,000)
- F^{AB} = the portion of fixed costs that *does* vary with the activity cost driver (\$10,000)
- v^{AB} = the cost per batch for the ABC driver (\$100/batch)
- b = the number of units in a batch (30)
- v^{AB}/b = the cost per unit for batch-related costs when the batch is size *b*, \$3.333 (\$100/batch ÷ 30 units/batch)

CVP Analysis and ABC (continued)

The CVP model under ABC (for batch-related costs):

$$Q = \frac{F^{VB} + \pi_B}{p - v - (v^{AB}/b)}$$

Therefore, output quantity for HFI is:

$$Q = \frac{\$50{,}000 + \$48{,}000}{\$75 - \$35 - (\$100/30)} = 2{,}673 \text{ units } (2{,}673/30 = 89.1 \text{ batches})$$

There are no partial batches so $9,000 (90 batches × $100 per batch) must be figured into the equation

$$Q = \frac{\$50{,}000 + \$9{,}000 + \$48{,}000}{\$75 - \$35} = 2{,}675 \text{ units in 90 batches}$$

Dealing with Risk and Uncertainty

Sensitivity analysis is the name for a variety of methods that examine how an amount (e.g., B/E point) changes if factors involved in predicting that amount change (e.g., sales volume or unit variable cost). For CVP, three methods of *sensitivity analysis* are commonly employed:

(1) ***What-if analysis*** *(using the contribution margin and contribution margin ratio)*

(2) Construction of ***decision tables/decision trees***, and

(3) ***Monte Carlo Simulation*** (MCS)

Other Approaches to handling risk/uncertainty:

(1) Margin of safety and Margin of safety Ratio

(2) Degree of operating leverage (DOL)

Handling Risk and Uncertainty: What-if analysis

What-if analysis is the calculation of an amount given different levels of a factor that influences that amount

– Example: if contribution margin (cm) is $40 per unit and the cm ratio is 0.53333, each unit change in sales volume affects profit by $40 and each dollar change in sales affects profits by $0.53333

Risk and Uncertainty: Some Useful Metrics

Margin of safety (MOS) is the dollar amount of sales above the B/E point (i.e., forecasted (or actual) sales level minus the B/E sales level):

MOS = planned (or actual) sales − breakeven sales
(in units or in dollars)

Margin of safety ratio (MOS%) = MOS ÷ planned (or actual) sales volume = the percentage that sales could fall (from planned or actual levels) before losses occur

Handling Risk and Uncertainty: Degree of Operating Leverage

- Operating leverage refers to the extent of fixed costs in the cost structure of an organization. The greater the operating leverage, the greater the operating risk (i.e., not being able to cover fixed costs via operations).

- Degree of operating leverage (DOL), at any sales volume level, represents the sensitivity of operating income to changes in sales volume.

$$\text{DOL} = \text{CM} \div \text{operating profit}$$

Multi-Product (or Service) CVP Analysis

- If all fixed costs are traceable to individual products, then the organization can develop a separate CVP model for each product

- Alternatively, the multi-product firm can make an assumption regarding a standard sales mix in which its products are sold

- Sales mix can be determined on the basis of sales dollars or unit sales

- The assumption of sales mix allows the firm to calculate and use a weighted-average contribution margin (cm) *per unit* and weighted average cm *ratio* to complete the multi-product CVP analysis

Example: Multi-Product CVP Analysis

Windbreakers, Inc. sells light-weight sports/recreational jackets and currently has three products: Calm, Windy, and Gale. Total (joint) fixed costs for the period are expected to be $168,000, and we assume the windbreakers' sales mix, measured by sales ***dollars***, will remain constant. Additional information is provided below. (Since sales mix is constant in $, we will use the contribution margin ratio in the analysis. See next slide…)

	Calm	Windy	Gale	Total
Last period's sales	$ 750,000	$ 600,000	$ 150,000	$ 1,500,000
Percent of sales	50%	40%	10%	100%
Price	$ 30	$ 32	$ 40	
Unit variable cost	24	24	36	
Contribution margin	$ 6	$ 8	$ 4	
Contribution margin ratio	0.20	0.25	0.10	

Example: Multi-Product CVP (continued)

From this information, we can calculate the wtd. avg. cm ratio:

Weighted-average CMR = 0.5(0.2) + 0.4(0.25) + 0.1(0.1) = 0.21

The breakeven point for all three products can be calculated as follows:

Y = $168,000 ÷ 0.21

Y = $800,000

This means that for Windbreakers to break even, $800,000 of all three products must be sold in the same proportion as last year's sales mix. The sales for each product need to be as follows:

For Calm	0.5($800,000) =	$400,000	(13,334 units)
For Windy	0.4($800,000) =	320,000	(10,000 units)
For Gale	0.1($800,000) =	80,000	(2,000 units)
		$800,000	

Assumptions of CVP Analysis

- The CVP model assumes revenues and costs are *linear* over a "relevant range" (even though the actual cost behavior may not be linear)
- Outside the *relevant range*, these calculations may not be accurate
- *Step costs* also make approximation via the relevant range unworkable; CVP analysis becomes much more cumbersome
- The basic model is *deterministic*.

I. Decision Making with a Strategic Emphasis

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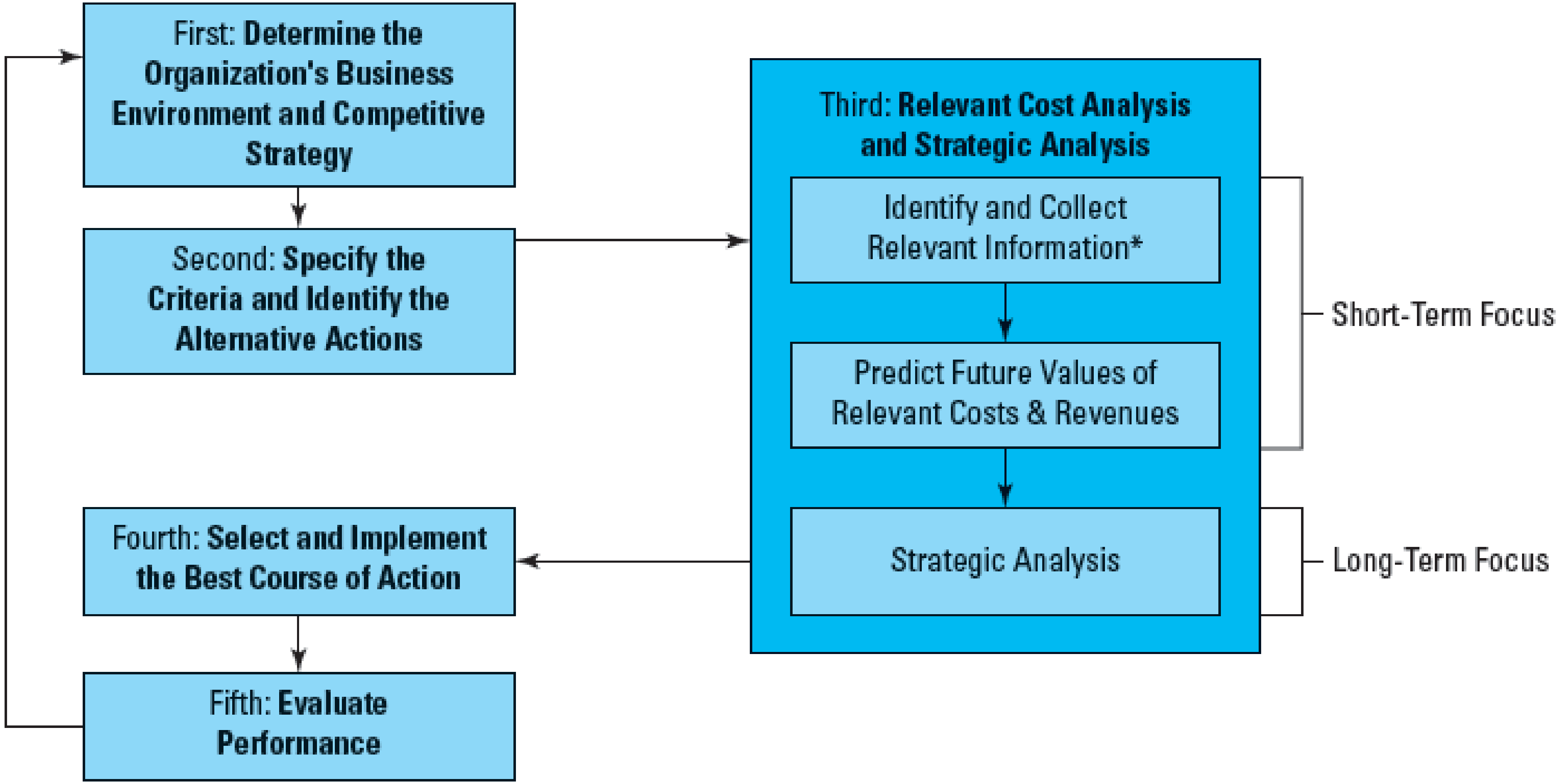
The Decision-Making Process



Relevant Cost Analysis

- A relevant cost is a *future* cost that *differs* between the decision alternatives
  - Both characteristics must be present for a cost to be relevant
  - Relevant costs can be variable or fixed, but variable costs are generally relevant while fixed costs are not
  - Relevant cost analysis and total cost analysis produce the same results
- An irrelevant cost is a cost that has been incurred in the past or committed for the future

Equipment-Replacement Decision Example

Which costs are not relevant to the decision to keep an old machine or replace it with a new, more efficient one?

- Original cost of old machine, $4,200
- Current book value of old machine, $2,100
- Purchase price of a new machine, $7,000
- New machine will have zero salvage value
- Repairs to old machine would be $3,500 and would allow one more year of productivity
- Power for either machine is expected to be $2.50/hour
- New machine will reduce labor costs by $0.50/hour
- Expected level of output for next year is 2,000 units

Equipment Replacement Decision (continued)

Relevant cost analysis:

- ~~Original cost of old machine, $4,200~~
- ~~Current book value of old machine, $2,100~~
- Purchase price of a new machine, $7,000
- ~~New machine will have zero salvage value~~
- Repairs to old machine would be $3,500 and would allow one more year of productivity
- ~~Power for either machine is expected to be $2.50/hour~~
- New machine will reduce labor costs by $0.50/hour

Relevant Cost Analysis: Additional Considerations

- Batch-level cost drivers should be considered in relevant cost analysis
  - For example, if setup on one machine takes longer and requires more skilled labor than the other machine, these factors should be included in the analysis
- *Opportunity costs*, the benefit lost when one chosen option precludes the benefits from an alternative option, should also be considered in the analysis of alternative options
  - For example, addition of a new product could cause reduction, delay, or lost sales in other product areas

Relevant Cost Analysis: Additional Considerations (continued)

- Depreciation is not included in relevant cost analysis *except when considering tax implications*
- Time-value of money is relevant when deciding among alternatives with cash flows over two or more years
- Importance of qualitative factors:
  - Differences in quality
  - Functionality
  - Timeliness of delivery
  - Reliability in shipping
  - After-sale service level

Strategic Analysis

Strategic information keeps the decision maker’s attention focused on the firm’s crucial strategic goal

- By identifying *only* relevant costs, the decision maker might fail to link the decision to the firm’s strategy
- For example, while it may be advantageous to outsource production of a part based on cost figures, this decision might be a poor strategic move if the firm’s competitive position depends on product reliability that can be maintained only by manufacturing that part internally

Relevant Cost Analysis vs. Strategic Analysis

Relevant Cost Analysis	**Strategic Analysis**
Short-term focus	Long-term focus
Not necessarily linked to strategy	Linked to the firm's strategy
Product cost focus	Customer focus
Focused on individual product or decision situation	Integrative; considers all customer factors

This decision framework can be used to address common management decisions such as:

- The special-order decision
- The make, lease, or, buy decision
- The decision to sell a product before or after additional processing
- The short-term product-mix (or service-mix) decision
- Profitability analysis (i.e., whether to keep or drop products or services)

Example: the Special-Order Decision

- A special-order decision occurs when a firm has a one-time opportunity to sell a specified quantity of its product or service; these orders are generally non-recurring
- The first step in the decision process is to consider the relevant costs (an example follows):

TTS, Inc., normally charges \$9.00 per T-shirt, but Alpha Beta Gamma has offered to pay \$6.50 for each of 1,000 T-shirts. What are the relevant costs in determining whether this offer should be accepted?

The Special-Order Decision (continued)

Cost Element	Costs per Unit	Batch-Level Costs: Per Batch	Batch-Level Costs: Fixed Costs	Facilities-Level Costs (all fixed)
Shirt	$3.25			
Ink	0.95			
Operating labor	0.85			
Subtotal	$5.05			
Setup		$130	$29,000	
Inspection		30	9,000	
Materials handling		40	7,000	
Subtotal		$200	$45,000	
Machine-related				$315,000
Other				90,000
Total	$5.05	$200	$45,000	$405,000

The Special-Order Decision (continued)

	Relevant Unit Costs	Relevant Cost for One Batch of 1,000 Units
Unit-level costs		
Unprinted shirt	$3.25	$3,250
Ink and other supplies	0.95	950
Machine time (operator labor)	0.85	850
Total unit-level costs	$5.05	$5,050
Batch-level costs (that vary with the number of batches)		
Setup		130
Inspection		30
Materials handling		40
Total ($200/batch; $0.20/unit)	$0.20	$ 200
Total relevant costs	$5.25	$5,250

The Special-Order Decision (continued)

The costs that are not relevant total $450,000

TTS, Inc. Fixed Costs		
Setup	$	29,000
Inspection		9,000
Materials handling		7,000
Machine-related		315,000
Other		90,000
	$	450,000

Therefore.....

Total Cost = $5.05 per unit + $200 per batch + $450,000

The Special-Order Decision (continued)

Analysis of the net contribution looks favorable:

Sales	1,000 units @ $6.50	$6,500
Relevant costs	1,000 units @ $5.25	5,250
Net Contribution	1,000 units @ $1.25	$1,250

If TTS has excess capacity, based only on a short-term profitability analysis, the offer should be accepted because it will add $1,250 (i.e., 1,000 shirts × $1.25/shirt) to pre-tax income.

The Special-Order Decision (continued)

BUT...to make an informed decision, TTS must also consider the strategic factors in this decision

- Is TTS producing at or near full capacity?
  - In this case, the answer is no
  - If TTS were producing at or near capacity, it would have to consider opportunity costs
- Is this order really a one-time special order?
  - Special-order decisions are meant for infrequent situations, and if done on a regular basis, can erode profitability
- The credit history of the buyer, any potential complexities in the design that might cause problems
- How might the special-order price affect the long-term price structure of the firm?

Example: Make-or-Buy Decision

Decision context: which parts to make internally and which parts to purchase from an outside supplier?

- The relevant cost analysis proceeds much like that of a special-order decision (an example follows):

> Blue Tone is currently manufacturing the mouthpiece for its clarinet, but has the option to buy this item from a supplier. Fixed overhead costs will not change whether or not Blue Tone chooses to make or to buy the mouthpiece.

Make-or-Buy Example (continued)

Cost to buy the mouthpiece		$ 24.00
Cost to manufacture, per unit:		
Materials	$ 16.00	
Labor	4.50	
Variable overhead	1.00	
Total variable costs	21.50	
Fixed overhead	6.00	
Total cost to manufacture	$ 27.50	
Total relevant costs		21.50
Per-unit savings from continuing to make		$ 2.50

The relevant cost analysis indicates that manufacturing the part is more cost effective, but Blue Tone must also consider strategic factors, such as the quality of the part, reliability of the supplier, and potential alternative uses of plant capacity, before making a final decision.

Lease-or-Buy Example

Let's say the decision is not whether to make or buy an item for the firm, but whether to lease or buy that item (an example follows):

Quick Copy is considering an upgrade to the latest model copier that is not available for lease but must be purchased for $160,000. The purchased copier is useful for one year, after which it could be sold back to the manufacturer for $40,000. In addition, the new machine has a required annual service contract of $20,000. Should Quick Copy purchase the new copier or renew its lease on its old copier?

Lease-or-Buy Example (continued)

Quick Copy Lease or Buy Information (Exhibit 11.10)

	Lease	Purchase
Annual lease	$ 40,000	N/A
Charge per copy	0.02	N/A
Purchase cost	N/A	$ 160,000
Annual service contract	N/A	20,000
Value at end of period	N/A	40,000
Expected number of copies per year	6,000,000	6,000,000

The first step in this analysis is to use CVP analysis to calculate the indifference point . . .

Lease-or-Buy
Example (continued)

Lease cost = Purchase cost

$$\text{Annual fee} = \text{Net purchase cost} + \text{Service contract}$$

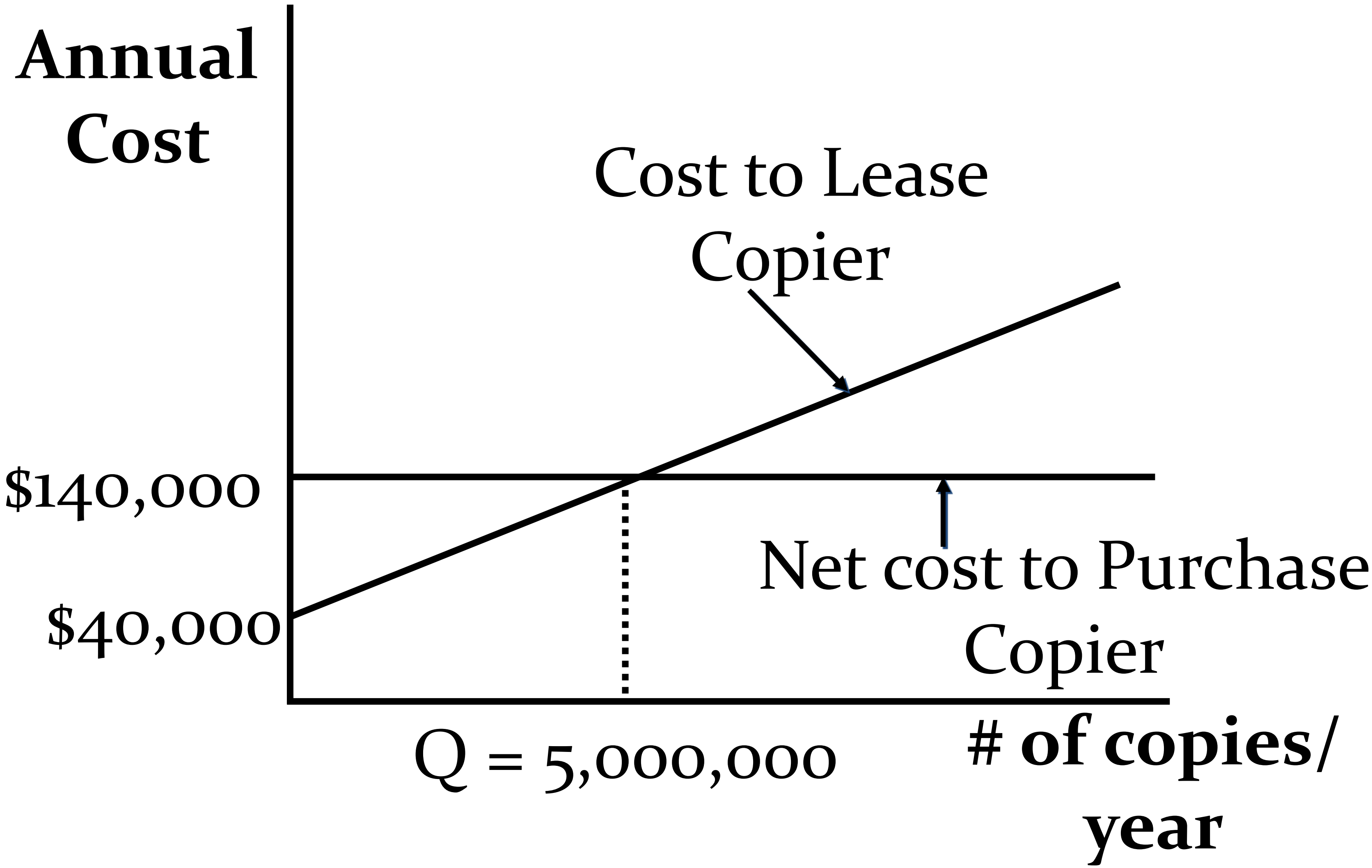
$$\$40{,}000 + (\$0.02 \times Q) = (\$160{,}000 - \$40{,}000) + \$20{,}000$$

$$Q = \$100{,}000 \div \$0.02$$

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

The indifference point, 5,000,000 copies, is lower than the expected annual machine usage of 6,000,000 copies. So, Quick Copy should purchase the machine if strategic factors, such as quality of the copy, reliability of the machine, and benefits and features of the service contract, are favorable

Lease-or-Buy Example (continued)



Sell-or-Process Further Example

Decision: whether to sell a product or service before an intermediate processing step or to add further processing and then sell the product or service for a higher price?

TTS has suffered an equipment malfunction causing 400 T-shirts not to be acceptable. The shirts can be sold as-is for $4.50 each or run through the printing process again. The cost of running the T-shirts through the printer a second time is variable cost of $1.80 per shirt and the cost of one setup.

Sell-or-Process Further Example (continued)

Analysis of Reprinting 400 Defective T-Shirts

	Reprint	Sell As Is
Revenue (400 @ $9.00)	$ 3,600	
(400 @$4.50)		$ 1,800
Relevant costs: (@$1.80 variable + setup)		
Supplies and ink ($0.95)	380	
Labor ($0.85)	340	
Setup, inspection, handling	200	
Total relevant costs	920	-
Contribution margin	$ 2,680	$ 1,800

The net advantage to reprinting the T-shirts is $880 ($2,680 – $1,800). TTS would need to consider the effect of selling to discount stores were the cost analysis in favor of that option.

Profitability Analysis

Profitability analysis addresses issues such as:

- Which product lines are most profitable?
- Are the products priced properly?
- Which products should be promoted and advertised more aggressively?
- Which product-line managers should be rewarded?

Windbreakers, Inc. manufactures three jackets. Management is concerned about the low profitability of the "Gale" jacket and is thinking about dropping the product. If the jacket is dropped, there will be no change in total fixed costs for the coming year.

Profitability Analysis (continued)

	Calm	Windy	Gale	Total
Units sold last year	25,000	18,750	3,750	47,500
Revenue	$750,000	$600,000	$150,000	
Price	$ 30.00	$ 32.00	$ 40.00	
Relevant costs				
Unit variable cost	24.00	24.00	36.00	
Unit contribution margin	$ 6.00	$ 8.00	$ 4.00	
Nonrelevant (i.e., allocated) fixed costs	3.60	3.60	3.60	$171,000
Operating profit per unit	$ 2.40	$ 4.40	$ 0.40	

Profitability Analysis (continued)

	Calm	Windy	Total
Sales	$750,000	$600,000	$1,350,000
Relevant costs			
Variable cost ($24 ea)	600,000	450,000	1,050,000
Contribution margin	$150,000	$150,000	$ 300,000
Nonrelevant costs			
Fixed cost (unavoidable)			171,000
Operating profit without Gale			$ 129,000

	Calm	Windy	Gale	Total
Sales	$750,000	$600,000	$150,000	$1,500,000
Relevant costs				
Variable cost ($24, 24, 36)	600,000	450,000	135,000	1,185,000
Contribution margin	$150,000	$150,000	$ 15,000	$ 315,000
Nonrelevant costs				
Fixed cost (unavoidable)				171,000
Operating profit with Gale				$ 144,000

Profitability Analysis (continued)

The company is $15,000 ($147,000 – $132,000) better off retaining rather than deleting the Gale jacket.

Windbreakers, Inc. should also consider strategic factors in this decision, such as whether dropping one product line would affect sales of another and whether employee morale would be affected by the decision.

Profitability Analysis in Service and Not-for-Profit (NFP) Organizations

Relevant cost analysis is often used by service and NFP firms to determine the desirability of new services: for example, Triangle Women's Center's new service will require $9,400 additional funding:

Relevant annual costs	
Salary of director	$ 65,000
Salary for two part-time assistants	60,000
Variable costs for 20 children at $60 per month each	14,400
Total relevant costs	$139,400
Total funding	
United Way	$100,000
City council	30,000
	$130,000
Expected deficit in the first year	$ 9,400

Short-Term Product-Mix Decision

How to make best use out of existing resources? That is, how to choose the best short-term product mix?

Continuing with the Windbreaker's Inc. example assume one production constraint:

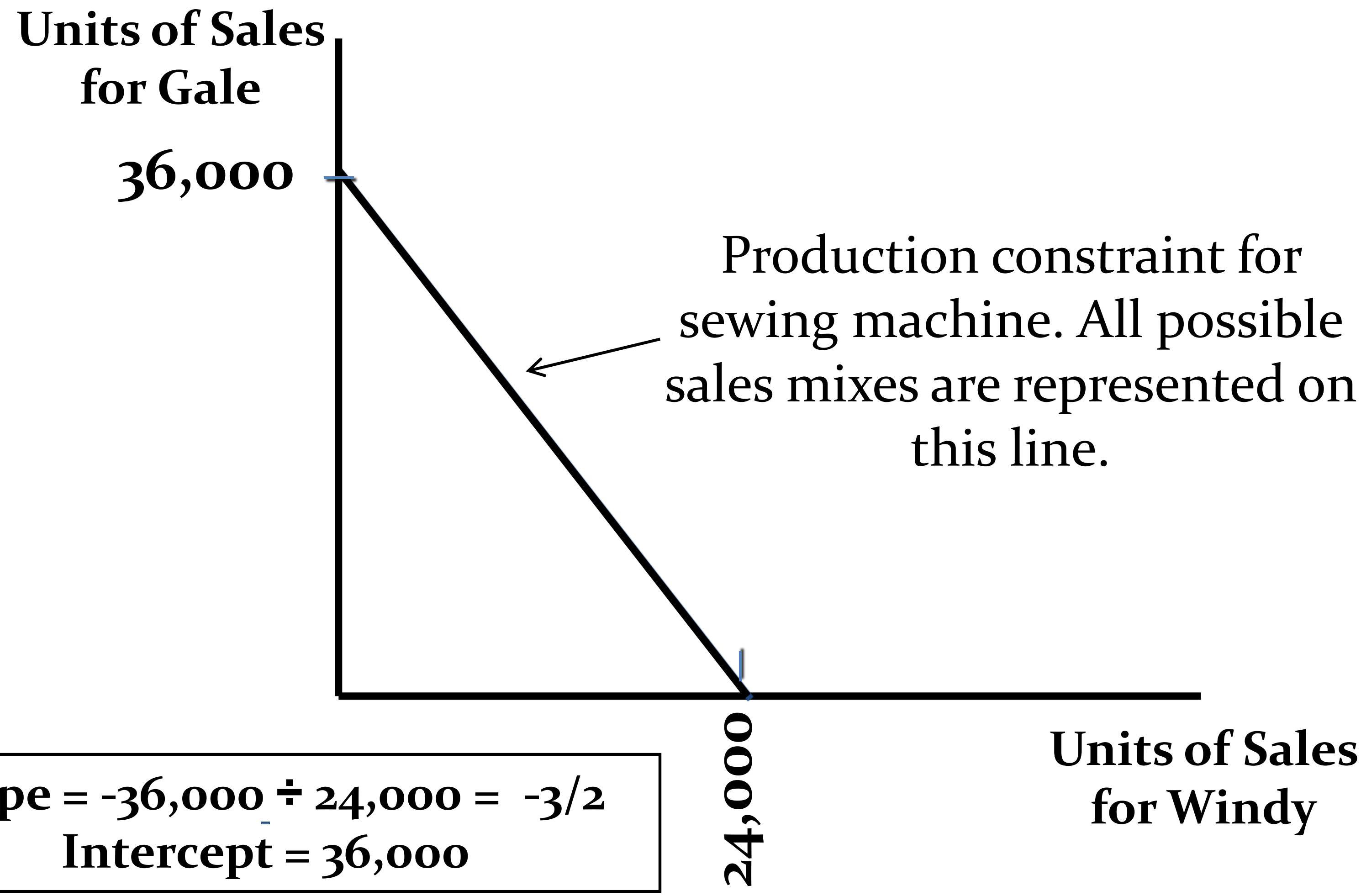
The Windy and Gale jackets are manufactured in the same plant—both require an automated sewing machine for assembly. There are 3 machines that can be run up to 20 hours per day, 5 days per week (1,200 hours per month). The demand for both jackets exceeds the capacity of the 3 machines (i.e., there is one production constraint or limiting resource).

Short-Term Product Mix Decision: One Production Constraint

The goal is to maximize contribution margin, subject to the production resource constraint. For this, we need to determine each product's contribution margin per unit of the scare resource:

	Windy	Gale
Contribution margin per unit	$ 8	$ 4
Sewing time per jacket	3 min.	2 min.
Number of jackets produced per hour	20	30
Contribution margin per machine hour	$ 160	$ 120
Maximum production for each product		
(1,200 @ 20)	24,000	
(1,200 @ 30)		36,000

Short-term Product Mix Decision: One Production Constraint



Slope = -36,000 ÷ 24,000 = -3/2
Intercept = 36,000

Short-term Product-Mix Decision: One Production Constraint

Units of Gale = 36,000 – 3/2 × Units of Windy

Production of Windy only results in a total contribution of:

1,200 × \$160 = \$192,000 (or \$8.00 × 24,000 units)

Production of Gale only results in a total contribution of:

1,200 × \$120 = \$144,000 (or \$4.00 × 36,000 units)

Production of Windy is favored over production of Gale (\$192,000 - \$144,000). When there is one constraint, one of the products will be favored over the others.

Short-term Product-Mix Decision: Two Production Constraints

In the presence of two or more production constraints, determining the best sales mix becomes more complicated, but the principle is the same.

Continuing with the Windbreaker's Inc. example:

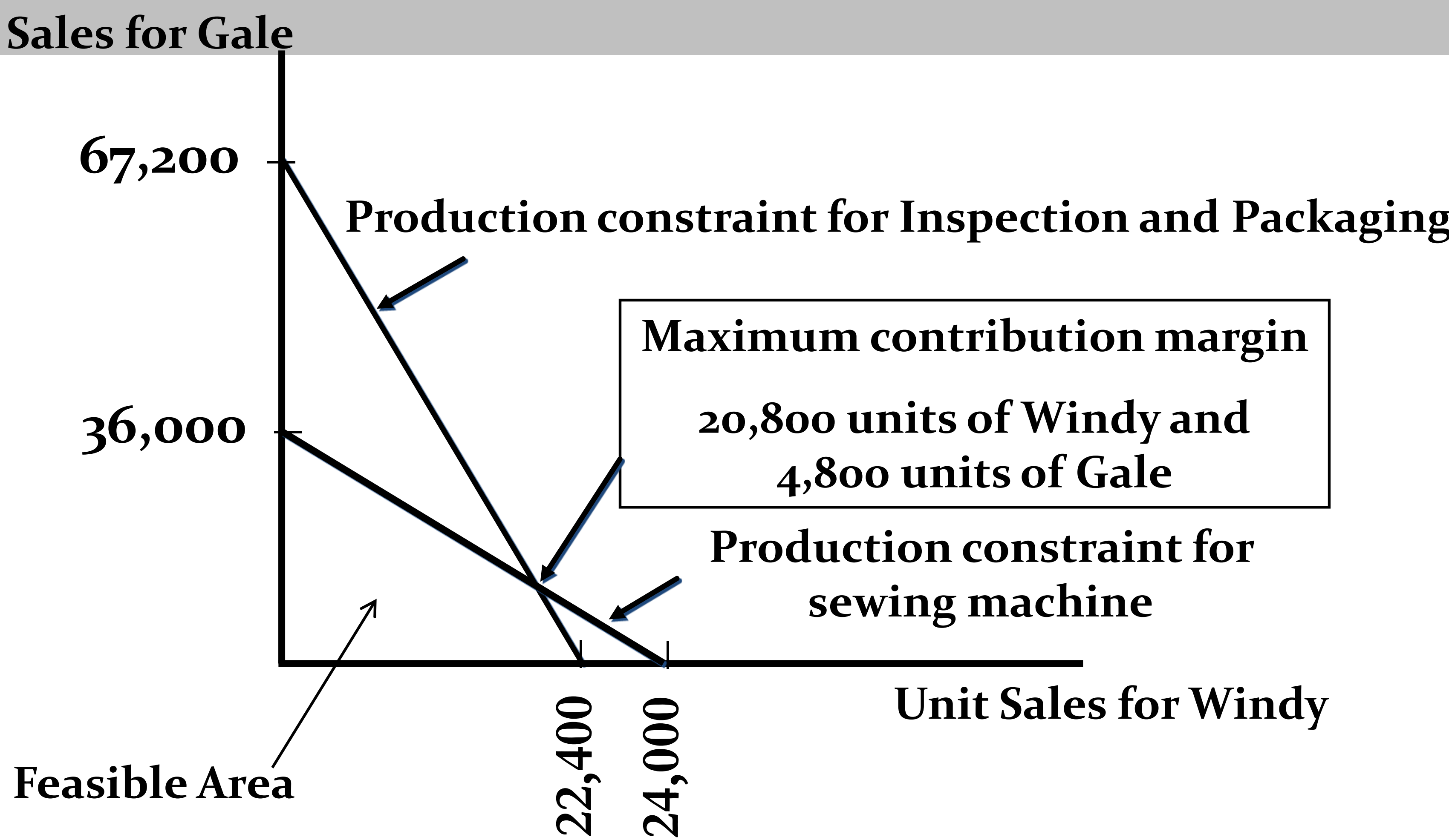
The completed jackets are inspected and labels are added before packaging. Forty workers are required for this operation. Each of the 40 workers works 35 productive hours per week…thus, 5,600 hours are available per month for inspecting and packaging.

Short-term Product-Mix Decision: Two Production Constraints

With two constraints, the results are as follows:

	Windy	Gale
Contribution margin per unit	$ 8	$ 4
Inspection and packing time per jacket	15 min.	5 min.
Number of jackets produced per hour	4	12
Contribution margin per machine hour	$ 32	$ 48
Maximum production for each product		
(5,600 @ 4 jackets/hr.)	22,400	
(5,600 @ 12 jackets/hr.)		67,200

Short-term Product-Mix Decision: Two Production Constraints



Corner-Point Analysis: Windy/Gale Examples

Corner Point	Windy	Gale	Contribution Margin
#1	0	0	$ 0
#2	0	36,000	144,000
#3	22,400	0	179,200
#4	20,800	4,800	$185,600

Behavioral and Implementation Issues

- Managers must be sure to keep the firm's strategic objectives in the forefront in any decision situation to avoid focusing solely on short-term gains
- *Predatory pricing* occurs when a company has set prices below average variable cost with a plan to raise prices later to recover losses from these lower prices
  - Courts have found in favor of the defendants time after time in cases involving predatory pricing
  - U.S. congressional leaders are considering revising the laws related to predatory pricing to promote competition in previously uncompetitive industries

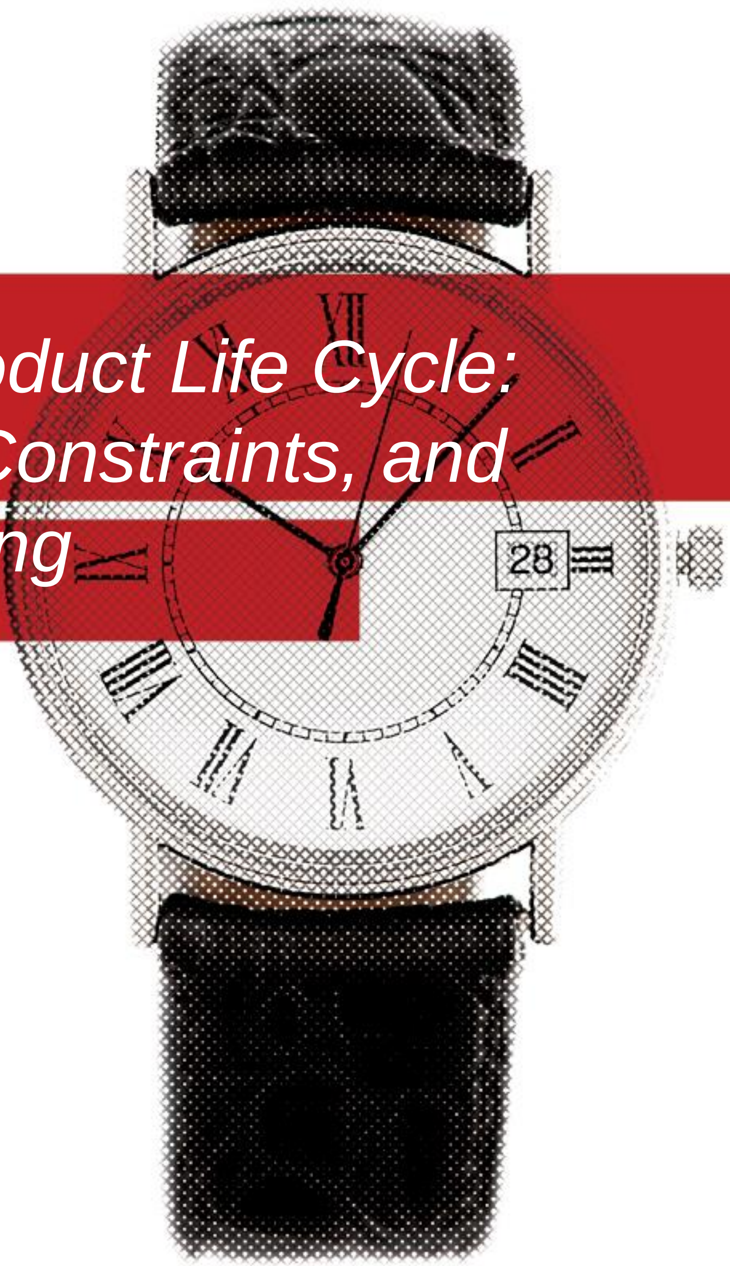
Behavioral and Implementation Issues (continued)

- Management's goal should be to maximize contribution margin while minimizing fixed costs
  - Relevant cost analysis focuses on variable costs, appearing to ignore fixed costs
  - If upper-level management focuses too heavily on variable costs, lower-level management may feel pressure to replace variable costs with fixed costs at the firm's expense
- Managers must be careful not to include irrelevant, including sunk, costs in their decision making
  - When fixed costs are shown as cost per unit, many managers tend to improperly classify them as relevant

Linear Programming & the Product-Mix Decision

- The short-term product/service-mix problem is a subset of what are called “**constrained optimization**” problems
  - The **Solver routine** in Excel can be used to solve linear constrained optimization problems
- Of particular interest is the **Sensitivity Report** that can be generated by Excel in addition to an optimal solution (e.g., optimum short-term product mix):
  - Allowable increase and decrease for each coefficient in the objective function, for which indicated solution still holds
  - Shadow price = opportunity cost of not having enough resource(s) = maximum amount the organization would pay per unit of the scare resource
  - Allowable range of resource values over which indicated shadow prices are valid.

K. Cost Planning for the Product Life Cycle: Target Costing, Theory of Constraints, and Strategic Pricing



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The Product Life Cycle

Four management methods discussed in this chapter:

- Target costing
- Theory of constraints (TOC)
- Life-cycle costing
- Strategic pricing

All involve the entire product life cycle:

- Managers now need to look at costs upstream (before manufacturing) and downstream (after manufacturing)

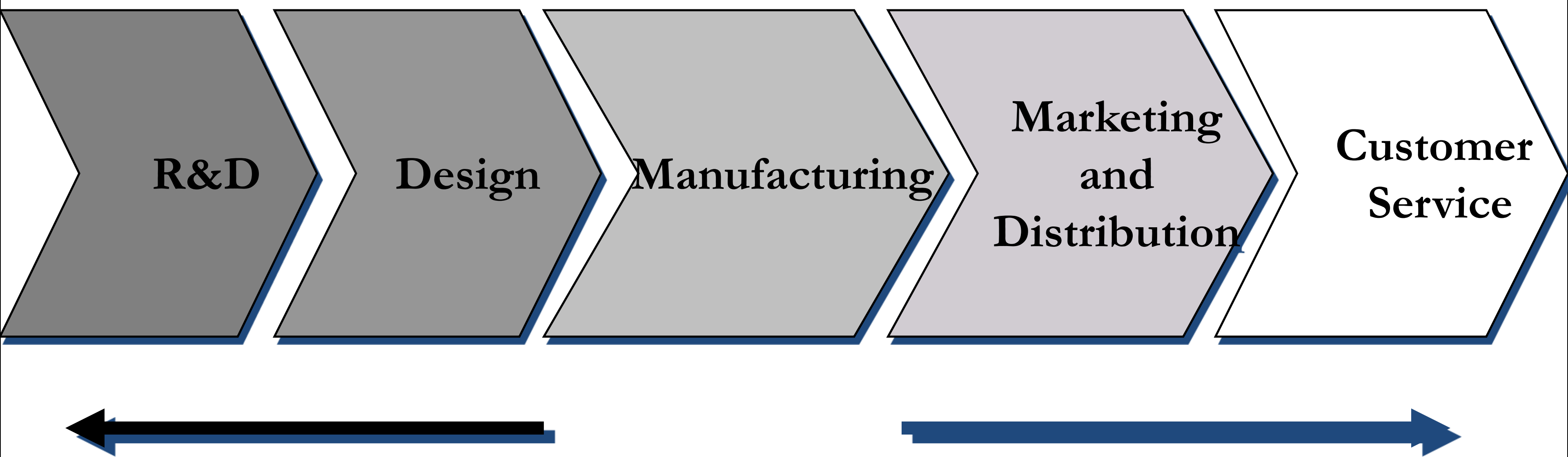
The Cost Life Cycle

“Cost life cycle” refers to the following sequence of activities:

- Research and Development (R&D)
- Design
- Manufacturing (or providing the service)
- Marketing/distribution
- Customer service

It is the life cycle of a product or service from the viewpoint of costs incurred

The Cost Life Cycle (continued)



Upstream Activities **Downstream Activities**

Design decisions account for much of total life-cycle costs

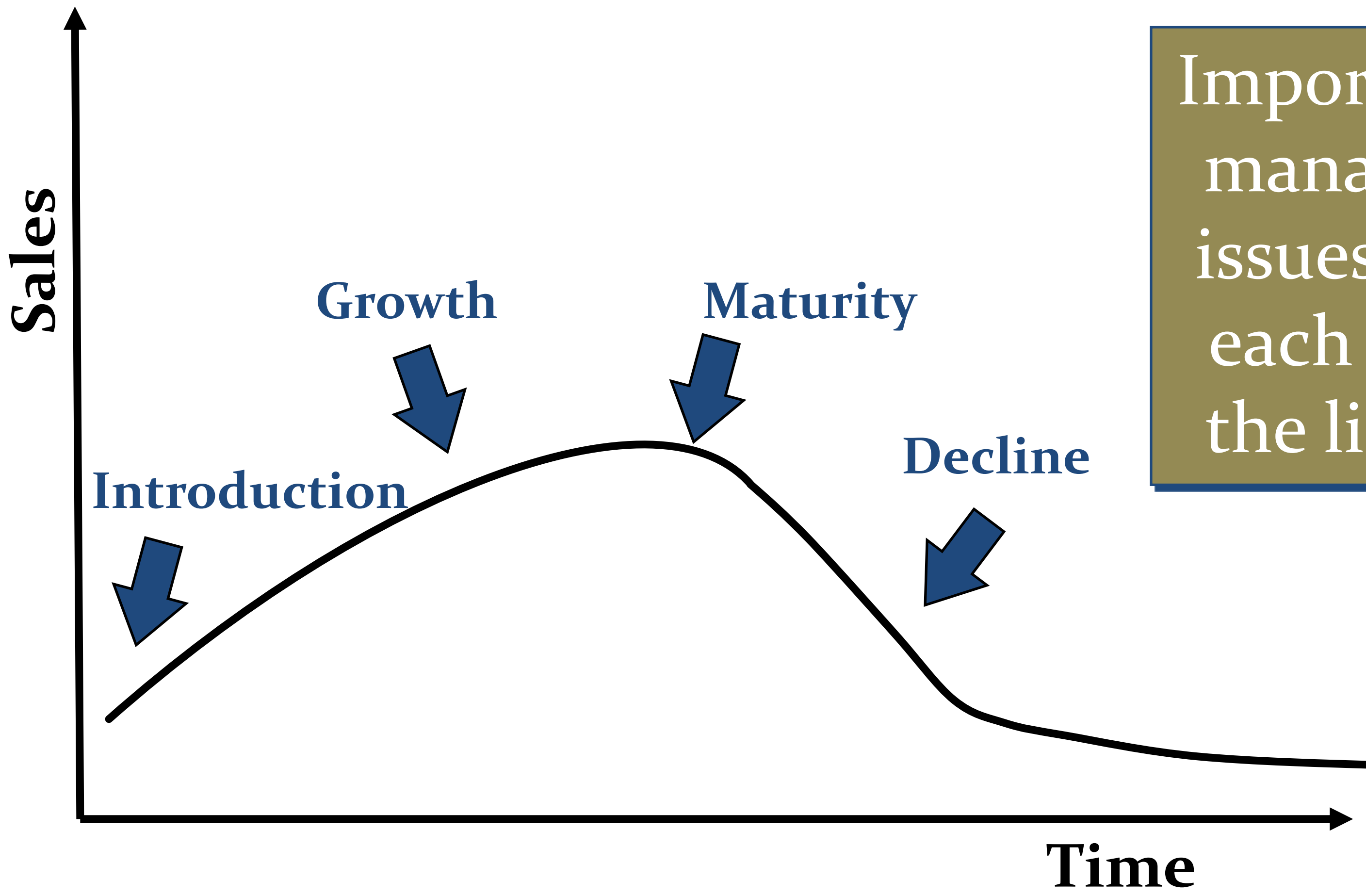
The Sales Life Cycle

The Sales life cycle is the sequence of phases in the product's or service's life:

- Introduction of the product or service to the market
- Growth in sales
- Maturity
- Decline
- Withdrawal from the market

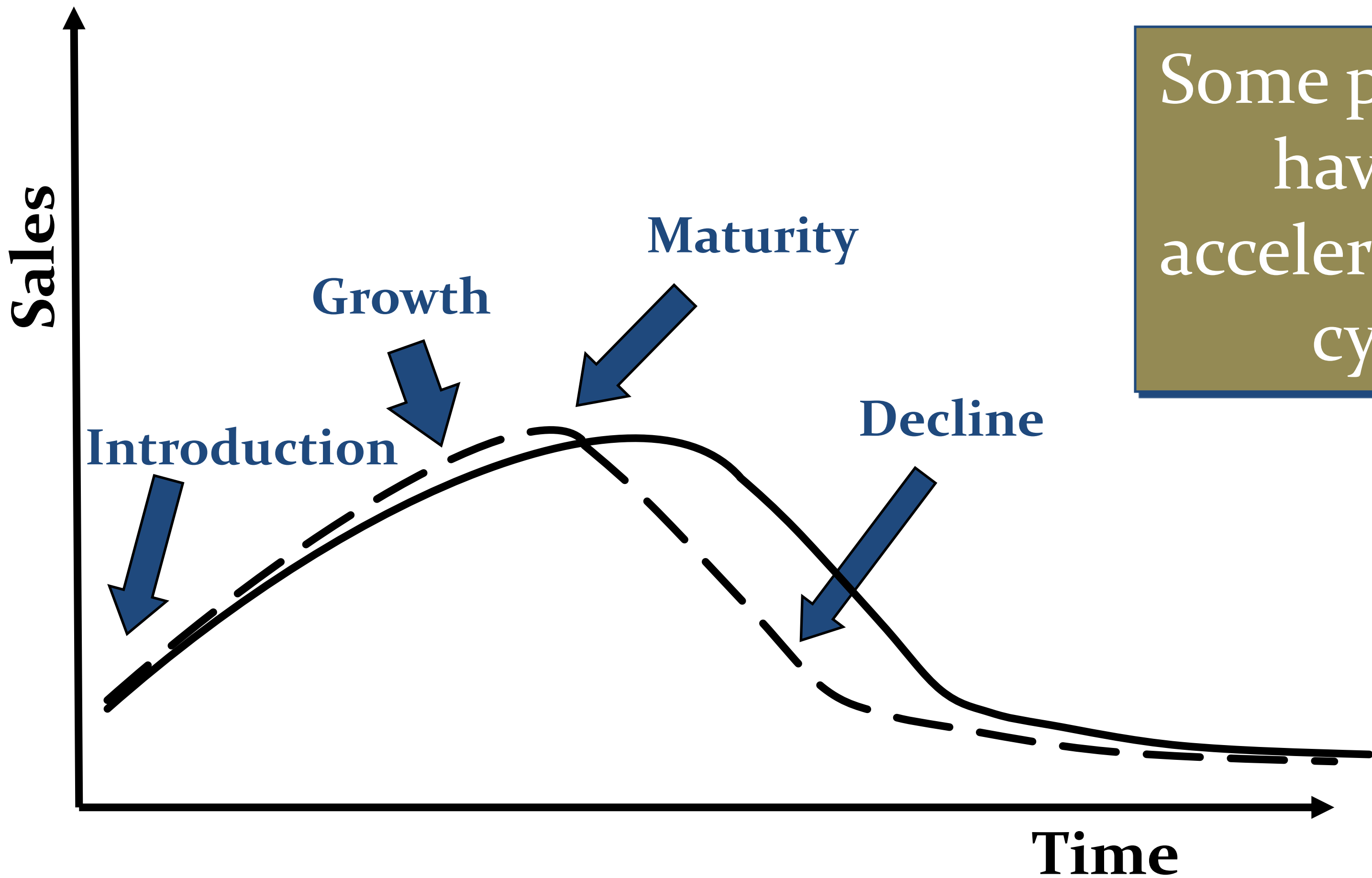
The sales life cycle is the life cycle of a product or service from the viewpoint of sales volume achieved

The Sales Life Cycle



Important cost management issues arise in each stage of the life cycle.

The Sales Life Cycle



Some products have an accelerated life cycle

Target Costing

- **Target costing: a costing method in which the firm determines the allowable (i.e., "target") cost for a product or service, given a competitive market price and a targeted profit**

- **Two options for reducing costs to achieve the target-cost level:**
  - By integrating new manufacturing technology using advanced cost management techniques, (such as ABC), and seeking higher productivity
  - By redesigning the product or service

Implementing Target Costing

❶ Determine the market price

❷ Determine the desired profit

– Profit per unit
– Profit as a % of revenue or cost

❸ Calculate the target cost as market price less desired profit

❹ Use "value engineering" to reduce cost

❺ Use kaizen costing and operational control to further reduce costs

Value Engineering

Value engineering (step 4):

- Analyze trade-offs between product functionality (features) and total product cost
- Perform a consumer analysis during the design stage of the new or revised product to identify critical consumer preferences

Value Engineering (continued)

For firm's that can add and delete features easily, *functional analysis* (examining the performance and cost of each major function or feature of the product) can be used

- *Benchmarking* is often used in this step to determine which features give the firm a competitive advantage
- Goal: provide a desired level of performance without exceeding the target cost

Value Engineering (continued)

Design analysis:

- Useful when the **firm cannot add and delete features easily**
- The design team prepares several possible designs of the product, each having similar features with different levels of performance and different costs
- Accountants work with the design team to choose one design that best meets customer preferences while not exceeding the target cost

Value Engineering (continued)

Other cost-reduction methods:

- *Cost tables:* computer-based databases (costs and cost drivers)
  - Firms that manufacture parts of different size from the same design can estimate the difference in cost and material usage for increasing or decreasing size
- *Group technology* is a method of identifying similarities in the parts of products a firm manufactures so the same parts can be used in two or more products, thereby reducing costs

Kaizen

Kaizen (step five): using continuous improvement & operational control to reduce costs in the *manufacturing stage* of the product life cycle

- Achieved through:
  - Streamlining the supply chain
  - Lean manufacturing
  - Improving manufacturing methods and productivity programs
  - Employing new management techniques
- Used extensively in the time period between product redesigns

Target Costing Example

HPI manufactures a hearing aid, HPI-2, that has 30% of the market. It has a cost of $650 and sells for $750. A competitor has just introduced a new model that incorporates a computer chip that improves quality. Its cost is $1,200. A consumer analysis indicates that cost-conscious consumers will remain loyal to HPI as long as price does not exceed $600. HPI wants to maintain the current rate of profit, $100 per hearing aid.

HPI must therefore reduce its cost to $500 ($600 price - $100 profit) to meet its profit goal

Target Costing Example (continued)

Design analysis options :

- Alternative A: reduce R&D, replace parts, and change inspection procedure – savings = $150
- Alternative B: replace parts and change inspection procedure – savings = $150
- Alternative C: increase R&D to develop a computer chip type hearing aid, replace parts, change inspection procedure, renegotiate new supplier contract – savings = $150

Target Costing Example (continued)

Management chooses alternative C because:

- The increase in R&D will improve the firm's competitive position in the future
- The move is strategically important: the new technology may be dominant in the future

Quality Function Deployment (QFD)

QFD: the integration of value engineering, marketing analysis, and target costing to assist in determining which components of the product should be targeted for redesign or cost reduction

Four steps in QFD:

1. Identify and rank customers’ purchasing criteria for the product
2. Identify the components of the product and the cost of each component
3. Determine how the product’s components contribute to customer satisfaction
4. Determine the importance index of each component

QFD Example: Step 1

First: Customer Criteria and Ranking

	Importance	Relative Importance	
Safety	95	46.3%	= 95÷205
Performance	60	29.3%	= 60÷205
Economy	50	24.4%	= 50÷205
Total	205	100.0%	

QFD Example: Step 2

<u>Second: Identify Components and Cost of Each</u>

	Cost	Percent of Total	
Motor	$40	53.3%	= 40÷75
Saw	20	26.7%	= 20÷75
Frame	15	20.0%	= 15÷75
Total	$75	100.0%	

QFD Example: Step 3

How Components Contribute to Customer Satisfaction

	Customer Criter:		
	Safety	Performance	Economy
Motor	10%	10%	60%
Saw	30%	50%	10%
Frame	60%	40%	30%
Total	100%	100%	100%

QFD Example: Step 4

<u>Fourth: Determine Importance Index for Each Component</u>

	Safety	Perform.	Economy	Importance Index
Relative importance	46.3%	29.3%	24.4%	
% contribution:				
Motor	10%	10%	60%	22.2%*
Saw	30%	50%	10%	31.0%
Frame	60%	40%	30%	46.8%
Total	100%	100%	100%	100.00%

* (10% × 46.3%) + (10% × 29.3%) + (60% × 24.4%)

QFD Example: Conclusion

	Importance Index	Relative Cost
Motor	22.2%	53.3%
Saw	31.0%	26.7%
Frame	46.8%	20.0%
Total	100.0%	100.0%

The above analysis shows that too much is being spent on the motor component, relative to its value to the customer. In contrast, not enough is being spent on the frame component relative to its value to the customer.

Benefits of Target Costing

- Increases customer satisfaction (design is focused on customer value)
- Reduces costs (more effective and efficient design)
- Helps the firm achieve desired profitability on new and redesigned products
- Can decrease total time required for product development through improved coordination of design, manufacturing, and marketing
- Can increase communication and cooperation among departments
- Can improve overall product quality

Measuring and Improving Speed

- **Many strategic initiatives undertaken by firms today focus on improving the speed of operations**

- **Manufacturing *cycle time* (*lead time* or *throughput time*) is the amount of time between the receipt of a customer order and the shipment of that order**
  - Note that start and finish time of the cycle can be defined in several ways. Example: the start time could be defined as the time raw materials are ordered, and the finish time as the time production is completed

Measuring and Improving Speed (continued)

- ***Manufacturing cycle efficiency* (MCE) is defined as processing time divided by total cycle time**
  - MCE separates total cycle time into:
    - Processing time
    - Inspection time
    - Materials handling time
    - Waiting time, and so on
  - Most firms would like to see MCE close to one
- ***Constraints* are activities that slow a product's total cycle time**

The Theory of Constraints (TOC)

TOC focuses on improving speed at the constraints, to decrease overall cycle time

Five steps in TOC:

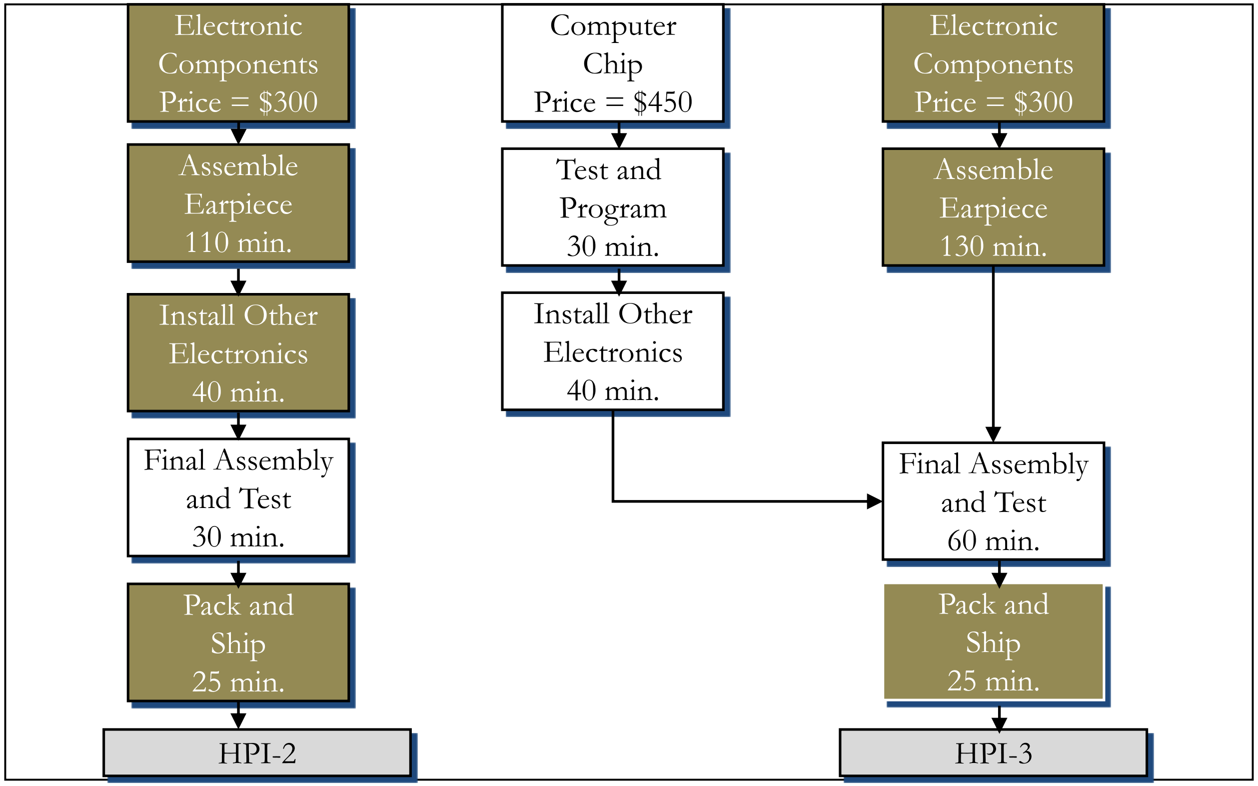
1. Identify the constraint
2. Determine the most profitable product mix given the constraint
3. Maximize the flow through the constraint
4. Add capacity to the constraint
5. Redesign the manufacturing process for flexibility and fast cycle time

TOC Example

HPI manufactures both the second generation (HPI-2) and the third generation (HPI-3) of hearing aids. Prices are competitive at $600 and $1,200, respectively, and are not expected to change. The monthly orders average 3,000 units for HPI-2 and 1,800 units for HPI-3. New customers are told they may have to wait at least three weeks for their orders, and management is concerned about the need to improve speed in the manufacturing process.

TOC Example Step 1: Identify the Constraint

Develop a *flow diagram*, which shows the sequence and time of each process



TOC Example Step 1: Identify the Constraint

Use the flow diagram and additional operational data to identify the constraint for HPI

- There is difficulty maintaining adequate staffing in all process areas except process 5
- Analysis of the process flow, staffing levels, and process time reveals the constraint occurs in process 4, perform final assembly and test; the other four processes have slack time

TOC Example Step 2: Determine the most profitable product mix given the constraint

The most profitable mix provides the maximum total profits for both products

- First, use throughput margin to determine the most profitable product given the constraint
- Throughput margin = selling price less materials cost

In the example, the relevant measure of profitability is *throughput margin per minute in final assembly and testing*

Step 2: (continued)

HPI-3 has a higher throughput margin per unit, but with the time constraint in process 4, HPI-2 is the more profitable product per constraint time minute.

	HPI-2	HPI-3
Price	$600.00	$1,200.00
Materials cost	300.00	750.00
Throughput margin	$300.00	$450.00
Constraint time (for Process 4)	30	60
Throughput per minute	$10.00	$7.50

Step 2: (continued)

HPI will produce all 3,000 units (total demand) for HPI-2 since it is the more profitable, and the remaining capacity will be used to produce HPI-3. HPI-2 will use 1,500 (3,000 units × 0.5 hour per unit) hours of the 2,400-hour capacity. The 900 hours remaining allow for production of 900 units of HPI-3.

	HPI-2	HPI-3
Total demand in units	3,000	1,800
Units of product in optimal mix	3,000	900
Unmet demand	-	900

TOC Example Step 3: Maximize the flow through the constraint

- Look for ways to speed the flow by simplifying the process, improving product design, reducing setup, and reducing other delays

- Objective is to balance the flow of production through the system (processes prior to and including the constraint) by carefully timing and scheduling those activities

Step 3: (continued)

- Another method to use is *Takt time* (total time available to meet expected customer demand)

- Example: after allowing for employee break time, a manufacturing plant operation has 400 minutes of manufacturing time available per day. If average customer demand is 800 units, the Takt time is 30 seconds per unit. The Takt time of 30 seconds is used to balance the flow of product through the processes.

400 minutes ÷ 800 units = 30 seconds per unit *takt time*

TOC Example Steps 4 & 5

Step 4: Add capacity to the constraint

- Adding new machines or additional labor is a long-term measure that can improve flow through the constraint

Step 5: Redesign the manufacturing process for flexibility and fast cycle time

- This step involves the most complete strategic response to the constraint because simply removing one or more minor features of a product might speed up the production process significantly

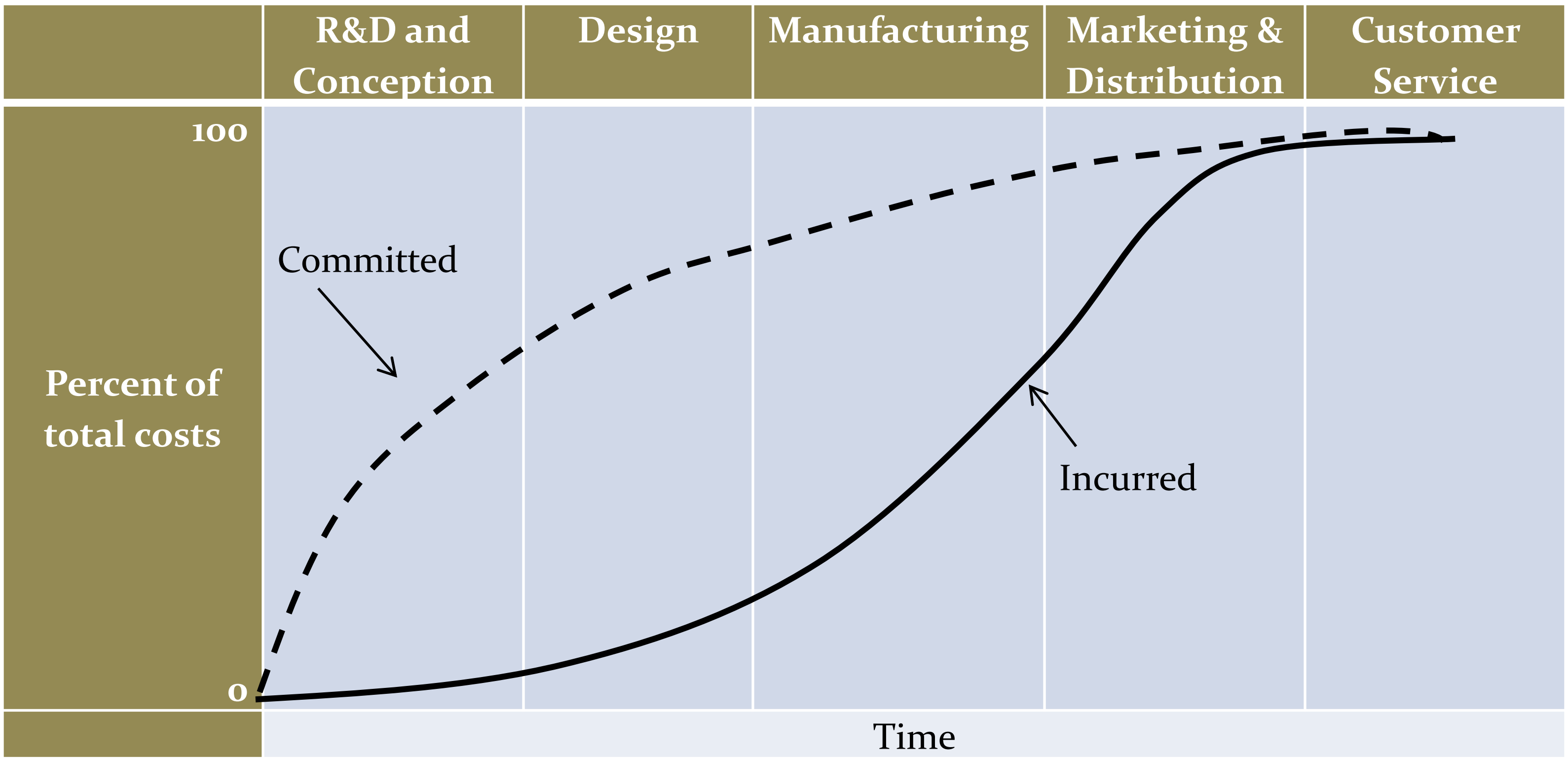
The Five Steps in Strategic Decision Making: Importance of Speed in the Fashion Industry: The Burberry Group PLC

1. **Determine the Strategic Issues Surrounding the Problem:** *Burberry competes on design and innovation in the fashion industry*
2. **Identify the Alternative Actions:** *focus on design or operations***?**
3. **Obtain Information and Conduct Analyses of the Alternatives:** *using an enterprise system, SAP, Burberry carefully determines product and process costs*
4. **Based on Strategy and Analysis, Choose and Implement the Desired Alternative:** *Burberry's CEO decides to simplify the product line to "one brand…one image," and to focus on more efficient and less costly operations*
5. **Provide an On-going Evaluation of the Effectiveness of implementation in Step 4.**

TOC vs. ABC

	TOC	ABC
Main Objective	Short-term focus: through put margin analysis based on materials and materials-related costs	Long-term focus; analysis of all product costs
Resource constraints	Included explicitly, a principal focus of TOC	Not included explicitly
Cost drivers	No direct utilization of cost drivers	Develop an understanding of cost drivers at all levels
Major Use	Optimization of production flow and short-term product mix	Strategic pricing and profit planning

Committed vs. Incurred Costs



Life-Cycle Costing

Life-cycle costing provides a more complete perspective of product costs and profitability than pricing based on manufacturing costs alone

- Managers need to be concerned with costs outside the manufacturing process because upstream and downstream costs can account for a significant portion of total life-cycle costs.
- Decision-making at the design stage is critical because decisions at this point commit a firm to a given production, marketing, and service plan, and lock in most of the product's total life cycle costs. most crucial way to manage these costs is at the design stage of the product and the manufacturing process.

Life-Cycle Costing Example

According to the "traditional" product-line statements below, ADI-1 appears to be the more profitable product

Product Line Income Statements Analytical Decisions, Inc.			
	ADI-1	ADI-2	Total
Sales	$ 4,500,000	$ 2,500,000	$ 7,000,000
Cost of sales	1,240,000	1,005,000	2,245,000
Gross margin	$ 3,260,000	$ 1,495,000	$ 4,755,000
R & D			2,150,000
Selling and service			1,850,000
Income before taxes			$ 755,000

Life-Cycle Costing Example (continued)

However, when upstream and downstream costs are considered, ADI-2 is actually more profitable

Life-Cycle Costing Analytical Decisions, Inc.			
	ADI-1	ADI-2	Total
Sales	$ 4,500,000	$ 2,500,000	$ 7,000,000
Cost of sales	1,240,000	1,005,000	2,245,000
Gross margin	$ 3,260,000	$ 1,495,000	$ 4,755,000
R & D	1,550,000	600,000	2,150,000
Selling and service	1,450,000	400,000	1,850,000
Income before taxes	$ 260,000	$ 495,000	$ 755,000

Strategic Pricing

- **Strategic pricing decisions require information from:**
  - The cost life cycle
  - The sales life cycle
- **The cost information for pricing is commonly based on one of four methods:**
  - Full manufacturing cost plus markup
  - Life-cycle cost plus markup
  - Full cost and desired gross margin percent
  - Full cost plus desired return on assets

Strategic Pricing (continued)

Strategic pricing depends on the position of the product or service in the *sales life cycle*

Phase 1 Introduce	Pricing is set relatively high to recover development costs and take advantage of new-product demand
Phase 2 Growth	Pricing is likely to stay relatively high as the firm attempts to build profitability
Phase 3 Maturity	The firm becomes more of a price taker than a price setter and attempts to reduce upstream and downstream costs
Phase 4 Decline	Volume and prices decline and the firm increases emphasis on controlling upstream and downstream costs

Peak Load Pricing

- Designed to capitalize on or modify consumer behavior, examples include:
  - Charging different rates for peak and off-peak cell phone minutes used
  - Charging more per kilowatt of electricity in the afternoon than in the middle of the night

L. Strategy and the Master Budget

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Basic Terminology

A budget*:*

– is a financial or nonfinancial expression of a *plan of action* for a specified period

– identifies the resources and commitments required to achieve the organization's goals for an upcoming period

Budgeting:

– The process of preparing a budget (or set of budgets) is called *budgeting*

Strategy and the Master Budget

- The starting point in the budget-preparation process is specification of the organization's *strategy*
- The organization's long-range plan identifies required actions over a 5- to 10-year period to attain the organization's strategic goal(s)
- An organization expresses its strategic goals and long-term objectives in its *capital budget* and *master budget*
- *Strategic budget expenditures* represent a special class of capital budgeting proposals, that is, those that lead to long-term value and competitive advantage by the organization

The Budgeting Process

- Budget Committee
- Budget Period
- Budget Guideline
- Negotiation, Review, and Approval
- Revision

The Master Budget

- Represents the “grand plan of action” for an upcoming period
- Translates the organization’s short-term objectives into action steps
- Culminates in the preparation of a set of *pro-forma* financial statements
- Communicates to employees and managers alike the expectations of top management
- Helps coordinate subunit activities

The Master Budget (continued)

The master budget comprises a set of operating and financial budgets:

- ***Operating budgets*** are plans that identify resources needed to carry out the budgeted activities, such as sales and services or production
  - Operating budgets include production, purchase, personnel, marketing budgets, and a budgeted income statement
- ***Financial budgets*** identify sources and uses of funds for the budgeted operations
  - Financial budgets include the cash budget, budgeted statement of cash flows, the budgeted balance sheet, and the capital expenditures budget

Preparing Individual Budgets (e.g., a Sales Budget)

Three-step process:

(1) Define the “bottom-line” information contained in the budget (e.g., sales for the upcoming period)

(2) Determine what this information is a function of (e.g., budgeted unit sales, budgeted selling price/unit)

(3) Put together information in a user-friendly way

Sales Budget

The *sales budget* is often referred to as the cornerstone of the entire master budget

The sales budget has two components:

- Forecasted sales *volume*
- Budgeted selling *prices*

Kerry Industrial Company
Sales Budget
For the Quarter Ended June 30, 2013

	April	May	June	Quarter
Sales in units	20,000	25,000	35,000	80,000
Selling price per unit	× $30	× $30	× $30	× $30
Total sales	$600,000	$750,000	$1,050,000	$2,400,000

Production Budget

- After the sales budget, we prepare a set of manufacturing budgets, beginning with a *production budget,* which shows planned production for a given period

- Budgeted production (in units) can be calculated through use of the following formula:

$$\begin{array}{c} \text{Budgeted} \\ \text{production} \\ \text{(in units)} \end{array} = \begin{array}{c} \text{Budgeted} \\ \text{Sales} \\ \text{(in units)} \end{array} + \begin{array}{c} \text{Desired ending} \\ \text{inventory} \\ \text{(in units)} \end{array} - \begin{array}{c} \text{Beginning} \\ \text{inventory} \\ \text{(in units)} \end{array}$$

Production Budget (continued)

Kerry example:

(1) Beginning inventory (April 1st) = 5,000 units (assumed)

(2) Desired ending inventory (April 30th) = 30% of the following month's projected unit sales

(3) The sales budget has total sales for May at 25,000 units.

Production Budget (continued)

Desired ending level at **April 30:**

30% × 25,000 units (May sales) = 7,500 units

Budgeted production for April

$$22{,}500 = 20{,}000 + 7{,}500 - 5{,}000$$

From the Sales Budget

Inventory from **April 1**: 5,000 units

Production Budget

July sales are budgeted at 40,000 units: 30% × 40,000 = 12,000

Kerry Industrial Company
Production Budget
For the Quarter Ended June 30, 2013

	April	May	June	Quarter
Budgeted sales in units	20,000	25,000	35,000	80,000
Desired ending inventory	7,500	10,500	12,000	12,000
Units needed	27,500	35,500	47,000	92,000
Beginning inventory	5,000	7,500	10,500	5,000
Budgeted production	**22,500**	**28,000**	**36,500**	**87,000**

30% of June's budgeted sales

Direct Materials Budgets

Two required budgets:

- ❑ Direct material *usage* budget
- ❑ Direct materials *purchases* budget

The direct materials *usage* budget:

- ❑ Shows the amount (and budgeted cost) of direct materials required for budgeted production
- ❑ The last line of the production budget = first line of the direct materials usage budget

Direct Materials Purchases Budget (continued)

The direct materials *purchases* budget*:*

- Contains budgeted purchases, in units and dollars, of direct materials for the upcoming period

- Is needed to complete the direct materials usage budget (i.e., provides unit cost data)

- Is a function of: materials required for production (from materials usage budget), target ending inventory of materials, beginning-of-period materials inventory, budgeted purchase price per unit of raw material

Direct Materials Purchases Budget: Kerry Company

KERRY WINDOW SYSTEMS, INC.
Direct Materials Purchases Budget
For the Quarter Ended June 30, 2013

Line	Item	April	May	June	Quarter
1.	Total direct materials needed in production (from part A of Exhibit 10.5), in lbs.	67,500	84,000	109,500	261,000
2.	Add: Desired direct materials ending inventory	+ 8,400	+ 10,950	+ 10,800*	+ 10,800
3.	Total direct materials needed	75,900	94,950	120,300	271,800
4.	Less: Direct materials beginning inventory	− 7,000	− 8,400	− 10,950	− 7,000
5.	**Total Direct materials purchases**	**68,900**	**86,550**	**109,350**	**264,800**
6.	Purchase price per pound	× $ 2.45	× $ 2.50	× $ 2.60	
7.	**Total cost of direct materials purchases**	**$168,805**	**$216,375**	**$284,310**	**$669,490†**

*Assumed, based on estimated production in July.
†$669,490 = $168,805 + $216,375 + $284,310

Direct Labor Budget

- Enables the personnel department to plan for hiring & repositioning of employees, based on production needs
- Is prepared for each class (type) of labor, e.g., skilled and semi-skilled
- Is a function of:
  – Budgeted output (from *production budget*)
  – Standard labor hours per unit of output
  – Standard wage rate per hour

Direct Labor Budget (continued)

Kerry uses 0.5 hours of semiskilled labor and 0.2 hours of skilled labor per unit @ standard wage rates of $8 and $12 per hour, respectively

Direct Labor Budget: Kerry Company

KERRY WINDOW SYSTEMS, INC.
Direct Labor Budget
For the Quarter Ended June 30, 2013

Line			April		May		June		Quarter
	Semiskilled Labor								
1.	Budgeted production (Exhibit 10.4)		22,500		28,000		36,500		87,000
2.	Semiskilled direct labor-hours per unit	×	0.5	×	0.5	×	0.5	×	0.5
3.	Total semiskilled direct labor-hours needed		11,250		14,000		18,250		43,500
4.	Hourly wage rate of semiskilled labor	×	$ 8	×	$ 8	×	$ 8	×	$ 8
5.	Total wages for semiskilled labor		$ 90,000		$112,000		$146,000		$348,000
	Skilled Labor								
6.	Budgeted production (Exhibit 10.4)		22,500		28,000		36,500		87,000
7.	Skilled direct labor-hours per unit	×	0.2	×	0.2	×	0.2	×	0.2
8.	Total skilled direct labor-hours needed		4,500		5,600		7,300		17,400
9.	Hourly wage for skilled labor	×	$12	×	$12	×	$12	×	$12
10.	Total wages for skilled labor		$ 54,000		$ 67,200		$ 87,600		$208,800
11.	**Total cost for direct manufacturing labor (5 + 10)**		**$144,000**		**$179,200**		**$233,600**		**$556,800**
12.	Total direct manufacturing labor-hours (3 + 8)		15,750		19,600		25,550		60,900

Cost of Goods Manufactured & Cost of Goods Sold (CGS) Budget

- The *cost of goods manufactured and CGS budget* is prepared after the factory overhead budget is prepared
- The budgeted income statement and the budgeted balance sheet both use information from this budget

Kerry Company: Cost of Goods Manufactured & CGS Budget, April 2013

	April
Direct materials (Line 12, Exhibit 10.5)	$165,025
Direct labor (Line 11, Exhibit 10.7)	144,000
Total factory overhead (Exhibit 10.8)	133,600
Total cost of goods manufactured	$422,625
Finished goods beginning inventory	90,000*
Total cost of goods available for sale	$512,625
Finished goods ending inventory†	140,875
Cost of goods sold	**$371,750**

*Finished goods beginning inventory, April 1, 5,000 units @ $18/unit.

Selling & Administrative Expense Budget

- This budget includes all the planned expenditures for selling and general administrative activities

- Many of the expenses included in this budget are considered discretionary and are a likely place for spending cuts

- Managers must be careful not to focus solely on short-term affects when making cuts in these areas (e.g., customer-service expenditures)

Kerry Company—Cash Receipts Budget: Operating Activities April 2013

Sales Data	March	April
Cash and bank credit card sales (70% of total sales)	$315,000	$420,000
Credit sales (30% of total sales)	135,000	180,000
Gross sales revenue (Exhibit 10.3)	$450,000	$600,000

Cash received from cash sales	
(60% of cash plus bank credit card sales)	$252,000
Cash received from bank credit card sales	
(40% of cash and bank credit card sales × 97%)	162,960
Collections of accounts receivable:	
From credit sales the month before this month:	
Within cash discount period	
(Prior month's credit sales × 80% × 60% × 98%)	63,504
After the cash discount period	
(Prior month's credit sales × 80% × 40%)	43,200
From credit sales two months before this month	
(75% of 20% of credit sales two months prior)	18,000
Total cash receipts, net of bank service charge (3%)	**$539,664**

Cash Budget

The *cash budget* brings together the cash effects of all budgeted activities--to ensure that the firm has adequate cash on hand:

- This budget generally has three sections:
  - Cash flow from operations
  - Investing activities, and
  - Financing activities
- Preparation of this budget involves careful review of all other budgets to identify cash inflows and outflows

Kerry Company—Cash Budget: April 2013

	April
Cash balance, beginning of period	**$75,000**
Cash flow from operations:	
Operating cash inflows (Exhibit 10.13)	$539,664
Operating cash outflows:	
Cash payments for direct material purchases	$163,283
Direct labor (Exhibit 10.9, line 11)	$144,000
Factory overhead (Exhibit 10.10, last line)	$83,600
Selling & administrative expenses (Exhibit 10.12, last line)	$139,000
Net cash flow from operations	$9,781
Investing activities	
Equipment purchase	$0
Cash balance before financing activities	$84,781
Financing activities:	
Bank borrowing, beginning of month	$0
Payments (i.e., cash outflows, for interest and principal)	$0
Net effect of financing activities	$0
Ending cash balance	**$84,781**

Budgeted I/S and B/S

The *budgeted income statement (I/S)* and *budgeted balance sheet* (B/S) can then be prepared using all the aforementioned budgets:

- The budgeted I/S describes the expected net income for the upcoming period
- The budgeted B/S, the last budget in the budget-preparation process, incorporates the effects of all operations and cash flows during the budget period and shows projected ending balances in asset, liability, and equity accounts

Budgeted Income Statement: Kerry Company

	April
Gross sales revenue (Exhibit 10.3)	$600,000
Less: Cash discounts for early payment of credit sales (last month's credit sales × 80% × 60% × 2%)	$ 1,296
Bank service charge (3% of bank credit-card sales)	$ 5,040
Net sales	$593,664
Less: Cost of goods sold (Exhibit 10.9)	371,750
Gross profit	$221,914
Selling and administrative expenses (Exhibit 10.10)	175,000
Net operating income	$ 46,914
Less: Interest expense (Exhibit 10.12)	0
Income before income taxes	$ 46,914
Less: Income taxes (@30%)	14,074
Net income	**$ 32,840**

Budgeted Balance Sheet

Assets			
Current assets:			
Cash (Exhibit 10.12)		$ 90,980	
Net accounts receivable[a]		333,000	
Direct materials inventory (Exhibit 10.5, line 11)		28,080	
Finished goods inventory (Exhibit 10.9)		224,852	
Total current assets			$ 676,912
Property, plant, and equipment:			
Land (Exhibit 10.14)		$ 40,000	
Buildings and equipment, gross	$969,750		
Less: Accumulated depreciation[b]	349,000	620,750	
Total property, plant and equipment			660,750
Total assets			$1,337,662

Budgeted Balance Sheet

Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable[c]	$113,724	
Income tax payable (Exhibit 10.13)	94,841	
Total liabilities		$ 208,565
Stockholders' equity:		
Common stock (Exhibit 10.14)	$303,300	
Retained earnings[d]	825,797	
Total stockholders' equity		1,129,097
Total liabilities and stockholders' equity		$1,337,662

Uncertainty and the Budgeting Process

- What-If Analysis
- Sensitivity Analysis
- Scenario analysis:
  - Best-case scenario
  - Worst-case scenario
  - Most-likely scenario

Budgeting in Service Companies

- These firms have different operating characteristics, operating environments, and considerations than those of manufacturing and merchandising firms

- Service firms are different due to the absence of production or merchandise purchase budgets and their ancillary budgets–the focus of the budgeting process must be personnel planning:
  - Does the firm have sufficient staff and resources to provide the expected level of service output in the upcoming period?
  - Do staff members have the appropriate skills?

Alternative Budgeting Approaches

Zero-base budgeting (ZZB) is a budgeting process that requires managers to prepare budgets from a zero base

– This type of budgeting allows no activities or functions to be included in the budget unless managers can justify their needs

– In-depth reviews and analyses of all budget items make managers aware of activities and functions that have outlived their usefulness

– Can be a difficult and time-consuming process

Alternative Budgeting Approaches (continued)

- *Activity-based budgeting (ABB)* is a budgeting process based on activities and cost drivers of operations:
  - Starts with the budgeted output and segregates costs required for the budgeted output into homogeneous cost pools
  - Can be a simple extension of a firm's ABC system
- *Time-driven activity-based budgeting* is a budgeting process based on the use of time-driven activity-based costing (TDABC) system

Alternative Budgeting Approaches (continued)

- Budgeting in both ABC and TDABC systems facilitates resource capacity planning
  - Role of practical capacity?
- Kaizen (Continuous improvement) budgeting:
  - Incorporates continuous improvement expectations into the budgets
  - Promotes active engagement in reforming and altering business practices and processes

Behavioral Issues in Budgeting

- *Budgetary slack,* or padding the budget, is the practice of managers knowingly including a higher amount of expenditures or a lower amount of revenue in a budget
- *Spending the budget* is another issue; managers often feel if they do not use all the resources they receive, next year's budget may be cut
- *Goal congruence* is a term that refers to the degree of consistency between goals of the firm, its subunits, and its employees
  - Involving employees in the budgeting process fosters goal congruence

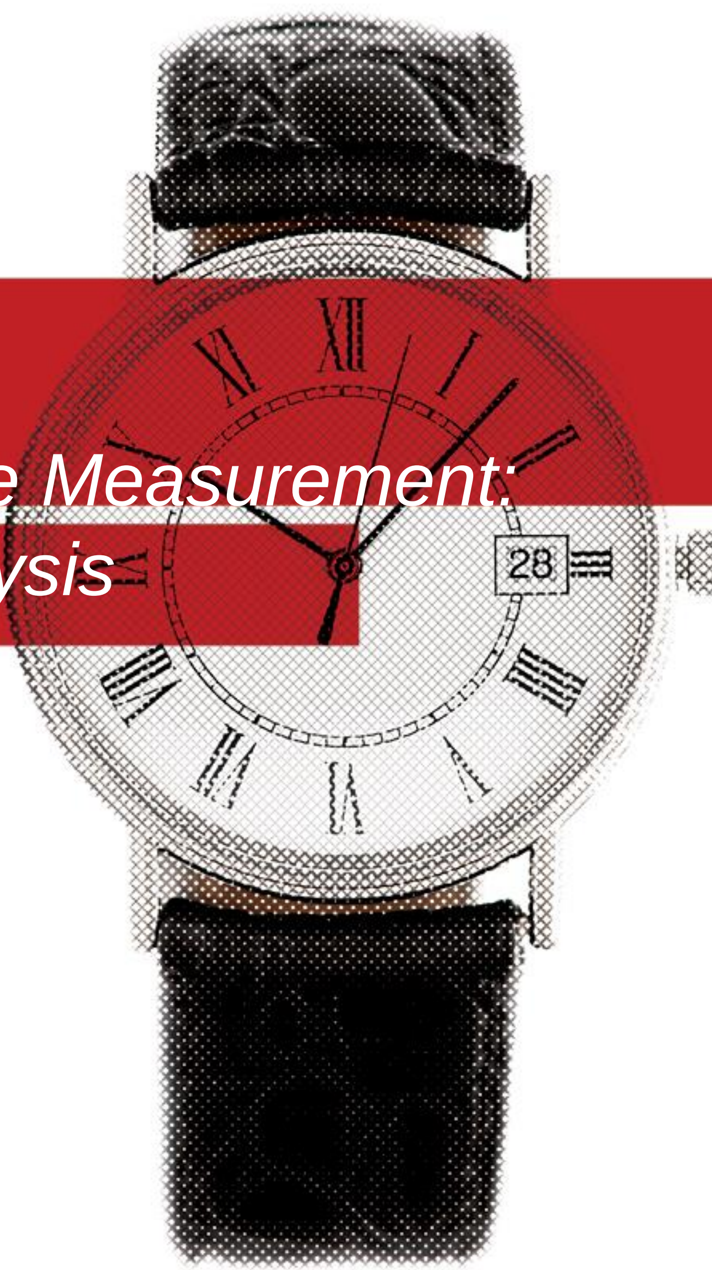
Behavioral Issues in Budgeting (continued)

- Difficulty level of the budget target?
  - An easy budget may fail to encourage employees to give their best efforts, while a very difficult target can be discourage managers from even trying
  - A “highly achievable target” is suggested with incentives for exceeding the budgeted figures
- Authoritative or participative budgeting?
  - Top-down budgeting is referred to as *authoritative budgeting*
  - Bottom-up budgeting is referred to as *participative budgeting*
  - Effective budgeting processes often combine the two types

Behavioral Issues in Budgeting (continued)

– **Linkage of compensation and budgeted performance:**
  - Problems with the “fixed performance contract”
  - Gaming the performance measure
– **Suggested improvements to basing incentive compensation on the basis of the fixed performance contract:**
  - Use of linear compensation plan
  - Use of “rolling forecasts” and relative performance (relative improvement contracts

M. Operational Performance Measurement: Variances Analysis



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Management Accounting & Control Systems

- *Control* = set of procedures, tools, and systems organizations use to monitor activities and to achieve organizational goals

- *Management accounting & control system* = core performance-measurement system of the organization, including both *planning* and *feedback* components:
  - Management Control Systems
  - Operational Control Systems → short-term operating performance

– ***Financial Performance Measures:***

- Standard Cost (and Revenue) Variance Analysis
- Use of standard costs and flexible budgets
- Interpretation of variances

– ***Nonfinancial Performance Indicators:***

- These measures can be leading indicators (predictors) of future financial performance
- Variance analysis applies here, too!

- Master (Static) Budget:
  - Prepared before the start of the period
  - Contains the following items:
    - Budgeted sales volume
    - Budgeted sales price per unit
    - Budgeted variable cost per unit
    - Budgeted total fixed costs

Short-Term Financial Control (continued)

- Flexible (Control) Budget:
  - Prepared at the end of the period (after actual activity is known)
  - Actual sales volume is used, but with budgeted selling price per unit, budgeted variable cost per unit, and budgeted total fixed costs
  - Key to performing *variance analysis* at the end of the period

Short-Term Financial Control (continued)

- Essence of short-term financial control—explain the **total operating-income variance** for the period
- Total operating-income variance = master budget operating income – actual operating income
- The total operating-income variance can be subdivided into the following component variances:
  - Flexible-budget variance (with components)
  - Sales volume variance
- Key tool: use of *standard costs* and *flexible budgets*

Master Budget Example

	Per Unit Amounts	Master Budget
Unit sales		1,000
Sales revenue	$800	$ 800,000
Less variable costs:	$450	450,000
Contribution margin	$350	$ 350,000
Less fixed costs		150,000
Operating income		$ 200,000

Actual Operating Profit Generated

During the period the company actual produced and sold 780 units (not 1,000 as was originally planned). The actual operating income was $128,000, as follows:

Unit sales	780
Sales revenue	$ 639,600
Less: variable costs	350,950
Contribution margin	$ 288,650
Less fixed costs	160,650
Operating income	$ 128,000

Total Operating-Income (Master Budget) Variance for the Period = $72,000 U

	Actual	Master Budget	Variances	
Unit sales	780	1,000	220	U
Sales revenue	$ 639,600	$ 800,000	$160,400	U
Less: variable costs	350,950	450,000	99,050	F
Contribution margin	$ 288,650	$ 350,000	$ 61,350	U
Less fixed costs	160,650	150,000	10,650	U
Operating income	$ 128,000	$ 200,000	$ 72,000	U

Explaining the Total Operating-Income Variance ($72,000 U)

- **The total operating-income variance should be traceable to a combination of the following four factors:**
  - Actual sales *volume* was different than planned
  - Actual *variable cost per unit* was different than planned
  - Actual *total fixed costs* were different than planned
  - Actual *selling price per unit* was different than planned
- **The flexible budget allows us to breakdown the total operating-income variance into components related to each of the above four factors**

Flexible Budget Example

To begin the variance-decomposition process at the end of the period we prepare a flexible (control) budget based on the 780-unit level, as follows:

Units	780
Sales ($800/unit)	$624,000
Variable costs ($450/unit)	$351,000
Contribution margin ($350/unit)	$273,000
Fixed costs	$150,000
Operating income	$123,000

N.B.: Variable cost per unit = $400 manufacturing + $50 selling

Decomposing the Total Operating Income Variance ($72,000 U)

SCHMIDT MACHINERY COMPANY
Analysis of Financial Results
For October 2013

	(1) Actual	(2) Flexible-Budget Variances	(3) Flexible Budget	(4) Sales Volume Variances	(5) Master (Static) Budget
Units	780	0	780	220U	1,000
Sales	$639,600	$15,600F	$624,000	$176,000U	$800,000
Variable costs	350,950	50F	351,000	99,000F	450,000
Contribution margin	$288,650	$15,650F	$273,000	$ 77,000U	$350,000
Fixed costs	160,650	10,650U	150,000**	0	150,000**
Operating Income	$128,000	$ 5,000F	$123,000	$ 77,000U	$200,000

Analysis of Total Operating-Income Variance

Total operating-income variance*
= $128,000 – $200,000 = $72,000U

Flexible-budget variance
= $128,000 – $123,000
= $5,000F

Sales volume variance
= $123,000 – $200,000
= $77,000U

*Also called the *total master (static) budget variance.*
**Budgeted fixed factory overhead cost = $120,000; budgeted fixed selling and administrative expense = $30,000.

Breakdown of Total Operating Income Variance ($72,000 U)

The difference between actual operating income and the flexible budget operating income = **$5,000 F**:

– This difference is called the *total flexible* (controllable) *budget variance*

– This variance captures the net effect of:

- Actual selling prices per unit being different than planned
- Actual variable cost per unit was different than planned
- Actual total fixed costs were different than planned

Breakdown of Total Operating Income Variance (continued)

The difference between the flexible budget operating income and the master budget operating income = **$77,000 U**:

- This difference is called the *sales volume variance*
- Everything else other than volume is being held constant in calculating this variance; hence, the difference in operating income between the two budget columns is due entirely to sales volume being different than planned
- The sales volume variance can also be calculated as: budgeted cm per unit × (actual – budgeted) units
- In the example: $350/unit × 220 units = **$77,000 U**

Breakdown of Total Operating Income Variance: Summary

- Total Operating Income Variance = Actual Operating Income – Master Budget Operating Income

  = $128,000 – $200,000 = **$72,000 U**

- Flexible (Controllable) Budget Variance = Actual Operating Income – Flexible Budget Operating Income

  = $128,000 – $123,000 = **$5,000 F**

Breakdown of Total Operating Income Variance (continued)

- Sales Volume Variance = Flexible-Budget Operating Income – Master Budget Operating Income

  = $123,000 – $200,000 = **$77,000** U

- Total Operating Income Variance = Flexible-Budget Variance + Sales Volume Variance

  = $5,000F + $77,000U = **$5,300** U

Breakdown of Total Flexible-Budget Variance ($5,000 F)

Sales Price Variance

$= \text{Actual Sales \$} - \text{Flexible Budget Sales \$}$

$= \$639{,}600 - \$624{,}000 = \mathbf{\$15{,}600\ F}$

or, $= AQ \times (AP - SP)$

$= 220 \text{ units} \times (\$820 - \$800)/\text{unit} = \mathbf{\$15{,}600\ F}$

Breakdown of Total Flexible-Budget Variance ($5,000 F) (continued)

- Total Fixed Cost Variance = Actual Fixed Costs – Flexible Budget Fixed Cost

  = $160,650 – $150,000 = **$10,650 U**

- Note that this budget (spending) variance on fixed costs can be further broken down:
  – First, by functional categories (e.g., Marketing)
  – Second, by individual costs within categories (e.g., Sales Manager Salaries)

Breakdown of Total Flexible-Budget Variance ($5,000F) (continued)

- Total Variable Cost Variance = Actual Variable Costs – Flexible Budget Variable Costs

  = $350,950 – $351,000 = **$50 F**

  or, = AQ × (AP – SP)

  = 780 units × ($449.9359 – $450.00)/unit = **$50 F**

- This total variance can be further broken down:
  - First, by functional categories (e.g., Manufacturing)
  - Second, by individual costs within categories (e.g., Direct Materials Cost)

General Model for Analyzing Variable Cost Flexible Budget Variances

(1) Actual Input Cost	(2) Actual Input at Standard Cost	(3) Flexible-Budget Amount
(AQ) × (AP)	(AQ) × (SP)	(SQ) × (SP)

Price (rate) variance = (1) − (2)

Quantity (efficiency) variance = (2) − (3)

Total flexible-budget variance = (1) − (3)

Legend:

AQ = Actual quantity of the resource (e.g., DM) purchased or used

AP = Actual cost per unit of the resource (e.g., per lb.)

SP = Standard cost per unit of the resource

SQ = Standard quantity of the resource that should have been used to produce the output for the period = Units of output × Standard resource input per unit of output

Formulas for Decomposing Variable Cost Flexible Budget Variances into Price and Quantity Components

- **Variable Cost Variance = Actual Variable Costs – Flexible Budget Variable Costs**

  $= (AQ \times AP) \times (SQ \times SP)$

- **Breakdown of total variance:**
  - Price (Rate) Variance = $AQ \times (AP – SP)$
  - Quantity (Efficiency) Variance = $SP \times (AQ – SQ)$

Formulas for Decomposing Variable Cost Flexible Budget Variances into Price and Quantity Components (continued)

Notes:

- For DM: AQ in the Price Variance formula represents "actual quantity *purchased*"
- SQ = "standard quantity of resource input (e.g., DL) for the output of the period"
- In a standard cost system, these variances are recorded in the formal accounting records (i.e., each in a descriptive account, such as "Direct Labor Rate Variance")

Example: Direct Materials (DM) Variance Decomposition

Hanson Inc. has the following direct material standard to manufacture one unit of “Jerf”:

1.5 pounds per Jerf at $4.00 per pound

Last month 1,700 pounds of material were purchased and used to make 1,000 Jerfs. The material cost a total of $6,630.

Direct Materials (DM) Variance: Question 1

What is the actual price per pound (AP) paid for the material?

a. $4.00 per pound.
b. $4.10 per pound.
c. $3.90 per pound.
d. $6.63 per pound.

Answer: Question 1

What is the actual price per pound (AP) paid for the material?

a. $4.00 per pound.
b. $4.10 per pound.
c. $3.90 per pound.
d. $6.63 per pound.

AP = $6,630 ÷ 1,700 lbs. = $3.90 per lb.

Direct Materials (DM) Variance: Question 2

Hanson's materials price variance (PV) for the month was:

a. $170 unfavorable.

b. $170 favorable.

c. $800 unfavorable.

d. $800 favorable.

Answer: Question 2

Hanson's materials price variance (PV) for the month was:

a. $170 unfavorable.
b. $170 favorable.
c. $800 unfavorable.
d. $800 favorable.

$PV = AQ \times (AP - SP)$

$PV = 1{,}700 \text{ lbs.} \times (\$3.90 - 4.00)/\text{lb.} = \$170 \text{ Favorable}$

Direct Materials (DM) Variance: Question 3

The standard quantity (SQ) of material that should have been used to produce 1,000 Jerfs is:

a. 1,700 pounds.
b. 1,500 pounds.
c. 2,550 pounds.
d. 2,000 pounds.

Answer: Question 3

The standard quantity of material (SQ) that should have been used to produce 1,000 Jerfs is:

a. 1,700 pounds.
b. 1,500 pounds.
c. 2,550 pounds.
d. 2,000 pounds.

SQ = 1,000 units × 1.5 lbs./unit = 1,500 lbs.

Direct Materials (DM) Variance: Question 4

Hanson's material usage variance (UV) for the month was:

a. $170 unfavorable.
b. $170 favorable.
c. $800 unfavorable.
d. $800 favorable.

Answer: Question 4

Hanson's material usage variance (UV) for the month was:

a. $170 unfavorable.
b. $170 favorable.
c. $800 unfavorable.
d. $800 favorable.

$UV = SP \times (AQ - SQ)$
$UV = \$4.00 \times (1{,}700 - 1{,}500)$ lbs. $= \$800$ unfavorable

Hanson, Inc. Example: Summary

Actual Quantity × Actual Price	Actual Quantity × Standard Price	Standard Quantity × Standard Price
1,700 lbs. × $3.90 per lb.	1,700 lbs. × $4.00 per lb.	1,500 lbs. × $4.00 per lb.
$6,630	$ 6,800	$6,000

Price variance
$170 favorable

Usage variance
$800 unfavorable

Total Flexible Budget Variance = $6,630 - $6,000 = $630U

Causes of DM Variances

- **Price Variances:**
  - Purchase of materials of different grade
  - Quantity discounts
  - Freight/delivery expediting cost (“rush orders”)
- **Quantity Variances:**
  - Purchase of non-standard quality materials
  - Poorly trained or poorly supervised workers
  - Poorly maintained machinery (not calibrated properly)

Causes of DL Variances

- **Price (Rate) Variances:**
  - Labor substitution
  - Out-of-date standards (e.g., new labor contract)
- **Quantity (Efficiency) Variances:**
  - Poorly trained workers
  - Poor quality raw materials used in production
  - Poorly maintained equipment
  - Poor supervision of workers
  - Out-of-date standards

Standard Costs

Standard Costs vs. a *Standard Cost System?*

- Standard Costs = costs that should be incurred under efficient operating conditions

- Standard Cost System = standard costs recorded in the formal accounting records

- Regardless of whether a standard cost system is used, standard costs can be useful at the end of the period for *financial control purposes* (i.e., conducting variance analysis)

Standard Costs (Continued)

- Types of Standards:
  - Ideal (Perfection) Standards
  - Continuous-Improvement Standards
  - Currently Attainable Standards
- Standard-Setting Procedures:
  - Authoritative Standards
  - Participative Standards
- Standard Cost Sheet:
  - Contains both price and quantity components of each cost

Recording Standard Costs: Hanson, Inc. Example

Recording DM Purchases:

Materials Inventory (AQ × SP)	$6,800	
Materials Purchase Price Variance	$ 170	
Accounts Payable (AQ × AP)		$6,630

Recording DM Usage:

Work-in-process Inventory (SQ × SP)	$6,000	
Materials Usage Variance	$ 800	
Materials Inventory (AQ × SP)		$6,800

The Strategic Role of Nonfinancial Performance Indicators

- Limitations of short-term financial-performance indicators?

- Need to focus on business processes, including:
  - operating processes
  - customer-management processes
  - innovation processes
  - social/regulatory processes

The Strategic Role of Nonfinancial Performance Indicators (continued)

- Example: Operating Process—Assessing the Move to JIT
- *Costs* of Implementing JIT?
- *Benefits* of Implementing JIT:
  - reduction in out-of-pocket inventory carrying costs
  - reduction in inventory holding (i.e., opportunity) costs
  - increases in sales, productivity, and market share
  - decreased production costs
- Relevant *nonfinancial performance indicators*:
  - customer-response time (CRT)
  - process cycle efficiency

Manufacturing (Factory) Overhead Costs: Examples

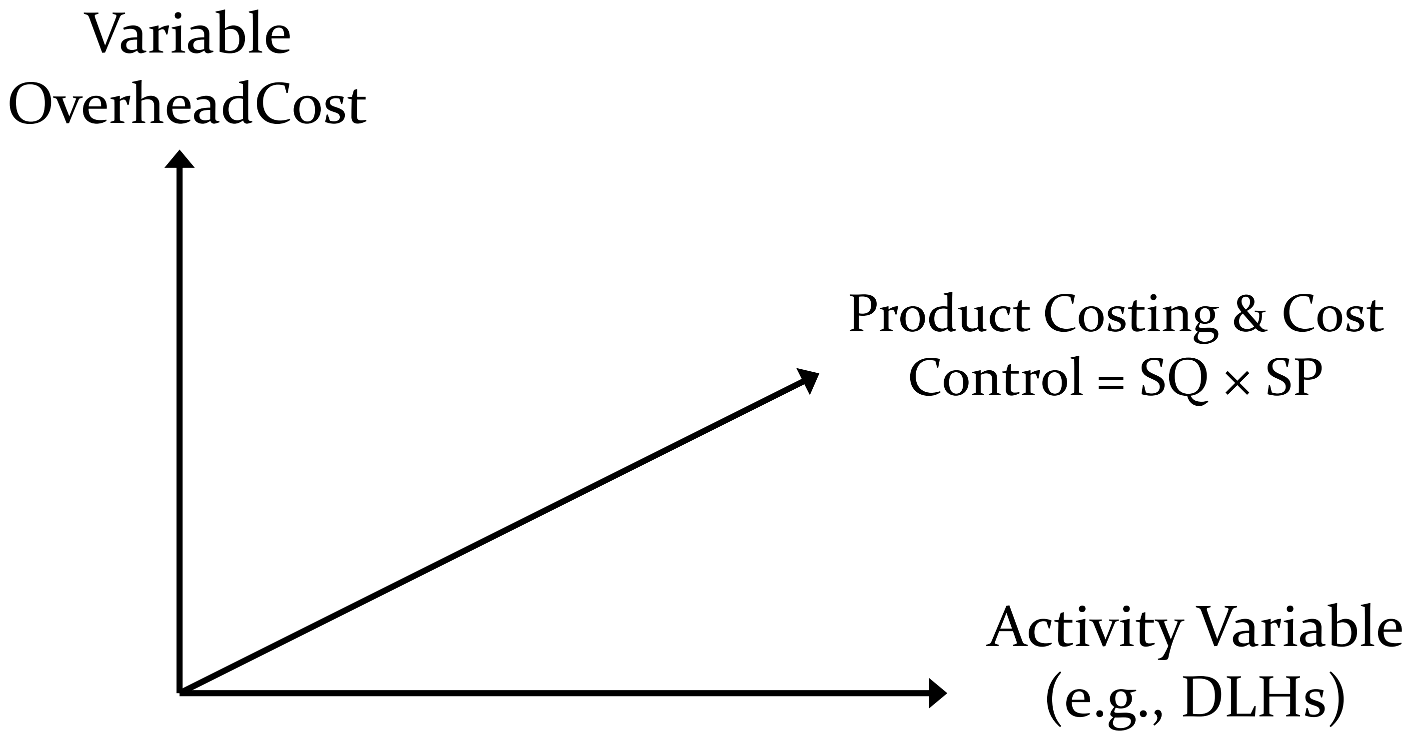
Variable Overhead

- Energy costs
- Indirect materials
- Indirect labor
- Equipment repair and maintenance

Fixed Overhead

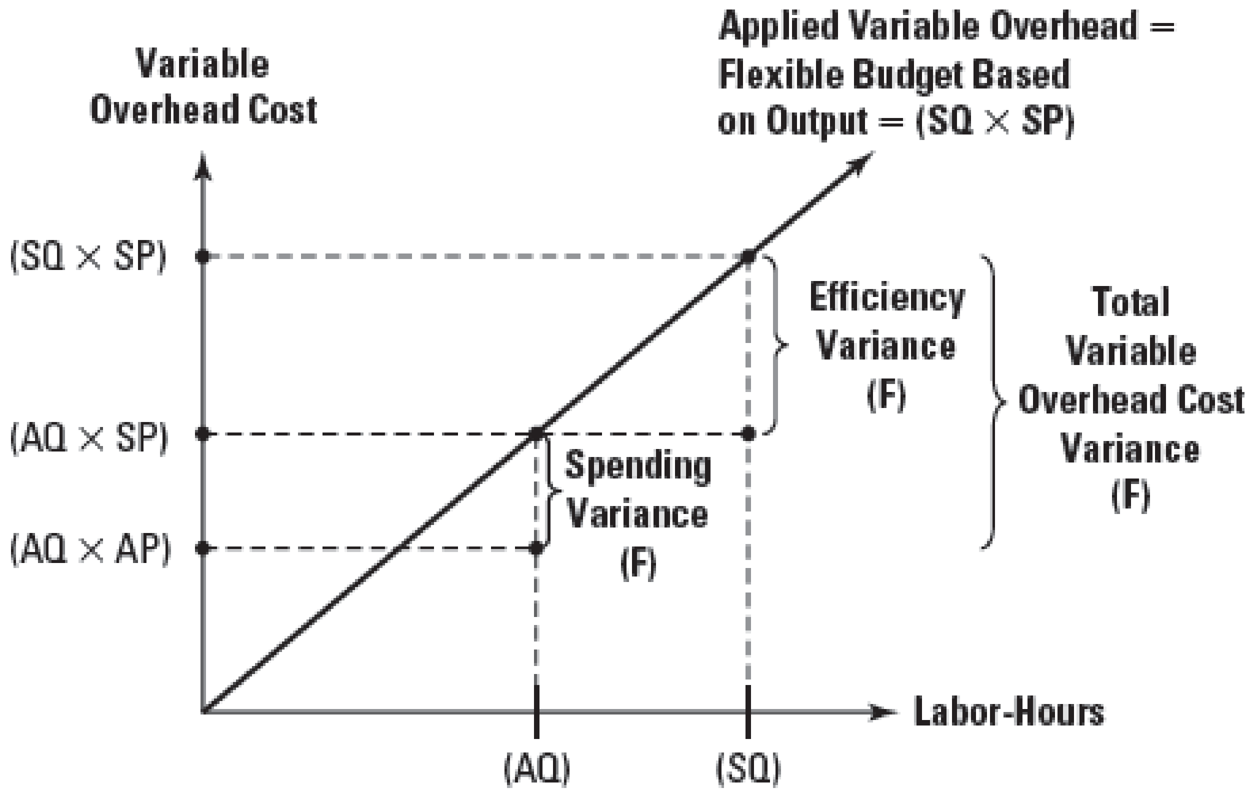
- Factory managers' salaries
- Plant and equipment depreciation
- Plant security guards
- Insurance and property taxes for factory building and equipment

Standard Variable Overhead Costs: Product Costing vs. Control



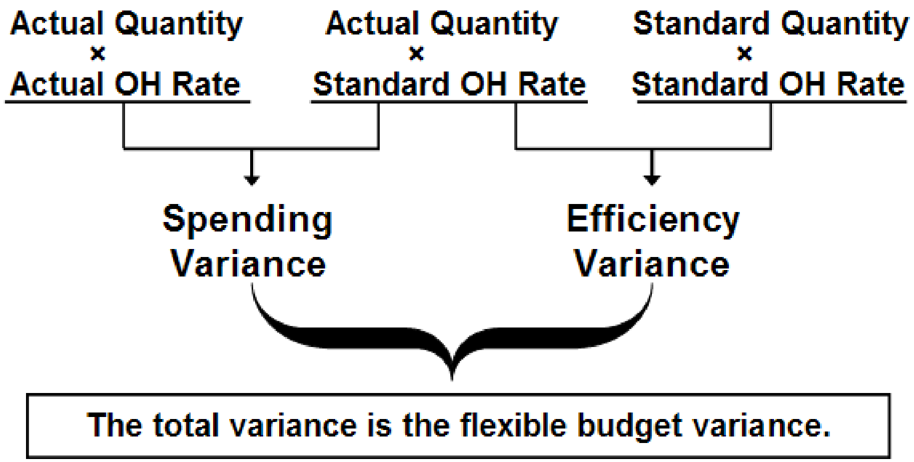
SQ = Standard allowed DLHs for units produced; SP = Standard *variable* overhead cost/DLH

Variable Overhead Variance Analysis



Legend: SQ = Standard direct labor-hours allowed for units produced = 5 hours/unit × 780 units = 3,900 hours
SP = Standard variable overhead cost per labor-hour = $12 (see Exhibit 15.2)
AQ = Actual labor-hours worked = 3,510 hours (Exhibit 14.6)
AP = Actual variable overhead cost per labor-hour worked = $40,630 ÷ 3,510 = $11.5755 (rounded)
Total variable overhead variance = Spending variance + Efficiency variance
F = A favorable effect on operating income

Variable Overhead Variance Analysis: Equation Approach



Variable Overhead Variance Analysis: Equation Approach (continued)

Actual Quantity × Actual OH Rate	Actual Quantity × Standard OH Rate	Standard Quantity × Standard OH Rate

Spending Variance

Efficiency Variance

Spending Variance	Efficiency Variance
AQ x (AR - SR)	SR x (AQ - SQ)
AQ = Actual Quantity	SR = Standard Rate
AR = Actual Rate	SQ = Standard Quantity

Variable Overhead Variance Analysis: Example Calculations

Schmidt Machinery Co. applies variable factory overhead on the basis of DLHs. Hanson has the following variable factory overhead standard to manufacture one unit of product:

5.0 standard DLHs per unit @ a standard variable overhead rate of $12.00 per DLH

In October 2010, 3,510 hours were worked to make 780 units, and $40,630 was spent for variable factory overhead

Variable Overhead Variance Analysis: Example Calculations (continued)

Actual Hours x Actual Rate	Actual Hours x Standard Rate	Standard Hours x Standard Rate
3,510 DLHs	3,510 DLHs	3,900 DLHs
x	x	x
$11.5755/DLH	$12.00/DLH	$12.00/DLH
$40,630	**$42,120**	**$46,800**

Spending Variance
$1,490 F

Efficiency Variance
$4,680 F

Variable Overhead Variance Analysis: Alternative Presentation Format

Total Variable Overhead Variance = Actual Variable Overhead – Flexible Budget for Variable Overhead

= \$40,630 – \$46,800 = **\$6,170 F**

Variable Overhead *Spending* Variance = AQ × (AP – SP)

= 3,510 DLHs × (\$11.5755 – \$12.00)/DLH = **\$1,490 F**

Variable Overhead *Efficiency* Variance = SP x (AQ – SQ)

= \$12.00/DLH x (3,510 – 3,900) DLHs = **\$4,680 F**

Interpretation of Variable Overhead Cost Variances

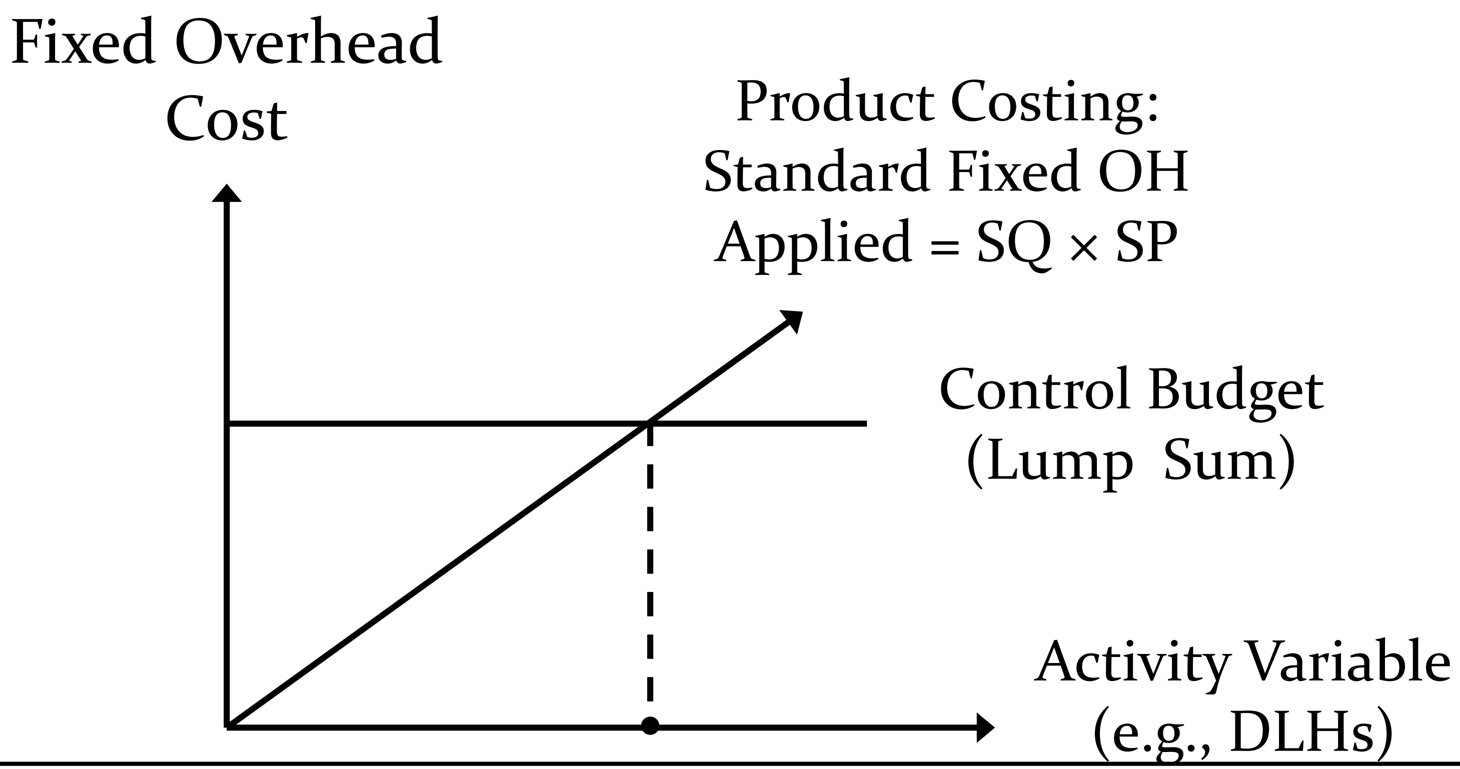
Spending Variance

Results from spending more or less than expected for overhead items such as supplies and utilities.

Efficiency Variance

Reflects efficiency or inefficiency in the use of the selected activity measure; does *not* reflect overhead control.

Standard Fixed Overhead Cost: Planning vs. Control



SQ = Standard allowed DLHs for units produced; SP = Standard *fixed* overhead cost/DLH; denominator volume = no. of DLHs used to set the fixed overhead application rate.

Product Costing: Determining the Standard Fixed Overhead Application Rate

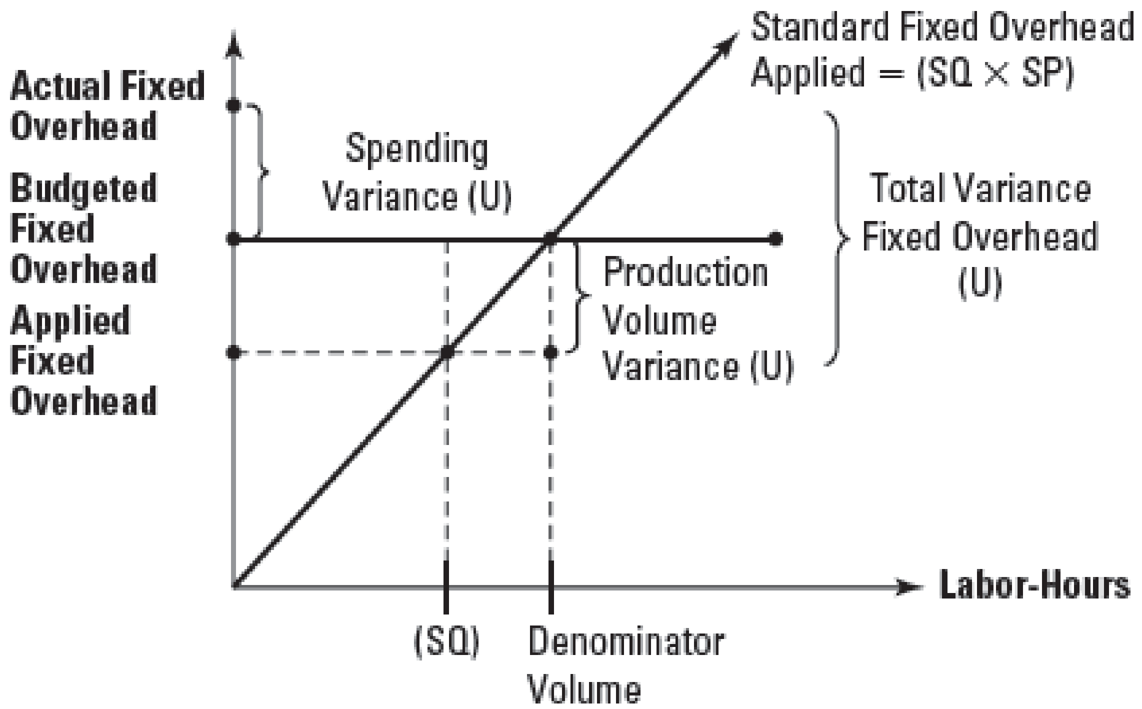
❶ Determine the total budgeted fixed manufacturing overhead for the upcoming period

❷ Select an activity variable for applying fixed factory overhead costs to outputs

❸ Choose a denominator volume level for the selected activity variable(e.g., "practical capacity")

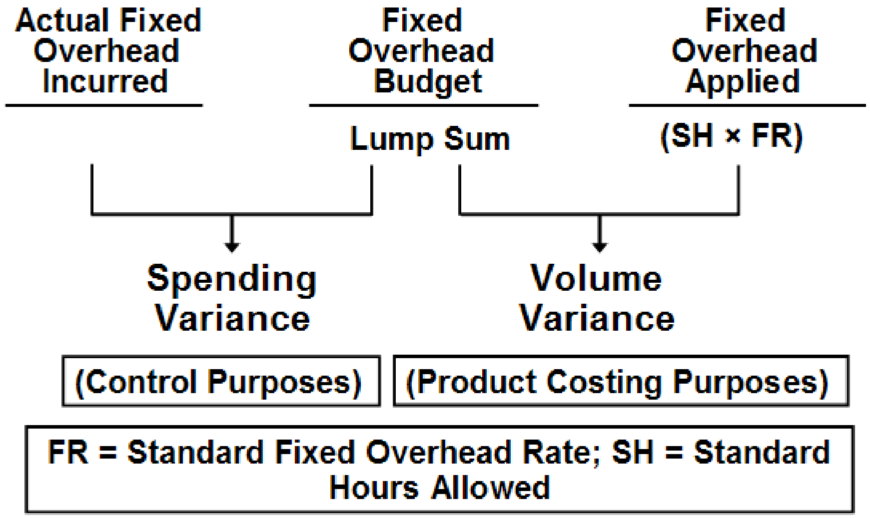
❹ Divide the amount in Step 1 by the amount in Step 3 to determine the standard fixed overhead application rate for product-costing purposes

Fixed Overhead Variance Analysis



Legend: SQ = Standard labor-hours allowed for units produced = 5 × 780 = 3,900 hours
Denominator volume = Number of labor-hours used to determine the fixed overhead application rate = 5,000 (i.e., 1,000 units × 5 hours/unit)
Budgeted fixed overhead = $120,000 (assumed)
SP = Standard fixed overhead cost per labor-hour = $120,000 ÷ 5,000 = $24 (see Exhibit 15.2)
Actual fixed overhead = $130,650 (assumed)
Total fixed overhead variance = Spending variance + Production volume variance

Calculating Fixed Overhead Variances



Example: Calculating Fixed Overhead Variances

Schmidt's budgeted fixed manufacturing overhead cost is $120,000 for October 2010. The budgeted activity measure for the month is 1,000 units (@ 5 DLHs/unit).

Actual production is 780 units and actual fixed overhead is $130,650 for the month.

Compute the fixed overhead *spending* and *production volume* variances.

$$FR = \frac{\$120{,}000 \text{ budgeted fixed overhead}}{5{,}000 \text{ DLHs}} = \$24.00/\text{DLH}$$

Example: Calculating Fixed Overhead Variances (continued)

Actual Fixed Overhead Incurred	Budgeted Fixed Overhead	Fixed Overhead Applied (780 units x 5 DLHs/unit x $24.00/DLH)
$130,650	**$120,000**	**$93,600**

Spending Variance **$10,650 U**

Production Volume Variance **$26,400 U**

Fixed Overhead Variance Analysis: Alternative Presentation Format

Total Fixed Overhead Variance = Actual Fixed Overhead – Fixed Overhead Applied to Production

= \$130,650 – \$93,600 = **\$26,400** U (also called *Under*applied fixed overhead)

Fixed Overhead Spending (Budget) Variance

= Actual Fixed Overhead – Budgeted Fixed Overhead

= \$130,650 – \$120,000 = **\$10,650** U

Fixed Overhead Production Volume Variance

= Budgeted Fixed Overhead – Applied Fixed Overhead

= \$120,000 - \$93,600 = **\$26,400** U

Fixed Overhead Production Volume Variance: Alternative Calculation

Fixed Overhead Production Volume Variance
= Standard Fixed Overhead Application Rate × (Actual Units Produced – Denominator Volume, in units)

= $120.00/unit × (780 – 1,000) units

= **$26,400 U** (i.e., *under*applied fixed overhead)

Interpretation of Fixed Overhead Variances

Spending (Budget) Variance	**Production Volume Variance**
Results from spending more or less than expected for individual fixed overhead items. That is, spending on individual fixed overhead items was different than planned..	Results from operating at a level other than the denominator volume level. Arises because of the *product-costing* purpose of fixed overhead. Not of direct interest for control purposes.

Causes of Fixed Overhead Variances

Spending (Budget) Variance:

- Ineffective budget procedures
- Inadequate control of costs
- Misclassification of cost items

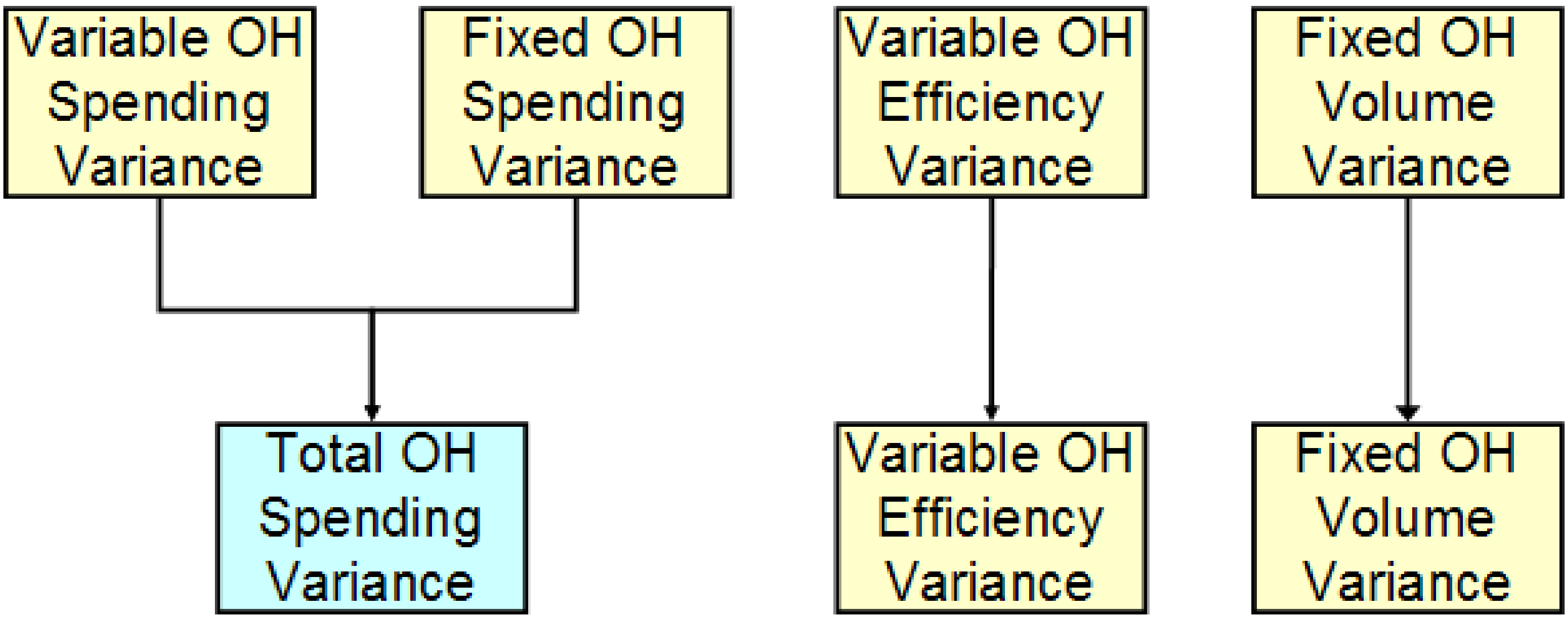
Production Volume Variance:

- Management decisions
- Unexpected changes in market demand
- Unforeseen problems in manufacturing operations

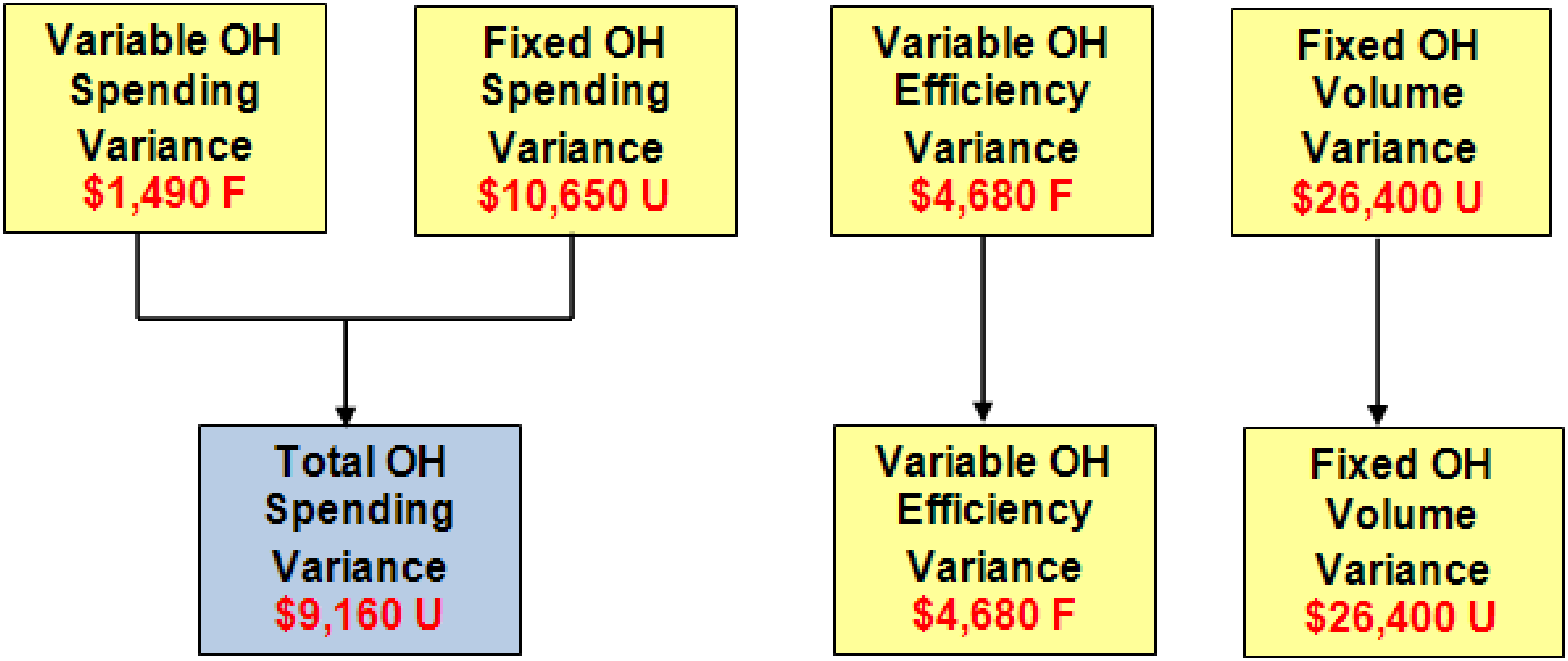
Four-Way Breakdown of the Total Overhead Variance: Summary

	(A)	(B)	(C)	(D)
	Cost Incurred	**Flexible Budget Based on *Inputs***	**Flexible Budget Based on *Output***	**Standard Overhead Cost Applied**
Variable Overhead	Amount spent	Actual quantity of the activity for applying variable overhead × Standard variable overhead rate	Total standard quantity of the activity for applying variable overhead to the output of the period × Standard variable overhead rate	
	Variable overhead spending variance (A–B)		Variable overhead efficiency variance (B–C)	
Fixed Overhead	Amount spent		Budgeted (lump-sum) amount	Total standard quantity of the activity for applying overhead to the output of the period × Standard fixed overhead rate
	Fixed overhead budget (spending) variance (A–C)		Production volume (denominator) variance (C–D)	

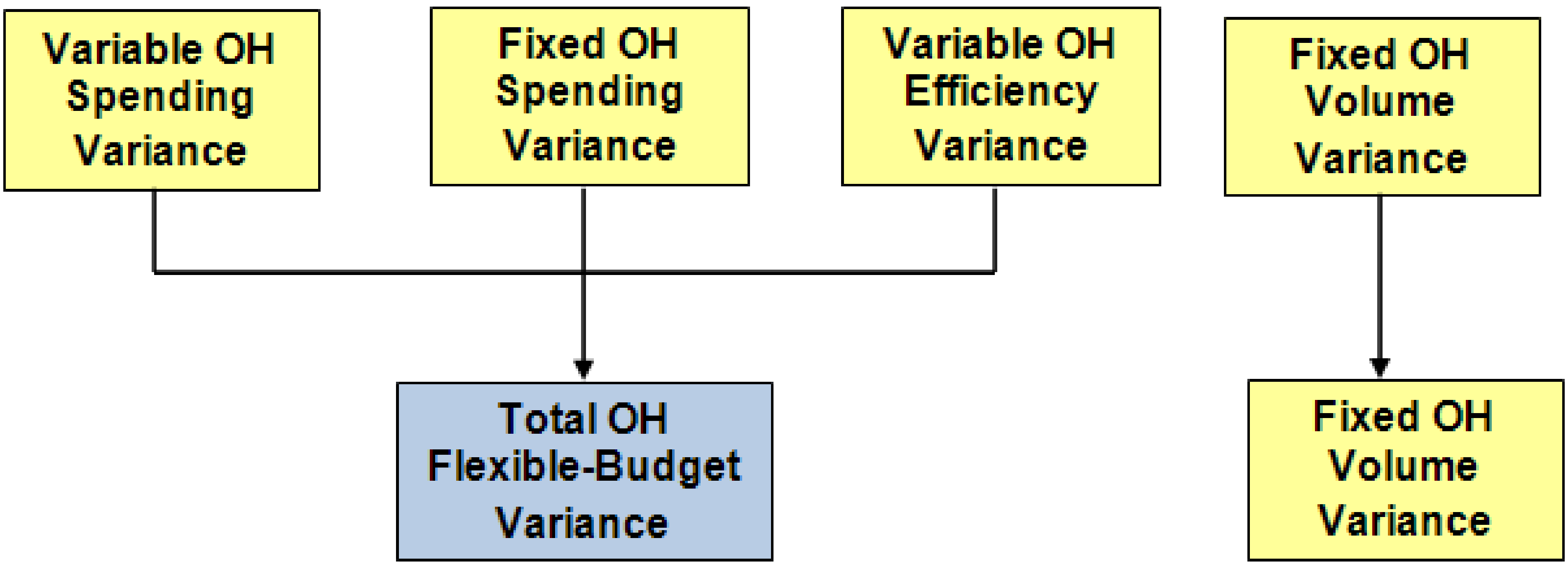
Alternative Analysis: Three-Way Breakdown of the Total Overhead Variance



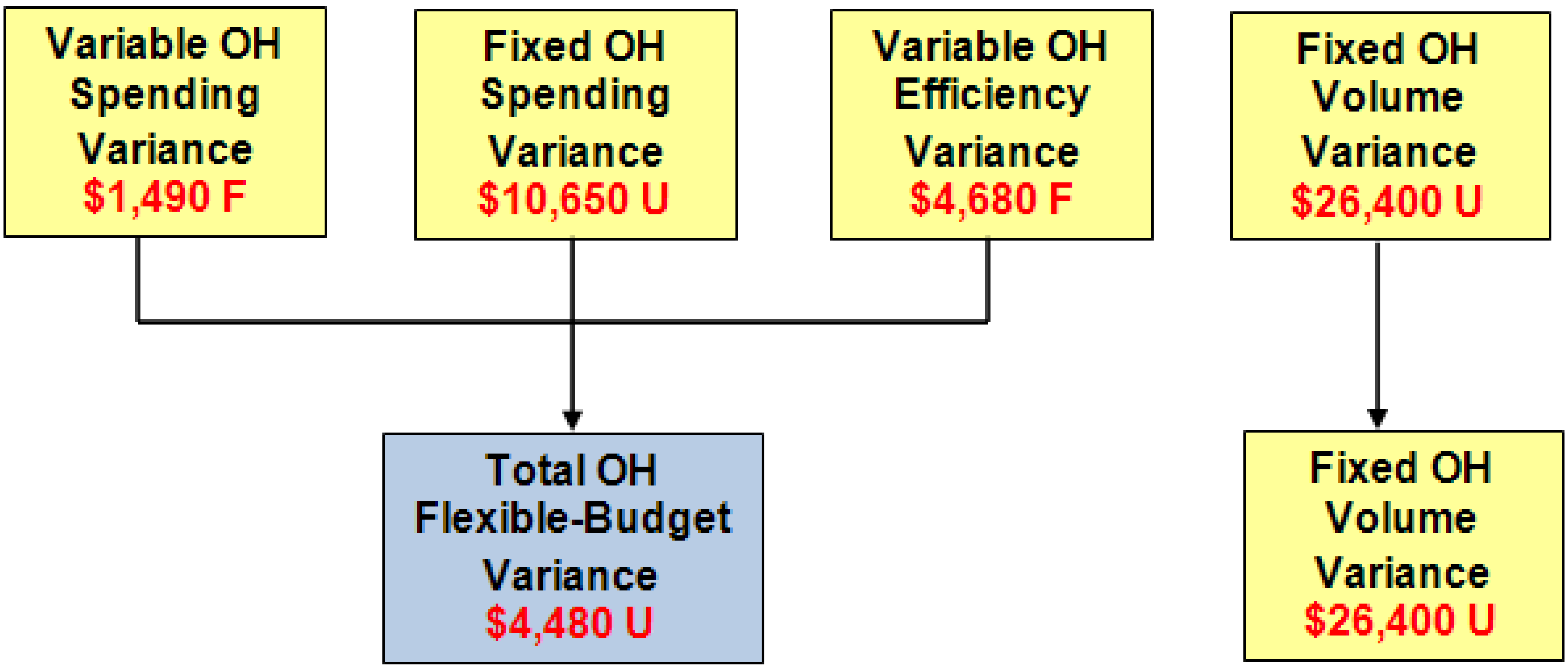
Schmidt Company: Three-Way vs. Four-Way Analysis of Total Factory Overhead Variance



Two-Way Analysis of Total Factory Overhead Variance



Schmidt Company: Two-Way Analysis of Total Factory Overhead Variance



Disposition of Standard Manufacturing Cost Variances

Schmidt Company
Manufacturing Cost Variances

DM purchase price variance	$ 4,350 U
DM usage variance	10,350 U
DL rate variance	7,020 U
DL efficiency variance	15,600 F
Variable factory overhead spending variance	1,490 F
Variable factory overhead efficiency variance	4,680 F
Fixed overhead spending variance	10,650 U
Fixed overhead production volume variance	26,400 U
Net manufacturing cost variance	$ 37,000 U

Alternative 1: Close Net Manufacturing Cost Variance to CGS

Dr. CGS (net variance)	**$37,000**	
Dr. DL Efficiency Variance	15,600	
Dr. VOH Efficiency Variance	4,680	
Dr. VOH Spending Variance	1,490	
Cr. DM Purchase Price Variance		$4,350
Cr. DM Quantity (Efficiency) Variance		10,350
Cr. DL rate variance		7,020
Cr. FOH spending variance		10,650
Cr. FOH Production Volume Variance		26,400

Income Statement after Disposition of Net Manufacturing Cost Variance

SCHMIDT MACHINERY COMPANY
Income Statement
For 2013

Sales (Exhibit 14.4), at standard selling price	$624,000	
Add: Selling price variance (Exhibit 14.4)	15,600F	
Net sales, at actual selling price		$639,600
Cost of goods sold (at standard: 780 units × $520/unit) (Exhibit 15.2)	$405,600	
Add: Net manufacturing cost variance	+37,000U†	
Total cost of goods sold		442,600
Gross margin		$197,000
Selling and administrative expenses ($39,000 variable + $30,000 fixed)		69,000
Operating income (before disposition of sales volume variance)		$128,000

Alternative 2: Prorate (Allocate) Net Manufacturing Cost Variance

- If the net variance is considered *material*, then the variance should be allocated (prorated) to the Inventory and CGS accounts
- Allocation should be based on the relative amount of this period's standard cost in the end-of-period balance of each affected account
- For external-reporting purposes, the provisions of FAS #151 regarding the treatment of "abnormal amounts" of idle-capacity expense must be followed

Effects on Absorption Costing Income of Denominator-Level Choice for Allocating Fixed Overhead Costs

- The issue: management's ability to *manage (or "smooth") reporting earnings*
- This ability is related to alternative treatments (dispositions) of the production volume variance
- The amount of fixed overhead cost absorbed into inventory or released as an expense on the income statement is affected by the denominator chosen for the fixed overhead application rate
- Income manipulation can occur if the production-volume variance is written off entirely to CGS

Standard Costs Applied to Service Organizations

- Jobs with repetitive tasks lend themselves to efficiency measures
- Computing non-manufacturing efficiency variances requires some assumed relationship between input and output activity

Examples

Service Applications (continued)

Department	Input	Output
Mailing	Labor hours	Number of pieces mailed
Personnel	Labor hours	Number of personnel changes processed
Food service	Labor hours	Number of meals served
Consulting	Billable hours	Customer revenues
Nursing	Labor hours	Number of patients and/or procedures
Check Processing	Computer hours	Number of checks processed

Traditional Approach to Product Costing:

Cost Item	Variable	Per	Fixed
Direct materials	$20	Unit	
Direct labor	30	DLH	
Indirect materials	2	DLH	
Repair and Maintenance	5	DLH	
Receiving			$5,000
Engineering Support			30,000
Setup			75,000

Traditional Financial-Performance Report

Cost Item	Actual Cost	Flexible Budget Based on Output	Flexible Budget Variance	
Direct materials	$50,000	$40,000	$10,000	U
Direct labor	36,000	30,000	6,000	U
Indirect materials	3,000	2,000	1,000	U
Repair and Maintenance	6,500	5,000	1,500	U
Receiving	3,000	5,000	2,000	F
Engineering Support	30,000	30,000	30,000	
Setup	50,000	75,000	25,000	F
Total	$178,500	$187,000	$8,500	F

Flexible Budget Using ABC

Cost Item	Flexible Budget	
Direct materials	$40,000	(2,000 × $20)
Direct labor	30,000	(2,000 × 0.5 × $30)
Indirect materials	2,000	(1,000 × $2)
Repair and Maintenance	6,000	(300,000 × $0.01) + $3,000
Receiving	3,500	(2 × $1,500) + $500
Engineering Support	30,000	($30,000 per period)
Setup	50,000	(2 × $25,000)
Total	$161,500	

Financial-Performance Report Using ABC

Cost Item	Actual Cost	Flexible Budget	Variance
Direct materials	$50,000	$40,000	$10,000 U
Direct labor	36,000	30,000	6,000 U
Indirect materials	3,000	2,000	1,000 U
Repair and Maintenance	6,500	6,000	500 U
Receiving	3,000	3,500	500 F
Engineering Support	30,000	30,000	
Setup	50,000	50,000	
Total	$178,500	$161,500	$17,000 U

Flexible-Budget Analysis under ABC When There is a Standard Batch Size for Production Activity

- this situation provides the opportunity for a more detailed analysis

- variable setup costs under ABC:
  - convert actual output to standard # of batches
  - convert the above to standard setup hours

Flexible-Budget Analysis under ABC When There is a Standard Batch Size for Production Activity (continued)

- flexible budget cost for variable overhead = standard allowed hours × standard variable overhead cost per setup hour
- calculate flexible-budget variance for variable setup cost
- decompose flexible-budget variance into *spending* and *efficiency* components

The Variance-Investigation Decision

How do I know which variances to investigate?

Larger variances, in dollar amount or as a percentage of the standard, are investigated first.

The Variance Investigation Decision (continued)

Uncontrollable (random) variances:

- Random Error

Controllable (systematic) variances:

- Prediction error
- Modeling error
- Measurement error
- Implementation error

Role of Control Charts to Help Distinguish Random vs. Systematic Cost Variances

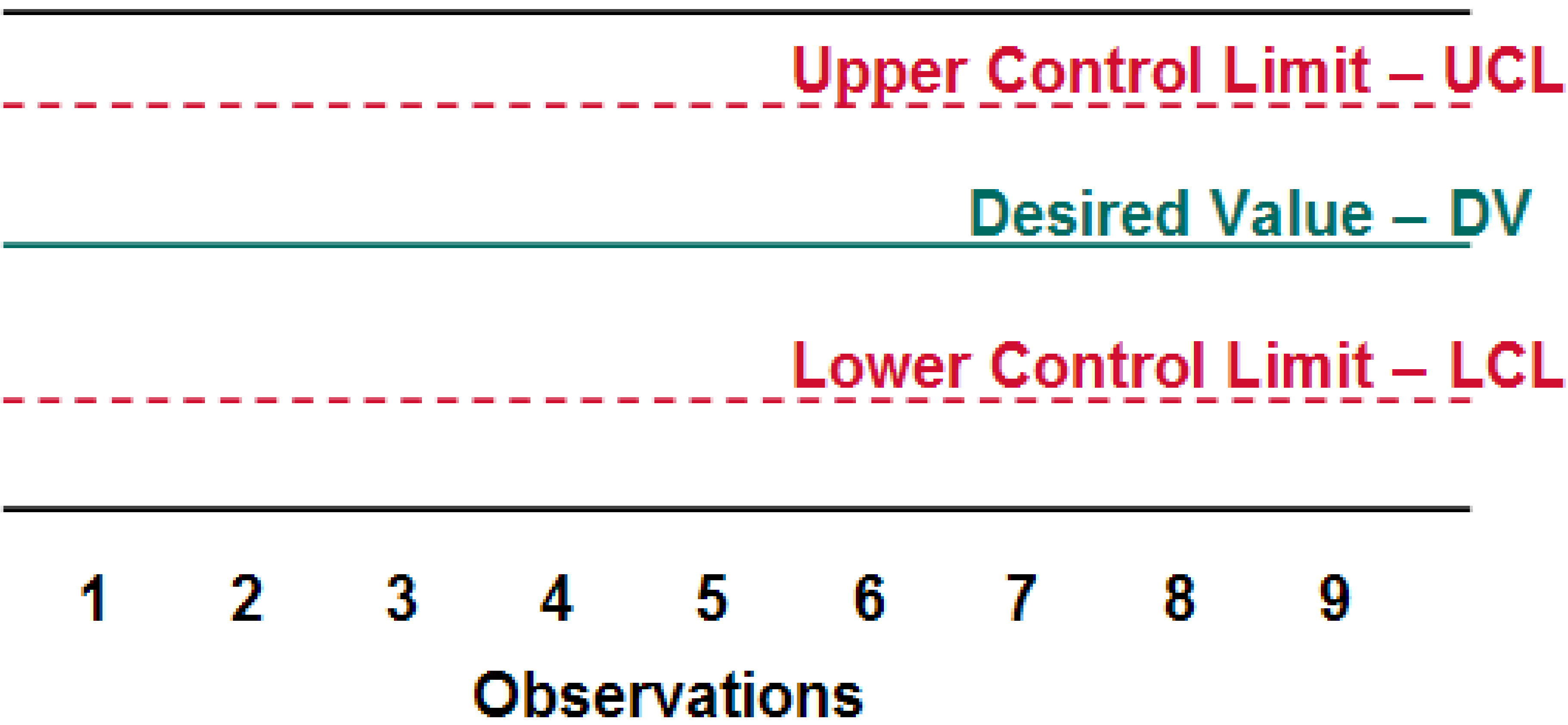
Control Charts

Display variations in a process and help to analyze the variations over time

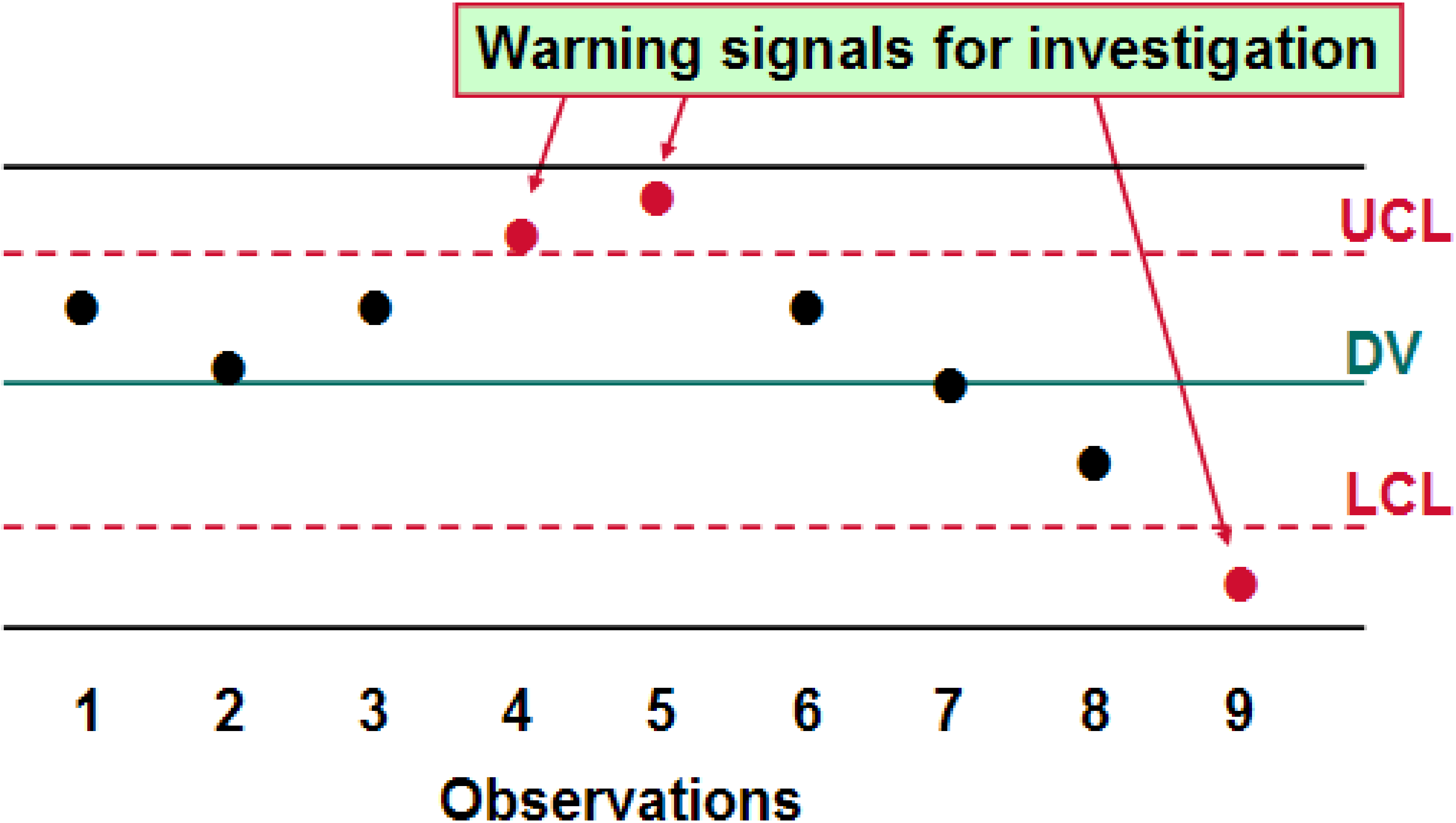
Distinguish between random variations and variations that should be investigated

Provide a warning signal when variations are beyond a specified level

Control Charts (continued)



Control Charts (continued)



Appendix: Variance Investigation Decisions Under Uncertainty

Action	States of Nature: Random	States of Nature: Nonrandom
Investigate	I	$I + C$
Do not investigate	none	L

Where: I = cost of an investigation

C = the cost to correct a variance

L = present value of losses by not correcting the variance

Appendix: Variance Investigation Decisions—Indifference Probability

$$E(\text{Investigate}) = [(\text{I} + (1 - p))] + [(\text{I} + \text{C}) \times p]$$

$$E(\text{Do not investigate}) = \text{L} \times p$$

Set the above two equations equal, solve for p, the indifference probability:

$$p = \text{I} \div (\text{L} - \text{C})$$

Appendix: Variance Investigation Decisions—Expected Value of Perfect Information

EVPI = Expected cost with perfect information –
Expected cost without perfect information

EVPI = Expected cost with perfect information –
Expected value of cost-minimizing choice under uncertainty

EVPI = Maximum amount a rational manager would pay for perfect information

Further Analysis of Sales & Productivity

- The flexible budget can play a strategic role in analyzing sales and productivity

- The strategic role of *sales analysis* is to understand the reasons behind an increase (or decrease) in total sales dollars over the budgeted amount or an increase (or decrease) over the prior year

- The *selling price variance* and the *sales volume variance* help managers see how changes in prices and volume affect total sales, contribution, and profit

Further Analysis of Sales & Productivity (continued)

- **The strategic role of *productivity*** *analysis* is to assist management in identifying the drivers of productivity and to implement methods that improve productivity and profitability

- **The key determinants of productivity for most organizations are:**
  - Control of waste
  - Control of labor costs
  - Product and manufacturing process innovation
  - Fluctuations in demand due to changes in business cycle (or other reasons)

Productivity Analysis

- ***Productivity* is the ratio of output to input**
  - For example, a firm that uses five days to manufacture 100 units has a *productivity* of 20 (100 units/5 days) units per day
- **A measure of productivity can either be operational or financial**
  - *Operational productivity* is the ratio of output units to input units (both numerator and denominator are physical measures)
  - *Financial productivity* is also a ratio of output to input, except that either the numerator or denominator is a dollar amount

Partial vs. Total Productivity

A productivity measure may include all production factors or focus on a single factor or part of the production factors that the firm uses in manufacturing

– *Partial productivity* measures focus on the relationship between one input factor and the output attained

  - Examples include direct materials (DM) productivity, workforce productivity, and process productivity

– *Total productivity* measures include all input resources used in production

Partial Productivity

Partial productivity measures are important because changes in the productivity of different resources do not always occur in the same direction or at an equal rate

We use Erie Precision Tool Company as an example

Erie Precision Tool Company manufactures drill bits, and its operating information for 2012 and 2013 is provided (see next slide)

Partial Productivity (continued)

ERIE PRECISION TOOL COMPANY
Operating Data

	2013	2012
Units manufactured and sold	4,800	4,000
Total sales ($500 price per unit)	$2,400,000	$2,000,000
Direct materials (25,000 pounds at $24/pound in 2012 and 32,000 pounds at $25/pound in 2013)	800,000	600,000
Direct labor (4,000 hours at $40 per hour in 2012 and 4,000 hours at $50/hour in 2013)	200,000	160,000
Fixed factory overhead and fixed operating expenses	300,000	300,000
Operating income	$1,100,000	$ 940,000

Sales increased by 20%, but income increased by only 17%. Did productivity decline?

Partial Productivity (continued)

ERIE PRECISION TOOL COMPANY
Partial Productivity—Direct Materials and Direct Labor

	Partial Operational Productivity	
	2013	**2012**
Direct materials	4,800/32,000 = 0.15	4,000/25,000 = 0.16
Direct labor	4,800/4,000 = 1.20	4,000/4,000 = 1.00

	Partial Financial Productivity	
	2013	**2012**
Direct materials	4,800/$800,000 = 0.006	4,000/$600,000 = 0.0067
Direct labor	4,800/$200,000 = 0.024	4,000/$160,000 = 0.025

Direct material productivity declined while operational direct labor productivity improved and financial direct labor profitability declined.

Partial Productivity (continued)

ERIE PRECISION TOOL COMPANY

Effects of Changes in Operational Partial Productivity of Direct Materials and Direct Labor

Input Resource	(1) 2013 Output	(2) 2012 Partial Operational Productivity	(3) = (1) ÷ (2) 2013 Output at 2012 Productivity	(4) Input Used in 2013	(5) = (3) − (4) Savings (Loss) in Units of Input
Direct materials	4,800	0.16	30,000	32,000	(2,000)
Direct labor	4,800	1.00	4,800	4,000	800

The above shows the effects of changes in operational productivity in 2010 on the amount of materials and labor used in 2010 relative to productivity in 2009

Partial Productivity: Summary Analysis

- The partial operational productivity measure for direct materials decreased while the partial operational productivity measure for direct labor increased

- Partial financial productivity measures for both direct materials and direct labor decreased

- The discrepancy between the direct labor measures suggests that although employee productivity/hr. increased, the cost increase due to higher hourly wages more than offset the gain in productivity/hr.

Flexible Budget Partitioning
Partial Financial Productivity

	A	B	C	D
Output	**2013**	**2013**	**2013**	**2012**
Productivity	**2013**	**2012**	**2012**	**2012**
Input Cost	**2013**	**2013**	**2012**	**2012**

Productivity Change (A–B) | **Input Price Change** (B–C) | **Output Change** (C–D)

Flexible Budget Partitioning of Partial Financial Productivity (continued)

Calculations for the Erie Precision Tool Company:

	Actual 2013 Operating Results	2013 Output at *2012 Productivity* and 2013 Input Cost	2013 Output at 2012 Productivity and *2012 Input Cost*	Actual 2012 Operating Results
Output units	4,800	4,800	4,800	4,000
Input units and costs				
Direct materials	32,000 × $25 = $ 800,000	30,000 × $25 = $750,000	30,000 × $24 = $720,000	25,000 × $24 = $600,000
Direct labor	4,000 × $50 = 200,000	4,800 × $50 = 240,000	4,800 × $40 = 192,000	4,000 × $40 = 160,000
Total	$1,000,000	$990,000	$912,000	$760,000

Partition Financial Partial Productivity into Productivity & Input Price Changes

	Actual 2013 Operating Results	2013 Output at 2012 Productivity and 2013 Input Cost	2013 Output at 2012 Productivity and 2012 Input Cost	Actual 2012 Operating Results
Output units:	4,800	4,800	4,800	4,000
Input units/costs:				
DM	$800,000	$750,000	$720,000	$600,000
DL	200,000	240,000	192,000	160,000
Total	$1,000,000	$990,000	$912,000	$760,000
DM (units/$)	0.006	0.0064	0.006667	0.006667
DL (units/$)	0.024	0.0200	0.025000	0.025000

Productivity Change | Input Price Change | Output Change

Operational vs. Financial Productivity Measures

- **Operational productivity measures**
  - Use physical measures, which are easier for operational personnel to understand
  - The measures are unaffected by price changes and other factors, which makes them easier to benchmark
- **Financial productivity measures**
  - Considers the effect of cost (major concern for management) and quantity of an input resource on productivity
  - Can be used in operations that use more than one production factor

Limitations of Partial Productivity

- Measures only the relationship between an input resource and the output; ignores any effect that changes in manufacturing factors have on productivity

- Ignores any effect that changes in other production factors have on productivity, such as an increase in material quality

- Fails to include effects that changes in the firm's operating characteristics have on the productivity of the input resources, such as installation of high-efficiency equipment

- An improved partial productivity does not necessarily mean the firm or division operates efficiently

Total Productivity

- **Total productivity** is a financial measure that compares output to the total cost of all input resources used to produce the output

- **Computation of total productivity involves three steps:**

  – Determine the output of each period
  – Calculate the total variable costs incurred to produce the output
  – Compute total productivity by dividing the amount of output by the total cost of variable input resources

Total Productivity (continued)

Once again using Erie Precision Tool Company: total productivity in units and dollars.

ERIE PRECISION TOOL COMPANY
Total Productivity

Panel 1: Total Productivity in Units	2013	2012
(a) Total units manufactured	4,800	4,000
(b) Total variable manufacturing costs incurred	$1,000,000	$ 760,000
(c) Total productivity: (a) / (b)	0.004800	0.005263
(d) Decrease in productivity: 0.005263 − 0.004800 = 0.000463, or 8.8% (0.000463 ÷ 0.005263)		
Panel 2: Total Productivity in Sales Dollars		
(a) Total sales	$2,400,000	$2,000,000
(b) Total variable manufacturing costs incurred	$1,000,000	$ 760,000
(c) Total productivity: (a) / (b)	$ 2.4000	$ 2.6316
(d) Decrease in productivity: $2.6316 − $2.4000 = $0.2316, or 8.8% ($0.2316 ÷ $2.6316)		

Benefits and Limitations of Total Productivity

- *Total productivity* measures the combined productivity of all operating factors, which decreases the possibility of managers manipulating some manufacturing factors to improve productivity measures for others

- Personnel at the operational level may have difficulty linking the results to day-to-day operations

- Deterioration in total productivity can result from costs of resources that are beyond the manager's control

Benefits and Limitations of Total Productivity (continued)

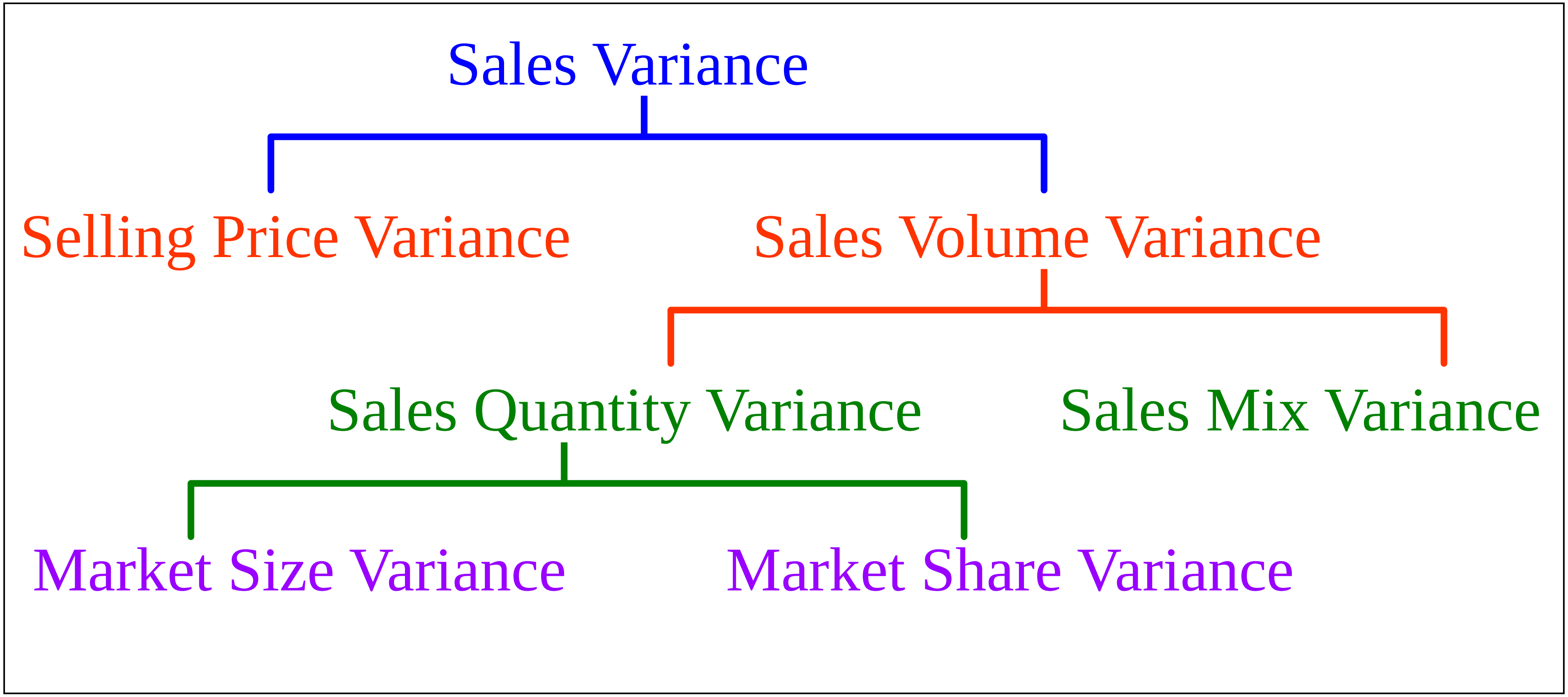
- The basis for assessing changes in productivity could vary over time, so a constant base-year is suggested
- Productivity measures often ignore the effects on productivity of changes in demand for the product, changes in selling prices of the goods or services, and special purchasing or selling arrangements
  – Changes in demand alter the size of operations and productivity measures (but not necessarily productivity itself)
  – Receiving or offering a discount in price can alter total and partial productivity measures without affecting productivity

Analyzing Sales for the Multi-Product Firm

- **The flexible budget helps answer strategic questions about sales performance by way of the *selling price variance* and the *sales volume variance***
  - The selling price variance for each product = actual sales units times the difference between budgeted and actual selling price per unit
  - The total sales volume variance = weighted-average contribution margin/unit (based on budgeted sales mix) times the difference between budgeted and actual sales volume

- **The sales volume variance** for a multi-product firm can be partitioned into a *sales quantity variance* and a *sales-mix variance*

Breakdown of Total Sales Variance



Sales Quantity Variance

The ***sales quantity variance*** measures the effect on contribution and income of deviations in the number of units sold from the total number of units budgeted to be sold. The sales quantity variance for each product is calculated as follows:

$$\text{Sales quantity variance of a product} = \left[\text{Total units of all products sold} - \text{Budgeted total units of all products}\right] \times \text{Budgeted sales mix of the product} \times \text{Budgeted cm/unit of the product}$$

Sales-Mix Variance

First, the *sales mix %* is the relative proportion of a given product's sales (in units) to total sales (in units)

The *sales mix variance* attributable to each product is the effect that a change in sales mix % for the product (budgeted mix % vs. actual mix %) has on the total contribution margin (CM) of the period:

$$\text{Sales mix variance of a product} = \left[\text{Actual sales mix of the product} - \text{Budgeted sales mix of the product}\right] \times \text{Total units sold} \times \text{Budgeted cm/unit of the product}$$

Calculating the Sales Variances

Take as an example the Schmidt Machinery Company - *budgeted information* appears below

Schmidt Machinery Company
Master Budget
For the Month Ended December 31, 2013

	XV-1		FB-33		
	Total	Per Unit	Total	Per Unit	Total
Units	1,000		3,000		4,000
Sales	$ 800,000	$ 800	$ 1,800,000	$ 600	$ 2,600,000
Variable costs	450,000	450	960,000	320	1,410,000
CM	$ 350,000	$ 350	$ 840,000	$ 280	$ 1,190,000
Fixed costs	150,000		450,000		600,000
Operating income	$ 200,000		$ 390,000		$ 590,000

Calculating the Sales Variances (continued)

Schmidt Machinery Company *actual results* for 2010:

Schmidt Machinery Company
Income Statement
For the Month Ended December 31, 2013

	XV-1		FB-33		Both Products
	Total	Per Unit	Total	Per Unit	Total
Units	1,600		3,400		5,000
Sales	$ 1,280,000	$ 800	$ 2,040,000	$ 600	$ 3,320,000
Variable costs	720,000	450	1,088,000	320	1,808,000
CM	$ 560,000	$ 350	$ 952,000	$ 280	$ 1,512,000
Fixed costs	150,000		450,000		600,000
Operating income	$ 410,000		$ 502,000		$ 912,000

Calculating the Sales Variances (continued)

To begin, we calculate the actual and budgeted sales mix %s for 2013:

Product	Actual Units Sold	Actual Sales Mix	Budgeted Sales Mix	Budgeted Sales
XV-1	1,600	32%	25%	1,000
FB-33	3,400	68%	75%	3,000
Total	5,000	100%	100%	4,000

Flexible Budget Framework for Partitioning the Total Sales Volume Variance

	A	B	C
Total units	Actual	Actual	Budget
Sales mix	Actual	Budget	Budget
CM/unit	Budget	Budget	Budget

A → B: Sales Mix Variance

B → C: Sales Quantity Variance

Calculating the Sales Variances: Product XV-1

	A	B	C
Total units	5,000	5,000	4,000
Sales mix	32%	25%	25%
Budgeted cm/unit	$ 350	$ 350	$ 350
Total CM	$ 560,000	$ 437,500	$ 350,000

$ 122,500 F

$ 87,500 F

Sales Mix Variance

Sales Quantity Variance

Sales Volume Variance

$ 122,500 + $ 87,500 = $ 210,000 F

Calculating the Sales Variances: Product FB-33

	A	B	C
Total units	5,000	5,000	4,000
Sales mix	68%	75%	75%
Budgeted cm/unit	$ 280	$ 280	$ 280
Total CM	$ 952,000	$ 1,050,000	$ 840,000

$98,000 U — Sales Mix Variance

$210,000 F — Sales Quantity Variance

Sales Volume Variance = $98,000 U + $210,000 F = $112,000 F

Calculating the Sales Variances: Summary Results

Product	Sales Mix Variance			Sales Quantity Variance			Sales Volume Variance	
XV-1	$122,500	F	+	$ 87,500	F	=	$ 210,000	F
FB-33	98,000	U	+	210,000	F	=	112,000	F
Total	$ 24,500	F	+	$ 297,500	F	=	$ 322,000	F

Sales Volume Variance: Summary Comments

There are several things a manager would learn from this analysis:

– The change in sales mix in favor of XV-1 has a net positive effect on CM and profit because XV-1 has a higher budgeted cm/unit than FB-33

– The favorable quantity variance reflects the fact that total unit sales were greater than the total units reflected in the master (static) budget for the period

Market Size Variance

The *market size variance* measures the effect of changes in the market size of the firm's product on the operating results of the firm, including total contribution margin:

$$\text{Market size variance} = \left[\begin{array}{c}\text{Actual market size}\\ \text{(in units)}\end{array} - \begin{array}{c}\text{Budgeted market size}\\ \text{(in units)}\end{array}\right] \times \begin{array}{c}\text{Budgeted}\\ \text{market share}\end{array} \times \begin{array}{c}\text{Wtd. Avg.}\\ \text{budgeted cm/unit}\end{array}$$

The weighted-average budgeted cm/unit is the total BUDGTED CM divided by TOTAL BUDGETED UNITS

Market Share Variance

The ***market share variance*** assesses the effect that changes in the firm's proportion of the total market have on the operating results of the firm, including total contribution margin and operating income:

$$\text{Market share variance} = \left[\text{Actual market share} - \text{Budgeted market share}\right] \times \text{Total actual market size (in units)} \times \text{Wtd.-Avg. budgeted cm/unit}$$

The market size and market share variances for Schmidt Machinery Company, assuming budgeted market size of 40,000 units and a budgeted market share of 10%, appears on the next slide

Calculating the Market Variances

Market Size Variance

=	Actual market size (in units)	–	Budgeted market size (in units)	x	Budgeted market share	x	Wtd.-Avg. budgeted cm/unit
=(	31,250	–	40,000	)x	10%	x	$297.50
=	$260,312.50 U						

($1,190,000/4,000 units)

Market Share Variance

=	Actual market share	–	Budgeted market share	x	Total actual market size (in units)	x	Wtd.-Avg. budgeted cm/unit
=(	16%	–	10%	)x	31,250	x	$297.50
=	$557,812.50 F						

Calculating the Market Variances (continued)

Reconciliation

Market Size Variance	**$260,312.50**	**U**
Market Share Variance	**557,812.50**	**F**
Sales Quantity Variance	**$297,500.00**	**F**

Although the market size was 8,750 units smaller than expected, the company's market share was 6% higher than the budgeted proportion. The increase in market share offset the unfavorable variance of the contracting market.

The Five Steps of Strategic Decision Making for Schmidt Machinery

1. **Determine the Strategic Issues Surrounding the Problem:** *Schmidt is a differentiated firm, based on quality, design, and functionality*
2. **Identify the Alternative Actions:** *reduce marketing and sales of one or both the firm's products?*
3. **Obtain Information and Conduct Analyses of the Alternatives:** *calculate sales quantity, market share, and market size variances; project possible change in U.S. dollar*
4. **Based on Strategy and Analysis, Choose and Implement the Desired Alternative:** *based on variance analysis and consideration of the fluctuation in the dollar, Schmidt decides to plan for possible reduction in the FB-33 product*
5. **Provide an On-going Evaluation of the Effectiveness of implementation in Step 4.**

Comparison with Prior-Year Results

- A common application of sales performance analysis is to analyze the difference between current sales and prior year sales
- Suppose Schmidt Machinery Company has another month of operations to consider, the month of January. The company's actual performance for the months of December and January appear on the next slide

Comparison with Prior-Year Results

	January 2014	December 2013
Sales units	5,100	5,000
Sales mix for each product		
XV-1	30%	32%
FB-33	70%	68%
Price		
XV-1	$805	$800
FB-33	590	600
Variable cost per unit		
XV-1	450	450
FB-33	320	320
Comparative Income Statements		
Sales XV-1	$1,231,650	$1,280,000
Sales FB-33	2,106,300	2,040,000
Total Sales	$3,337,950	$3,320,000
Less variable costs	1,830,900	1,808,000
Contribution	$1,507,050	$1,512,000
Less fixed costs	600,000	600,000
Operating income	$907,050	$912,000

Comparison with Prior Year Results (continued)

	January 2014	Sales Price Variance	Flexible Budget	Sales Volume Variance	December 2013
Sales					
XV-1	$1,231,650	$ 7,650	$1,224,000	$(56,000)	$1,280,000
FB-33	2,106,300	(35,700)	2,142,000	102,000	2,040,000
Total sales	3,337,950	(28,050)	3,366,000	46,000	3,320,000
Variable costs					
XV-1	688,500	–	688,500	(31,500)	720,000
FB-33	1,142,400	–	1,142,400	54,400	1,088,000
Total variable costs	1,830,900		1,830,900	22,900	1,808,000
Contribution margin					
XV-1	543,150	7,650	535,500	(24,500)	560,000
FB-33	963,900	(35,700)	999,600	47,600	952,000
Total contribution margin	1,507,050	$ (28,050)	$1,535,100	$ 23,100	1,512,000
Fixed costs	600,000				600,000
Operating income	$ 907,050				$ 912,000

Comparison with Prior Year Results (continued)

The sales mix and sales quantity variances are determined as follows:

Sales mix variance

Change in mix x Units sold in Jan. x Dec. 2010 cm/unit

XV-1	**(.30 – .32) x 5,100 x $350 = $(35,700)**
FB-33	**(.70 – .68) x 5,100 x $280 = $28,560**

Sales quantity variance

Change in total units sold x Dec. 2006 sales mix x Dec. 2010 cm/unit

XV-1	**(5,100 – 5,000) x .32 x $350 = $11,200**
FB-33	**(5,100 – 5,000) x .68 x $280 = $19,040**