The background of the cover is a collage of blue-toned images. It features a globe in the upper right, a person in the lower left, and various abstract patterns and textures throughout. The overall aesthetic is modern and professional.

*Principles of*

# MANAGERIAL ACCOUNTING

Christine Jonick, Ed.D.



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# TABLE OF CONTENTS

## **CHAPTER 1: MANAGERIAL ACCOUNTING CONCEPTS 1**

1.1 Introduction .....	1
1.2 Cost terminology and concepts .....	3
1.3 Inventory terminology and concepts.....	4

## **CHAPTER 2: JOB ORDER COSTING 10**

2.1 Introduction.....	10
2.2 Comprehensive Example of Job Order Costing Transactions for a Manufacturing Company.....	17
2.3 Job Order Costing for a Service Company .....	26

## **CHAPTER 3: PROCESS COSTING 29**

3.1 Introduction.....	29
3.2 Process Costing Transactions for a Manufacturing Company.....	30
3.3 Process Costing Calculations for a Department in a Manufacturing Company .....	36

## **CHAPTER 4: ACTIVITY-BASED COSTING 42**

4.1 Introduction.....	42
4.2 Single factory rate to estimate factory overhead.....	43
4.3 Departmental rates to estimate factory overhead.....	44
4.4 Activity-based costing for a manufacturing business to estimate factory overhead .....	45
4.5 Differences based on factory overhead method.....	48

4.6 Activity-based costing for a manufacturing business to estimate factory overhead .....	48
4.7 Activity-based costing for a service business to estimate factory overhead .....	49

## **CHAPTER 5: COST VOLUME PROFIT ANALYSIS      51**

5.1 Introduction .....	51
5.2 Cost Volume Profit Analysis (CVP) .....	54
5.3 Breakeven Point .....	58
5.4 Operating leverage .....	64
5.5 Margin of safety .....	65

## **CHAPTER 6: VARIABLE COSTING ANALYSIS      67**

6.1 Introduction .....	67
6.2 Units manufactured equals units sold .....	69
6.3 Units manufactured greater than units sold .....	70
6.4 Units manufactured less than units sold .....	71
6.5 Analysis of variable and absorption costing .....	72
6.6 Contribution margin analysis .....	74

## **CHAPTER 7: BUDGETING      80**

7.1 Introduction .....	80
7.2 Static Budget .....	80
7.3 Flexible Budget .....	81
7.4 Master Budget .....	82
7.5 Operating Budget .....	82
7.6 Sales Budget .....	86
7.7 Cost of Goods Sold Budget .....	90

7.8 Selling and Administrative Cost Budget.....	92
7.9 Budgeted Income Statement .....	93
7.10 Cash Budget.....	94
7.11 Capital Expenditure Budget .....	96

## **CHAPTER 8: VARIANCE ANALYSIS** **98**

8.1 Introduction.....	98
8.2 Direct materials cost variance.....	99
8.3 Direct labor cost variance .....	100
8.4 Factory overhead variances .....	101

## **CHAPTER 9: DIFFERENTIAL ANALYSIS** **105**

9.1 Introduction.....	105
9.2 Make or buy a component part .....	106
9.3 Continue with or discontinue a product.....	107
9.4 Lease or sell equipment .....	108
9.5 Sell a product or process further.....	109
9.6 Keep or replace a fixed asset .....	110
9.7 Accept business at reduced price.....	110
9.8 Capital investment analysis.....	111



# 1

## Managerial Accounting Concepts

### 1.1 INTRODUCTION

**Accounting** is the system of recording and keeping track of financial transactions in a business and summarizing this information in reports. These reports provide information to people who are interested in knowing about the financial aspects of a business. The information guides business managers, investors, and creditors in planning and decision making. In fact, accounting is often referred to as “**the language of business**” because business people communicate, evaluate performance, and determine value using dollars and amounts generated by the accounting process.

**Financial accounting** involves producing periodic reports called financial statements to inform such external groups as investors, boards of directors, creditors, and government/tax agencies about a company’s financial performance and status. The income statement, retained earnings statement, balance sheet, and statement of cash flows are published at fixed intervals to summarize the historical earnings performance and current financial position of a company. Financial statements are prepared according to Generally Accepted Accounting Principles (GAAP), which helps ensure the information is **relevant** (useful and timely for making decisions), **reliable** (accurate and unbiased), **consistent** (prepared the same way each time information is reported), and **comparable** (prepared the same way by different companies).

**Managerial accounting** is targeted more toward a company’s managers and employees. The information gathered and summarized for these internal groups is customized to provide feedback for planning, decision making, and evaluation purposes. Managerial reports do not necessarily follow any particular format, but instead are uniquely designed to meet the needs of specific users. Analyses are often focused on targeted segments of a business rather than on a company as a whole. Information may be published over periodic time intervals or on an as-needed basis. Managerial accounting involves not only actual financial data from past periods, but also current estimates and future projections.

A manager’s responsibilities in a business include making decisions related to planning (identifying goals and strategies for accomplishing them), leading (directing daily operations and carrying out plans), and controlling (comparing

expected and actual results and taking action for improvement). Since human, financial, and time resources are limited, managers must select from among many alternatives, foregoing other options. They try to optimize the collective outcome of their choices. Managerial accounting provides timely and relevant financial information that contributes to effective decision making.

A business's operations are classified as one of three types - service, merchandising, or manufacturing - depending on what it has for sale. A service business sells expertise, advice, assistance, professional skills, or an experience rather than a physical product. A merchandising business purchases finished and packaged products from other companies, marks up the costs of these items, and sells them to customers. A manufacturing business assembles and packages products for sale to merchandisers or end users.

Managerial accounting is relevant to all three types of businesses. In this document, we will focus on manufacturing since that type of business involves the most in-depth facets and examples of managerial accounting. We will also discuss managerial accounting for service businesses where appropriate. Topics will fall into four broad categories: accumulating costs, analyzing costs, evaluating performance, and comparing alternatives.

The goal of a business is to generate profit, which is the difference between income and costs in a particular time period. Costs are the result of paying cash or committing to pay cash in the future in order to earn revenue. Costs may be accumulated for a product, sales territory, department, or activity. It is critical to analyze costs because controlling them directly impacts profitability. Costs are also used to determine selling prices of products, and they are monitored over time to evaluate progress and discover irregularities.

## ACCUMULATING COSTS

Costs must be determined and recorded accurately, systematically, and on a timely basis. Unless cost information is correct and reliable, it is not very useful to managers who depend on it to make effective plans and informed decisions. **Job order costing** and **process costing** are two methods of systematically accumulating costs on manufactured products. **Activity-based costing** is a system that is combined with the other two methods to identify and measure costs more specifically.

## ANALYZING COSTS

Not all costs are created equal. Some are unavoidable; others are somewhat controllable. Separating them out allows managers to focus on controllable costs that should be monitored in order to contain or lower them. Costs may also be used to mathematically determine sales required to achieve desired levels of volume and profitability. **Break even analysis** and other cost relationships, as well as

**variable costing**, will address these issues.

## EVALUATING PERFORMANCE

Planning involves looking into the future and estimating what a business's financial activities will look like. This process is called **budgeting** and projects what sales, costs, production, cash flows, etc. will be in at a future point in time. Controlling methods such as **variance analysis** compare expected outcomes to actual results and analyze overall progress in meeting goals.

## COMPARING ALTERNATIVES

Managerial decision making includes choosing one option over others, such as whether to make or buy a component part or whether to continue manufacturing a product or not. **Differential analysis** compares alternatives to determine which choice will yield either the greatest benefit or the least cost. Capital investment analysis is a type of differential analysis that involves evaluating proposed investments in property, plant, and equipment that a company will use in its operations.

## 1.2 COST TERMINOLOGY AND CONCEPTS

For a manufacturing company, a significant goal of managerial accounting is to keep track of the costs of the units that are produced. A **cost** is a current or future expenditure of cash for something that will ultimately generate revenue. In manufacturing, many costs relate to products that are ultimately sold to customers.

**Period costs** include selling and administrative expenses that are unrelated to the production process in a manufacturing business. **Selling expenses** are incurred to market products and deliver them to customers. **Administrative expenses** are required to provide support services that are not directly related to the manufacturing or selling activities. Administrative costs may include expenditures for a company's accounting department, human resources department, and president's office. Selling and administrative expenses may also include utilities, insurance, property taxes, depreciation, supplies, maintenance, salaries, etc., that are incurred in a business, but outside of the factory production area.

**Product costs** are incurred when a company manufactures goods. Product costs may be classified as either direct or indirect. **Direct costs** are expenditures in a factory that can be specifically traced to a manufactured item and that become part of its overall cost. **Indirect costs** are also incurred in a factory where production takes place, but they are more general and cannot be attributed to any specific product.

There are three product costs associated with a manufactured item:

1. Direct materials
2. Direct labor cost

### 3. Factory overhead

**Direct materials** are raw materials that will be used to create finished goods. Their cost becomes part of the product that customers ultimately purchase.

**Direct labor** is the cost of hourly wages of production workers who assemble manufactured goods. These employees work on products that are sold to customers when finished.

**Factory overhead** is an indirect cost and includes ANY expense in a factory that is not specifically traced to products that customers purchase. These may be general expenses, such as utilities, insurance, property taxes, depreciation, supplies, maintenance, supervisor salaries, and expired prepaid items. Factory overhead also includes any materials or labor that do not become part of a manufactured product.

Product costs may be further categorized, as follows:

1. **Prime cost** = direct labor + direct materials
2. **Conversion costs** = direct labor + factory overhead

#### EXAMPLE

A manufacturing company produces kitchen cabinets. **Direct materials** include wood, hinges, and hardware. **Direct labor** is the cost of wages of factory employees who assemble the cabinets. **Factory overhead** includes expenditures for electricity and water bills, insurance premiums, roof repair, depreciation of machinery, materials used to build shelves in the factory, and wages of factory workers to assemble those shelves.

Assume that direct materials cost \$700, direct labor is \$500, and factory overhead is \$300 for cabinets that have been manufactured.

- |   |                                   |
|---|-----------------------------------|
| 1. How much are prime costs?              | $\$700 + \$500 = \$1,200$         |
| 2. How much are conversion costs?         | $\$500 + \$300 = \$ 800$          |
| 3. What is the total cost of the product? | $\$700 + \$500 + \$300 = \$1,500$ |

## 1.3 INVENTORY TERMINOLOGY AND CONCEPTS

A manufacturer reports its product costs as one of three types of inventory in the current assets section of its balance sheet, depending on stages of completion. **Materials** consist of items in inventory that have not yet been entered into production or used. **Work in process** includes manufactured products that have been started but are not yet completed. In other words, they are currently in production. Finally, **finished goods** are manufactured products that have been completed but not yet sold to customers.

### 1.3.1 Financial Reporting for a Manufacturer

The three inventory accounts, and their balances at the end of the month, appear in the current asset section of a manufacturer's balance sheet. A sample

balance sheet follows.

<b>Jonick Company Balance Sheet June 30, 2019</b>			
<b>Assets</b>			
Current assets:			
Cash		\$40,000	
Accounts receivable		25,000	
Inventory			
Materials	\$18,000		
Work in process	31,000		
Finished goods	<u>26,000</u>		
Total inventory		75,000	
Prepaid insurance		4,000	
Prepaid rent		<u>2,000</u>	
Total current assets			\$146,000

When manufactured items are sold, their costs are removed from the *Finished Goods* inventory account and transferred to the *Cost of Goods Sold* expense account on the income statement. *Cost of Goods Sold* represents the amount a company paid for the manufactured items that it sold. *Cost of Goods Sold* is matched with *Sales* on the first two rows of the income statement. The difference between *Sales* and *Cost of Goods Sold* is gross profit, which is the amount of markup on the manufactured goods.

The income statement also includes expenses other than *Cost of Goods Sold*. *Selling and administrative expenses* are non-factory costs that are classified as operating expenses. These period costs are necessary to operate the business and generate sales.

A sample income statement follows.

<b>Jonick Company Income Statement For the Month Ended June 30, 2018</b>		
Sales		\$300,000
Cost of goods sold		<u>140,000</u>
Gross profits		\$160,000
Operating expenses:		
Selling expenses	\$75,000	
Administrative expenses	<u>35,000</u>	
Total operating expenses		<u>110,000</u>

Net income		\$50,000
------------	--	----------

The *Cost of Goods Sold* amount on the income statement is determined by considering the changes in the three inventory account balances during the period. The elements of its calculation contain important information for managers, but they are too detailed and lengthy to present directly on the income statement. Therefore, a separate **statement of cost of goods sold** is prepared to show the details of the calculations. The final cost of goods sold amount from the statement of cost of goods sold is what appears on the income statement.

The statement of cost of goods sold that follows presents how the \$140,000 amount on the income statement is determined. The statement is followed by an explanation of its sections.

<b>Jonick Company</b> <b>Statement of Cost of Goods Sold</b> <b>For the Month Ended June 30, 2019</b>				
Finished goods inventory, June 1				\$34,000
Work in process inventory, June 1			\$42,000	
Direct materials				
Materials inventory, June 1	\$16,000			
Purchases	<u>59,000</u>			
Cost of materials available to use	\$75,000			
Materials inventory, June 30	<u>(18,000)</u>			
Cost of direct materials used		\$57,000		
Direct labor		40,000		
Factory overhead		<u>24,000</u>		
Total manufacturing costs in June			<u>121,000</u>	
Total manufacturing costs			\$163,000	
Work in process inventory, June 30			<u>(31,000)</u>	
Cost of goods manufactured				<u>132,000</u>
Cost of goods available for sale				<u>\$166,000</u>
Finished goods inventory, June 30				<u>(26,000)</u>
Cost of goods sold				<u>\$140,000</u>

Three amounts that must often be solved for algebraically are the amounts of inventory transferred out of the *Materials*, *Work in Process*, and *Finished Goods* inventory accounts during a period. These amounts may be determined with an equation similar to that used for the periodic inventory system for merchandising. Beginning and ending inventory values are determined by taking physical inventory counts, and, therefore, they are known. Amounts for inventory added during the period are available from purchase orders and production reports that accumulate costs on manufactured goods. The following general equation summarizes the calculation of inventory transferred out of the inventory accounts:

Beginning inventory balance + additions during the month – ending inventory balance

The equations that follow for each inventory account use the amounts from the statement of cost of goods sold to illustrate the calculations for the amounts transferred out of *Materials*, *Work in Process*, and *Finished Goods*, respectively. The ledger account that corresponds to each type of inventory uses these same amounts to show increases, decreases, and running balances. The ledger accounts show the flow of manufacturing costs from *Materials* to *Work in Process* to *Finished Goods* to *Cost of Goods Sold*.

<b>Materials</b>		
Beginning <i>Materials</i> balance		\$16,000
+ Purchases of materials during the period		+ 59,000
- <u>Ending <i>Materials</i> balance (still in inventory)</u>		<u>- 18,000</u>
= <i>Materials</i> used and transferred to <i>Work in Process</i>		\$57,000

The following ledger also reflects the movement in and out of the *Materials* account, with a debit entry representing an increase and a credit entry showing a decrease.

<b>Materials</b>					
Date	Item	Debit	Credit	Debit	Credit
1.	Balance, June 1			16,000	
2.	Purchases of materials during June	59,000		75,000	
3.	Materials moved to production in June		<b>57,000</b>	18,000	

The following excerpt from the statement of cost of goods sold presents the information shown in the equation and ledger for *Materials*.

Direct materials		
Materials inventory, June 1	\$16,000	
Purchases	<u>59,000</u>	
Cost of materials available to use	\$75,000	
Materials inventory, June 30	<u>(18,000)</u>	
Cost of direct materials used		\$57,000

\$57,000 was transferred from one inventory account to the next: from *Materials* (credit) to *Work in Process* (debit)

<b>Work in Process</b>		
Beginning <i>Work in Process</i> balance		\$42,000
+ Materials, labor, and factory overhead added to production		+ 121,000
- <u>Ending <i>Work in Process</i> balance (still in inventory)</u>		<u>- 31,000</u>
= <i>Work in Process</i> completed and transferred to <i>Finished Goods</i>		\$132,000

The following ledger also reflects the movement in and out of the *Work in*

*Process* account, with a debit entry representing an increase and a credit entry a decrease.

Work in Process					
Date	Item	Debit	Credit	Debit	Credit
1.	Balance, June 1			42,000	
2.	Materials moved to production in June	57,000		99,000	
3.	Labor added to production in June	40,000		139,000	
4.	Overhead added to production in June	24,000		163,000	
5.	Work in process completed in June		<b>132,000</b>	31,000	

The following excerpt from the statement of cost of goods sold presents the information shown in the equation and ledger for *Work in Process*.

Work in process inventory, June 1		\$42,000		\$132,000 was transferred from one inventory account to the next: from <i>Work in Process</i> (credit) to <i>Finished Goods</i> (debit)
Total manufacturing costs in June		<u>121,000</u>		
Total manufacturing costs		\$163,000		
Work in process inventory, June 30		<u>(31,000)</u>		
Cost of goods manufactured			<u>132,000</u>	

**Finished Goods**

Beginning <i>Finished Goods</i> balance	\$34,000
+ <i>Work in Process</i> completed during the period	+ 132,000
- <u>Ending <i>Finished Goods</i> balance (not yet sold)</u>	<u>- 26,000</u>
= <i>Finished Goods</i> sold and transferred to <i>Cost of Goods Sold</i>	\$140,000

The following ledger also reflects the movement in and out of the *Finished Goods* account, with a debit entry representing an increase and a credit entry a decrease.

Finished Goods					
Date	Item	Debit	Credit	Debit	Credit
1.	Balance, June 1			34,000	
2.	Work in process completed in June	132,000		166,000	
3.	Cost of product sold in June		140,000	26,000	

The following excerpt from the statement of cost of goods sold presents the information shown in the equation and ledger for *Finished Goods*.

Finished goods inventory, June 1				\$34,000
Cost of goods manufactures				<u>132,000</u>
Cost of goods available for sale				<u>\$166,000</u>
Finished goods inventory, June 30				<u>(26,000)</u>
Cost of goods sold				<u>\$140,000</u>

\$140,000 was transferred from one inventory account to the next: from *Finished Goods* (credit) to *Cost of Good Sold* (debit)

**Cost of Goods Sold:**

\$140,000 was transferred from one inventory account to an expense account when the product was sold: from *Finished Goods* (credit) to *Cost of Goods Sold* (debit)

Cost of Goods Sold					
Date	Item	Debit	Credit	Debit	Credit
1.	Cost of product sold in June	140,000		140,000	

The accumulation of production costs, and the transfer of those costs from account to account based on stage of completion, track the manufacturing process from beginning to end, when the products are sold. This information is critical to managers in manufacturing companies who make purchasing decisions, determine selling prices, prepare sales budgets, and schedule production.

# 2

## Job Order Costing

### 2.1 INTRODUCTION

Job order costing is a method of keeping track of the costs of manufactured items. Once products are completed, their overall costs are marked up and sold at a profit to customers.

Job order costing is a method of cost accumulation that is used for items or batches of items that are **unique** – that is, each customer’s order is different. Custom-made kitchen cabinets are an example of a manufactured product that is often customer-specific. Each order is based on different sizes, layouts, wood choices, finishes, hardware, installation costs, customer preferences, etc. No two orders are alike, so the total cost of each order will differ as a result. A single order might involve a homeowner updating her kitchen for a new look. A batch order might be processed for a home builder who is constructing 10 identical homes and therefore requires 10 of the same sets of cabinets. Each single or batch order is referred to as a **job** and is assigned a unique identification number, such as “Job 15”.

Costs accumulate on manufactured goods while they are in production. The three costs of production are direct materials, direct labor, and factory overhead. For unique products, each job accumulates different amounts of each of these three costs. An analogy would be several patients in a doctor’s office - each person has different symptoms and therefore receives different treatments, medications, and tests from the same doctor. Each person’s total medical bill is like a “tab” that the patient has run up with the doctor.

The three costs of production accumulate in an account called *Work in Process*, which is like the “tab” for the manufactured item. There are three debits to *Work in Process* - one for direct materials, one for direct labor, and one for factory overhead – as a result. The total of these three costs equals the cost of producing the item.

The following *Work in Process* ledger for a single order assumes there is no beginning inventory and illustrates the three debits that represent the three costs of production.

Work in Process					
Date	Item	Debit	Credit	Debit	Credit
1.	Materials moved to production	5,000		5,000	
2.	Labor added to production	4,000		9,000	
3.	Overhead added to production	1,100		10,100	

The total cost of this job is \$10,100, as is shown in the final debit balance in *Work in Process* ledger.

A manufacturer may work on many jobs simultaneously. Even if several jobs are started at once, it does not necessarily mean that they will all be completed at the same time. In job order costing, each job is typically worked on at its unique location on the production floor as material and labor come to the products, which remain in place.

The following series of journal entries describe and illustrate job order costing transactions that are specific to accumulating the three costs of production: materials, labor, and factory overhead.

1. **Direct materials** become an integral part of a manufactured product that is sold to a customer. They are requisitioned (asked for) and brought from the stockroom to the production area so that they can be worked on.

Materials that cost \$5,000 are requisitioned from the stockroom. This journal entry represents the first of the three debits to the *Work in Process* account.

Account	Debit	Credit
Work in Process	5,000	
Materials		5,000

*First debit to Work in Process*

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

The wood, hinges, etc. that are considered direct materials are moved from the *Materials* account (by crediting and reducing it) to the *Work in Process* account (by debiting it and increasing it.) *Work in Process* is the asset account in which the cost of the manufactured item accumulates, and materials is the first of the three production costs.

2. **Direct labor** involves work done directly by factory laborers on manufactured items that are sold to customers. This journal entry represents the second of the three debits to the *Work in Process* account. In this case, direct labor is \$4,000.

Account	Debit	Credit
Work in Process	4,000	
Wages Payable		4,000

*Second debit to Work in Process*

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

Labor in the factory includes the hourly wages paid to production workers. It is considered direct if a production employee is working on a product that will be sold to a customer. Direct labor costs are added to *Work in Process* by debiting that account and increasing it. *Work in Process* is the asset account in which the cost of the manufactured item accumulates, and labor is the second of the three production costs.

**FACTORY OVERHEAD INCURRED**

The following six entries represent transactions that are recorded as debits to the *Factory Overhead* account. This account is used to record all factory expenses except direct materials and direct labor. Rather than *Supplies Expense*, *Maintenance Expense*, *Depreciation Expense*, *Insurance Expense*, *Wages Expense* (indirect), etc., the *Factory Overhead* account is used to substitute for any expense incurred in the factory. Factory overhead costs are indirect because they cannot be specifically traced to particular jobs, but are instead incurred in the factory as a whole. *Factory Overhead* is debited (increased) for any actual overhead cost incurred. While these expenses are in the *Factory Overhead* account, they are not yet part of any of the manufactured items.

3. The company uses \$400 of its raw materials to build a closet in the factory.

*Recording an expense in the factory as Factory Overhead*

Account	Debit	Credit
Factory Overhead	400	
Materials		400

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

Materials, such as wood, may be requisitioned for general factory use. These materials are considered an indirect cost since they do not become part of a manufactured item. *Materials* is credited just like it was for the requisition of direct materials. In this case, *Factory Overhead* is debited for the indirect materials rather than *Work in Process*.

*Supplies Expense* is not used because the indirect expense occurs in the factory, where all expenses are accounted for a *Factory Overhead*.

- Wages of \$300 are incurred for production employees building a closet in the factory.

Recording an expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	300	
Wages Payable		300

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

If the same production employees also perform some general factory work, such as hanging the wood shelves, the labor is considered indirect since the time is not spent working on an actual manufactured item. *Wages Payable* is credited just like it was for the direct labor. In this case, *Factory Overhead* is debited for the indirect labor rather than *Work in Process*.

*Wages Expense* is not used because the indirect expense occurs in the factory, where all expenses are accounted for a *Factory Overhead*.

- The company pays \$350 cash for one of its utility bills.

Recording an expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	350	
Cash		350

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Cash* is an **asset** account that is **decreasing**

*Factory Overhead* is debited rather than *Utilities Expense* since the expense occurs in the factory.

- The company receives an invoice for \$200 from a repairman who fixed a leak in the factory building.

Recording an expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	200	
Accounts Payable		200

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Accounts Payable* is a **liability** account that is **increasing**

*Factory Overhead* is debited rather than *Maintenance Expense* since the expense occurs in the factory.

7. \$150 of the prepaid insurance that the company paid in advance expires.

Recording an expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	150	
Prepaid Insurance		150

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Prepaid Insurance* is an **asset** account that is **decreasing**

*Factory Overhead* is debited rather than *Insurance Expense* since the expense occurs in the factory.

8. The company records depreciation on factory equipment.

Recording an expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	150	
Accumulated Depreciation		150

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Accumulated Depreciation* is a **contra asset** account **increasing**

*Factory Overhead* is debited rather than *Depreciation Expense* since the expense occurs in the factory.

Factory expenses accumulate in the *Factory Overhead* account, as just shown in the journal entries (3) through (8). Notice that the *Work in Process* was not used at all in these transactions, so at this point the third cost of manufacturing has not been added to the cost of any job yet.

Assuming there were no previous balances in the *Work in Process* or *Factory Overhead* accounts, their ledgers would appear as follows based on the previous eight transactions:

Work in Process					
Date	Item	Debit	Credit	Debit	Credit
1.	Materials moved to production	5,000		5,000	
2.	Labor added to production	4,000		9,000	

Factory Overhead					
Date	Item	Debit	Credit	Debit	Credit
3.	For indirect materials	400		400	
4.	For indirect labor	300		700	
5.	For utilities	350		1,050	
6.	For maintenance	200		1,250	
7.	For insurance	150		1,400	
8.	For depreciation	100		1,500	

So far there are only two entries in the *Work in Process* ledger account. The third cost of production, factory overhead, must be added (or “applied”) to *Work in Process* to arrive at the total cost of the job(s). This final debit to *Work in Process* allocates an estimated amount of the factory expenses from the *Factory Overhead* account to the cost of each unit manufactured.

Since all expenses associated with the period may not yet be determined and all bills not yet received, actual factory overhead is not yet known. The running balance of \$1,500 shown may be incomplete since more bills may be outstanding. The company needs timely information about the cost of each job, so factory overhead is estimated at the time it is applied to *Work in Process*.

Also, since factory overhead cannot be specifically traced to a particular job, it is instead allocated to jobs using an activity base that estimates its consumption. Each company uses a method of estimating that makes sense for them, so the process can vary among companies. Three common activity bases used to allocate factory overhead costs are (1) a percentage of direct labor cost (such as \$1,500 x 20%) or the (2) number of direct labor hours or (3) number of machine hours. When units such as hours are used, a predetermined factory overhead rate is multiplied by the number of hours. The predetermined factory overhead rate equals estimated total factory overhead costs divided by the estimated number of hours in the activity base.

In this example, assume total estimated factory overhead is \$2,000. It will be allocated, or applied to jobs, using a predetermined factory overhead rate that uses an activity base of an estimated 200 direct labor hours. Therefore,  $\$2,000 / 200 =$  a factory overhead rate of \$10 per direct labor hour.

If 110 direct labor hours were actually used in this period’s operations, factory overhead applied to *Work in Process* would be \$1,100 (110 hours x \$10 per direct labor hour). The journal entry that follows reflects this third cost of production being added to the *Work in Process* and removed from the *Factory Overhead* account using this estimating process.

- 9. The company applied \$1,100 of factory overhead to jobs in production.

*Second debit to Work in Process*

Account	Debit	Credit
Work in Process	1,100	
Factory Overhead		1,100

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

The *Factory Overhead* account is reduced by crediting it, and that expense amount is moved into the *Work in Process* (asset) account by debiting it.

This journal entry represents the third of the three debits to the *Work in Process* account.

As shown in the ledger accounts that follow, there are now three entries in the *Work in Process* ledger account. The third cost of production, factory overhead, has been added (or “applied”) to *Work in Process* to arrive at the total cost of the job(s).

Work in Process					
Date	Item	Debit	Credit	Debit	Credit
1.	Materials moved to production	5,000		5,000	
2.	Labor added to production	4,000		9,000	
3.	Overhead added to production	1,100		10,100	

Factory Overhead					
Date	Item	Debit	Credit	Debit	Credit
3.	For indirect materials	400		400	
4.	For indirect labor	300		700	
5.	For utilities	350		1,050	
6.	For maintenance	200		1,250	
7.	For insurance	150		1,400	
8.	For depreciation	100		1,500	
3.	Overhead added to production		1,100	400	

The total cost of this manufactured item is the three debits to Work in Process: \$5,000 for direct materials plus \$4,000 for direct labor plus \$1,100 for factory overhead, totaling \$10,100.

**ANALOGY**

Assume three people go out on a Friday night (separately). Each will eat dinner, have some drinks, and enjoy some entertainment – the three costs of going out. Yet the food, beverages, and entertainment will be different for each person, and, therefore, the costs will not be the same. Each person has a “tab” – first the food, then the drinks, then the entertainment – that adds up to the final cost of the night out.

Similarly, different products manufactured under job order costing each have a “tab” on which their three costs – direct materials, direct labor, and factory overhead – accumulate. The costs are different for each product, so the final total for each is different as well.

**2.2 COMPREHENSIVE EXAMPLE OF JOB ORDER COSTING TRANSACTIONS FOR A MANUFACTURING COMPANY**

The following example will expand upon the job order costing journal entries previously presented and add other transactions in the manufacturing cycle. These include purchasing raw materials, recording jobs completed, selling finished jobs, and adjusting estimated to actual factory overhead incurred. The new transactions will be marked as **NEW** and a brief explanation and/or calculation will follow each.

Assume that Roberts Wonder Wood is a factory that produces custom kitchen cabinets. Wood and metal hardware are the main materials used in production. Roberts uses a job order costing system. The transactions are to be recorded for six jobs in production in August, Roberts’ first month of operations.

The following information relates to production costs and usage for Roberts during August.

<b>Job</b>	<b>Materials</b>	<b>Factory Labor</b>	<b>Machine hours</b>
Job 1	\$880	\$750	6
Job 2	1,240	990	10
Job 3	670	510	8
Job 4	2,300	1,860	25
Job 5	1,560	1,490	14
Job 6	910	730	7
For general factory use	270	850	

1. Materials are purchased on account for \$9,400.

Account	Debit	Credit
Materials	9,400	
Accounts Payable		9,400

- ▲ *Materials* is an **asset** (inventory) account that is **increasing**
- ▲ *Accounts Payable* is a **liability** account that is **increasing**

Materials must first be acquired before they can be used in production or in the factory. The asset account, *Materials*, is debited when materials are purchased. These items are “in stock” and available to be requisitioned (requested for use by someone in the factory.) They are not yet in production or being worked on.

2. Materials are requisitioned from the stockroom based on the cost information shown in the table.

Account	Debit	Credit
Work in Process	7,560	
Materials		7,560
Factory Overhead	270	
Materials		270

*First debit to Work in Process*

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

Record any expense in the factory as *Factory Overhead*

Materials for the six jobs:  $880 + 1,240 + 670 + 2,300 + 1,560 + 910 = \mathbf{\$7,560}$   
 Indirect materials: **\$270**

3. Labor costs are incurred in the factory based on the cost information shown in the table.

Account	Debit	Credit
Work in Process	6,330	
Wages Payable		6,330
Factory Overhead	850	
Wages Payable		850

*Second debit to Work in Process*

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

Record any expense in the factory as *Factory Overhead*

Labor for the six jobs:  $750 + 990 + 510 + 1,860 + 1,490 + 730 = \mathbf{\$6,330}$   
 Indirect materials: **\$850**

4. Factory overhead indirect costs incurred on account are \$440.

Record any expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	440	
Accounts Payable		440

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Accounts Payable* is a **liability** account that is **increasing**

5. Expired prepaid insurance for the month is \$370.

Record any expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	370	
Prepaid Insurance		370

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Prepaid Insurance* is an **asset** account that is **decreasing**

6. Depreciation on factory equipment for the month is \$840.

Record any expense in the factory as *Factory Overhead*

Account	Debit	Credit
Factory Overhead	370	
Accumulated Depreciation		370

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Accumulated Depreciation* is a **contra asset** account **increasing**

7. Factory overhead is applied to jobs in production at an estimated rate based on the number of machine hours. Estimated factory overhead for the year is \$27,000 and the estimated number of machine hours for the year is 900.

Third debit to *Work in Process*

Account	Debit	Credit
Work in Process	2,100	
Factory Overhead		2,100

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

- a. Calculate the predetermined factory rate:  $\$27,000 / 900 \text{ hours} = \$30$  per machine hour
- b. Add the number of machine hours for the six jobs:  $6 + 10 + 8 + 25 + 14 + 7 = 70$
- c. Multiply total number of machine hour by the predetermined factory overhead rate:  $70 \times \$30 = \$2,100$

8. Jobs 1, 2, 3, and 5 are completed.

Account	Debit	Credit
Finished Goods	9,230	
Work in Process		9,230

- ▲ *Finished Goods* is an **asset** (inventory) account that is **increasing**
- ▼ *Work in Process* is an **asset** (inventory) account that is **decreasing**

Once a job is completed, it is no longer considered work in process. It instead must be reclassified as finished goods. To make this transfer, debit *Finished Goods* to increase that inventory account and credit the *Work in Process* account to decrease it.

The amount of the transfer from *Work in Process* to *Finished Goods* is determined by adding the three costs of production for each of the four jobs that were completed. The schedule of cost of jobs completed organizes this information. Each job has a materials cost, a factory labor cost, and a number of machine hours that is multiplied by the predetermined factory overhead rate of \$30 per hour.

Schedule of Cost of Jobs Completed

Job completed	Materials	Factory Labor	Machine hours	Total job cost
Job 1	\$880	\$750	6 x \$30 = \$180	\$1,810
Job 2	1,240	990	10 x \$30 = 300	2,530
Job 3	670	510	8 x \$30 = 240	1,420
Job 5	1,560	1,490	14 x \$30 = 420	3,470
<b>Totals</b>	<b>\$4,350</b>	<b>3,740</b>	<b>\$1,140</b>	<b>\$9,230</b>

9. Jobs 2 and 5 are sold on account for \$4,100 and \$5,200, respectively.

Account	Debit	Credit
Accounts Receivable	9,300	
Sales		9,300
Cost of Goods Sold	6,000	
Finished Goods		6,000

- ▲ *Accounts Receivable* is an **asset** account that is **increasing**
- ▲ *Sales* is a **revenue** account that is **increasing**
- ▲ *Cost of Goods Sold* is an **expense** account that is **increasing**
- ▼ *Finished Goods* is an **asset** (inventory) account that is **decreasing**

There are two journal entries for a sale. The first is to record the selling price of the product to customers. The second is to reduce the inventory by its cost.

Add the selling prices of the two jobs sold: \$4,100 + \$5,200 = **\$9,300**

Add the manufacturing costs of the two jobs sold: \$2,530 + \$3,470 = **\$6,000**

The amount of the transfer from *Finished Goods* to *Cost of Goods Sold* is determined by adding the three costs of production for each of the two jobs that were sold. The schedule of cost of jobs sold organizes this information. Each job has a materials cost, a factory labor cost, and a number of machine hours that is multiplied by the predetermined factory overhead rate of \$30 per hour.

Schedule of Cost of Jobs Sold

Job completed	Materials	Factory Labor	Machine hours	Total cost
Job 2	\$1,240	\$990	10 x \$30 = \$300	\$2,530
Job 5	1,560	1,490	14 x \$30 = 420	3,470
<b>Totals</b>	<b>\$2,800</b>	<b>\$2,480</b>	<b>\$720</b>	<b>\$6,000</b>

10a. Actual factory overhead is \$2,150.

Not enough factory overhead was applied in transaction #7

Account	Debit	Credit
Cost of Goods Sold	50	
Factory Overhead		50

- ▲ *Cost of Goods Sold* is an **expense** account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account **decreasing**

This transaction may occur weeks or months after the product is manufactured and sold. When all bills for the period have been received and all the actual costs are known, the company adjusts the amount of estimated factory overhead to the actual amount.

Refer to transaction #7, recorded previously, and note that \$2,100 of factory overhead was applied to *Work in Process* based on an estimate using machine hours.

The company now knows that actual factory overhead is \$2,150. Therefore, factory overhead was **under applied** by \$50 (\$2,150 - \$2,100) in transaction #7. Reconciling the estimated and the actual amounts requires an additional credit to *Factory Overhead* for \$50. The first credit of \$2,100 (transaction #7) plus this follow-up credit of \$50 in (transaction #10a) equals the actual factory overhead of \$2,150.

Notice that the *Cost of Goods Sold* account is debited to adjust factory overhead to its actual amount. The *Work in Process* account is not used when reconciling estimated to actual factory overhead. If the difference between the two is unusually large, the estimate may need to be revised in the future.

The following is an alternative to transaction 10a. (Only 10a or 10b would occur, not both.)

10b. Actual factory overhead is \$2,050.

Too much factory overhead was applied in transaction #7

Account	Debit	Credit
Factory Overhead	50	
Cost of Goods Sold		50

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Cost of Goods Sold* is an **expense** account **decreasing**

**Refer to transaction #7**, recorded previously, and note that **\$2,100** of factory overhead was applied to *Work in Process* at that time based on an estimate using machine hours.

The company now knows that actual factory overhead is **\$2,050**. Therefore, factory overhead was **over applied** by \$50 (\$2,100 - \$2,050) in transaction #7. Reconciling the estimated and the actual amounts requires a debit to *Factory Overhead* for \$50. The first credit of \$2,100 (transaction #7) minus this follow-up debit of \$50 (transaction #10b) equals the actual factory overhead of \$2,050.

Two other questions related to the cost of jobs remaining in inventory may also be asked:

1. What is the cost of the items remaining in *Finished Goods*?

Jobs 1, 2, 3, and 5 were completed. Of those, Jobs 2 and 5 were sold. Therefore, Jobs 1 and 3 remain in *Finished Goods*.

Add the manufacturing costs of the two jobs that are completed but not sold:  
 $\$1,810 + \$1,420 = \mathbf{\$3,230}$

**Schedule of Completed Jobs**

Job completed	Materials	Factory Labor	Machine hours	Total job cost
Job 1	\$880	\$750	6 x \$30 = \$180	\$1,810
Job 3	670	510	8 x \$30 = 240	1,420
<b>Totals</b>	<b>\$1,550</b>	<b>\$1,260</b>	<b>\$ 420</b>	<b>\$3,230</b>

2. What is the cost so far of the jobs that are still in *Work in Process*?

Jobs 4 and 6 were not finished at the end of the period.

Add the manufacturing costs of the two jobs that are not completed yet:  $\$4,910 + \$1,850 = \mathbf{\$6,760}$

**Schedule of Uncompleted Jobs**

Work in process	Materials	Factory Labor	Machine hours	Total cost
Job 4	\$2,300	\$1,860	25 x \$30 = \$750	\$4,910
Job 6	910	730	7 x \$30 = 210	1,850
<b>Totals</b>	<b>\$3,210</b>	<b>\$2,590</b>	<b>\$960</b>	<b>\$6,760</b>

Assuming there were no previous balances, the inventory account ledgers would appear as follows based on the previous transactions:

Materials					
Date	Item	Debit	Credit	Debit	Credit
1.	Materials purchased	9,400		9,400	
2.	Materials moved to production		7,560	1,840	

Work in Process					
Date	Item	Debit	Credit	Debit	Credit
2.	Materials moved to production	7,560		7,560	
3.	Labor added to production	6,330		13,890	
7.	Overhead added to production	2,100		15,990	
9.	Transferred to finished goods		9,230	6,760	

Finished Goods					
Date	Item	Debit	Credit	Debit	Credit
8.	Transfer from work in process	9,230		9,230	
9.	Transfer to cost of goods sold		6,000	3,230	

The balances of the three inventory accounts would appear in the current assets section of the balance sheet at the end of the accounting period, as shown in the following example.

Jonick Company Balance Sheet June 30, 2019			
Assets			
Current assets:			
Cash		\$8,000	
Accounts receivable		3,000	
<b>Inventory:</b>			
<b>Materials</b>	<b>\$1,840</b>		
<b>Work in process</b>	<b>6,760</b>		
<b>Finished goods</b>	<b><u>3,230</u></b>		
<b>Total inventory</b>		<b>11,830</b>	
Prepaid insurance		2,000	
Prepaid rent		<u>1,000</u>	
Total current assets			\$25,830

### 2.2.1 Selling and Administrative Expenses

The previous problem deals only with the factory itself. Sometimes the factory is part of a larger business. Period costs may also be required to generate revenue,

although they not involved in the manufacturing process. There may be a sales staff and other expenses to promote and sell the manufactured items. In general, these are classified as selling expenses. There may also be activities that do not directly relate to production or sales but are necessary to run the business. These may include a human resources department, an accounting department, a company president, secretarial support staff, etc. All are considered administrative expenses, outside of the factory part of the business. Here are examples that involve selling, administrative and factory expenses. *Factory Overhead* is used to record only factory expenses, but not selling or administrative costs.

1. The company uses some of its raw materials to build a closet in the factory (\$200), shelving in the salespeople’s offices (\$150), and braces in the administrative area (\$50), for a total of \$400.

Account	Debit	Credit
Factory Overhead	200	
Selling Expenses	150	
Administrative Expenses	50	
Materials		400

Recording an expense in and out of the factory

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Selling Expenses* is an **expense** account that is **increasing**
- ▲ *Administrative Expenses* is an **expense** account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

2. The company incurs labor costs for the closet in the factory (\$150), shelving in the salespeople’s offices (\$100), and braces in the administrative area (\$50), for a total of \$300.

Account	Debit	Credit
Factory Overhead	150	
Selling Expenses	100	
Administrative Expenses	50	
Wages Payable		300

Recording an expense in and out of the factory

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Selling Expenses* is an **expense** account that is **increasing**
- ▲ *Administrative Expenses* is an **expense** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

3. The company pays cash for one of its utility bills for \$350. Of this total, \$200 is a factory expense, \$100 is a selling expense, and \$50 is an administrative expense, for a total of \$350.

Account	Debit	Credit
Factory Overhead	200	
Selling Expenses	100	
Administrative Expenses	50	
Cash		350

Recording an expense in and out of the factory

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Selling Expenses* is an **expense** account that is **increasing**
- ▲ *Administrative Expenses* is an **expense** account that is **increasing**
- ▼ *Cash* is an **asset** account that is **decreasing**

4. The company receives an invoice for repair to the building. Half of that is a factory expense, \$60 is a selling expense, and \$40 is an administrative expense, for a total of \$200.

Account	Debit	Credit
Factory Overhead	100	
Selling Expenses	60	
Administrative Expenses	40	
Accounts Payable		200

Recording an expense in and out of the factory

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Selling Expenses* is an **expense** account that is **increasing**
- ▲ *Administrative Expenses* is an **expense** account that is **increasing**
- ▲ *Accounts Payable* is a **liability** account that is **increasing**

5. Prepaid insurance that the company paid in advance has expired, as follows: factory expense, \$50; selling expense, \$60; and administrative expense, \$40.

Account	Debit	Credit
Factory Overhead	50	
Selling Expenses	60	
Administrative Expenses	40	
Prepaid Insurance		150

Recording an expense in and out of the factory

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Selling Expenses* is an **expense** account that is **increasing**
- ▲ *Administrative Expenses* is an **expense** account that is **increasing**
- ▼ *Prepaid Insurance* is an **asset** account that is **decreasing**

6. The company records depreciation on factory equipment (\$70), sales equipment (\$20), and equipment used for administrative purposes (\$10), for a total of \$100.

Recording an expense in and out of the factory

Account	Debit	Credit
Factory Overhead	50	
Depreciation Expenses - Selling	60	
Depreciation Expenses - Administrative	40	
Accumulated Depreciation		150

- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Selling Expenses* is an **expense** account that is **increasing**
- ▲ *Administrative Expenses* is an **expense** account that is **increasing**
- ▲ *Accumulated Depreciation* is a **contra asset** account **increasing**

## 2.3 JOB ORDER COSTING FOR A SERVICE COMPANY

Job order costing is also used for service businesses where the service and costs are unique to each customer, such as those of an attorney, accountant, physician, or event planner. Each customer, client, or patient is a separate job or project. Clients, customers, and patients incur direct costs, direct labor and applied overhead costs. And while there are no materials related to inventory for a service business, there may be expenditures associated directly with a particular project, such as travel or supplies.

### 2.3.1 Comprehensive Example of Job Order Costing Transactions for a Service Company

Creative Compton, Inc. is an advertising agency that designs web sites and promotional materials for medium-sized businesses. For each client project, Creative Compton accumulates the direct labor costs of its professional designers at an hourly rate of \$140. The company allocates overhead costs to jobs at a rate of 35% of total direct labor cost incurred. Creative Compton, Inc. earns a 60% profit on each job.

Journalize the journal entries for the direct labor, the overhead, the sale of the project, and the reconciliation of actual to estimated overhead.

1. Job 4 incurs 20 hours of professional direct labor time (20 hours x \$140 per hour).

Account	Debit	Credit
Development Costs	2,800	
Wages Payable		2,800

- ▲ *Development Costs* is an **asset** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

2. The company pays cash for the following costs that are directly related to Job 4: travel, \$340; supplies, \$60; and domain name filing fees, \$120.

Account	Debit	Credit
Development Costs	520	
Cash		520

- ▲ *Development Costs* is an **asset** account that is **increasing**
- ▼ *Cash* is an **asset** account that is **decreasing**

3. Estimated overhead costs incurred for Job 4 are \$980. (\$2,800 direct wages cost x 35%)

Account	Debit	Credit
Development Costs	980	
Overhead		980

- ▲ *Development Costs* is an **asset** account that is **increasing**
- ▼ *Overhead* is an **expense** account that is **decreasing**

4. A customer is invoiced for the completed Job 4.

Account	Debit	Credit
Accounts Receivable	6,880	
Fees Earned		6,880
Cost of Service	4,300	
Development Costs		4,300

- ▲ *Accounts Receivable* is an **asset** account that is **increasing**
- ▲ *Sales* is a **revenue** account that is **increasing**
- ▲ *Cost of Services* is an **expense** account that is **increasing**
- ▼ *Development Costs* is an **asset** account that is **decreasing**

There are two journal entries for a sale. The first is to record the project’s selling price to the customer. The second is to reduce the development costs incurred and expense them off to *Cost of Services*.

Cost of the project: \$2,800 direct labor + \$520 direct costs + \$980 overhead costs = **\$4,300**

Selling price of the project: \$4,300 costs x 1.6 to include the markup = **\$6,880**

5. Actual overhead for Job 4 is ultimately determined to be \$960.

Too much factory overhead was applied in transaction #3

Account	Debit	Credit
Overhead	20	
Cost of Service		20

- ▲ *Overhead* is an **expense** account that is **increasing** that is **increasing**
- ▼ *Cost of Services* is an **expense** account **decreasing**

**In transaction #3**, recorded previously, **\$980** of overhead was applied to *Development Costs* based on an estimate of 35% of direct labor. The difference

between applied factory overhead and estimated factory overhead is \$20 (\$980 estimated - \$960 actual). Since too much had been applied, \$20 now needs to be backed out by debiting the *Overhead* account. *Cost of Services* is used as the credit account rather than *Development Costs* in reconciling the *Overhead* account.

# 3

## Process Costing

### 3.1 INTRODUCTION

Process costing is another method of keeping track of the costs of manufactured items. Once products are completed, their overall costs are marked up and sold at a profit to customers. Process costing is used when large quantities of identical items are manufactured in a continuous flow on a first-in, first-out basis. Examples of products that would use process costing are Cheerios brand cereal, iPhones, or Toyota Camrys.

Items enter production in batches rather than individually. A **batch** is defined as each time a quantity of materials is added to the first point of production to keep the work flow going. Direct costs accumulate and indirect costs are applied to the batches as they move through the production processes. A **unit** is one of the products that is manufactured in a batch. Eventually, costs are averaged over the units produced during the period to determine the cost of one item.

With process costing, products typically move from department to department in a “production line” format instead of the materials and labor coming to the product at one location (as is typically the case in job order costing, where each product is unique). Each department performs a different function and can be considered its own little business or mini-factory. As such, each department adds its own direct materials, direct labor, and factory overhead costs. These three costs accumulate in a departmental account called *Work in Process – Department Name*, which is like the “tab” of the manufactured item. There will be three debits to *Work in Process* for each department - one for direct materials, one for direct labor, and one for factory overhead.

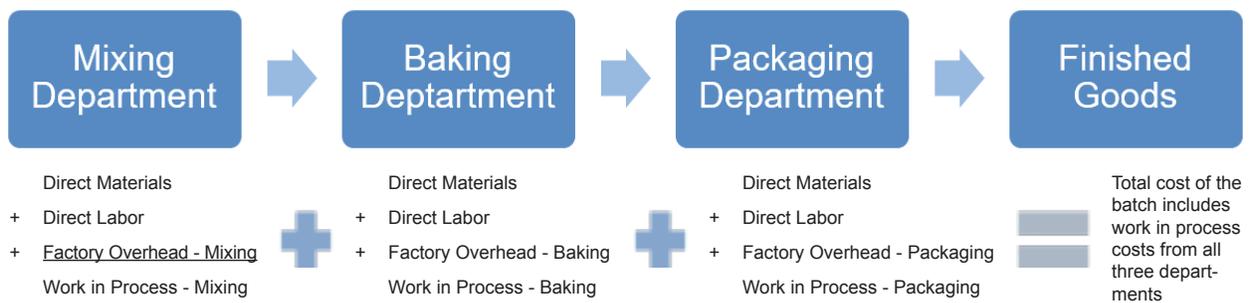
As an example, a company manufactures the 16” chocolate chip cookies (yum!) similar to those in the cookie shops in the malls. The company’s factory has three departments: (1) Mixing, (2) Baking, and (3) Packaging. The products move through these departments in order: Mixing first, Baking next, and Packaging last. The process occurs on a FIFO (first in, first out) basis where the first batch started is the first one to be completed. The batch started behind the first batch is the next to be completed, and so forth. Each time the Mixing Department adds more ingredients, a new batch is introduced into the overall production line.

Process costing involves recording product costs for each manufacturing department (or process) as the product moves through. Each department has its

own *Work in Process* and *Factory Overhead* accounts that include the department names, as follows:

<b>Department</b>	<b>Work in Process account</b>	<b>Factory Overhead account</b>
Mixing	<i>Work in Process – Mixing</i>	<i>Factory Overhead – Mixing</i>
Baking	<i>Work in Process – Baking</i>	<i>Factory Overhead – Baking</i>
Packaging	<i>Work in Process – Packaging</i>	<i>Factory Overhead – Packaging</i>

The batch moves from one department to the next. Materials, labor, and factory overhead costs are added in each department. The sum of the departmental work in process costs is the total cost of the batch that is transferred to *Finished Goods*.



### 3.2 PROCESS COSTING TRANSACTIONS FOR A MANUFACTURING COMPANY

Cost accumulation in each department and the transfer from one department to the next is recorded using the following series of journal entries.

#### MIXING DEPARTMENT

A batch begins in the Mixing Department when materials are added.

1. Direct materials - ingredients such as flour, eggs, sugar, and (of course) chocolate chips - that cost \$4,600 and indirect materials that cost \$400 are requisitioned.

Account	Debit	Credit
Work in Process – Mixing Dept.	4,600	
Factory Overhead – Mixing Dept.	400	
Materials		5,000

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

- Direct labor - workers combining ingredients, hand stirring the batter, and operating the mixers - costs \$2,100 and indirect labor for general factory use costs \$200.

Account	Debit	Credit
Work in Process – Mixing Dept.	2,100	
Factory Overhead – Mixing Dept.	200	
Wages Payable		2,300

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

- Factory overhead of \$1,000 is applied on an estimated basis so that the batch absorbs a proportionate share of the department’s general factory costs, such as utilities, insurance, and supervisor salary.

Account	Debit	Credit
Work in Process – Mixing Dept.	1,000	
Factory Overhead – Mixing Dept.		1,000

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

Notice there are three debits to *Work in Process - Mixing* for the three costs of manufacturing in Mixing. These three debits total \$7,700 (\$4,600 + \$2,100 + \$1,000).

Once the batch is mixed, there is nothing more the Mixing Department can do; in terms of mixing, the product is complete. The mixed batch is then sent off to the Baking Department by crediting *Work in Process - Mixing* (decreasing that asset account) and debiting *Work in Process - Baking* (increasing that asset account) for \$7,700.

- Transfer from the Mixing Department to the Baking Department, \$7,700

Account	Debit	Credit
Work in Process – Baking Dept.	7,700	
Work in Process – Mixing Dept.		7,700

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Work in Process* is an **asset** (inventory) account that is **decreasing**

(Although not illustrated here because our journal entries are only tracking the first batch, as the work in process is transferred from Mixing to Baking, a new batch of materials may be introduced into the Mixing Department to keep the flow of production continuous.)

**BAKING DEPARTMENT**

The batch is now in production in the Baking Department.

- 5. Direct materials - spray oil used to keep the cookies from sticking to the pans - that costs \$600 and indirect materials that cost \$300 are requisitioned.

Account	Debit	Credit
Work in Process – Baking Dept.	600	
Factory Overhead – Baking Dept.	300	
Materials		900

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

- 6. Direct labor - workers pressing the cookies onto sheets and operating machinery - costs \$1,400 and indirect labor for general factory use costs \$100.

Account	Debit	Credit
Work in Process – Baking Dept.	1,400	
Factory Overhead – Baking Dept.	100	
Wages Payable		1,500

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

- 7. Factory overhead of \$500 is applied on an estimated basis so that the batch absorbs a proportionate share of the department’s general factory costs, such as utilities, insurance, and supervisor salary.

Account	Debit	Credit
Work in Process – Baking Dept.	500	
Factory Overhead – Mixing Dept.		500

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

Notice there are four debits to *Work in Process – Baking*. One is for the cost transferred in from the Mixing Department; the others are the three costs of manufacturing added in the Baking Department. These four debits total \$10,200 (\$7,700 + \$600 + \$1,400 + \$500).

Once the batch is baked, there is nothing more the Baking Department can do; as far as what it is set up to do, the product is complete. So, it transfers the baked batch to the Packaging Department by crediting *Work in Process - Baking* (decreasing that asset account) and debiting *Work in Process - Packaging* (increasing that asset account) for \$10,200.

8. Transfer from the Baking Department to the Packaging Department, \$10,200

Account	Debit	Credit
Work in Process – Packaging Dept.	10,200	
Work in Process – Baking Dept.		10,200

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Work in Process* is an **asset** (inventory) account that is **decreasing**

**PACKAGING DEPARTMENT**

The batch is now in production in the Packaging Department.

9. Direct materials - boxes and packing materials - that cost \$1,100 and indirect materials that cost \$900 are requisitioned.

Account	Debit	Credit
Work in Process – Packaging Dept.	1,100	
Factory Overhead – Packaging Dept.	900	
Materials		2,000

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

10. Direct labor - workers hand packing and sealing shipping boxes - costs \$3,000 and indirect labor for general factory use costs \$700.

Account	Debit	Credit
Work in Process – Packaging Dept.	3,000	
Factory Overhead – Packaging Dept.	700	
Wages Payable		3,700

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Factory Overhead* is an **expense** account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

11. Factory overhead of \$900 is applied on an estimated basis so that the batch absorbs a proportionate share of the department’s general factory costs, such as utilities, insurance, and supervisor salary.

Account	Debit	Credit
Work in Process – Packaging Dept.	900	
Factory Overhead – Packaging Dept.		900

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

Notice there are four debits to *Work in Process – Packaging*. One is for the cost transferred in from the Baking Department; the others are the three costs of

manufacturing in Packaging. These four debits total \$15,200 (\$10,200 + \$1,100 + \$3,000 + \$900).

**TRANSFER FROM PACKAGING DEPARTMENT TO FINISHED GOODS**

Once the batch is packed in boxes, there is nothing more the Packaging Department can do; the product is entirely complete. The packaged batch is transferred to *Finished Goods* at the overall accumulated cost of \$15,200.

12. Transfer from the Packaging Department to *Finished Goods*, \$15,200

Account	Debit	Credit
Finished Goods	15,200	
Work in Process – Packaging Dept.		15,200

- ▲ *Finished Goods* is an **asset** (inventory) account that is **increasing**
- ▼ *Work in Process* is an **asset** (inventory) account that is **decreasing**

The manufactured goods accumulate costs all throughout the production process. Each batch picks up materials cost, direct labor cost, and factory overhead cost in each of the three departments. The total of all these costs equals the total cost of producing the batch. Determining the cost of the batch and the cost of each unit in the batch is the goal of process costing.

The process costing journal entries illustrate the cost accumulation process through the three *Work in Process* accounts all the way through to *Finished Goods*.

There are other process costing transactions that are similar to those for job order costing. A process costing manufacturer would also purchase materials on account, record numerous factory expenses by debiting *Factory Overhead* (in a specific department), sell goods on account and recognize a corresponding reduction of finished goods inventory, and account for over applied and under applied factory overhead amounts. Examples of these transactions are shown under the Job Order Costing topic and will not be repeated here. The only difference between the two methods is that under process costing the department name must be included whenever a *Factory Overhead* account is used.

**TRACKING PRODUCT COSTS**

There are three departments in the cookie factory example, and each one operates independently and does its own accounting. Assuming the company prepares monthly financial statements, each department must provide monthly information about its inventory for the balance sheet. We will now just look at the recordkeeping that occurs in a single department for a one-month period.

We will now focus only on the **Packaging Department** in the month of **May**. Assume you are the Packaging Department manager. You are responsible for keeping track of the cost of every unit that has been started and passes through your department during the month, whether the units have been finished by the

end of May or not. For those units that have been completed, you must figure the total cost of each batch and the cost of each unit in the batch. For those units that are in production but not yet completed by the end of the month, you must determine the cost to date of that batch and each unit in the batch.

We will make two assumptions: (1) All materials that are needed to work on a batch of items in a department are added when the batch is started; (2) When a batch is started in the department, it will either be completed in the same month or completed in the following month.

Remember that there are three costs of a manufactured item: direct materials, direct labor, and factory overhead. **Conversion costs** are simply direct labor PLUS factory overhead. For process costing, the two costs of a manufactured item will be referred to as direct materials and conversion costs.

### ANALOGY

There are three departments in this factory. If you are the manager of the Packaging Department, your responsibility is limited to tracking the costs of the units in your department, but not in any of the other departments. The other departments have their own managers to take care of accounting for their costs. You don't have to keep track of the cost of every item in EVERY department - just your own.

Similarly, as a university professor, I have to report final course grades for the 160 students in my four classes. During the semester I record exam, homework, and project grades for my students, and from those I mathematically calculate each student's final course grade. It is my responsibility to do this for every student in my classes, but I do not have to calculate the final course grades for all students in all classes at the university!

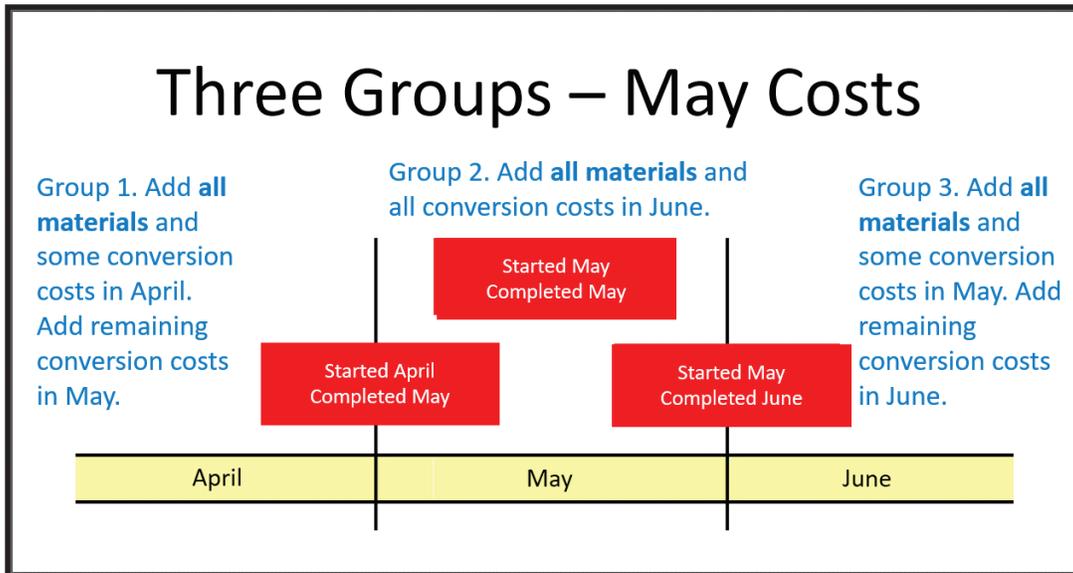
In a process costing system, both the cost of units transferred out of each department and the cost of any partially completed units remaining in the department must be determined.

In each department, we determine both the **total** and **per-unit** costs of the products that were **completed** in a given month. These completed units are classified into two groups: those started in the previous month and those started in the current month. The per-unit cost is not necessarily the same in the two groups, and any difference may be analyzed to see if unit cost is decreasing (typically favorable) or increasing (unfavorable) over time.

We also accumulate costs for a third group of products: those started in the current month but not completed by the end of the month. Their costs include 100% of the materials cost and a percentage below 100% of the conversion costs based on how complete they are to date. This third group, not finished by the end

of the current month, becomes the beginning work in process for the next month, when the remaining conversion will take place to complete them.

The following timeline illustrates the flow of product from month to month.



### 3.3 PROCESS COSTING CALCULATIONS FOR A DEPARTMENT IN A MANUFACTURING COMPANY

Goals of process costing are to determine a manufacturing department’s cost of finished goods during a month and the cost of work in process at the end of that month. An example of the process follows.

Information for production in the **Packaging Department** for **May** is as follows:

Beginning work in process, May 1: 5,900 units, 20% completed (1)	\$102,896
Direct materials costs in May for 44,700 units	599,427
Direct labor costs incurred in May	589,323
Factory overhead costs incurred in May	314,601
Work completed in May: 43,300 units	
Ending work in process, May 31: 7,300 units, 30% completed (3)	

A grid is used to organize the unit (not dollar) information above and to calculate key amounts.

The first step is to classify the units into one of three groups in the **whole units** column based on when they were started and completed according to the information given.

Group	Whole Units	Equivalent Units of Production for Materials	Equivalent Units of Production for Conversion Costs
(1) Started in April; Completed in May	(1) 5,900		
(2) Started in May; Completed in May	(2) 37,400		
(3) Started in May; Completed in June	(3) 7,300		
TOTAL	(4) 50,600		

(1) Group 1 consists of 5,900 (given) units started the previous month and completed this month.

(2) Group 2 includes 37,400 units that are both started and completed this month. This amount must be calculated in one of two ways.

- a. Total completed in May (43,300) minus those started in April (5,900) = 37,400
- b. Total started in May (44,700) minus those not completed in May (7,300) = 37,400 (Remember the assumption that the job is started when materials are added.)

(3) Group 3 has 7,300 (given) units started this month to be completed next month.

(4) Total whole units equals the sum of the whole units in the three groups:

$$5,900 + 37,400 + 7,300 = 50,600$$

The second step is to classify the units into one of three groups in the **equivalent units of production for materials** column based on when they were started and completed according to the information given. Remember the assumption is that materials are added when a batch is started. Equivalent units of production for materials equals the number of units in each group that had materials added in May.

Group	Whole Units	Equivalent Units of Production for Materials	Equivalent Units of Production for Conversion Costs
(1) Started in April; Completed in May	(1) 5,900	(5) 0	
(2) Started in May; Completed in May	(2) 37,400	(6) 37,400	
(3) Started in May; Completed in June	(3) 7,300	(7) 7,300	
TOTAL	(4) 50,600	(8) 44,700	

The first group was started in April, so none of the whole units had materials added in May (all were added in April, when started). The second and third groups were started in May, so all of the whole units had materials added in May.

- (5) Group 1: The equivalent units of production for materials is zero.
- (6) Group 2: The equivalent units of production is the same as the whole units amount, 37,400.
- (7) Group 3: The equivalent units of production is the same as the whole units amount, 7,300.
- (8) Total materials equals the sum of the materials in the three groups.

**Calculation: 0 + 37,400 + 7,300 = 44,700**

The third step is to classify the units into one of three groups in the **equivalent units of production for conversion costs** (direct labor and factory overhead) column based on when they were started and completed according to the information given.

Group	Whole Units	Equivalent Units of Production for Materials	Equivalent Units of Production for Conversion Costs
(1) Started in April; Completed in May	(1) 5,900	(5) 0	(9) 4,720
(2) Started in May; Completed in May	(2) 37,400	(6) 37,400	(10) 37,400
(3) Started in May; Completed in June	(3) 7,300	(7) 7,300	(11) 2,190
TOTAL	(4) 50,600	(8) 44,700	(12) 44,310

Equivalent units of production for conversion costs uses the percentages of conversion costs completed in May that are given to mathematically convert partial units to whole units for costing purposes. The equivalent units of production for conversion costs equals the number of whole units times the percentage of conversion that takes place in May.

- (9) Group 1: The units were already 20% complete at the beginning of May, so the remaining 80% of the conversion costs are incurred in May.

**Calculation: 5,900 x 80% = 4,720**

- (10) Group 2: These units are started and completed in May, so 100% of the conversion costs takes place in May.

**Calculation: 37,400 x 100% = 37,400**

(11) Group 3: Only 30% of the conversion costs takes place in May. The remaining conversion will take place in June.

$$\text{Calculation: } 7,300 \times 30\% = 2,190$$

(12) Total equivalent units of production for conversion costs equals the sum of the three groups.

$$\text{Calculation: } 4,720 + 37,400 + 2,190 = 44,310$$

### EXAMPLE

Think of equivalent units of production for conversion costs like this. You have 8 one-gallon buckets in your backyard. It starts to pour rain. When the rain stops, you go out and see that each bucket is  $\frac{3}{4}$  full. Mathematically you can convert this to say that the same amount of water would make 6 of the buckets 100% full ( $8 \times \frac{3}{4}$ ). It is highly unlikely that it would rain in such a way that only one bucket would fill at a time. But after the rain stopped, you could empty two of the buckets by filling the other six.

(If you had to carry the water a mile and could only carry two buckets at a time, combining them would save you one trip! You would only have to go three times rather than four!)

The following dollar amounts should now be calculated from the information given, as follows:

- Total conversion costs in May

**Calculation:**

$$\$589,323 \text{ (direct labor)} + \$314,601 \text{ (factory overhead)} = \$903,924$$

- Conversion cost per equivalent unit

**Calculation:**

$$\$903,924 \text{ total conversion cost} / 44,310 \text{ equivalent units} = \$20.40 \text{ per unit}$$

- Materials cost per unit started in May

**Calculation:**

$$\$599,427 \text{ total materials cost} / 44,700 \text{ units started} = \$13.41 \text{ per unit}$$

- Cost per unit of work in process on May 1 (100% of materials + 20% of conversion costs)

**Calculation:**

$$\$102,896 \text{ total work in process cost} / 5,900 \text{ units started} = \$17.44 \text{ per unit}$$

In a process costing system, the cost of units transferred out of each department must be determined as well as the cost of any partially completed units remaining in the department. Based on the previous calculations, the following seven cost results can be determined. These amounts are the goals of process costing and can be used to determine progress and for comparison purposes over time.

1. Cost per unit of finished goods started in April and completed in May  
**Calculation:  $\$17.44 + (\$20.40 \times 80\%) = \$17.44 + \$16.32 = \$33.76$**
  
2. Total cost of all finished goods started in April and completed in May  
**Calculation:  $\$33.76$  (from #1)  $\times$  5,900 whole units = \$199,184**
  
3. Cost per unit of finished goods started and completed in May  
**Calculation:  $\$13.41 + \$20.40 = \$33.81$**
  
4. Total cost of all finished goods started and completed in May  
**Calculation:  $\$33.81$  (from #2)  $\times$  37,400 whole units = \$1,264,494**
  
5. Cost per unit of the work in process inventory on May 31  
**Calculation:  $\$13.41 + (\$20.40 \times 30\%) = \$19.53$**
  
6. Total cost of the work in process inventory on May 31  
**Calculation:  $\$19.53$  (from #3)  $\times$  7,300 whole units = \$142,569**
  
7. Total cost of units transferred to Finished Goods  
**Calculation:  $\$199,184 + \$1,264,494 = \$1,463,678$**

The following journal entries relate to the production activity for the Packaging Department in May.

1. Direct materials costs incurred for 44,700 units, \$599,427 (given)

Account	Debit	Credit
Work in Process – Packaging Dept.	599,427	
Materials		599,427

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Materials* is an **asset** (inventory) account that is **decreasing**

2. Direct labor costs incurred, \$589,323 (given)

Account	Debit	Credit
Work in Process – Packaging Dept.	589,323	
Wages Payable		589,323

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▲ *Wages Payable* is a **liability** account that is **increasing**

3. Factory overhead applied, \$314,601 (given)

Account	Debit	Credit
Work in Process – Packaging Dept.	314,601	
Factory Overhead – Packaging Dept.		314,601

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

4. Transfer of completed products to *Finished Goods*, \$1,463,678

Account	Debit	Credit
Finished Goods	1,463,678	
Work in Process - Packaging Dept.		1,463,678

- ▲ *Finished Goods* is an **asset** (inventory) account that is **increasing**
- ▼ *Work in Process* is an **asset** (inventory) account that is **decreasing**

The *Work in Process - Packaging* ledger account summarizes these transactions and balances.

Work in Process – Packaging Department					
Date	Item	Debit	Credit	Debit	Credit
1.	Beginning work in process, May 1			102,896	
2.	Materials added to production in May	599,427		702,323	
3.	Labor added to production in May	589,323		1,291,646	
4.	Overhead added to production in May	314,601		1,606,247	
5.	Transferred to <i>Finished Goods</i>		1,463,678	142,569	

# 4

## Activity-Based Costing

### 4.1 INTRODUCTION

Companies must accurately determine the costs of their products and services to make sound management decisions, such as determining their selling prices to customers. A manufacturer's product costs consist of direct materials, direct labor, and factory overhead. The materials and labor are direct costs that can be identified and traced to the product. Factory overhead, however, are indirect and must be allocated to the product cost on an estimated basis.

We have already looked at applying factory overhead to work in process using a predetermined factory overhead rate in the discussion of job order costing. We used a single factory overhead rate based on direct labor hours, total direct labor, or machine hours.

The following journal entry is an example of allocating \$2,100 of factory overhead to work in process.

Account	Debit	Credit
Work in Process	2,100	
Factory Overhead		2,100

▲ *Work in Process* is an **asset** (inventory) account that is **increasing**

▼ *Factory Overhead* is an **expense** account that is **decreasing**

The issue we address now is how precise the estimate of \$2,100 actually is. Three different ways of allocating factory overhead will be looked at, as follows:

1. Single factory-wide rate – the same rate based on the same activity base for all departments
2. Departmental rates – different rates for different departments, but a single rate within a department
3. Activity-based costing – different rates for different processes and activities, regardless of department

An example of two different orders of custom wood furniture will be used to illustrate the three methods. Both the direct materials and direct labor costs are

known for each job; only the factory overhead must be estimated. Assume jobs are manufactured in a factory with two departments, Cutting and Assembly.

### 4.2 SINGLE FACTORY RATE TO ESTIMATE FACTORY OVERHEAD

A single predetermined rate may be used to estimate factory overhead in all departments. The following amounts are given. Estimated factory overhead is based on number of direct labor hours used.

Total budgeted factory overhead costs for the year	\$546,000
Total budgeted direct labor hours	3,000

The factory overhead rate is \$182 per direct labor hour, determined as follows.

$$\frac{\text{Total budgeted factory overhead}}{\text{Total budgeted activity base}} = \frac{\$546,000}{3,000} = \$182$$

If 300 direct labor hours are used for the two jobs as follows, total estimated factory overhead is \$54,600.

Job 1:	210 hours	x	\$182 per direct labor hour	=	\$38,220
Job 2:	90 hours	x	\$182 per direct labor hour	=	16,380
					Total
					\$54,600

The journal entry to apply factory overhead of \$54,600 to the jobs is as follows:

Account	Debit	Credit
Work in Process	54,600	
Factory Overhead		54,600

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

Rather than direct labor hours, machine hours, percentage of direct labor, or other relevant activity base could be used to estimate factory overhead.

The single factory-wide rate is relatively simple to apply, but it assumes the same rate across all departments, each of which performs different functions. It also assumes all products consume factory overhead at the same rate. This “one-size-fits-all” approach may not be as accurate as other more targeted methods of estimating.



	Single Factory	Departmental
Job 1:	\$38,220	\$38,625
Job 2:	16,380	15,975

Using departmental rates is more job-specific and therefore results in a more precise allocation of factory overhead to the jobs than the single rate. However, it takes a bit more effort to calculate vs. using the single factory rate that is applied to all jobs uniformly.

## 4.4 ACTIVITY-BASED COSTING FOR A MANUFACTURING BUSINESS TO ESTIMATE FACTORY OVERHEAD

### EXAMPLE 1

Recall that the simplest method for estimating factory overhead is to use the same predetermined rate in all departments, for all activities, and for all products in a manufacturing facility. Two amounts must be estimated for the calculation, as follows:

$$\frac{\text{Total budgeted factory overhead}}{\text{Total budgeted activity base}} \quad (\text{such as direct labor hours, machine hours, etc.})$$

The single factory overhead rate is a very loose estimate because it relies on one fixed dollar amount to assign factory overhead costs across the many facets, various segments, and different activities involved in the manufacturing process. It is unlikely that one rate can capture all the diversity of what goes on in a factory with reliable precision.

**Activity-based costing (ABC)** is a more specific and more accurate way of assigning factory overhead to manufactured goods versus using single factory or departmental rates. An activity is a unit of work that consumes resources when performed by a company. A cost object (in the case of manufacturing, the item produced) is the target of the activity. Cost objects include products, jobs, services, projects, clients, patients, customers, and contracts.

In a factory, ABC identifies activities within the manufacturing process that occur repeatedly, such as purchasing, production scheduling, setups, moves, inspections, testing, clean-ups, and invoicing. Each activity has its own activity base to measure usage. The following list matches common activities of a manufacturing company with their respective activity bases.

Accounting reports	Number of accounting reports
Customer return processing	Number of customer returns
Electric power	Kilowatt hours used
Human resources	Number of employees
Inventory control	Number of inventory transactions
Invoice and collecting	Number of customer orders
Machine depreciation	Number of machine hours
Materials handling	Number of material moves
Order shipping	Number of customer orders
Payroll	Number of payroll checks processed
Production control	Number of production orders
Production setup	Number of setups
Purchasing	Number of purchase orders
Quality control	Number of inspections
Sales order processing	Number of sales orders

A factory overhead rate for each routinely-performed activity is calculated by dividing the total budgeted cost amount for the activity for a period by the budgeted activity base quantity over the same time frame. The fraction for each activity is similar to the one used for the predetermined single factory rate, except at a more micro level.

There may still be some factory overhead costs that are not associated with any particular activity for the cutting and assembly processes. These may include factory expenses such as utilities, maintenance, insurance, and depreciation. These general overhead costs must be applied to jobs on an estimated (or “budgeted”) basis. In this example, machine hours and direct labor hours will be used as the activity base for cutting and assembly, respectively. Factory overhead amounts for the cutting and assembly processes will be less than those under the single rate or departmental rate methods since the costs for identifiable activities have already been separated out.

The following information lists a company’s six production activities and a fraction for each that is used to determine the activity rate in the right column. The denominator for each fraction is the activity base used. The amounts in the Calculation column are estimates that are given, presumably prepared by management using available company data.

Activity	Fraction	Calculation	Activity Rate
Setups	Budgeted total cost of setups	\$1,700	\$ 50 per setup
	Budgeted number of setups	34	
Moves	Budgeted total cost of moves	\$450	\$ 15 per move
	Budgeted number of moves	30	
Inspections	Budgeted total cost of inspections	\$7,500	\$ 25 per inspection
	Budgeted number of inspections	300	
Clean-ups	Budgeted total cost of clean-ups	\$1,450	\$10 per cleanup
	Budgeted number of clean-ups	145	
Cutting	Budgeted total general cutting costs	\$39,000	\$30 per machine hour
	Budgeted machine hours	1,300	
Assembly	Budgeted total general assembly costs	\$4,500	\$15 per direct labor hour
	Budgeted direct labor hours	300	

The following example will illustrate ABC for estimating factory overhead for a custom furniture manufacturer whose production takes place in its Cutting and Assembly departments. Identifiable activities include setups, moves, inspections, and cleanups.

The company uses ABC to estimate factory overhead for two jobs. Job 1 is a batch of 300 identical nine-drawer wood dressers. Job 2 is a batch of 160 identical free-standing wood clothing closets.

The usage amounts of these activities for each job are given in the following table. For each job, the number of times each activity occurs is multiplied by the overhead rate for that activity. The sum of all the activity costs is the amount of factory overhead applied to the job.

Activity	Activity Rate (calculated above)	Dresser Usage	Dresser Costs	Closet Usage	Closet Costs
Setups	\$50 per setup	24 setups	\$50 x 24 = \$1,200	10 setups	\$50 x 10 = \$500
Material transfers	\$15 per move	20 moves	\$15 x 20 = 300	10 moves	\$15 x 10 = 150
Inspections	\$25 per inspection	140 inspections	\$25 x 140 = 3,500	160 inspections	\$25 x 160 = 4,000
Cleanups	\$10 per cleanup	85 cleanups	\$10 x 85 = 850	60 cleanups	\$10 x 60 = 600
Cutting	\$30 per machine hour (mh)	950 mh	\$30 x 950 = 28,500	350 mh	\$30 x 350 = 10,500
Assembly	\$15 per direct labor hour (dlh)	210 dlh	\$15 x 210 = 3,150	90 dlh	\$15 x 90 = 1,350
			\$ 37,500		\$17,100

The journal entry to apply factory overhead of \$54,600 (\$37,500 + \$17,100) to the two jobs using ABC is as follows:

Account	Debit	Credit
Work in Process	54,600	
Factory Overhead		54,600

- ▲ *Work in Process* is an **asset** (inventory) account that is **increasing**
- ▼ *Factory Overhead* is an **expense** account that is **decreasing**

## 4.5 DIFFERENCES BASED ON FACTORY OVERHEAD METHOD

Although the total factory overhead applied, \$54,600, is the same for all three methods, how it is allocated between the two jobs varies by method, as follows:

	Single Factory	Departmental	ABC Costing
Job 1:	\$38,220	\$38,625	\$37,500
Job 2:	<u>16,380</u>	<u>15,975</u>	<u>17,100</u>
Total	\$54,600	\$54,600	\$54,600

ABC is the most specific strategy because it analyzes identifiable activities closely, resulting in more precise estimates of many of the elements of overall factory overhead. The results of the other two methods in the sample problem would overstate the amount of factory overhead that is applied to Job 1 and understate the amount for Job 2. When making decisions, such as determining a product’s selling price, it is critical to have sound cost information.

## 4.6 ACTIVITY-BASED COSTING FOR A MANUFACTURING BUSINESS TO ESTIMATE FACTORY OVERHEAD

### EXAMPLE 2

Speed Rider, Inc. manufactures golf carts and go karts. The company budgeted \$562,000 for the year for factory overhead and assigned it to four activities: fabrication, \$195,000; assembly, \$160,000; setup, \$138,000; and inspection, \$84,000. The company plans to produce 500 golf carts and 700 go karts during the year.

The activity-base usage quantities for each product by each activity are as follows:

	Fabrication	Assembly	Setup	Inspection
Golf cart	1,800 dlh	1,600 dlh	200 setups	700 inspections
Go kart	1,200	2,400	400	500

Determine the activity-based factory overhead **per unit** for each product.

1. Calculate the rate for each activity

Fabrication	$\$195,000 / (1,800 + 1,200) =$	\$65 per direct labor hour
Assembly	$\$160,000 / (1,600 + 2,400) =$	\$40 per direct labor hour
Setup	$\$138,000 / (200 + 400) =$	\$230 per setup
Inspection	$\$84,000 / (700 + 500) =$	\$70 per inspection

2. Calculate the total overhead for each vehicle by adding its four overhead costs.

<b>Golf cart</b>	(\$65 x 1,800 dlh)	+	(\$40 x 1,600 dlh)	+	(\$230 x 200 setups)	+	(\$70 x 700 inspections)		
	\$117,000		\$64,000		\$46,000		\$49,000	=	<b>\$276,000</b>
<b>Go kart</b>	(\$65 x 1,200 dlh)	+	(\$40 x 2,400 dlh)	+	(\$230 x 400 setups)	+	(\$70 x 500 inspections)		
	\$78,000		\$96,000		\$92,000		\$35,000	=	<b>\$301,000</b>

3. Calculate the overhead per vehicle by dividing total cost for all units by the number of units budgeted.

<b>Golf cart</b>	\$276,000 / 500 units	=	<b>\$552</b>	factory overhead per jet ski
<b>Go kart</b>	\$301,000 / 700 units	=	<b>\$430</b>	factory overhead per snowmobile

### 4.7 ACTIVITY-BASED COSTING FOR A SERVICE BUSINESS TO ESTIMATE FACTORY OVERHEAD

Service businesses may also use activity-based costing to allocate general overhead costs to clients, patients, and guests, also by estimating costs of activities based on their use of resources, and assigning costs to customers based on their use of activities.

A hospital, for example, might identify the following activities whose general costs must be shared among patients. Each activity rate is estimated based on the activity’s budgeted overhead cost for the year divided by the number of occurrences expected during the year. For each patient stay, the number of times each activity occurs is multiplied by the overhead rate for that activity. The sum of all the activity costs is the amount of overhead applied to the cost of servicing the patient.

ABC costing for a patient’s six-day stay in a hospital is summarized in the following table.

Activity	Activity Rate (estimated)	Patient usage	Patient Costs
Admissions	\$70 per admission	1 admission	\$70 x 1 = \$70
Operating room use	\$900 per hour	4 hours	\$900 x 4 = 3,600
Dispensing medications	\$25 per administration	3 times per day / 6 days	\$25 x 3 x 6 = 450
Radiology testing	\$290 per image	2 images	\$290 x 2 = 580
Diagnostic lab	\$150 test	6 tests	\$150 x 6 = 900 = 900
Medical assistance	\$20 per visit	6 visits per day / 6 days	\$20 x 6 x 6 = 720
Cleaning and laundry	\$80 per day	6 days	\$80 x 6 = 480
Discharge	\$100 per discharge	1 discharge	\$100 x 1 = 100
			<b>TOTAL \$6,900</b>

A total of \$6,900 of overhead costs is associated with this patient’s hospital stay.

ABC increases the accuracy of allocating overhead by budgeting multiple targeted activities that can be estimated more precisely than relying on one

general overhead rate that applies to all overhead in a business. This more granular approach also gives companies better insight into ways to control the cost of a product, such as reducing the time it takes to perform an activity or decreasing the number of times an activity occurs.

ABC helps managers, who already view costs by activity, and accountants communicate more effectively. “An activity-based system aligns organizational information with the business mission and operations rather than financial transactions. It tears down the barriers that segregate financial information from other information.”<sup>1</sup>

# 5

## Cost Volume Profit Analysis

### 5.1 INTRODUCTION

Businesses focus on profitability and look for ways to improve operational performance by analyzing projected or actual financial information. One relatively simple strategy is to look at cost behavior, which is how costs respond to changes in sales volume. Knowing how costs behave helps managers forecast operating income based on sales volume. This insight also helps managers estimate costs related to the decisions they make in the business.

### COST CLASSIFICATIONS

Costs are classified as variable, fixed, or mixed.

A **variable cost** is an expenditure directly associated with a sale. For each sale of a unit of product or service, one unit of variable cost is incurred.

The following are three examples. The sale of one manufactured desk for \$200 includes the direct materials and direct labor costs combined of \$100. The sale of one pizza for \$10 has the variable cost of \$3 for the cost of the ingredients. The rental of one room night at a hotel for \$80 has the variable cost \$5 for the guests' breakfast that is included. There is only a variable cost if there is sale. The more sales there are, the more total variable cost there is.

The following table illustrates the cost behavior of a variable cost using the pizza example.

Number of pizzas sold	Variable cost per pizza	Total variable cost for all pizzas sold
200	\$3	\$600
400	3	1,200
600	3	1,800
800	3	2,400

Variable cost behavior is summarized as follows:

1. Variable cost **per unit** is the same regardless of number of units sold  
Example: Regardless whether 200 or 800 pizzas are sold, the cost of making each pizza is \$3.

- 2. **Total** variable cost increases (or decreases) as the number of units sold increases (or decreases)

Example: Total variable cost is \$600 for 200 pizzas sold and increases to \$2,400 for 800 pizzas.

The more pizzas sold, the more the total variable cost is.

**Fixed costs** remain the same in terms of their total dollar amount, regardless of the number of units sold. These are general expenditures that cannot be traced to any one item sold and may include electricity, insurance, depreciation, salary, and rent expenses.

Fixed costs are considered within a relevant range. The costs remain the same regardless of the number of units sold until capacity has been reached, at which time the company cannot produce or sell any more without spending money for expansion. We will assume for our examples that the business is operating within its relevant range.

The following table illustrates fixed and variable cost behaviors using the pizza example.

Number of pizzas sold	Total fixed costs	Fixed cost per pizza	Variable cost per pizza	Total variable costs
200	\$480	\$2.40	\$3.00	\$600
400	480	1.20	3.00	1,200
600	480	0.80	3.00	1,800
800	480	0.60	3.00	2,400

- 1. **Total** fixed costs remain the same regardless of the level of sales.

Example: Regardless whether 200 or 800 pizzas are sold, total fixed cost is \$480.

- 2. Fixed cost **per unit** decreases (increases) as the number of units sold increases (decreases)

Example: Fixed cost per unit is \$2.40 for 200 pizzas sold and decreases to \$.60 each for 800 pizzas.

The term **leverage** relates to fixed costs in terms of their ability to generate sales. Since a company is committed to paying them, it wants to maximize the value from doing so. The goal is to “get the most bang for your buck” for the fixed amount the company must pay each period. Leverage is taking advantage of fixed costs to generate sales. The more sales, the better fixed costs have been leveraged.

The table that follows summarizes the cost totals for the four quantities/batches of pizza sold.

Number of pizzas sold (batch)	Total cost of the batch of pizzas	Cost per pizza using unit costs	Cost per pizza using total cost
200	\$600 + \$480 = \$1,080	\$2.40 + \$3.00 = \$5.40	\$1,080 / 200 pizzas = \$5.40
400	1,200 + 480 = 1,680	1.20 + 3.00 = 4.20	1,680 / 400 pizzas = 4.20
600	1,800 + 480 = 2,280	0.80 + 3.00 = 3.80	2,280 / 600 pizzas = 3.80
800	2,400 + 480 = 2,880	0.60 + 3.00 = 3.60	2,880 / 800 pizzas = 3.60

The total cost of a batch of pizzas equals total variable cost plus total fixed cost. The cost per pizza in each batch can be determined in two ways: (1) fixed cost per pizza plus variable cost per pizza or (2) total cost per batch divided by the number of pizzas in the batch. Both calculations produce the same result.

The batch of 800 units generates the most sales dollars from its fixed costs and therefore leverages them most effectively. The more highly leveraged, the lower the fixed cost per unit. In this case, the \$480 is spread over more units, so each unit picks up a lower amount of that \$480. And the lower the fixed cost per unit, the lower the total cost per unit, which is a desirable goal.

**Mixed costs** have both a fixed and a variable component. There is typically a base amount that is incurred even if there are no sales at all. There is also an incremental amount assigned to each unit sold.

The following are three examples of mixed costs. A prepaid cell phone plan might include a base rate of \$30 for 1G of data and \$5 for each additional 300 megabytes of data. A sales person might earn a base salary of \$25,000 per year plus \$3 for each unit of product he sells. Equipment rental may cost \$8,000 per year plus \$1 for each hour used over 10,000 hours.

For purposes of analysis, mixed costs are separated into their fixed and variable components. The high-low estimation method may be used to break out the costs by looking at the total sales in dollars and the total cost of those sales for several periods, such as months. The month with the highest activity level and the month with the lowest activity level are selected for the calculation.

The high-low method of separating costs is illustrated using the following information over a six-month period.

Month	Units sold	Total cost
January	1,400	\$52,700
February	2,100	61,200
March	<b>2,900 highest</b>	<b>69,800</b>
April	2,500	66,400
May	<b>1,100 lowest</b>	<b>48,200</b>
June	1,800	56,900

Since the fixed cost does not change with the number of sales, the difference between the total costs of the month with the most units sold (March) and the month with the fewest units sold (May) must be variable costs. Therefore, using data from these two months,

$$\begin{aligned} \text{Variable cost per unit} &= \text{Difference in total cost} / \text{Difference in units sold} \\ &= (69,800 - 48,200) / (2,900 - 1,100) \\ \text{Variable cost per unit} &= \$21,600 / 1,800 \text{ units sold} = \$12 \end{aligned}$$

Now that the variable cost per unit is known to be \$12, the fixed costs can be determined by used either the March (highest sales) or May (lowest sales) using the following equation:

$$\begin{aligned} &\text{Total cost} - \text{variable costs} = \text{fixed costs} \\ \text{March: } &\$69,800 - (\$12 \text{ per unit} \times 2,900 \text{ units sold}) = \$69,800 - \$34,800 = \$35,000 \\ \text{May: } &\$48,200 - (\$12 \text{ per unit} \times 1,100 \text{ units sold}) = \$48,200 - \$13,200 = \$35,000 \end{aligned}$$

The high-low method estimates that variable cost per unit is \$12 and fixed costs are \$35,000.

## 5.2 COST VOLUME PROFIT ANALYSIS (CVP)

Cost volume profit (CVP) analysis is a managerial accounting technique used to determine how changes in sales volume, variable costs, fixed costs, and/or selling price per unit affect a business's operating income. The focus may be on a single product or on a sales mix of two or more different products.

The results of these analyses help managers make informed decisions about products or services they sell, such as setting selling prices, selecting combinations of different products to sell, projecting profitability, and determining the feasibility of offering a product or service for sale.

The elements of CVP analysis are defined as follows:

- a. Selling price - the amount a customer pays to acquire a product or service
- b. Cost - the variable and fixed expenses involved in producing or selling a product or service
- c. Volume - the number of units or the amount of service sold
- d. Profit - the difference between the selling price of a product (or service) minus the costs to produce (or provide) it

The following assumptions are made when performing a CVP analysis.

1. All costs are categorized as either fixed or variable.
2. Sales price per unit, variable cost per unit and total fixed cost are constant. The only factors that affect costs are changes in activity.
3. All units produced are sold.

### 5.2.1 Contribution Margin

Managers must monitor a company’s sales volume to track whether it is sufficient to cover, and hopefully exceed, fixed costs for a period, such as a month. **Contribution margin** is useful in determining how much of the dollar sales amount is available to apply toward paying fixed costs during the period. Contribution margin is calculated at two different levels.

1. **Unit** contribution margin = selling price of one unit – variable cost of one unit
2. **Total** contribution margin = total sales – total variable costs

The following information relates to Jonick Company for the month of June:

Sales	1,000 units
Selling price per unit	\$25
Variable cost per unit	\$10
Fixed costs	\$8,000

1. **Unit** contribution margin = selling price of one unit – variable cost of one unit  

$$\mathbf{\$15 = \$25 - \$10}$$

The unit contribution margin is \$15, which is the \$25 sales price per unit minus the \$10 variable cost per unit. With each sale, \$15 is left after the variable cost is paid to go toward paying down the fixed costs.

2. **Total** contribution margin = total sales – total variable costs

$$\begin{array}{rclclcl}
 \$15 \times 1,000 \text{ units} & = & \$25 \times 1,000 \text{ units} & - & \$10 \times 10,000 \text{ units} & \\
 \mathbf{\$15,000} & = & \mathbf{\$25,000} & - & \mathbf{10,000} & 
 \end{array}$$

The total contribution margin is \$15,000 is the \$25,000 total sales amount minus \$10,000 in variable cost. The \$15,000 is available to pay the fixed costs. Since fixed costs are only \$8,000, there is operating income of \$7,000.

The following income statement information separates variable and fixed costs and is formatted to show the contribution margin.

Sales	\$25,000
Variable costs	<u>10,000</u>
Contribution margin	\$15,000
Fixed costs	<u>8,000</u>
Operating income	<u>\$7,000</u>

Contribution margin may also be expressed as a ratio, showing the percentage of sales that is available to pay fixed costs. The calculation is simply the contribution margin divided by sales. The same percentage results regardless of whether total or per unit amounts are used.

1. **Unit** contribution margin ratio =  $\frac{\text{selling price of one unit} - \text{variable cost of one unit}}{\text{selling price of one unit}} = \frac{\$25 - \$10}{\$25} = 60\%$
2. **Total** contribution margin =  $\frac{\text{total sales} - \text{total variable costs}}{\text{total sales}} = \frac{\$25,000 - \$10,000}{\$25,000} = 60\%$

The higher the percentage, the more of each sales dollar that is available to pay fixed costs. To determine if the percentage is satisfactory, management would compare the result to previous periods, forecasted performance, contribution margin ratios of similar companies, or industry standards. If the company’s contribution margin ratio is higher than the basis for comparison, the result is favorable.

The following three independent examples show the effects of increases in sale volume, selling price per unit, and variable cost per unit, respectively.

**EXAMPLE 1**

**Change in sales volume: effect on contribution margin ratio**

As the number of units sold increases, so does operating income when fixed costs are within their relevant range and remain the same. This is shown in the following two income statements with sales of 1,200 and 1,400 units, respectively.

1,200 units sold x \$25 selling price  
1,200 units sold x \$10 variable cost

Sales	\$30,000
Variable costs	12,000
Contribution margin	\$18,000
Fixed costs	8,000
Operating income	\$10,000

1,400 units sold x \$25 selling price  
1,400 units sold x \$10 variable cost

Sales	\$35,000
Variable costs	14,000
Contribution margin	\$21,000
Fixed costs	8,000
Operating income	\$13,000

$(30,000 - 12,000) / 30,000 = 60\%$  contribution margin

$(35,000 - 14,000) / 35,000 = 60\%$  contribution margin

Contribution margin remains at 60% regardless of the sales volume. As sales increase, variable costs increase proportionately.

**EXAMPLE 2**

**Change in selling price per unit: effect on contribution margin ratio**

Alternatively, if the selling price per unit increases from \$25 to \$30 per unit, both operating income and the contribution margin ratio increase as well. Variable cost per unit remains at \$10 and fixed costs are still \$8,000.

Original: \$25 x 1,000 = \$25,000 in sales

Revised: \$30 x 1,000 = \$30,000 in sales

Sales	\$25,000
Variable costs	<u>10,000</u>
Contribution margin	\$15,000
Fixed costs	<u>8,000</u>
Operating income	<u>\$7,000</u>

Sales	\$30,000
Variable costs	<u>10,000</u>
Contribution margin	\$20,000
Fixed costs	<u>8,000</u>
Operating income	<u>\$12,000</u>

$(25,000 - 10,000) / 25,000 = 60\%$  contribution margin

$(30,000 - 10,000) / 30,000 = 67\%$  contribution margin

The contribution margin ratio with the selling price increase is 67%. The additional \$5 per unit in unit selling price adds 7% to the contribution margin ratio.

**EXAMPLE 3**

**Change in variable cost per unit: effect on contribution margin ratio**

Finally, if the selling price per unit remains at \$25 and fixed costs remain the same, but unit variable cost increases from \$10 to \$15, total variable cost increases. As a result, the contribution margin and operating income amounts decrease.

Original: \$10 x 1,000 = \$10,000 in variable cost

Revised: \$15 x 1,000 = \$15,000 in variable cost

Sales	\$25,000
Variable costs	<u>10,000</u>
Contribution margin	\$15,000
Fixed costs	<u>8,000</u>
Operating income	<u>\$7,000</u>

Sales	\$25,000
Variable costs	<u>15,000</u>
Contribution margin	\$10,000
Fixed costs	<u>8,000</u>
Operating income	<u>\$2,000</u>

$(25,000 - 10,000) / 25,000 = 60\%$  contribution margin

$(25,000 - 15,000) / 25,000 = 40\%$  contribution margin

The contribution margin ratio with the unit variable cost increase is 40%. The additional \$5 per unit in the variable cost lowers the contribution margin ratio 20%.

Each of these three examples could be illustrated with a change in the opposite direction. A decrease in sales quantity would not impact the contribution margin

ratio. A decrease in unit selling price would also decrease this ratio, and a decrease in unit variable cost would increase it. Any change in fixed costs, although not illustrated in the examples, would not affect the contribution margin ratio.

### 5.3 BREAKEVEN POINT

The breakeven point is the number of units that must be sold to achieve an operating income of zero. At the breakeven point, sales in dollars equals costs. The breakeven calculation answers the question *How many units does the company have to sell to pay all its expenses for the month?*

This slightly revised information relates to Jonick Company for the month of June and will be used to illustrate the breakeven point.

Sales	1,000 units
Selling price per unit	\$18
Variable cost per unit	\$10
Fixed costs	\$8,000

The following income statement presents a breakeven situation.

Sales	\$18,000
Variable costs	<u>10,000</u>
Contribution margin	\$8,000
Fixed costs	<u>8,000</u>
Operating income	<u>\$0</u>

Note that the contribution margin of \$8,000, the amount available to cover fixed costs, equals the fixed costs amount of \$8,000. Therefore, operating income is zero.

The number of units sold was given in the previous example. In many cases, that is the question that must be answered based on the selling price per unit, the variable cost per unit, and the fixed cost given.

Breakeven analysis is a form of CVP that uses the equation for a line to determine the number of units that must be sold to break even. The equation that follows proves the breakeven point in units is 1,000.

$$\text{Breakeven point in units} = \frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$8,000}{\$18 - \$10} = 1,000 \text{ units per month}$$

The denominator of unit selling price per unit minus the unit variable cost may also be stated as the unit contribution margin.

### 5.3.1 Interpreting the Breakeven Result

The lower the breakeven point, the better, since it takes relatively fewer units of sales to cover all the fixed and variable costs. Once the volume of sales reaches the number of units needed to break even, all fixed costs have been paid. Every subsequent unit sold yields profit equal to the amount of the unit contribution margin.

The breakeven point is a relative number; it does not have much meaning on its own. It must be compared to another breakeven number, such as the expected or budgeted number of units to break even, an industry average, or the breakeven point for comparable companies. If the breakeven point is higher than a business's capacity or ability to fulfill, the operation of the business is likely doomed to fail. A breakeven point that is at or below what was expected, easy to accomplish, and/or well beyond the company's capacity indicates that the business will be successful due to its ability to meet cost obligations and yield profit.

#### EXAMPLE 1

Brian is considering opening a small factory that makes a single product – widgets. Each unit will sell for \$80. The variable cost of manufacturing each unit is \$30. Fixed factory overhead costs include rent, insurance, maintenance, supervisor salaries, supplies, and depreciation, for a total of \$120,000.

The breakeven point in units per month is determined as follows:

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$120,000}{\$80 - \$30} = 2,400 \text{ units per month}$$

**Proof:**  $2,400 \times (\$80 - \$30) = \$120,000 - \$120,000 = 0$

The manufacturing capacity is 5,000 units per month. The maximum possible operating income per month is \$110,000, determined as follows:

$$5,000 \text{ units capacity} - 2,400 \text{ units to break even} = 2,600 \text{ units} \times \$50 \text{ contribution margin} = \$130,000$$

Brian estimates his monthly sales will be 4,500 per month. The breakeven point of 2,400 per month is encouraging. The first 2,400 units sold would be applied toward paying the \$120,000 in fixed costs. When 2,401 units are sold, there will be operating income of \$50 since the contribution margin on that one unit above breakeven is pure profit. From that point on, each additional unit sold will generate \$50 in operating income as well. Since Brian anticipates that he will sell 1,900 units **above** the breakeven point of 2,400, he will generate operating income as follows:

$$1,900 \text{ units} \times \$50 \text{ contribution margin} = \$95,000 \text{ operating income}$$

**EXAMPLE 2**

The information from Example 1 remains the same, except Brian forecasts he will be able to sell 2,500 units per month. Now the breakeven point of 2,400 is seems a less appealing outcome since anticipated sales are only 100 units more.

$$100 \text{ units} \times \$50 \text{ contribution margin} = \$5,000 \text{ operating income}$$

This amount of profit may not be worth the effort of operating the business. Almost all the sales volume must be used to cover fixed and variable costs.

**EXAMPLE 3**

The information from Example 1 remains the same except the manufacturing capacity is 2,500 units per month. Brian may be able to sell 4,000 units if he has them, but he is only able to produce 2,400. Again, the outcome does not seem very lucrative with operating income of only \$5,000.

**5.3.2 Breakeven Point with Target Profit**

One other element that might be included in the breakeven calculation is target profit, which can be built in to the equation as if it were an additional fixed cost. At the breakeven point operating income is zero, which is rarely the goal of a for-profit company. An owner or manager may identify a desired operating income and add that amount to the fixed costs in the numerator. The question then becomes *How many units does the company have to sell to pay all its expenses for the month AND earn a profit of \$30,000?* The resulting number of sales units will generate this desired operating income.

**EXAMPLE 4**

Brian is considering opening a small factory that makes a single product – widgets. Each unit will sell for \$80. The variable cost of manufacturing each unit is \$30. Fixed factory overhead costs include rent, insurance, maintenance, supervisor salaries, supplies, and depreciation, for a total of \$120,000. Brian would also like to generate a target profit of \$50,000.

The breakeven point in units per month is determined as follows:

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$120,000 + \$50,000}{\$80 - \$30} = 3,400 \text{ units per month to break even}$$

**Proof:**  $3,400 \times (\$80 - \$30) = \$170,000 - \$170,000 = 0$

Brian must sell an additional 1,000 units to generate enough contribution margin to cover both fixed costs and target profit. The target profit of \$50,000

equals the 1,000 additional number of units times the contribution margin per unit of \$50.

### 5.3.3 Relationships in the Breakeven Equation

The breakeven equation uses fixed costs, the unit selling price, and the unit variable cost to determine the number of units. If one of those amounts changes, the breakeven point does as well.

Referring to the previous data for Jonick Corporation, the breakeven point was 1,000 units, computed as follows.

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$8,000}{\$18 - \$10} = 1,000 \text{ units per month to break even}$$

The following three independent changes would decrease the breakeven point.

1. **An increase in the selling price per unit**, which also increases the contribution margin

Change: Unit selling price increases from \$18 to \$20  
Result: Breakeven point decreases from 1,000 to 800 units

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$8,000}{\$20 - \$10} = 800 \text{ units per month to break even}$$

2. **A decrease in the variable cost per unit**, which also increases the contribution margin

Change: Unit variable cost decreases from \$10 to \$8  
Result: Breakeven point decreases from 1,000 to 800 units

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$8,000}{\$18 - \$8} = 800 \text{ units per month to break even}$$

3. **A decrease in fixed costs**, in which case the contribution margin is unchanged

Change: Fixed costs decrease from \$8,000 to \$6,400  
Result: Breakeven point decreases from 1,000 to 800 units

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$6,400}{\$18 - \$10} = 800 \text{ units per month to break even}$$

The breakeven point in units would increase if the direction of any of the previous three changes were reversed.

### 5.3.4 Breakeven Point with Sales Mix

To this point the breakeven point has been calculated for a company that sells a single product. A sales mix must be considered when calculating the breakeven point for companies that sell two or more products.

A company that sells two different products does not necessarily sell an equal number of each. The first step in calculating the breakeven point in units is to determine the sales mix, which is the percent of overall sales each of the two products represents. Each product has its own unit selling price and unit variable cost. The weighted average of each of the unit amounts is used in the breakeven equation.

Carlie operates a specialty outlet that sells two products – hair dryers and curling irons. Related information is as follows:

	<u>Unit selling price</u>	<u>Unit variable cost</u>	<u>Percent of sales</u>
Hair dryer	\$70	\$30	60%
Curling iron	50	20	40

Fixed costs are \$25,200 for the month.

The breakeven point divides the fixed costs by the contribution margin for the sales mix.

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}}$$

Only one unit selling price and one unit variable cost may be included in the denominator. Yet there is one of each for each product. Therefore, a weighted average of each will be used to combine them proportionately.

$$\text{Weighted average unit selling price} = \frac{\text{Hair dryers}}{(\$70 \times 60\%)} + \frac{\text{Curling irons}}{(\$50 \times 40\%)} = \$42 + \$20 = \mathbf{\$62}$$

$$\text{Weighted average variable cost} = \frac{\text{Hair dryers}}{(\$30 \times 60\%)} + \frac{\text{Curling irons}}{(\$20 \times 40\%)} = \$18 + \$8 = \mathbf{\$26}$$

The weighted average contribution margin is \$62 - \$26, or \$36 per unit.

The breakeven calculation can now be performed using these weighted unit amounts.

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$25,200}{\$62 - \$26} = 700 \text{ units per month to breakeven}$$

Finally, the sales mix percentages are used to determine how many of each product must be sold to break even. Since it was determined that 60% of sales are hair dryers and 40% are curling irons, the calculations would be as follows.

Hair dryers: 700 units to break even  $\times$  60% = 420 hair dryers

Curling irons: 700 units to break even  $\times$  40% = 280 curling irons

**Proof:**  $420 * (\$70 - \$30) + 280 * (\$50 - \$20) = \$16,800 + \$8,400 = \$25,200$ , which is exactly the amount of the fixed costs!

### 5.3.5 Breakeven Analysis for a Service Business

A breakeven analysis can be just as useful for a service business as it is for a company that sells product. A simple example of a rental property will be used as an illustration.

Max is considering opening a 10-room upscale boutique hotel. He found a facility suitable for this purpose and would rent the building from its owner for \$8,000 per month, which would be one of his fixed costs. Other fixed costs would include monthly payments for salaries, utilities, insurance, maintenance and advertising and would be an additional \$10,000 per month. The nightly rate charged to guests would be \$110, the going rate in the area. The variable cost per room night would be \$10 for room supplies and breakfast food for the guests.

The monthly capacity is 300 room nights (10 rooms  $\times$  30 days). The average occupancy rate for similar properties in the area is 60%, which for this property would be 180 rooms per month.

Based on this information, the breakeven point in number of room nights per month would be as follows:

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$18,000}{\$110 - \$10} = 180 \text{ room nights per month to break even}$$

Although the property has the capacity for 180 rooms per month, it would have to achieve a 60% occupancy rate – 180 rooms – just to pay its bills. Even this might be challenging for a new start-up since existing properties tend to operate at this rate. A newcomer might need a bit of time to ramp up the business and get the word out to potential guests.

Even at 60%, the property would not produce any operating income. Max would have to be very sure he could exceed the industry average in the area before taking steps to start this business.

However, if Max can justify charging more per room night, the scenario may change. If he can charge guests \$190 instead of \$110, his breakeven point will decrease to 100 room nights per month.

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$18,000}{\$190 - \$10} = 100 \text{ room nights per month to break even}$$

If he is then able to achieve a 50% occupancy rate, 150 room nights, his venture may be viable. The business would yield operating income of \$9,000 for the month.

	60% occ.	50% occ.
	\$110	\$190
Sales	\$19,800	\$28,500
Variable costs	<u>1,800</u>	<u>1,500</u>
Contribution margin	\$18,000	\$27,000
Fixed costs	<u>18,000</u>	<u>18,000</u>
Operating income	<u>\$0</u>	<u>\$9,000</u>

Breakeven analysis is a useful tool for looking at different combinations of costs and selling prices to predict outcomes. It is then up to management or inventors to determine the likelihood of each scenario occurring.

### 5.4 OPERATING LEVERAGE

Operatying leverage is the degree to which a company can increase operating income by increasing sales. It looks at the relationship between the contribution margin and operating income. The difference between those two amounts is fixed costs.

The following is a comparative income statement for two companies.

	ABC Co.	XYZ Co.
Sales	\$500,000	\$500,000
Variable costs	<u>400,000</u>	<u>400,000</u>
Contribution margin	\$100,000	\$100,000
Fixed costs	<u>80,000</u>	<u>50,000</u>
Operating income	<u>\$20,000</u>	<u>\$50,000</u>

In this example, sales, total variable costs, and contribution margin are the same for both companies. ABC Co. has higher fixed costs, so as a result, it also has lower operating income.

A company’s operating leverage is determined as follows.

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

$$\text{Operating leverage} = \frac{\text{Contribution margin}}{\text{Operating income}} \quad \frac{\text{ABC Co. } \$100,000}{\$20,000} = 5 \quad \frac{\text{XYZ Co. } \$100,000}{\$50,000} = 2$$

Operating leverage results are used to determine the effect on a change in sales on operating income. The percent increase (decrease) in sales is multiplied by the operating leverage to find the percent increase (decrease) in operating income. The higher the operating leverage, the more impact a change in sales will have on operating income.

In the example, both companies had sales of \$500,000. An increase of 20%, or \$100,000, to \$600,000 in sales would affect each of the two companies' operating income as follows.

ABC Co. 20% x 5 = 100% increase in operating income (\$20,000 x 100% = \$20,000)  
 XYZ Co. 20% x 2 = 40% increase in operating income (\$50,000 x 40% = \$20,000 additional)

An increase of 20% in sales to \$600,000 brings operating income for ABC Co. from \$20,000 to \$40,000, a 100% increase. The operating income of XYZ Co. increases from \$50,000 to \$70,000, or 40%.

	\$500,000 in sales		\$600,000 in sales	
	ABC Co.	XYZ Co.	ABC Co.	XYZ Co.
Sales	\$500,000	\$500,000	\$600,000	\$600,000
Variable costs	400,000	400,000	480,000	480,000
Contribution margin	\$100,000	\$100,000	\$120,000	\$120,000
Fixed costs	80,000	50,000	80,000	50,000
Operating income	\$20,000	\$50,000	\$40,000	\$70,000

### 5.5 MARGIN OF SAFETY

The **margin of safety** looks at how far above the breakeven point a company's sales are. The greater the difference, the more secure a company can feel about hedging against possible declines in sales. The margin of safety can be expressed as a dollar amount, a percentage, or a number of units.

As an example, a company's breakeven point of 2,400 units per month is determined as follows:

$$\frac{\text{Total fixed costs}}{\text{Unit selling price} - \text{unit variable cost}} = \frac{\$120,000}{\$80 - \$30} = 2,400 \text{ units per month to break even}$$

Actual sales for the month were 8,000 units. The contribution margin per unit is \$50 (\$80 - \$30).

Margin of safety in units:  $8,000 - 2,400 = 5,600$

Margin of safety in dollars:  $(8,000 \times \$50) - (2,400 \times \$50) = \$400,000 - \$120,000 = \$280,000$

Margin of safety percentage:  $(\$400,000 - 120,000) / \$400,000 = 70\%$

The margin of safety is 70%, which gives the company a significant cushion over its breakeven point. The higher the margin of safety, and the more it exceeds the breakeven point, the better.

# 6

## Variable Costing Analysis

### 6.1 INTRODUCTION

Operating income on the income statement is one of the most important results that a manufacturing company reports on its financial statements. External parties such as investors, creditors, and governmental agencies look to this amount to evaluate a company's performance and how it affects them. Managers and others within a company use operating income as a measure for evaluating and improving operational performance.

We have been preparing income statements for manufacturers using this basic structure.

Sales	\$750,000
Cost of goods sold	<u>525,000</u>
Gross profit	\$225,000
Selling and administrative expenses	<u>125,000</u>
Operating income	<u>\$100,000</u>

This format is referred to as an **absorption costing** income statement. Expenses are separated into two accounts: *Cost of Goods Sold*, which are product costs of the manufactured goods themselves, and *Selling and Administrative Expenses*, which are general operating costs.

Each of these two expense accounts includes both variable and fixed costs. *Cost of Goods Sold* is made up of the three costs of manufacturing: direct materials and direct labor, which are variable, and factory overhead, which may be both variable and fixed. Likewise, *Selling and Administrative Expenses* may include both variable and fixed costs.

**Absorption costing** is required under generally accepted accounting principles (GAAP) for external reporting. All manufacturing costs, whether fixed or variable, must be treated as product costs and included in an inventory amount on the balance sheet until the product is sold. When the product is sold, its cost is then expensed off as cost of goods sold on the income statement. Under absorption costing, fixed factory overhead is allocated to the finished goods inventory account and is expensed to cost of goods sold when the product is sold.

For managers within a company, it is also useful to prepare an income statement in a different format that separates out the expenses that truly vary directly with revenues. Variable costs are typically more controllable than fixed costs, so it is useful to isolate them so they can be analyzed by management. A **variable costing** income statement only includes variable manufacturing costs in the finished goods inventory and cost of goods sold amounts on the financial statements. Under variable costing, fixed factory overhead is NOT allocated to the finished goods inventory and is NOT expensed to cost of goods sold when the product is sold. Instead, total fixed factory overhead is treated as a period cost that is deducted from gross profit. On a variable costing [income statement](#), all [variable expenses](#) are deducted from revenue to determine the [contribution margin](#), from which all [fixed expenses](#) are subtracted to arrive at operating income for the period.

The following is a sample variable costing income statement.

Sales		\$750,000
Variable cost of goods sold		<u>375,000</u>
Manufacturing margin		\$375,000
Variable selling and administrative expenses		<u>75,000</u>
Contribution margin		\$300,000
Fixed costs:		
Fixed manufacturing costs	\$150,000	
Fixed selling and administrative expenses	<u>50,000</u>	
Total fixed costs		<u>200,000</u>
Operating income		\$100,000

As is shown on the variable costing income statement, total sales is matched with the total direct costs of generating those sales. The difference between sales and total variable costs is the contribution margin, which is the amount available to pay all fixed costs.

Under both methods, direct costs (materials and labor) and **variable** factory overhead costs are applied to the cost of the product. The difference between the two costing methods is how the **fixed** factory overhead costs are treated. Under variable costing, fixed [factory overhead costs](#) are expensed in the period in which they are incurred, regardless of whether the product is sold yet. Under absorption costing, fixed [factory overhead costs](#) are expensed only when the product is sold.

To recap, the variable costing income statement is different from the absorption costing income statement in several ways. (1) Only **variable** production costs are included in cost of goods sold. (2) *Manufacturing margin* replaces *gross profit*. (3) Variable selling and administrative expenses are grouped with variable production costs as part of the calculation of contribution margin. (4) *Contribution margin* is listed after deducting all variable costs from sales. (5) Fixed production costs

are shown below the contribution margin on the income statement with fixed operating costs.

Contribution margin (variable costing) is often higher than gross profit (absorption costing because many production costs, and most [selling and administrative expenses](#), are fixed. Since variable costing tends to reduce cost of goods sold than it increases general operating expenses, the net result is a higher contribution margin.

The following data will be used for three pairs of income statements that follow in sample problems. The only difference in the three scenarios is the number of units produced.

Number of units sold	15,000
Selling price per unit	\$50
Number of units produced	15,000 for Example A 20,000 for Example B 10,000 for Example C
Variable manufacturing cost per unit	\$25
Fixed manufacturing costs	\$150,000
Variable selling and administrative cost per unit	\$5
Fixed selling and administrative costs	\$50,000

## 6.2 UNITS MANUFACTURED EQUALS UNITS SOLD

The following is a side-by-side comparison of variable and absorption costing income statements when 15,000 units have been manufactured and 15,000 units have been sold.

**Units manufactured equals units sold  
Manufactured 15,000 units / Sold 15,000**

Variable Costing Income Statement		
Sales		\$750,000
Variable cost of goods sold		<u>375,000</u>
Manufacturing margin		\$375,000
Variable selling and administrative expenses		<u>75,000</u>
Contribution margin		\$300,000
Fixed costs:		
Fixed manufacturing costs	\$150,000	
Fixed selling and administrative expenses	<u>50,000</u>	
Total fixed costs		<u>200,000</u>
Operating income		\$100,000

15,000 x \$50

15,000 x \$25

15,000 x \$5

- *Variable cost of goods sold* equals the 15,000 units sold times the variable manufacturing cost per unit of \$25.
- *Variable selling and administrative expenses* equals the 15,000 units sold times the variable amount per unit of \$5.

**Units manufactured equals units sold**  
**Manufactured 15,000 units / Sold 15,000**

Absorption Costing Income Statement	
Sales	\$750,000
Cost of goods sold	<u>525,000</u>
Gross profit	\$225,000
Selling and administrative expenses	<u>125,000</u>
Operating income	<u>\$100,000</u>

15,000 x \$50  
 15,000 x (\$25 + \$10)  
 (15,000 x \$5) + 50,000

- *Cost of goods sold* equals the 15,000 units sold times the sum of the variable manufacturing cost per unit of \$25 plus the fixed manufacturing cost per unit of **\$10** (\$150,000 total fixed cost / **15,000** units produced.)
- *Selling and administrative expenses* equals the 15,000 units sold times the variable amount per unit of \$5 plus the fixed selling and administrative expenses of \$50,000.

Note that the operating income on both the variable costing and absorption costing income statements is the same, \$100,000. This will always be the case when the number of units manufactured equals the number of units sold because there is no change in the number of units in inventory. The beginning and ending number of units in inventory are the same since the number of units added is the same as the number removed.

### 6.3 UNITS MANUFACTURED GREATER THAN UNITS SOLD

The following is a side-by-side comparison of variable and absorption costing income statements when 20,000 units have been manufactured and 15,000 units have been sold.

**Units manufactured greater than units sold**  
**Manufactured 20,000 units / Sold 15,000**

Variable Costing Income Statement		
Sales		\$750,000
Variable cost of goods sold		<u>375,000</u>
Manufacturing margin		\$375,000
Variable selling and administrative expenses		<u>75,000</u>
Contribution margin		\$300,000
Fixed costs:		
Fixed manufacturing costs	\$150,000	
Fixed selling and administrative expenses	<u>50,000</u>	
Total fixed costs		<u>200,000</u>
Operating income		<u>\$100,000</u>

15,000 x \$50  
 15,000 x \$25  
 15,000 x \$5

**Units manufactured equals units sold  
Manufactured 20,000 units / Sold 15,000**

Sales	\$750,000
Cost of goods sold	<u>487,500</u>
Gross profit	\$262,500
Selling and administrative expenses	<u>125,000</u>
Operating income	<u>\$137,500</u>

15,000 x \$50  
15,000 x (\$25 + \$7.50)  
  
(15,000 x \$5) + 50,000

- *Cost of goods sold* equals the 15,000 units sold times the sum of the variable manufacturing cost per unit of \$25 plus the fixed manufacturing cost per unit of **\$7.50** (\$150,000 total fixed cost / **20,000** units produced.)

What is unchanged at 20,000 vs. 15,000 units manufactured:

1. The entire variable costing income statement
2. Selling and administrative expenses on the absorption costing income statement

When more units are manufactured than are sold, there are more units in ending inventory than there were in beginning inventory. In this case, 5,000 of the units produced were not sold, so they were added to inventory. Operating income under variable costing is lower than under absorption costing when inventory increases. This is because for variable costing the fixed factory overhead for all units produced is expensed off during the period, regardless of whether the units produced were sold. Under absorption costing, the fixed factory overhead is expensed off is only for the units sold, resulting in lower overall expenses and therefore higher operating income.

### 6.4 UNITS MANUFACTURED LESS THAN UNITS SOLD

The following is a side-by-side comparison of variable and absorption costing income statements when 10,000 units have been manufactured and 15,000 units have been sold.

**Units manufactured greater than units sold  
Manufactured 10,000 units / Sold 15,000**

Sales		\$750,000
Variable cost of goods sold		<u>375,000</u>
Manufacturing margin		\$375,000
Variable selling and administrative expenses		<u>75,000</u>
Contribution margin		\$300,000
Fixed costs:		
Fixed manufacturing costs	\$150,000	
Fixed selling and administrative expenses	<u>50,000</u>	
Total fixed costs		<u>200,000</u>
Operating income		<u>\$100,000</u>

15,000 x \$50  
15,000 x \$25  
  
15,000 x \$5

Units manufactured equals units sold  
 Manufactured 10,000 units / Sold 15,000

Absorption Costing Income Statement	
Sales	\$750,000
Cost of goods sold	575,000
Gross profit	\$175,000
Selling and administrative expenses	125,000
Operating income	\$50,000

15,000 × \$50  
 5,000 × (\$25 + \$10) + 10,000 × (\$25 + \$15)  
 (15,000 × \$5) + 50,000

- *Cost of goods sold* equals the 15,000 units sold times the sum of the variable manufacturing cost per unit of \$25 plus the fixed manufacturing cost per unit of \$15 (\$150,000 total fixed cost / 10,000 units produced.)

What is unchanged at 10,000 vs. 15,000 units manufactured:

1. The entire variable costing income statement
2. Selling and administrative expenses on the absorption costing income statement

When more units are sold than are manufactured, there are fewer units in ending inventory than there were in beginning inventory. Some of the beginning inventory had to be sold to fulfill the order for more than what was produced. In this case, 5,000 of the units sold came from beginning inventory. Operating income under variable costing is higher than under absorption costing when inventory decreases. This is because under variable costing the fixed factory overhead that is expensed off during the period is only for units produced, even if more units are sold than were produced. Under absorption costing, the fixed overhead is included in the higher number of units sold, resulting in higher overall expenses and therefore lower operating income.

## 6.5 ANALYSIS OF VARIABLE AND ABSORPTION COSTING

Sales were 15,000 units in each of the three variable costing and three absorption costing income statements just presented. It was the number of units produced that varied among the three pairs of statements.

The three variable costing income statements at the different levels of production were exactly the same, each yielding operating income of \$100,000, as shown in the following comparative statements.

**Comparative Variable Costing Income Statements**

	15,000 units		20,000 units		10,000 units	
Sales		\$750,000		\$750,000		\$750,000
Variable cost of goods sold		<u>375,000</u>		<u>375,000</u>		<u>375,000</u>
Manufacturing margin		\$375,000		\$375,000		\$375,000
Variable selling and administrative expenses		<u>75,000</u>		<u>75,000</u>		<u>75,000</u>
Contribution margin		\$300,000		\$300,000		\$300,000
Fixed costs:						
Fixed manufacturing costs	\$150,000		\$150,000		\$150,000	
Fixed selling and administrative expenses	<u>50,000</u>		<u>50,000</u>		<u>50,000</u>	
Total fixed costs		<u>200,000</u>		<u>200,000</u>		<u>200,000</u>
Operating income		<u>\$100,000</u>		<u>\$100,000</u>		<u>\$100,000</u>

The number of units manufactured during the period – 15,000; 20,000; and 10,000; respectively – does not affect operating income under the variable costing approach. This is as it should be, since production affects inventory, which is a balance sheet rather than an income statement account. When more units are produced (20,000) than sold (15,000), ending inventory is 5,000 units higher than beginning inventory. When fewer units are produced (10,000) than sold (15,000), ending inventory is 5,000 units lower than beginning inventory. Yet regardless of changes in inventory, operating income remains constant for a given level of sales because variable cost of goods sold and fixed manufacturing costs are identical for all three variable costing scenarios.

Under absorption costing, however, operating income changes when the company’s inventory balance changes. The results from the three absorption income statements presented earlier are shown again, as follows.

**Comparative Absorption Costing Income Statements**

	15,000 units	20,000 units	10,000 units
Sales	\$750,000	\$750,000	\$750,000
Cost of goods sold	<u>575,000</u>	<u>487,500</u>	<u>575,000</u>
Gross profit	\$175,000	\$262,500	\$175,000
Selling and administrative expenses	<u>125,000</u>	<u>125,000</u>	<u>125,000</u>
Operating income	<u>\$50,000</u>	<u>\$137,500</u>	<u>\$50,000</u>

When all units manufactured (15,000) are sold (15,000), operating income under absorption costing is the same as it is under variable costing, \$100,000. Under both costing methods, \$150,000 of fixed factory overhead costs is deducted to arrive at operating income. It just appears in two different line items. Under variable costing, the flat amount of \$150,000 follows the contribution margin line. Under absorption costing, the \$150,000 is included in cost of goods sold. The fixed cost per unit is \$10, determined by dividing the \$150,000 total fixed factory overhead cost by the number of units produced, 15,000. The \$10 per unit is then multiplied by 15,000, the number of units sold.

**Variable costing** fixed manufacturing costs      \$150,000 fixed factory overhead  
**Absorption costing** fixed manufacturing costs      \$10 fixed cost per unit x 15,000 units sold = \$150,000

When more units are manufactured (20,000) than sold (15,000), operating income is higher under absorption costing (\$137,500). Under variable costing, fixed factory overhead is the flat amount of \$150,000 that follows the contribution margin line. Under absorption costing, \$112,500 of fixed factory overhead cost is included in cost of goods sold. The fixed cost per unit is \$7.50, determined by dividing the \$150,000 total fixed factory overhead cost by the number of units produced, 20,000. The \$7.50 per unit is then multiplied by 15,000, the number of units sold to get \$112,500.

**Variable costing** fixed manufacturing costs      \$150,000 fixed factory overhead  
**Absorption costing** fixed manufacturing costs      \$7.50 fixed cost per unit x 15,000 units sold = \$112,500

Since there is \$37,500 less in cost of goods sold under absorption costing, there is \$37,500 more operating income as a result for the same level of sales.

Conversely, when fewer units are manufactured (10,000) than sold (15,000), operating income is lower under absorption costing (\$50,000). Under variable costing, fixed factory overhead is the flat amount of \$150,000 that follows the contribution margin line. Under absorption costing, \$225,000 of fixed factory overhead cost is included in cost of goods sold. The fixed cost per unit is \$15, determined by dividing the \$150,000 total fixed factory overhead cost by the number of units produced, 10,000. The \$15 per unit is then multiplied by 15,000, the number of units sold to get \$225,000.

**Variable costing** fixed manufacturing costs      \$150,000 fixed factory overhead  
**Absorption costing** fixed manufacturing costs      \$15 fixed cost per unit x 15,000 units sold = \$225,000

Since there is \$75,000 more in cost of goods sold under absorption costing, there is \$75,000 less operating income as a result for the same level of sales.

The point of this analysis is to illustrate that under absorption costing, operating income changes based on increases or decreases in inventory due to producing more or fewer units than were sold in a period. Such changes are unrelated to a company's operating performance, and managers need to be aware of this type of distortion under absorption costing. On a variable costing income statement, changes in inventory have no effect on operating income, making this method more reliable and desirable for analyzing profitability for an accounting period.

## 6.6 CONTRIBUTION MARGIN ANALYSIS

A key element of the variable costing income statement is contribution margin, which is what is left over from sales after paying variable costs. In other words,

contribution margin is the amount or percentage of sales available to pay fixed costs and contribute to operating income. Once fixed costs are covered, any remaining contribution margin represents profit that results from the sales.

Contribution margin may be looked at from a variety of perspectives that often involve comparisons within different segments of a company. Data may be isolated by product, geographic area, salesperson, customer, distribution method, etc. and analyzed in terms of how individuals or entities within a segment perform in terms of contribution margin percentage. Managers may use these targeted results to discover strengths that may be capitalized on and/or weaknesses that may need to be addressed.

As an example, a company manufactures two products and sells them in two regions, East and West, to two customers that have a presence in both regions. There are four salespeople in each region. Sales in these regions may be either in-store or online.

The following sales and production information will be used to show comparisons of the contribution margin for a company as a whole, by region, and by product.

	<u>East</u>	<u>West</u>	<u>Total</u>
Sales			
Product 1	\$120,000	\$60,000	\$180,000
Product 2	<u>40,000</u>	<u>100,000</u>	<u>140,000</u>
TOTAL	\$160,000	\$160,000	\$320,000
Variable manufacturing costs			
Product 1	\$24,000	\$12,000	\$36,000
Product 2	<u>4,800</u>	<u>12,000</u>	<u>16,800</u>
TOTAL	\$28,800	\$24,000	\$52,800
Variable selling expenses			
Product 1	\$50,400	\$25,200	\$75,600
Product 2	<u>13,200</u>	<u>33,000</u>	<u>46,200</u>
TOTAL	\$63,600	\$58,200	\$121,800

The contribution margin ratio of 45.4% for the company as a whole is determined as follows.

<b>Company</b>	
Sales	\$320,000
Variable cost of goods sold	<u>52,800</u>
Manufacturing margin	\$267,200
Variable selling expenses	<u>121,800</u>
Contribution margin	\$145,400
Contribution margin ratio	45.4%

For every \$1.00 of sales, a little over \$.45 remains after variable costs are covered to apply toward paying fixed costs and yielding profit. The contribution margin is \$145,400, and the contribution margin ratio is 45.4% ( $\$145,400 / \$320,000$ ). If fixed costs were \$100,000, for example, operating income would be \$45,400.

The analysis by product shows that the contribution margin ratio for Product 1, 38.0%, is lower than that of the company as a whole, 45.4%. The ratio for Product 2 is significantly higher than both those rates at 55.0%.

	Product 1	Product 2
Sales	\$180,000	\$140,000
Variable cost of goods sold	<u>36,000</u>	<u>16,800</u>
Manufacturing margin	\$144,000	\$123,200
Variable selling expenses	<u>75,600</u>	<u>46,200</u>
Contribution margin	\$68,400	\$77,000
Contribution margin ratio	38.0%	55.0%

Although sales of Product 2 are lower, its contribution margin ratio is 17% higher than that of Product 1. This is because the costs of producing and selling Product 2 are proportionately lower.

Based on this information, managers may look for ways to contain variable costs associated with Product 1. They also might encourage and incentivize sales staff to promote Product 2 to customers more than Product 1.

A comparison by sales region shows that the contribution margin ratio for the East, 42.3%, is lower than that of the company as a whole, 45.4%. The ratio for the West is higher than both these rates at 48.6%.

	East	West
Sales	\$160,000	\$160,000
Variable cost of goods sold	<u>28,800</u>	<u>24,000</u>
Manufacturing margin	\$131,200	\$136,000
Variable selling expenses	<u>63,600</u>	<u>58,200</u>
Contribution margin	\$67,600	\$77,800
Contribution margin ratio	42.3%	48.6%

At the same sales levels, the East has higher variable costs for both production and selling. Management may look at the mix of products sold in each region to determine if differences in costs in the regions are product related or if action needs to be taken to contain costs in the East.

At an even more micro level, the performance of each of the four sales people in a region may be determined. As an example, the data for sales staff in the East - Annie Adams, Charles Bell, Valerie Crew, and Scott Davis – follows.

	<b>Adams</b>	<b>Bell</b>	<b>Crew</b>	<b>Davis</b>
Sales	\$32,000	\$40,000	\$51,000	\$37,000
Variable cost of goods sold	<u>5,800</u>	<u>7,500</u>	<u>8,600</u>	<u>6,900</u>
Manufacturing margin	\$26,200	\$32,500	\$42,400	\$30,100
Variable selling expenses	<u>11,500</u>	<u>19,100</u>	<u>20,300</u>	<u>12,700</u>
Contribution margin	\$14,700	\$13,400	\$22,100	\$17,400
Contribution margin ratio	45.9%	33.5%	43.3%	47.0%

The sales mix in terms of the percentage of each product that each salesperson sold plays a role in the variable expenses incurred and the resulting contribution margin ratio. Note that the highest contribution margin in dollars does not always result in the highest contribution margin ratio. Managers must evaluate returns on sales from both these perspectives when making decisions moving forward.

Although specific data is not provided for the following two segments – customer and distribution channel – results are presented here to show two additional types of comparisons that may be meaningful in investigating operational performance.

	<b>Customer 1</b>	<b>Customer 2</b>
Sales	\$190,000	\$130,000
Variable cost of goods sold	<u>31,700</u>	<u>21,100</u>
Manufacturing margin	\$158,300	\$108,900
Variable selling expenses	<u>75,100</u>	<u>46,700</u>
Contribution margin	\$83,200	\$62,200
Contribution margin ratio	43.8%	47.8%

	<b>In-Store</b>	<b>Online</b>
Sales	\$150,000	\$170,000
Variable cost of goods sold	<u>23,700</u>	<u>29,100</u>
Manufacturing margin	\$126,300	\$140,900
Variable selling expenses	<u>60,100</u>	<u>61,700</u>
Contribution margin	\$66,200	\$79,200
Contribution margin ratio	44.1%	46.6%

Contribution margin analysis is also useful for planning purposes. For each product, sales volume, unit selling price, unit variable cost of production, and unit variable cost of selling can be forecasted to estimate contribution margin. Subsequently, one or more of these four variables may be changed to see the impact on contribution margin. The following table compares six projections based on different data. Amounts in bold font are changes from Projection 1.

	Projection 1	Projection 2	Projection 3	Projection 4	Projection 5	Projection 6
<b>Sales quantity</b>	100,000	<b>120,000</b>	100,000	100,000	<b>95,000</b>	<b>110,000</b>
<b>Selling price per unit</b>	\$8.00	\$8.00	<b>\$8.30</b>	\$8.00	\$8.00	<b>\$8.30</b>
<b>Variable production cost per unit</b>	2.50	2.50	2.50	<b>3.00</b>	2.50	<b>2.75</b>
<b>Variable selling cost per unit</b>	1.75	1.75	1.75	1.75	<b>1.40</b>	<b>1.90</b>

Sales	\$800,000	\$960,000	\$830,000	\$800,000	\$760,000	\$913,000
Variable cost of goods sold	<u>250,000</u>	<u>300,000</u>	<u>250,000</u>	<u>300,000</u>	<u>237,500</u>	<u>302,500</u>
Manufacturing margin	\$550,000	\$660,000	\$580,000	\$500,000	\$522,500	\$610,500
Variable selling expenses	<u>175,000</u>	<u>210,000</u>	<u>175,000</u>	<u>175,000</u>	<u>133,000</u>	<u>209,000</u>
Contribution margin	\$375,000	\$450,000	\$405,000	\$325,000	\$389,500	\$401,500
Contribution margin ratio	46.9%	46.9%	48.8%	40.6%	51.3%	44.0%

Managers consider both the contribution margin dollar amount and the ratio in making decisions related to selling price and projecting quantities sold. A higher contribution margin ratio alone is favorable relative to a lower one; the 46.9% for Projection 1 is greater than the 44.0% for Projection 6. Yet if fixed costs are \$375,000, the contribution margin dollar amount for Projection 1 would only be enough to break even, whereas Projection 6 would yield operating income of \$26,500. Many decisions require a combination of analyses to determine the optimal outcome, but the results from separate measures can be insightful in determining points of strength and weakness.

Finally, managers may use the elements of a variable costing income statement to compare planned to actual dollar amounts and units sold.

	Projected	Actual
<b>Sales quantity</b>	90,000	110,000
<b>Selling price per unit</b>	\$8.50	\$8.00
<b>Variable production cost per unit</b>	2.80	2.70
<b>Variable selling cost per unit</b>	1.60	1.80

Sales	\$765,000	\$880,000
Variable cost of goods sold	<u>252,000</u>	<u>297,000</u>
Manufacturing margin	\$513,000	\$583,000
Variable selling expenses	<u>144,000</u>	<u>198,000</u>
Contribution margin	\$369,000	\$385,000

The actual contribution margin is \$16,000 higher compared to what was projected, partially due to more unit sales than anticipated. The net decrease in unit variable cost factors in as well. Although sales revenue is higher than expected,

it would be worth looking into why selling price per unit was lower than projected. It is feasible that the price concession spurred the higher sales quantity.

Variable costing may also be applicable to a service business, even though manufacturing costs are not involved. A small hotel, for example, earns revenue from renting rooms. Variable costs may include food and beverage expense for breakfast, supplies expense, selling expense, and an incremental utilities expense amount for times when rooms are occupied. Fixed costs of rent expense for the property, salaries expense, depreciation expense, and insurance expense are typical.

The following is an example of a variable costing income statement for a hotel. The room rate is \$120 per night, and 700 room nights are recorded during the month. The rate per unit for each variable cost is shown in the income statement.

<b>Jonick Inn</b>		
<b>Variable Costing Income Statement</b>		
<b>For the Month Ended June 30, 2019</b>		
Rooms revenue (700 x \$120)		\$84,000
Variable costs:		
Selling expense (700 x \$24)	\$16,800	
Food and beverage expense (700 x \$10)	7,000	
Supplies expense (700 x \$8)	5,600	
Utilities expense (700 x \$5)	<u>3,500</u>	
Total variable costs		<u>32,900</u>
Contribution margin		\$51,100
Fixed costs:		
Rent expense	\$14,000	
Salary expense	12,600	
Depreciation expense	10,900	
Insurance expense	<u>1,400</u>	
Total fixed costs		<u>38,900</u>
Operating income		<u>\$12,200</u>

Other service businesses that would benefit from variable costing are hospitals, banks, restaurants, and airlines.

# 7 Budgeting

## 7.1 INTRODUCTION

Financial statements and managerial reports are often prepared to summarize historical transactions that occurred in a company to evaluate past performance. This information is also used as an integral part of the process of moving forward. Combined with insights into consumer trends and current economic, legal, social, and political environments, managers forecast future operations and develop strategies for achieving projected goals.

A **budget** is a quantitative, written statement of a company's action plan for a future period of time. Budgets are planning tools that companies use to determine future activities and to keep financial control of operations. Budgets may be prepared at fixed intervals of time, such as annually, where they are reviewed and revised once a year. Alternatively, continuous budgets extend for one year but are adjusted each month to reflect activities for the upcoming 12 months. When a current month passes, its financial information is removed and the data for the new month that is 12 months in the future is added.

## 7.2 STATIC BUDGET

A **static budget** is prepared for a period of time based on a fixed amount of activity. For example, the Packing Department in a manufacturing company may prepare a budget that itemizes fixed and variable costs.

<b>Packing Department Budget For the Year Ended December 31, 2019</b>	
Variable costs:	
Packing materials	\$30,000
Direct labor	15,000
Variable utilities cost	<u>5,000</u>
Total variable costs	\$50,000
Fixed costs:	
Supervisor salary expense	\$60,000
Depreciation expense	7,000
Machine rental expense	<u>3,000</u>
Total fixed costs	\$70,000
Total budgeted costs	<u>\$120,000</u>

This departmental budget does not specify the number of units to be processed, making it difficult to determine if actual costs are reasonable and within budget. Actual costs may wind up being higher than what was budgeted. For example, actual costs of \$130,000 might seem unfavorable since it exceeds total budgeted costs of \$120,000. However, more units may have been processed than were considered in preparing the budget. In that case, being over budget may actually be a positive outcome since additional production costs were the result of more sales orders.

The assumptions underlying the static budget are a bit vague. Even if the number of anticipated units to be processed were stated, such as a quantity of 10,000, the budget would remain unchanged if production volume were higher or lower. The lack of detail behind how the numbers are derived often limits the usefulness of the static budget information.

### 7.3 FLEXIBLE BUDGET

A **flexible budget** addresses the shortcoming of the static budget by providing budgeted amounts at various quantity levels. A sample flexible budget follows.

<b>Packing Department Budget For the Year Ended December 31, 2019</b>				
Planned number of production units	10,000	12,000	16,000	20,000
Variable costs:				
Packing materials	\$30,000	\$36,000	\$48,000	\$60,000
Direct labor	15,000	18,000	24,000	30,000
Variable utilities cost	<u>5,000</u>	<u>6,000</u>	<u>8,000</u>	<u>10,000</u>
Total variable costs	\$50,000	\$60,000	\$80,000	\$100,000
Fixed costs:				
Supervisor salary expense	\$60,000	\$60,000	\$60,000	\$60,000
Depreciation expense	7,000	7,000	7,000	7,000
Machine rental expense	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>
Total fixed costs	\$70,000	\$70,000	\$70,000	\$70,000
Total budgeted costs	<u>\$120,000</u>	<u>\$130,000</u>	<u>\$150,000</u>	<u>\$170,000</u>

The flexible budget is more useful to managers since budgeted costs can be compared to actual costs for several activity levels. The example of the flexible budget for the Packing Department shows four possible levels of production: 10,000; 12,000; 15,000; and 20,000 units. If actual costs were \$130,000 and 12,000 units were processed, the budget would have accurately predicted actual costs. If actual costs were \$130,000 and 10,000 units were produced, the department would have been over budget by \$10,000. A flexible budget is basically a menu of static budgets to select from based on the number of actual units involved.

The same financial statement formats that summarize and present results of economic events from previous periods may also be used to communicate quantitative projections of future performance. For example, the income statement includes sales and multiple line items related to cost information, each of which can be budgeted independently based on a company’s action plan for a future period. Collectively they result in a pro forma income statement that projects future net income.

## 7.4 MASTER BUDGET

A **master budget** is a collection of all the separate budgets for different elements of a business combined into one report. Master budgets contain operating budgets that include goals for sales and associated costs of production, which result in the budgeted income statement. Financial budgets such as the cash and capital expenditures budgets are included on the budgeted balance sheet.

## 7.5 OPERATING BUDGET

**Operating budgets** include separate budgets for each of three key line items on the income statement.

1. Sales budget
2. Cost of goods sold budget \*

\* To prepare the cost of goods sold budget, a manufacturer first prepares the following five supporting budgets:

a. production budget	Requires sales budget result
b. direct materials purchases budget	Requires production budget result
c. direct materials cost budget	Requires materials purchases budget result
d. direct labor cost budget	Requires production budget result
e. factory overhead budget	Independent of previous budgets

3. Selling and administrative budget

The results of all the individual operating budgets are combined to present a budgeted income statement, which culminates with the anticipated amount of net income.

To illustrate, two distinct master budgets for 2019 for two different manufacturing companies will be presented side by side.

The first company makes only one product, a 42” art deco replica of the Statue of Liberty, which it sells to wholesalers and souvenir shops. Only one direct material, metal, is used in producing these statues.

The second company makes protective headgear and produces two products: bicycle helmets and ski helmets. Each type of headgear requires two direct materials: plastic and foam lining.

The best approach is to first review the budgets for the statue souvenirs in the left column of the side-by-side budgets. It is the simpler of the two since it covers only one product that uses one direct material. It illustrates the basic concepts. The budgets for the helmets are similar to those for the statues, but they are a bit more complex since two products and two direct materials are involved. The manufacture of the helmets occurs in two departments: forming and assembly.

The following information will be used to prepare a sales budget, production budget, direct materials purchases budget, direct materials cost budget, direct labor cost budget, factory overhead budget, selling and administrative budget, and budgeted income statement. The data in the left column is for the statue souvenirs; the information in the right column is for the helmets.

<b>Statue Souvenirs (1 product and 1 direct material)</b>	
Estimated sales volume	3,000 units
Selling price per unit	\$200
Estimated inventory of completed units on Jan. 1	2,600 units
Desired inventory of completed units on Dec. 31	600 units
Number of pounds of metal per completed unit	8.6 pounds
Price per pound of metal	\$6
Estimated inventory of metal on Jan. 1	1,800 pounds, \$10,800
Desired inventory of metal on Dec. 31	300 pounds, 1,800
Time spent for direct labor per completed unit	5 hours
Direct labor rate per hour	\$10
Estimated factory overhead costs for the year:	
Supervisor salary	\$ 7,600
Utilities	1,900
Indirect materials	1,700
Depreciation	800
Estimated work in process on Jan. 1	\$25,100
Desired work in process on Dec. 31	3,100
Estimated finished goods on Jan. 1	\$36,700
Desired finished goods on Dec. 31	9,400
Estimated selling costs for the year:	
Advertising expense	\$16,300
Sales commissions expense	14,100
Utilities expense	12,000
Estimated administrative costs for the year:	
Salaries expense	\$87,700
Utilities expense	11,400
Office supplies expense	5,600
Estimated tax rate	20%

<b>Bicycle and Ski Helmets (2 products and 2 direct materials)</b>	
Estimated sales volume	
Bicycle helmets	2,600 units
Ski helmets	4,800 units
Selling price per unit	
Bicycle helmets	\$50 per unit
Ski helmets	\$130 per unit
Estimated inventory of completed units on Jan. 1	
Bicycle helmets (@ \$24 per unit)	110 units
Ski helmets (@ \$95 per unit)	320 units
Desired inventory of completed units on Dec. 31	
Bicycle helmets (@ \$25 per unit)	150 units
Ski helmets (@ \$93 per unit)	280 units
Number of pounds of plastic per completed unit	
Bicycle helmets	0.8 pounds
Ski helmets	1.6 pounds
Number of pounds of foam lining per completed unit	
Bicycle helmets	0.3 pounds
Ski helmets	0.6 pounds
Price per pound of plastic	\$4
Price per pound of lining	\$2
Estimated inventory of plastic on Jan. 1	120 pounds
Desired inventory of plastic on Dec. 31	90 pounds
Estimated inventory of foam lining on Jan. 1	100 pounds
Desired inventory of foam lining on Dec. 31	140 pounds
Estimated bicycle work in process on Jan. 1 (@\$15)	450 units
Estimated bicycle work in process on Dec. 31 (@\$10)	610 units
Estimated ski work in process on Jan. 1 (@\$70)	520 units
Estimated ski work in process on Dec. 31 (@\$40)	500 units
Number of direct labor hours of forming per completed unit	
Bicycle helmets	0.2 hours
Ski helmets	0.4 hours

Number of direct labor hours of assembly per completed unit	
Bicycle helmets	0.6 hours
Ski helmets	1.2 hours
Direct labor rate per hour for forming	\$15
Direct labor rate per hour for assembly	\$12
Estimated factory overhead costs for the year:	
Indirect factory wages	\$59,900
Depreciation plant and equipment	8,700
Utilities	2,800
Insurance and property tax	1,600
Estimated selling costs for the year:	
Sales salaries expense	\$129,200
Advertising expense	60,800
Telephone expense – selling	4,100
Travel expense – selling	6,300
Estimated administrative costs for the year:	
Office salaries expense	\$22,700
Depreciation expense – office	2,600
Telephone expense – office	900
Office supplies expense	800
Miscellaneous office expense	700
Estimated tax rate	25%

## 7.6 SALES BUDGET

The **sales budget** is prepared first by estimating the number of units that will be sold. This analysis looks at budgeted and actual sales from the previous year and adjusts those amounts to reflect economic conditions, shifts in trends, feedback from customers, and pricing changes.

In addition, the expected unit selling price for each product must be determined by examining previous pricing and profitability, current costs, the market demand for the products, and competitors' pricing.

The sales budgets for the two companies' products are as follows.

Souvenir Statues					
Sales Budget					
	Unit Sales Value	x	Unit Sales Price	=	Total Sales
Metal statues	3,000	x	\$200	=	\$600,000

Headgear					
Sales Budget					
	Unit Sales Value	x	Unit Sales Price	=	Total Sales
Bicycle helmet	2,600	x	\$50	=	\$130,000
Ski helmet	4,800	x	130	=	624,000
Total sales revenue					<b>\$754,000</b>

The budgeted sales in dollars equals the expected sales volume times the expected selling price per unit for each product. The sum of all products' sales is ultimately transferred to the budgeted income statement.

Cost of goods sold is the next line item on the income statement. Five shorter, more targeted budgets are first prepared to arrive at key elements of the cost of goods sold budget.

- a. The **production budget** estimates the number of units of each product that will have to be manufactured to achieve the anticipated sales and inventory levels. It begins with the estimated number of units to be sold from the sales budget. The number of desired units in ending inventory is added to that to determine total number of units required. Since some of those needed are already in stock, those do not need to be produced. The total units that do need to be produced are those needed for sales and ending inventory minus those that are already in inventory at the start of the period.

The production budgets for the two companies' products are as follows.

Souvenir Statues		
Production Budget		
		Units
Estimated units to be sold		3,000
Desired ending inventory, December 31	+	<u>600</u>
Total units needed	=	3,600
Estimated beginning inventory, January 1	-	<u>2,600</u>
Total units to be produced	=	<b><u>1,000</u></b>

Headgear			
Production Budget			
		Bicycle	Ski
Estimated units to be sold		2,600	4,800
Desired ending inventory, December 31	+	<u>150</u>	<u>280</u>
Total units needed	=	2,750	5,080
Estimated beginning inventory, January 1	-	<u>110</u>	<u>320</u>
Total units to be produced	=	<b><u>2,640</u></b>	<b><u>4,760</u></b>

- b. The **direct materials purchases budget** estimates how much will be spent to buy the quantity of materials needed for production. It begins with the total number of units to be manufactured from the production budget.

Each statue requires 8.6 pounds of metal, so the total number of pounds for production can be calculated. Each helmet requires both plastic and foam lining, and the total amount needed for production is determined for each type. The number of pounds that should remain in ending inventory is

added to total pounds needed for production. Then, the number of pounds of materials in beginning inventory is deducted from total required since that amount is already in stock and does not need to be purchased. The number of pounds that does need to be purchased is multiplied by the cost per pound to get the total cost of materials purchases.

The direct materials purchases budgets for the two companies' products are as follows.

**Souvenir Statues**

Direct Materials Purchases Budget			
Estimated units to be produced			1,000
Number of pounds per unit	x		<u>8.6</u>
Pounds of metal required for production	=		8,600
Desired ending inventory, December 31	+		<u>300</u>
Total pounds needed	=		8,900
Estimated beginning inventory, January 1	-		<u>1,800</u>
Total pounds to be purchased	=		7,100
Price per pound	x		<u>\$6</u>
Total direct materials to be purchased	=		<b>\$42,600</b>

**Headgear**

Direct Materials Purchases Budget						
	Units	Lbs. per unit	Plastic	Lining		Total
Units required for production:						
Bicycle helmet	2,640	0.8	2,112			
Bicycle helmet	2,640	0.3		792		
Ski helmet	4,760	1.6	7,616			
Ski helmet	4,760	0.6		2,856		
Desired ending inventory, December 31			<u>90</u>	<u>140</u>		
Total pounds needed			9,818	3,788		
Estimated beginning inventory, January 1			<u>120</u>	<u>100</u>		
Total pounds to be purchased			9,698	3,668		
Price per pound			<u>\$4</u>	<u>\$2</u>		
Total direct materials to be purchased			<b>\$38,792</b>	<b>\$7,376</b>		<b>\$46,168</b>

- c. The **direct materials cost budget** looks at the total cost of materials available to be used in production by adding what was already on hand at the beginning of the year to what will be purchased during the year, taken from the direct materials purchases budget. From that total the remaining direct materials at the end of the year are deducted, since they were not used, to arrive at the cost of direct materials added to production during the year.

The direct materials cost budget can be presented in a summarized format, as shown for the souvenir statues, or with a greater level of detail, as is the case for the helmets, which require two types of materials rather than just one. The direct materials cost budgets for the two companies' products are as follows.

**Souvenir Statues**

<b>Direct Materials Cost Budget</b>		
Direct materials inventory, January 1		\$10,800
Direct materials purchases	+	<u>42,600</u>
Cost of direct materials available for use	=	53,400
Direct materials inventory, December 31	-	<u>1,800</u>
Cost of direct materials added to production	=	<b><u>\$51,600</u></b>

**Headgear**

<b>Direct Materials Cost Budget</b>					
	Pounds	Price per lb	Subtotal		Total
Direct materials inventory, January 1:					
Plastic	120	\$4	\$480		
Lining	100	\$2	<u>200</u>		
Total beginning inventory					\$680
Direct materials purchases:					
Plastic	9,698	\$4	\$38,792		
Lining	3,688	\$2	<u>7,376</u>		
Total inventory purchase					<u>46,168</u>
Cost of direct materials available for use					\$46,848
Direct materials inventory, December 31:					
Plastic	90	\$4	\$360		
Lining	140	\$2	<u>280</u>		
Total ending inventory					<u>640</u>
Cost of direct materials added to production					<b><u>\$46,208</u></b>

- d. The **direct labor cost budget** estimates the second direct cost of a manufactured product, direct labor. It multiplies the number of units to be produced, taken from the production budget, by the number of hours per unit. That result is then multiplied by the labor rate per hour.

The direct labor cost budgets for the two companies' products are as follows.

**Souvenir Statues**

Direct Labor Cost Budget		
Total units to be produced		1,000
Production time per unit	x	5
Hours required for production	=	5,000
Labor rate per hour	x	\$10
Total direct labor cost	=	<b>\$50,000</b>

**Headgear**

Direct Labor Cost Budget						
	Units	Hours/Unit	Plastic	Lining	Total	
Units required for production						
Bicycle helmet (plastic)	2,640	0.2	528			
Bicycle helmet (lining)	2,640	0.6		1,584		
Ski helmet (plastic)	4,760	0.4	1,904			
Ski helmet (lining)	4,760	1.2		5,712		
Total hours needed			2,432	7,296		
Rate per hour			\$15	\$12		
Total direct labor cost			<b>\$36,480</b>	<b>\$87,552</b>		<b>\$124,032</b>

The direct labor cost budget for the helmets is a bit more detailed since it deals with two products that each require two different direct materials.

- e. The **factory overhead cost budget** estimates each of a number of fixed costs independently. The total of all the results is the budgeted factory overhead cost. The factory overhead cost budgets for both companies follow.

**Souvenir Statues**

Factory Overhead Cost Budget		
Supervisor salary		7,600
Utilities	+	1,900
Indirect materials	+	1,700
Depreciation	+	800
Total factory overhead cost	=	<b>\$12,000</b>

**Headgear**

Factory Overhead Cost Budget		
Indirect factory wages		\$59,900
Depreciation	+	8,700
Utilities	+	2,800
Insurance	+	1,600
Total factory overhead cost	=	<b>\$73,000</b>

The five previous targeted budgets provide the information required for the **cost of goods sold budget**.

## 7.7 COST OF GOODS SOLD BUDGET

Both cost of goods sold budgets that follow include beginning and ending work in process and beginning and ending finished goods amounts. The calculations

begin with what was available at the beginning of the period, add what was transferred in during the period, and deduct what was remaining at the end of the period to determine what was transferred out. A transfer out from finished goods, of course, indicates a sale and a move to cost of goods sold.

The cost of goods sold budgets for both companies follow. Direct materials, direct labor, and factory overhead amounts are taken from their respective supporting budgets prepared previously.

**Souvenir Statues**

<b>Cost of Goods Sold Budget</b>				
Finished good inventory, January 1				\$36,700
Work in process inventory, January 1			\$25,100	
Direct materials	\$51,600			
Direct labor	+ 50,000			
Factory overload	+ <u>12,000</u>			
Total manufacturing costs for the year		=	<u>113,600</u>	
Total work in process during the year		+	\$138,700	
Work in process inventory, December 31		-	<u>(3,100)</u>	
Cost of goods manufactured				= 135,600
Cost of finished goods available for sale				= \$172,300
Finished goods inventory, December 31				- <u>(9,400)</u>
Cost of goods sold				= <b><u>\$162,900</u></b>

**Headgear**

<b>Cost of Goods Sold Budget</b>				
Finished good inventory, January 1				\$33,040
Work in process inventory, January 1			\$43,150	
Direct materials	\$46,208			
Direct labor	+ 124,032			
Factory overload	+ <u>73,000</u>			
Total manufacturing costs for the year		=	<u>243,240</u>	
Total work in process during the year		+	\$286,390	
Work in process inventory, December 31		-	<u>(26,100)</u>	
Cost of goods manufactured				= \$260,290
Cost of finished goods available for sale				= 293,330
Finished goods inventory, December 31				- <u>(29,790)</u>
Cost of goods sold				= <b><u>\$263,540</u></b>

The first step on the cost of goods sold budget is to list and total the three manufacturing costs: direct materials, direct labor, and factory overhead. Their amounts are taken from their respective cost budgets and appear in the left column. Total manufacturing costs for the year is the sum of the three, entered in the middle column.

Next, the manufacturing costs for the year are added to the work in process at the beginning of the year to arrive at the available total work in process for the year. From that result, the ending work in process - the product that is still unfinished - is deducted to determine the cost of goods manufactured.

Finally, the cost of goods manufactured is added to the finished goods at the beginning of the year to arrive at the cost of finished goods available for sale. From that result, the finished goods that were not sold are deducted to arrive at the cost of goods that were sold.

The following table shows the calculations for the work in process and finished goods amounts for the headgear manufacturing company. This level of detail is not necessary to show in the statement of cost of goods manufactured, but it is useful in understanding how amounts in that statement were derived.

CALCULATIONS - Cost of Goods Sold Budget						
	Units		Cost/Unit			
Finished goods inventory, January 1:						
Bicycle helmet	110	x	\$24	=	\$2,640	
Ski helmet	320	x	95	=	<u>30,400</u>	
Total beginning inventory						\$33,040
Work in process inventory, January:						
Bicycle helmet	450	x	\$15	=	\$6,750	
Ski helmet	520	x	70	=	<u>36,400</u>	
Total beginning work in process						\$43,150
Work in process inventory, December 31:						
Bicycle helmet	610	x	\$10	=	\$6,100	
Ski helmet	500	x	40	=	<u>20,000</u>	
Total ending work in process						\$26,100
Finished goods inventory, December 31:						
Bicycle helmet	150	x	\$25	=	\$3,750	
Ski helmet	280	x	93	=	<u>26,040</u>	\$29,790
Total ending inventory						

The sales and cost of goods sold budgets provide key information necessary to arrive at the budgeted gross profit amount.

### 7.8 SELLING AND ADMINISTRATIVE COST BUDGET

The **selling and administrative cost budget** lists operating expenses on a line-by-line basis and totals the amounts. The selling and administrative cost budgets for both companies follow.

**Souvenir Statues**

<b>Selling and Administrative Cost Budget</b>			
Selling expenses:			
Sales commissions expenses		\$16,300	
Advertising expense	+	14,100	
Utilities expense	+	<u>12,000</u>	
Total selling expenses			= \$42,400
Administrative expenses:			
Salaries expense		\$87,700	
Utilities expense	+	11,400	
Office supplies expense	+	<u>5,600</u>	
Total administrative expenses			+ <u>\$104,700</u>
Total selling and administrative expenses			= <u><b>\$147,100</b></u>

**Headgear**

<b>Selling and Administrative Cost Budget</b>			
Selling expenses:			
Sales commissions expenses		\$129,200	
Advertising expense	+	60,800	
Travel expense – selling	+	6,300	
Telephone expense – selling	+	<u>4,100</u>	
Total selling expenses			= \$200,400
Administrative expenses:			
Office salaries expense		\$22,700	
Depreciation expense – office equipment	+	2,600	
Telephone expense – administrative	+	900	
Office supplies expense	+	800	
Miscellaneous administrative expense	+	<u>700</u>	
Total administrative expenses			+ <u>27,700</u>
Total selling and administrative expenses			= <u><b>\$228,100</b></u>

**7.9 BUDGETED INCOME STATEMENT**

The sales, cost of goods sold, and selling and administrative cost budgets are supporting budgets that are combined to produce a **budgeted income statement** for the year. The budgeted income statements for both companies follow.

**Souvenir Statues**

**Headgear**

Budgeted Income Statement		
Sales		\$600,000
Cost of goods sold	-	<u>162,900</u>
Gross profit	=	\$437,100
Total selling and administrative expenses	-	<u>147,100</u>
Income before taxes	=	\$290,000
Income taxes	-	<u>58,000</u>
Net income	=	<b><u>\$232,000</u></b>

Budgeted Income Statement		
Sales		\$754,000
Cost of goods sold	-	<u>263,540</u>
Gross profit	=	\$490,460
Total selling and administrative expenses	-	<u>228,100</u>
Income before taxes	=	\$262,360
Income taxes	-	<u>65,590</u>
Net income	=	<b><u>\$196,770</u></b>

The operating budgets culminate with the budgeted income statement.

Additional budgets may be prepared that relate to balance sheet accounts.

**Financial budgets** look at critical aspects of a business that are not directly operational but that impact a company’s ability to pay its obligations. The discussion will be limited to the cash budget and the capital expenditures budget.

### 7.10 CASH BUDGET

The availability and commitment of cash is critical to management planning and operational success. The **cash budget** provides relevant information by estimating cash receipts and cash payments for one or more periods.

Cash receipts result from cash sales, collection of accounts receivable, other revenue sources, sales of assets, and issuance of stocks and bonds. Cash payments occur due to incurring costs and expenses, paying invoices on account, purchasing assets, paying off debts, and paying interest and dividends. The frequency and amount of these transactions are estimated and consolidated to form the cash budget.

The most common reason for cash receipts is sales to customers, and the most frequent cash payments are due to sales-related costs. The following example will illustrate the preparation of the cash budget.

Assume that Jonick Corporation begin operating on January 1, 2019.

**Projected sales to customers** for the first four months are as follows.

Estimated Sales				
	January	February	March	April
Budgeted sales	\$68,000	\$90,000	\$124,000	\$139,000
Budgeted cash sales (20%)	13,600	18,000	24,800	27,800
Budgeted sales on account (80%)	54,400	72,000	99,200	111,200

The company expects that 20% of each month’s sales will be for cash and the remainder on account. It anticipates that 40% of sales on account will be collected in

the month of sale, 50% will be collected in the following month, and the remaining 10% collected during the second month after the sale.

The following table illustrates the budgeted cash collections from sales for each of the four months with corresponding calculations.

Budgeted Cash Collections from Sales								
	January		February		March		April	
Cash collections from sales:								
Cash collected from cash sales	\$13,600	(\$68,000 x 20%)	\$18,000	(\$90,000 x 20%)	\$24,800	(\$124,000 x 20%)	\$27,800	(\$139,000 x 20%)
Cash collected from this month's sales on account (40%)	21,760	(\$54,400 x 40%)	28,800	(\$72,000 x 40%)	39,680	(\$99,200 x 40%)	44,480	(\$111,200 x 40%)
Cash collected from last month's sales on account (50%)	0	-	27,200	(\$54,400 x 50%)	36,000	(\$72,000 x 50%)	49,600	(\$99,200 x 50%)
Cash collected sales on account two months ago (10%)	0	-	0	-	5,440	(\$54,400 x 10%)	7,200	(\$72,000 x 10%)
Total cash collections from sales	<u>\$35,360</u>		<u>\$74,000</u>		<u>\$105,920</u>		<u>\$129,080</u>	

Each month, the company expects to collect for cash sales plus for sales on account for the current month and for the previous two months. In this example, cash collections are expected to be \$35,360 for January, \$74,000 for February, \$105,920 for March, and \$129,080 for April.

**Projected purchases from vendors** for the first four months are as follows.

Estimated Purchases				
	January	February	March	April
Budgeted purchases	\$34,000	\$45,000	\$62,000	\$70,000
Budgeted cash purchases (30%)	10,200	13,500	18,600	21,000
Budgeted purchases on account (70%)	23,800	31,500	43,400	49,000

The company expects that 30% of each month's purchases will be for cash and the remainder on account. It anticipates that 60% of purchases on account will be paid in the month of sale, 30% will be paid in the following month, and the remaining 10% paid during the second month after the sale.

The following table illustrates the budgeted cash payments to vendors for each of the four months with corresponding calculations.

Budgeted Cash Payments from Purchases								
	January		February		March		April	
Cash payments from purchases:								
Cash paid for purchases	\$10,200	(\$34,000 x 30%)	\$13,500	(\$45,000 x 30%)	\$18,600	(\$62,000 x 30%)	\$21,000	(\$70,000 x 30%)
Cash paid for this month's purchases on account (60%)	14,280	(\$23,800 x 60%)	18,900	(\$31,500 x 60%)	26,040	(\$43,400 x 60%)	29,400	(\$49,000 x 60%)
Cash paid for last month's sales on account (30%)	0	-	7,140	(\$23,800 x 30%)	9,450	(\$31,500 x 30%)	13,020	(\$43,400 x 30%)
Cash paid for purchases on account two months ago (10%)	0	-	0	-	2,380	(\$23,800 x 10%)	3,150	(\$31,500 x 10%)
Total cash collections from sales	<u>\$24,480</u>		<u>\$39,540</u>		<u>\$56,470</u>		<u>\$66,570</u>	

Each month, the company expects to pay for cash purchases that month and for purchases on account for the current month and for the previous two months. In this example, cash payments are expected to be \$24,480 for January, 39,540 for February, \$56,470 for March, and \$66,570 for April.

Jonick Corporation also anticipates the following cash-related transactions will take place during the first four months the business operates.

1. The company will issue stock for \$50,000 cash in January.
2. The company will purchase equipment for \$8,000 cash in January.
3. The company will purchase equipment for \$12,000 cash in February.
4. The company will sell equipment for \$3,000 in March.
5. The company will pay \$1,000 in cash dividends in March.

Based on the information about Jonick Corporation’s anticipated cash inflows and outflows, the following cash budget can be prepared for the first four months of operations.

<b>Cash Budget</b>				
	<b>January</b>	<b>February</b>	<b>March</b>	<b>April</b>
Estimated cash receipts:				
Cash sales	\$13,600	\$18,000	\$24,800	\$27,800
Collection of accounts receivable	54,400	<u>72,000</u>	99,200	<u>111,200</u>
Issuance of stock	<u>50,000</u>			
Sale of equipment			<u>3,000</u>	
Total estimated cash receipts	\$118,000	\$90,000	\$127,000	\$139,000
Estimated cash payments:				
Cash purchases	\$10,200	\$13,500	\$18,600	\$21,000
Payment of accounts payable	23,800	31,500	<u>43,400</u>	49,000
Purchase of equipment	<u>8,000</u>	<u>12,000</u>		
Payment of dividends				<u>\$1,000</u>
Total estimated cash payments	\$42,000	\$57,000	\$62,000	\$71,000
Cash increase	76,000	33,000	65,000	68,000
Cash at beginning of the month	<u>0</u>	<u>76,000</u>	<u>33,000</u>	<u>65,000</u>
Cash at end of the month	<u>\$76,000</u>	<u>\$109,000</u>	<u>\$98,000</u>	<u>\$133,000</u>

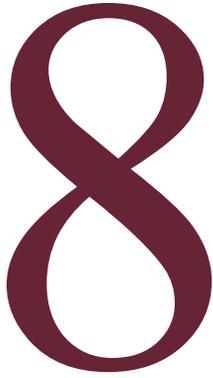
### 7.11 CAPITAL EXPENDITURE BUDGET

A **capital expenditure budget** is a list of fixed assets that a company plans to acquire over a future period of time. These assets may be purchased to replace existing assets that are aging or outdated, or they may be additional resources necessary to meet growing demand. Amounts for these expenditures are usually determined by looking at current costs and factoring in potential pricing adjustments in the future.

A sample capital expenditures budget follows.

Capital Expenditures Budget					
Asset	2020	2021	2022	2023	2024
Machinery – Cutting Department	\$12,000	\$18,000		\$24,000	\$31,000
Machinery – Assembly Department	57,000	43,000	18,000		15,000
Delivery vehicle		35,000		42,000	
Office equipment	<u>21,000</u>	<u>4,000</u>	<u>7,000</u>	<u>1,000</u>	<u>3,000</u>
Total	<u>\$90,000</u>	<u>\$100,000</u>	<u>\$25,000</u>	<u>\$67,000</u>	<u>\$49,000</u>

Budgets provide a financial roadmap for executing the plans management has developed. Keep in mind that they are projections of what will take place in the future rather than reports of past performance. They can be compared to evaluate actual performance once it can be measured. That assessment often leads to discovering strengths and weaknesses that can be considered when making subsequent plans going forward.



# Variance Analysis

## 8.1 INTRODUCTION

Budgets are the result of planning efforts to estimate a company's performance for a period of time in the future. They are tools that guide managers and employees for keeping operations on track to achieve stated goals. Once a budget's time period expires, its estimates then serve as benchmarks against which actual results may be compared.

The discussion of budgeting for a manufacturing company included budgets for each of the three product costs: direct materials, direct labor, and factory overhead. Those budgets were as follows.

Estimated units to be produced		1,000
Number of pounds per unit	x	<u>8.6</u>
Pounds of metal required for production	=	8,600
Desired ending inventory, December 31	+	<u>300</u>
Total pounds needed	=	8,900
Estimated beginning inventory, January 1	-	<u>1,800</u>
Total pounds to be purchased	=	7,100
Price per pound	x	<u>\$6</u>
Total direct materials to be purchased	=	<b><u>\$42,600</u></b>

Total units to be produced		1,000
Production time per unit	x	5
Hours required for production	=	5,000
Labor rate per hour	x	<u>\$10</u>
Total direct labor cost	=	<b><u>\$50,000</u></b>

Supervisor salary		7,600
Utilities	+	1,900
Indirect materials	+	1,700
Depreciation	+	<u>800</u>
Total factory overhead cost	=	<b><u>\$12,000</u></b>

Two key estimates are part of the direct materials production budget: the number of pounds needed for the desired level of production and the price per pound. Likewise, the direct labor cost budget shows the number of labor hours required to produce a desired number of units and the labor rate per hour.

The factory overhead cost budget is prepared a bit differently, listing a dollar amount for each cost. Some factory overhead costs may be further broken out into their fixed and variable components.



The difference column shows that 200 fewer pounds were used than expected (favorable). It also shows that the actual price per pound was \$0.30 higher than standard cost (unfavorable). The total actual cost is \$1,320 higher than the standard cost. The direct materials used in production cost more than was anticipated, which is an unfavorable outcome.

Managers can better address this situation if they have a breakdown of the variances between quantity and price. Specifically, knowing the amount and direction of the difference for each can help them take targeted measures for improvement.

The following table is expanded to include this additional information.

Direct Materials Cost Variance									
	Actual		Standard		Difference		Actual Pounds	Standard Price	Variance
Direct materials quantity in pounds	8,400		8,600		(200)	x		\$6.00	(\$1,200)
Direct materials price per pound	<u>\$6.30</u>		<u>\$6.00</u>		\$0.30	x	8,400		\$2,520
Total direct materials cost	<u>\$52,920</u>	-	<u>\$51,600</u>	=	<u>\$1,320</u>				<u>\$1,320</u>

The difference in the quantity is multiplied by the standard price to determine that there was a \$1,200 favorable direct materials quantity variance. This is offset by a larger unfavorable direct materials price variance of \$2,520. The net direct materials cost variance is still \$1,320 (unfavorable), but this additional analysis shows how the quantity and price differences contributed to the overall variance.

The following equations summarize the calculations for direct materials cost variance.

$$\text{Direct materials quantity variance} = (\text{actual quantity} - \text{standard quantity}) \times \text{standard price}$$

$$\text{Direct materials price variance} = (\text{actual price} - \text{standard price}) \times \text{actual quantity}$$

$$\text{Total direct materials cost variance} = \text{direct materials quantity variance} + \text{direct materials price variance}$$

### 8.3 DIRECT LABOR COST VARIANCE

Actual and standard quantities and rates for direct labor for the production of 1,000 units are given in the following table. Total actual and standard direct labor costs are calculated by multiplying number of hours by rate, and the results are shown in the last row of the first two columns.

Direct Labor Cost Variance				
	Actual	Standard	Difference	
Direct labor quantity in hours	5,100	5,000	100	
Direct labor rate per hour	<u>\$9.50</u>	<u>\$10.00</u>	(\$0.50)	
Total direct labor cost	<u>\$48,450</u>	- <u>\$50,000</u>	=	- <u>\$1,550</u>

The difference column shows that 100 extra hours were used vs. what was expected (unfavorable). It also shows that the actual rate per hour was \$0.50 lower than standard cost (favorable). The total actual cost direct labor cost was \$1,550 lower than the standard cost, which is a favorable outcome.

Managers can better address this situation if they have a breakdown of the variances between quantity and rate. Specifically, knowing the amount and direction of the difference for each can help them take targeted measures for improvement.

The following table is expanded to include this additional information.

Direct Labor Cost Variance									
	Actual	Standard	Difference		Actual Hours	Standard Rate		Variance	
Direct labor quantity in hours	5,100	5,000	100	x		\$10.00	=	\$1,000	
Direct labor rate per hour	<u>\$9.50</u>	<u>\$10.00</u>	(\$0.50)	x	5,100		=	(\$2,550)	
Total direct labor cost	<u>\$48,450</u>	- <u>\$50,000</u>	=	- <u>\$1,550</u>	←————→				- <u>\$1,550</u>

The difference in hours is multiplied by the standard price per hour, showing a \$1,000 unfavorable direct labor time variance. This is offset by a larger favorable direct labor rate variance of \$2,550. The net direct labor cost variance is still \$1,550 (favorable), but this additional analysis shows how the time and rate differences contributed to the overall variance.

The following equations summarize the calculations for direct labor cost variance.

$$\text{Direct labor time variance} = (\text{actual hours} - \text{standard hours}) \times \text{standard rate}$$

$$\text{Direct labor rate variance} = (\text{actual rate} - \text{standard rate}) \times \text{actual hours}$$

$$\text{Total direct labor cost variance} = \text{direct labor time variance} + \text{direct labor rate variance}$$

### 8.4 FACTORY OVERHEAD VARIANCES

Factory overhead costs are also analyzed for variances from standards, but the process is a bit different than for direct materials or direct labor. The first step is to break out factory overhead costs into their fixed and variable components, as

shown in the following factory overhead cost budget.

<b>Factory Overhead Cost Budget</b>	
Number of units at normal production capacity	10,000
Variable costs:	
Packing materials	\$30,000
Direct labor	15,000
Variable utilities cost	<u>5,000</u>
Total variable costs	\$50,000
Fixed costs:	
Supervisor salary expense	\$60,000
Depreciation expense	7,000
Machine rental expense	<u>3,000</u>
Total fixed costs	\$70,000
Total budgeted costs	<u>\$120,000</u>

This factory overhead cost budget starts with the number of units that could be produced at normal operating capacity, which in this case is 10,000 units. Assume each unit consumes one direct labor hour in production. Total variable factory overhead costs are \$50,000, and total fixed factory overhead costs are \$70,000. The following factory overhead rate may then be determined.

$$\text{Factory overhead rate} = \frac{\text{budgeted factory overhead at normal capacity}}{\text{normal capacity in direct labor hours}} = \frac{\$120,000}{10,000} = \$12 \text{ per direct labor hour}$$

The total factory overhead rate of \$12 per direct labor hour may then be broken out into variable and fixed factory overhead rates, as follows.

$$\text{Variable factory overhead rate} = \frac{\text{budgeted variable factory overhead at normal capacity}}{\text{normal capacity in direct labor hours}} = \frac{\$50,000}{10,000} = \$5 \text{ per direct labor hour}$$

$$\text{Fixed factory overhead rate} = \frac{\text{budgeted fixed factory overhead at normal capacity}}{\text{normal capacity in direct labor hours}} = \frac{\$70,000}{10,000} = \$7 \text{ per direct labor hour}$$

The \$5 fixed rate plus the \$7 variable rate equals the \$12 total factory overhead rate per direct labor hour.

Factory overhead variances can be separated into a controllable variance and a volume variance.

The **variable factory overhead controllable variance** is the difference between the actual variable overhead costs and the budgeted variable overhead for actual production. The following calculations are performed.

$$1. \quad \begin{array}{l} \text{Budgeted variable} \\ \text{factory overhead} \end{array} = \begin{array}{l} \text{standard hours for} \\ \text{actual units produced} \end{array} \times \begin{array}{l} \text{variable factory} \\ \text{overhead rate} \end{array}$$

If 8,000 units are produced and each requires one direct labor hour, there would be 8,000 standard hours.

$$\text{Budgeted variable factory overhead} = 8,000 \times \$5 \text{ per direct labor hour} = \$40,000$$

$$2. \quad \begin{array}{l} \text{Variable factory overhead} \\ \text{controllable variance} \end{array} = \begin{array}{l} \text{actual variable} \\ \text{factory overhead} \end{array} - \begin{array}{l} \text{budgeted variable} \\ \text{factory overhead} \end{array}$$

Assume actual variable overhead cost is \$39,500

$$\begin{array}{l} \text{Variable factory overhead} \\ \text{controllable variance} \end{array} = \$39,500 - \$40,000 = (\$500), \text{ a favorable variance since} \\ \text{actual is less than expected.}$$

The variable factory overhead controllable variance indicates how well the company was able to adhere to the budget.

The **fixed factory overhead volume variance** is the difference between the budgeted fixed overhead at normal capacity and the standard fixed overhead for the actual units produced. The following calculations are performed.

Fixed factory overhead volume variance =

$$(\text{standard hours normal capacity} - \text{standard hours for actual units produced}) \times \text{fixed factory overhead rate}$$

If 8,000 units are produced and each requires one direct labor hour, there would be 8,000 standard hours.

$$\begin{array}{l} \text{Fixed factory overhead} \\ \text{volume variance} \end{array} = (10,000 - 8,000) \times \$7 \text{ per direct labor hour} = \$14,000$$

The 8,000 standard hours are less than the 10,000 available at normal capacity, so the fixed overhead was underutilized. This results in an unfavorable variance due to the missed opportunity to produce more units for the same fixed overhead.

If 11,000 units are produced (pushing beyond normal operational capacity) and each requires one direct labor hour, there would be 11,000 standard hours.

$$\begin{array}{l} \text{Fixed factory overhead} \\ \text{volume variance} \end{array} = (10,000 - 11,000) \times \$7 \text{ per direct labor hour} = (\$7,000)$$

When standard hours exceed normal capacity, the fixed factory overhead costs are leveraged beyond normal production. A favorable fixed factory overhead volume variance results. Additional units were produced without any necessary increase in fixed costs.

An income statement that includes variances is very useful for managers to see how deviations from budgeted amounts impact gross profit and net income. These insights help in planning by addressing reasons for unfavorable variances and continuing with line items that are favorable.

In this example, assume the selling price per unit is \$20 and 1,000 units are sold. The standard cost per unit of \$113.60 calculated previously is used to determine cost of goods sold – at standard amount. Assume selling expenses are \$18,300 and administrative expenses are \$9,100.

<b>Income Statement with Variances</b>		
Sales		\$200,000
Cost of goods sold – at standard		<u>113,600</u>
Gross profits – at standard		\$86,400
Variances from standard cost:		
Direct materials quantity	(\$1,200)	
Direct materials price	2,520	
Direct labor time	1,000	
Direct labor rate	(2,550)	
Factory overhead controllable	(600)	
Factory overhead volume	<u>400</u>	
Net variance from standard cost – favorable		<u>(430)</u>
Gross profit		\$86,830
Operating expenses:		
Selling expenses	\$18,300	
Administrative expenses	<u>9,100</u>	
Total operating expenses		<u>27,400</u>
Net income before income taxes		<u>\$59,430</u>

The net variance from standard cost and the line items leading up to it build deviations from standard amounts right into the income statement. Managers can focus on discovering reasons for these differences to budget and operate more effectively in future periods.

# 9 Differential Analysis

## 9.1 INTRODUCTION

Managerial decision making often involves choosing among alternative courses of action. From a financial perspective, the better of two options is either the one that yields the highest amount of income or, if neither produces income, the one that results in the least amount of loss.

**Differential analysis** is a decision-making technique that examines the benefits and costs associated with each of two options and compares the net results of the two. The alternative selected is the one with the most favorable (or least unfavorable) financial impact. The evaluation includes only those costs that will change if one alternative is selected over another. Fixed costs or other costs that are constant for the two options are excluded from the analysis since they will not differentiate one choice from the other. Sunk costs, which are past expenditures that have already been incurred and cannot be recovered, are also ignored since the amount will be the same regardless of the alternative selected.

### EXAMPLE

A bed & breakfast inn owner uses differential analysis to decide whether to renovate a first-floor guest bedroom or to convert that space to a gift shop. A summary of the year's revenues and costs for the two alternatives follows.

Differential Analysis			
	Guest Room	Gift Shop	Difference
Revenues	\$36,000	\$42,000	
Costs	(11,000)	(15,000)	
Income	<b>\$47,000</b>	<b>\$57,000</b>	<b>\$10,000</b>

Since the gift shop will yield \$2,000 more in operating income than the guest room, the gift shop alternative should be selected.

Seven additional examples will be used to illustrate how differential analysis can be applied to specific business decisions.

1. Make or buy a component part
2. Continue with or discontinue a business segment
3. Lease or sell equipment
4. Sell a product or process further
5. Keep or replace a fixed asset
6. Accept business at reduced price
7. Capital investment analysis

## 9.2 MAKE OR BUY A COMPONENT PART

A manufacturing company may have the capacity and ability to make one of the parts that goes into the manufacture of its products. It may also have the alternative of purchasing the same part from an external supplier. Assuming equal quality and availability, the lower-cost option will be selected.

### EXAMPLE

Compu Company manufactures laptop computers and now will sell them complete with a carrying case. The company is currently operating below full capacity and has the ability to manufacture the cases. The company may use differential analysis to determine if it should make or buy the cases.

For this differential analysis, only costs need to be considered. The selling price per unit would not be affected by the decision, and no other factors impact revenue.

The following are the costs of producing one carrying case in house.

Direct materials	\$22.40
Direct labor	14.00
Fixed factory overhead	5.60

Rather than manufacturing the carrying cases, the company can purchase them from an outside vendor for \$34.20 each, plus a transportation cost of \$3.70 per case.

The following differential analysis compares the manufacturing costs per unit with the costs related to purchasing the carrying case. Note that the factory overhead is fixed and would be incurred under either alternative, so it is not listed.

Differential Analysis			
	Make	Buy	Difference
Costs:			
Purchase price		\$34.20	
Inbound shipping charge		<u>3.70</u>	
Direct materials	\$22.40		
Direct labor	<u>14.00</u>		
Total cost per case	<b><u>\$36.40</u></b>	<b><u>\$37.90</u></b>	<b><u>\$1.50</u></b>

The cost of making the carrying case is \$1.50 less than purchasing it. Compu Company should manufacture the cases.

### 9.3 CONTINUE WITH OR DISCONTINUE A PRODUCT

A product, department, territory, or other segment of a company may not be performing to expectations and may even be generating a loss. The company may consider discontinuing that segment to eliminate its variable costs and any operating losses associated with the segment. However, fixed costs such as depreciation, property taxes, and insurance will not be reduced. Therefore, eliminating a segment does not always result in higher income for the business as a whole. The decision as to whether to continue with or discontinue a product, etc., is based upon the relative difference between the financial impacts.

#### EXAMPLE

Healthy Habits Company sells a variety snack food items. The following income statement information relates to the popcorn product line for the previous year.

Sales	\$720,000
Cost of goods sold	<u>480,000</u>
Gross profit	\$240,000
Operating expenses	<u>500,000</u>
Loss from operations	(\$260,000)

It is estimated that 25% of the cost of goods sold amount is fixed and 40% of the operating expenses are fixed.

The following differential analysis compares the cost of continuing the popcorn product with the cost of discontinuing it. Note that the fixed portions of the cost of goods sold and operating expenses would be incurred under either alternative, so they are not included.

Differential Analysis			
	Continue	Discontinue	Difference
Revenue	\$700,000		
Costs:			
Variable cost of goods sold <sup>1</sup>	\$360,000		
Variable operating expenses <sup>2</sup>	<u>300,000</u>		
Income	<b><u>\$40,000</u></b>		<b><u>\$40,000</u></b>

<sup>1</sup> \$480,000 x 75%

<sup>2</sup> \$500,000 x 60%

Although continuing the sale of popcorn results in an operating loss for that product line, it does yield \$40,000 in operating income when fixed costs are eliminated from the calculation. Since fixed costs will be incurred regardless of whether popcorn is sold or not, keeping it in the product offerings has a positive impact on the company’s earnings. Discontinuing popcorn results in no revenue or variable costs at all, so the company would miss out on the \$40,000 contribution toward paying fixed costs. The company should continue selling popcorn.

### 9.4 LEASE OR SELL EQUIPMENT

A company may have purchased and used a fixed asset, such as equipment, a vehicle, or a building, and finds it no longer needs that item in its operations. The company may choose to sell the asset or lease it to another company to generate an income stream. The company can use a differential analysis to determine the alternative that provides the greater financial return.

#### EXAMPLE

Harper Company purchased equipment for \$40,000 several years ago. It currently has a book value of \$15,000. Harper can sell the equipment for \$10,000. The company would have to pay a 2% commission on the sale. Alternatively, the company could lease the equipment to Alden Company for \$2,400 for each of four years. At the end of the lease period, the company could return the equipment to its manufacturer for \$100 for scrap. In both cases, it will cost Harper Company \$900 to restore the equipment site in the factory once it is removed.

Differential Analysis			
	Lease	Sell	Difference
Revenue <sup>1</sup>	\$9,600	<u>\$10,000</u>	
Scrap value	<u>100</u>		
Costs:			
Sales commission <sup>2</sup>		<u>200</u>	
Income	<b><u>\$9,700</u></b>	<b><u>\$9,800</u></b>	<b><u>\$100</u></b>

<sup>1</sup> \$2,400 x 4

<sup>2</sup> \$10,000 x 2%

The income from the four-year lease plus the scrap value is compared to the selling price minus the commission. The \$900 restoration cost is not considered since it must be paid under either option. The original purchase price is a sunk cost that will not be recouped or changed regardless of the decision; therefore, it is ignored as well. Since selling the equipment will result in a \$100 greater return, the company should sell the equipment.

### 9.5 SELL A PRODUCT OR PROCESS FURTHER

A manufactured item may be produced in various stages or processes. In some cases, the initial production yields one finished product and processing it further results in a different product. In other cases, there may be a market for a partially completed manufactured good, where the buyer ultimately completes the product to its own specifications. A manufacturer may have to decide whether to sell a product at an initial stage or process it further. The preferred choice is the one that is more financially beneficial.

#### EXAMPLE

Morning Roast Coffee, Inc. produces dark roast coffee in batches of 5,000 pounds. Materials cost is \$5.80 per pound. The dark roast coffee can be sold without further processing for \$9.70 per pound or may be processed further to yield dark roast decaf, which can be sold for \$12.10 per pound. The processing into decaf requires additional costs of \$7,480 per batch. The additional processing will also cause a 4% loss of product due to evaporation.

Differential Analysis			
	Sell	Process	Difference
Revenue <sup>1</sup>	\$48,500	\$60,500	
Costs:			
Materials cost <sup>2</sup>	29,000	36,480	
Evaporation <sup>3</sup>		2,420	
Income	<b>\$19,500</b>	<b>\$9,800</b>	<b>\$2,100</b>

<sup>1</sup> 5,000 x \$9.70    5,000 x \$12.10

<sup>2</sup> 5,000 x \$5.80    5,000 x \$5.80 + \$7,480

<sup>3</sup> \$60,500 x 4%

The differential analysis first considers the different revenues from each alternative and then the respective costs. Even with the 4% product loss from processing further, the decaf coffee results in higher income. The company should process the batch further.

## 9.6 KEEP OR REPLACE A FIXED ASSET

A company may consider replacing a fixed asset it currently owns and operates with one that is more efficient to reduce operating costs. The company can use differential analysis to compare the cost of keeping its original asset and the cost of replacing it with something new.

### EXAMPLE

McNamara Company is considering selling an existing piece of equipment for \$75,000 and replacing it with new equipment that will cost \$182,000. The old equipment cost \$200,000 and currently has accumulated depreciation of \$120,000. The estimated annual variable operational costs for the next six years are \$21,000 for the old equipment and \$6,000 for the new equipment.

Differential Analysis			
	Keep	Replace	Difference
Revenue		\$75,000	
Costs:			
Purchase price		182,000	
Operating costs <sup>1</sup>	\$126,000	36,000	
Income (loss)	<b>(\$126,000)</b>	<b>(\$143,000)</b>	<b>\$17,000</b>

<sup>1</sup>\$21,000 x 6      \$6,000 x 6

Replacing the equipment will generate revenue from the sale of the original asset, but the cost of acquiring the new asset will also be incurred. Each alternative has different annual operating costs. The purchase price of the original equipment is a sunk cost that will not be recouped or changed regardless of the decision; therefore, it is ignored. Each alternative independently generates a loss, so the choice with the lower loss is preferable. The company should keep and operate the original equipment.

## 9.7 ACCEPT BUSINESS AT REDUCED PRICE

A manufacturer may receive an offer to produce and sell additional items, but at a selling price lower than normal. If the company has the capacity for the additional production, it may use differential analysis to determine if the order should be accepted or rejected based on financial considerations.

### EXAMPLE

Spark Top Company manufactures countertop toaster ovens and sells them for \$60 per unit. An overseas wholesaler offers to purchase 5,000 toaster ovens for \$36 per unit, which would be additional production beyond what Spark Top had planned for. The company has the capacity to process this special order. The

variable manufacturing cost per unit is \$25, and the fixed manufacturing cost per unit is \$15. A tariff of \$800 is charged to the company for shipping each batch of 5,000 toaster ovens.

Differential Analysis			
	Accept	Reject	Difference
Revenue <sup>1</sup>	\$180,000		
Costs:			
Production costs <sup>2</sup>	125,000		
Tariff	800		
Income (loss)	<b>\$54,200</b>		<b>\$54,200</b>

<sup>1</sup> \$5,000 x \$36

<sup>2</sup> \$5,000 x \$25

No additional revenue or variable costs will be recognized if the company rejects the special order. If it is accepted, revenue will exceed variable costs. Fixed costs are not factored in since they will be incurred regardless of the decision. The company should accept the special order.

The implications of special order pricing may go beyond just financial considerations. For example, processing special orders may reduce demand for the same product at the normal selling price, ultimately decreasing overall income. In addition, regular customers may be irritated to learn that new customers are receiving a better deal and either demand a price match or consider shopping elsewhere.

**As has been discussed and illustrated, differential analysis** involves looking at the different benefits and costs that would arise from alternative solutions to a particular problem. Much of the analysis is quantitative, but it is also important to consider qualitative factors such as customer loyalty, vendor relationships, employee morale, social responsibility, and opportunity costs. The financial element, however, is a critical starting point for managerial decision making.

## 9.8 CAPITAL INVESTMENT ANALYSIS

One of a company’s most significant financial decisions involves the purchase of property, plant, and equipment that will be used in business operations. The costs of these assets are often very high, and they will be in place for many years to come.

Before acquiring a capital asset such as equipment, machinery, or a building, which involves a large expenditure and long-term commitment, a company should evaluate how effectively it is expected to generate a return on investment for the business. **Capital investment analysis** is a form of differential analysis used to determine (1) whether a fixed asset should be purchased at all, or (2) which fixed asset among a number of choices is the best investment. Three commonly used methods for evaluating capital investments will be discussed.

The first two, the average rate of return method and the cash payback method, are relatively straightforward calculations that are often used to determine whether a proposed investment meets a minimum standard for it even to be considered further.

The **average rate of return method** is the percentage return of net income from the proposed investment. It is calculated as follows:

$$\frac{\text{Average annual income}}{\text{Average investment}}$$

Each of the two amounts must first be calculated independently.

$$\text{Average annual income (numerator)} = \frac{\text{Total estimated income over the asset's useful life}}{\text{Number of years in the asset's useful life}}$$

$$\text{Average investment (denominator)} = \frac{\text{Book value at the beginning of the first year}^1 + \text{Book value at the end of the last year}^2}{2}$$

<sup>1</sup> The book value at the beginning of the first year is the asset's cost.

<sup>2</sup> The book value at the end of the last year is the asset's residual value.

As an example, a new piece of equipment that is being considered for purchase costs \$90,000 and has a residual value of \$10,000. It is expected to generate revenue of \$75,000 over its estimated useful life of 5 years.

$$\text{Average annual income} = \frac{\$75,000}{5} = \$15,000$$

$$\text{Average investment} = \frac{\$110,000 + \$10,000}{2} = \$60,000$$

$$\text{Average rate of return} = \frac{\$15,000}{\$60,000} = \mathbf{25\%}$$

The average rate of return of 25% should then be compared to the minimum rate of return that management requires. If the average rate of return is greater than the minimum acceptable rate, the equipment should be evaluated further since it seems promising. If it does not even meet this standard, however, it should not be purchased.

The **cash payback method** looks at the annual net cash inflow from the use of an asset to determine how many years it will take to recover the cost of the asset. Net cash flow includes all cash revenue generated minus all cash expenditures paid from using the asset. Depreciation is not a cash expenditure, so it would not be considered in determining net cash flow.

As an example, a new piece of equipment that is being considered for purchase costs \$80,000. It is expected to generate \$25,000 cash revenue each year and require cash expenditures of \$5,000 to maintain.

$$\text{Cash payback period} = \frac{\text{Cost}}{\text{Annual net cash flow}} = \frac{\$80,000}{\$25,000 - \$5,000} = 4 \text{ years}$$

The cash payback period of four years should be compared to the maximum period that management desires. If the cash payback period of four years is more than an acceptable payback period of three years, for example, the purchase should no longer be considered. If a payback period of five years is acceptable, the purchase should be looked into further.

If annual net cash flows are not expected to be equal each year, the cash payback period is determined by adding the annual expected cash flows year by year until the sum equals the initial cost of the asset.

For example, a new piece of equipment that is being considered for purchase costs \$80,000. Its expected annual cash flows are as follows:

Year	Net Cash Flow	Cash Flow to Date
1	\$12,000	\$12,000
2	18,000	30,000
3	24,000	54,000
4	26,000	80,000
5	30,000	110,000
6	34,000	144,000

In this case, net cash flows recover the initial cost of \$80,000 after four full years.

The average rate of return and the cash payback methods are relatively simple to calculate, yet they yield rather general results. Since neither considers the time value of money, they are more effective for shorter-term investments. They are often used as an initial screening to see if an investment should be immediately disqualified. If not, the investment may be analyzed further using more robust analyses.

The **net present value** (NPV) method for evaluating a potential investment also looks at estimated future net cash flows generated by the asset. It compares the purchase price (investment amount) to the present value of all the future net cash flows from using the asset. The investment is considered viable if the present value of the future net cash flows is greater than the purchase price. Otherwise, the investment should be avoided.

**Present value** factors the timing of future net cash inflows and the effect of a prevailing interest rate. An amount of cash received in the future is worth less than the same amount of cash received today. This is because cash received now may be invested at a given interest rate that causes its value to grow over time

compounding, where interest is earned both on principal and on interest that has already been earned. The opportunity to invest dollars received in the future rather than today is postponed, missing out on time available to earn interest.

Determining the **future value** of a current amount is calculated by multiplying the amount by itself plus the interest rate. For example, the future value of \$1.00 in 3 years at an interest rate of 6% would be calculated as follows:

$$\$1.00 \times 1.06 = \$1.06 \times 1.06 = \$1.12 \times 1.06 = \$1.19$$

Note that interest is calculated on interest previously earned. This process is called compounding.

Present value works in the opposite direction. An amount in the future is known or estimated (such as a net cash inflow), and the calculation backs that amount up to its current value. The process is called discounting. For example, the present value of \$1.00 to be received in 3 years at an interest rate of 6% would be calculated as follows:

$$\frac{\$1.00}{1.06} = \frac{\$0.94}{1.06} = \frac{\$0.89}{1.06} = \$0.84 \text{ (rounded to the nearest cent)}$$

The following table summarizes the present value of \$1 for 10 periods for three interest rates: 6%, 8%, and 10%. Amounts are rounded to five decimal places rather than to the nearest cent.

Period	6%	8%	10%
1	0.94340	0.92593	0.90909
2	0.89000	0.85734	0.82645
3	0.83962	0.79383	0.75132
4	0.79209	0.73503	0.68302
5	0.74725	0.68058	0.62093
6	0.70495	0.63017	0.56448
7	0.66505	0.58349	0.51316
8	0.62741	0.54027	0.46651
9	0.59190	0.50025	0.42410
10	0.55840	0.46319	0.38555

Note that all amounts in the present value table are less than \$1.00 since all represent a future cash receipt rather than the \$1.00 today. The further into the future the \$1.00 will be received for a given interest rate, the lower its present value.

Clearly not all future cash receipts are for \$1.00. To get the present value of a different value, multiply the actual number of dollars by the present value of \$1 amount given in the table at the intersection of a specified interest rate and number of years.

Examples 1 and 2 illustrate the process of discounting the future net cash flows to determine their total and comparing it to the cost of the asset.

**EXAMPLE 1**

A company is considering purchasing equipment #1 for \$100,000. It is expected to provide net cash flows of \$24,000 per year for the next six years for a total of \$144,000. The minimum desired rate of return on the investment is 6%.

Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow
1	\$24,000	0.94340	\$22,642
2	24,000	0.89000	21,360
3	24,000	0.83962	20,151
4	24,000	0.79209	19,010
5	24,000	0.74725	17,934
6	24,000	0.70495	16,919
Total	\$144,000	4.91731	\$118,016
Cost			(100,000)
NPV			\$18,016

Since the undiscounted net cash flow amount is the same each year, the total discounted net cash flow could also be calculated by using the present value of an annuity of \$1, as follows:

$\$24,000 \times 4.91731 = \$118,016$

Rather than multiplying \$24,000 six times by six different factors, \$24,000 can be multiplied once by the sum of all the factors (4.91731). The result is the same.

In this case, the net present value of the future cash flows of \$18,016 is greater than the cost of the asset, \$100,000. The investment may be accepted since it more than pays for itself over time.

If the cost of the asset had been \$130,000 rather than \$100,000, the net present value would have been (\$11,984), which is \$118,016 - \$130,000. In this case the NPV is negative and the proposed purchase should be rejected.

**EXAMPLE 2**

A company is considering purchasing equipment #2 for \$100,000. It is expected to provide net cash flows of different amounts each year for the next six years for a total of \$144,000. The minimum desired rate of return on the investment is 6%.

Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow
1	\$34,000	0.94340	\$32,076
2	30,000	0.89000	26,700
3	26,000	0.83962	21,830
4	24,000	0.79209	19,010
5	18,000	0.74725	13,451
6	<u>12,000</u>	0.70495	<u>8,459</u>
Total	\$144,000		\$121,526
Cost			<u>(100,000)</u>
NPV			\$24,526

Since the undiscounted net cash flow amounts are different each year, the total discounted net cash flow must be calculated using six individual calculations. Each year the undiscounted net cash flow amount is multiplied by the present value of \$1 factor at 6%.

In this case, the net present value of the future cash flows of \$21,256 is greater than the cost of the asset, \$100,000. The investment may be accepted since it more than pays for itself over time.

Net present value can be used to perform differential analysis to compare results of two or more proposed investments to determine which is more financially beneficial. Examples 3 and 4a show these comparisons.

**EXAMPLE 3**

A company is considering two different proposals for purchasing equipment. Both assets will be useful for six years. The first piece of equipment costs \$100,000, and the second costs \$140,000. The undiscounted cash flows appear in the two tables that follow.

#1 Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow	#2 Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow
1	\$34,000	0.94340	\$32,076	1	\$44,000	0.94340	\$41,510
2	30,000	0.89000	26,700	2	39,000	0.89000	34,710
3	26,000	0.83962	21,830	3	34,000	0.83962	28,547
4	24,000	0.79209	19,010	4	31,000	0.79209	24,555
5	18,000	0.74725	13,451	5	23,000	0.74725	17,187
6	<u>12,000</u>	0.70495	<u>8,459</u>	6	<u>16,000</u>	0.70495	<u>11,279</u>
Total	\$144,000		\$121,526	Total	\$187,000		\$157,788
Cost			<u>(100,000)</u>	Cost			<u>(140,000)</u>
NPV			\$24,526	NPV			\$17,788

The second piece of equipment has a higher estimated net cash flow each year, but it also costs more to purchase. Both assets yield a positive net present value, but the first piece of equipment has a higher NPV, \$21,526, vs. the NPV of the second piece, \$17,788. The first piece of equipment should be purchased based on this result.

It is possible that two different investments will span two different periods; that is, one may generate cash flows for more years than the other. In order to perform a differential analysis, the number of years must be the same for both. To make them comparable, the asset with the higher number of years of cash flows is adjusted to assume that it is sold for its residual value amount in the last year that the other asset provides cash flows.

**EXAMPLE 4A**

A company is considering two different proposals for purchasing equipment. The first asset provides cash flows for four years, and the second one provides cash flows for six years. Both assets cost \$100,000 and have a residual value of \$10,000. Both have undiscounted net cash flows of \$124,000 as shown in the tables that follow.

#1 Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow	#2 Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow
1	\$38,000	0.94340	\$35,849	1	\$34,000	0.94340	\$32,076
2	34,000	0.89000	30,260	2	32,000	0.89000	28,480
3	30,000	0.83962	25,189	3	26,000	0.83962	21,830
4	22,000	0.79209	17,426	4	22,000	0.79209	17,426
				4 (residual)	10,000	0.79209	7,921
				5	<del>18,000</del>	<del>0.74725</del>	<del>13,451</del>
				6	<del>12,000</del>	<del>0.70495</del>	<del>8,459</del>
Total	\$124,000		\$108,724	Total	\$124,000		\$107,733
Cost			<u>(100,000)</u>	Cost			<u>(100,000)</u>
NPV			\$8,724	NPV			\$7,733

Note that the cash flow period for the second piece of equipment is adjusted to four years to match that of the first piece of equipment. There are two net cash flows for the second piece of equipment in year four: (1) the inflow from using the equipment, and (2) the proceeds from selling it at its residual value. The cash flows for the fifth and sixth years for the second asset are not considered and are therefore greyed out in the table.

Both assets yield a positive net present value, but the first piece of equipment has a higher NPV, \$8,724, vs. the NPV of the second piece, \$7,733. The first piece of equipment should be purchased based on this result.

As a final illustration of two companies with different cash flow periods, note that the net present value would be identical if the annual net cash flows were the same. In this case, all are equal in years 1, 2, and 3. In year 4, they also both equal \$32,000: for the first asset the \$32,000 is all operational cash flow, and for the second piece of equipment, the \$32,000 includes \$22,000 of operational cash flow and \$10,000 selling price.

**EXAMPLE 4B**

A company is considering two different proposals for purchasing equipment. The first asset provides cash flows for four years, and the second one provides cash flows for six years. Both assets cost \$100,000 and have a residual value of \$10,000. Both have undiscounted net cash flows of \$124,000 as shown in the tables that follow.

#1 Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow	#2 Year	Undiscounted Net Cash Flow	Present Value of \$1 at 6%	Discounted Net Cash Flow
1	\$34,000	0.94340	\$35,076	1	\$34,000	0.94340	\$32,076
2	32,000	0.89000	28,480	2	32,000	0.89000	28,480
3	26,000	0.83962	21,830	3	26,000	0.83962	21,830
4	32,000	0.79209	25,347	4	22,000	0.79209	17,426
				4 (residual)	10,000	0.79209	7,921
				5	<del>18,000</del>	<del>0.74725</del>	<del>13,451</del>
				6	<del>12,000</del>	<del>0.70495</del>	<del>8,459</del>
Total	\$124,000		\$107,733	Total	\$124,000		\$107,733
Cost			<u>(100,000)</u>	Cost			<u>(100,000)</u>
NPV			\$7,733	NPV			\$7,733

Differential analysis is a useful planning tool for projecting relative results among alternatives. It encourages managers to think ahead and analyze the components of alternative outcomes with the goal of more insightful decision making.