ACCT 311: MANAGERIAL ACCOUNTING



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ACCT 311: Managerial Accounting (Black)

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This text was compiled on 08/26/2026

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1: INTRODUCTION TO MANAGERIAL ACCOUNTING

Learning Objectives

- Identify the primary activities and information needs of managers
- Explain the role of the managerial accountant as a member of the management team
- Compare and contrast financial and managerial accounting
- Identify the ethical implications inherent in managerial accounting and reporting
- Apply strategies for addressing the ethical implications of managerial accounting

1.1: Characteristics of Managerial Accounting
1.2: Key Finance and Accounting Personnel
1.3: Ethical Issues Facing the Accounting Industry
1.4: Computerized Accounting Systems

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1.1: Characteristics of Managerial Accounting

Learning Objectives

- Compare characteristics of financial and managerial accounting

Managerial accounting focuses on internal users—executives, product managers, sales managers, and any other personnel within the organization who use accounting information to make important decisions. Managerial accounting information need not conform with U.S. GAAP. In fact, conformance with U.S. GAAP may be a deterrent to getting useful information for internal decision-making purposes. For example, when establishing an inventory cost for one or more units of product (each jersey or hat produced at Sportswear Company), U.S. GAAP requires that production overhead costs, such as factory rent and factory utility costs, be included. However, for internal decision-making purposes, it might make more sense to include nonproduction costs that are directly linked to the product, such as sales commissions or administrative costs.

Another characteristic of managerial accounting data is its high level of detail. As noted in the opening dialogue between the president and accountant at Sportswear Company, the financial information in the annual report provides a general overview of the company's financial results but does not provide any detailed information about each product. Information, such as product profitability, would come from the managerial accounting function.

Finally, managerial accounting information often takes the form of nonfinancial measures. For example, Sportswear Company might measure the percentage of defective products produced or the percentage of on-time deliveries to customers. This kind of nonfinancial information comes from the managerial accounting function.

Table 1.1.1 summarizes the characteristics of both managerial and financial accounting.

Table 1.1.1: Comparison of Financial and Managerial Accounting

	Managerial Accounting
Users	*Inside the organization*
Accounting rules	*None*
Time horizon	*Future projections (sometimes historical if in detail)*
Level of detail	*Often presents segments of an organization (e.g., products, divisions, departments)*
Performance measures	*Financial and nonfinancial*

Follow-Up at Sportswear Company

There are many issues associated with determining product profitability, including how to allocate costs that are not easily traced to each product and whether the product revenue and cost information is accurate enough to make important managerial decisions. These important issues will be addressed throughout the book.

Throughout your study of managerial accounting, you will learn about the types of information needed to make these decisions, as well as techniques for analyzing this information. First, it is important to understand the various roles managers play in

the organization in order to understand the types of information and the level of detail that are needed. Most of the job responsibilities of a manager fit into one of three categories: planning, controlling, or evaluating.

The model in Figure 1.1.1 sums up the three primary responsibilities of management and the managerial accountant's role in the process. As you can see from the model, the function of accomplishing an entity's mission statement is a circular, ongoing process.



Figure 1.1.1: The Process of Adhering to the Mission Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Planning

One of the first items on a new company's agenda is the creation of a mission statement. A mission statement is a short statement of a company's purpose and focus. This statement should be broad enough that it will encompass future growth and changes of the company. Table 1.1.1 contains the mission statement of three different types of companies: a manufacturer, an e-commerce company, and a service company.

Table 1.1.1: Sample Mission Statements

Company	Mission Statement
Dow Chemical	"To passionately create innovation for our stakeholders at the intersection of chemistry, biology,
Starbucks	"To inspire and nurture the human spirit—one person, one cup, and one neighborhood at a time.
Google	"Our mission is to organize the world's information and make it universally accessible and usefu

Once the mission of the company has been determined, the company can begin the process of setting goals, or what the company expects to accomplish over time, and objectives, or the targets that need to be met in order to meet the company's goals. This is known as planning. Planning occurs at all levels of an organization and can cover various periods of time. One type of planning, called strategic planning, involves setting priorities and determining how to allocate corporate resources to help an organization accomplish both short-term and long-term goals. For example, one hotel may want to be the low-price, no-frills, clean alternative, while another may decide to be the superior quality, high-price luxury hotel with many amenities. Obviously, to be successful, either of these businesses must determine the goals necessary to meet their particular strategy.

Typically, a strategic plan will span any number of years an organization chooses (three, five, seven, or even ten years), and often companies will have multiple strategic plans, such as one for three years, one for five years, and one for ten years. Given the time length involved in many plans, the organization also needs to factor in the potential effects of changes in their senior executive leadership and the composition of the board of directors.

What types of objectives are part of a strategic plan? Strategic objectives should be diverse and will vary from company to company and from industry to industry, but some general goals can include maximizing market share, increasing short-term profits, increasing innovation, offering the best value for the cost, maintaining commitment to community programs, and exceeding environmental protection mandates.

From a managerial accounting perspective, planning involves determining steps or actions to meet the strategic or other goals of the company. For example, Daryn's Dairy, a major producer of organic dairy products in the Midwest, has made increasing the market share of its products one of its strategic goals. However, to be truly effective, the goals need to be defined specifically. For example, the goals might be stated in terms of percentage growth, both annually and in terms of the number of markets addressed in their growth projections.

Also, Daryn's planning process would include the steps the company plans to use to implement to increase market share. These plans may include current-year plans, five-year plans, and ten-year plans.

The current-year plan may be to sell the company's products in 10 percent more stores in the states in which it currently operates. The five-year plan may be to sell the products internationally in three countries, and the ten-year plan may be to acquire their chief competitor and, thus, their customers. Each of these plans will require outlining specific steps to reach these goals and communicating those steps to the employees who will carry out or have an impact on reaching these goals and implementing these plans.

Planning can involve financial and nonfinancial processes and measures. One planning tool is the budgeting process, which requires management to assess the resources—for example, time, money, and number and type of employees needed—to meet current-year objectives. Budgeting often includes both financial data, such as worker pay rates, and nonfinancial data, such as the number of customers an employee can serve in a given time period.

A retail company can plan for the expected sales volume, a hospital can plan for the number of x-rays they expect to administer, a law firm can plan the hours expected for the various types of legal services they perform, a manufacturing firm can plan for the level of quality expected in each item produced, and a utility company can plan for the level of air pollutants that are acceptable. Notice that in each of these examples, the aspect of the business that is being planned and evaluated is a qualitative (nonfinancial) factor or characteristic. In your study of managerial accounting, you will learn about many situations in which both financial and nonfinancial data or information are equally relevant. However, the qualitative aspects are typically not quantified in dollars but evaluated using some other standards, such as customers served or students advised.

While these functions are initially stated in qualitative terms, most of these items would at some point be translated into a dollar value or dollar effect. In each of these examples, the managerial accounting function would help to determine the variables that would help appropriately measure the desired goal as well as plan how to quantify these measures. However, measures are only useful if tracked and used to determine their effectiveness. This is known as the control function of management.

Controlling

To measure whether plans are meeting objectives or goals, management must put in place ways to assess success or lack of success. Controlling involves the monitoring of the planning objectives that were put into place. For example, if you have a retail store and you have a plan to minimize shoplifting, you can implement a control, such as antitheft tags that trigger an alarm when someone removes them from the store. You could also install in the ceilings cameras that provide a different view of customers shopping and therefore may catch a thief more easily or clearly. The antitheft tags and cameras serve as your controls against shoplifting.

Managerial accounting is a useful tool in the management control function. Managerial accounting helps determine the appropriate controls for measuring the success of a plan. There are many types of controls that a company can use. Some controls can be in the form of financial measures, such as the ratio for inventory turnover, which is a measure of inventory control and is defined as Cost of Goods Sold ÷ Average Inventory, or in the form of a performance measure, such as decreasing production costs by 10 percent to help guide or control the decisions made by managers. Other controls can be physical controls, such as fingerprint identification or password protection. Essentially, the controlling function in management involves helping to coordinate the day-to-day activities of a business so that these activities lead to meeting corporate goals.

Without controls, it is very unlikely a plan would be successful, and it would be difficult to know if your plan was a success. Consider the plan by Daryn's Dairy to increase market share. The plan for the first year was to increase market share by selling the company's products in 10 percent more stores in the states in which the company already operates. How will the company

implement this plan? The implementation, or carrying out, of the plan will require the company to put controls in place to measure which new stores are successfully selling the company's products, which products are being sold the most, what the sales volume and dollar value of the new stores are, and whether the sales in these new stores are affecting the volume of sales in current stores. Without this information, the company would not know if the plan is reaching the desired result of increased market share.

The control function helps to determine the courses of action that are taken in the implementation of a plan by helping to define and administer the steps of the plan. Essentially, the control function facilitates coordination of the plan within the organization. It is through the system of controls that the actual results of decisions made in implementing a plan can be identified and measured. Managerial accounting not only helps to determine and design control measures, it also assists by providing performance reports and control reports that focus on variances between the planned objective performance and the actual performance. Control is achieved through effective feedback, or information that is used to assess a process. Feedback allows management to evaluate the results, determine whether progress is being made, or determine whether corrective measures need to be taken. This evaluation is in the next management function.

Evaluating

Managers must ultimately determine whether the company has met the goals set in the planning phase. Evaluating, also called *assessing* or *analyzing*, involves comparing actual results against expected results, and it can occur at the product, department, division, and company levels. When there are deviations from the stated objectives, managers must decide what modifications are needed.

The controls that were put into place to coordinate the implementation of a particular company plan must be evaluated so that success can be measured, or corrective action can be taken. Consider Daryn's Dairy's one-year plan to increase market share by selling products in 10 percent more stores in the states in which the company currently operates. Suppose one of the controls put into place is to measure the sales in the current stores to determine if selling the company's products in new stores is adding new sales or merely moving sales from existing stores. This control measure, same-store sales, must be evaluated to determine the effect of the decision to expand the selling of products within the state. This control measure will be evaluated by comparing sales in the current year in those stores to sales from the prior year in those same stores. The results of this evaluation will help guide management in their decision to move forward with their plan, to modify the plan, or to scrap the plan.

As discussed previously, not all evaluations will involve quantitative or financial measures. In expanding market share, the company wants to maintain or improve its reputation with customers and does not want the planned increased availability or easier access to their products to decrease customer perceptions of the products or the company. They could use customer surveys to evaluate the perceived effect on the company's reputation as a result of implementing this one-year plan. However, there are many ways that companies can evaluate various controls. In addition to the financial gauges, organizations are now measuring efficiencies, customer development, employee retention, and sustainability.

Managers spend their time in various stages of planning, controlling, and evaluating. Generally, higher-level managers spend more time on planning, whereas lower-level managers spend more time on evaluating. At any level, managers work closely with the managerial accounting team to help in each of these stages. Managerial accountants help determine whether plans are measurable, what controls should be implemented to carry out a plan, and what are the proper means of evaluation of those controls. This would include the type of feedback necessary for management to assess the results of their plans and actions. Management accountants generate the reports and information needed to assess the results of the various evaluations, and they help interpret the results.

To put this in context, think about how you will spend your weekend. First, you are the manager of your own time. You must plan based on your workload and on how much time you will spend studying, exercising, sleeping, and meeting with friends. You then control how your plan is implemented by setting self-imposed or possibly group meeting–imposed deadlines, and last, you evaluate how well you carried out your plan by gathering more data—such as grades on assignments, personal fulfillment, and number of hours of sleep—to determine if you met your plans (goals). Not planning, controlling, and evaluating often results in less-than-desirable outcomes, such as late assignments, too little sleep, or bad grades. In this scenario, you did not need a separate managerial accountant to help you with these functions, because you could manage planning, controlling, and evaluating on your own. However, in the business world, most businesses will have both managers and managerial accountants.

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1.2: Key Finance and Accounting Personnel

Learning Objectives

- Describe the functions of key finance and accounting personnel.

Exercise 1.2.1

From the previous discussion, we know that planning and control functions are often designed to evaluate the performance of employees and departments of an organization. This often includes employees overseeing financial information. Thus it is important to understand how most large companies organize their accounting and finance personnel. What are the accounting and finance positions within a typical large company, and what functions do they perform?

Answer available at the end of this section.

Organizational Structure

Figure 1.2.1 is a typical organization chart; it shows how accounting and finance personnel fit within most companies. The personnel at the bottom of the chart report to those above them. For example, the managerial accountant reports to the controller. At the top of the chart are those who control the company, typically the board of directors (who are elected by the owners or shareholders). Review Figure 1.2.1 before moving on to the detailed discussion of each important finance and accounting position.

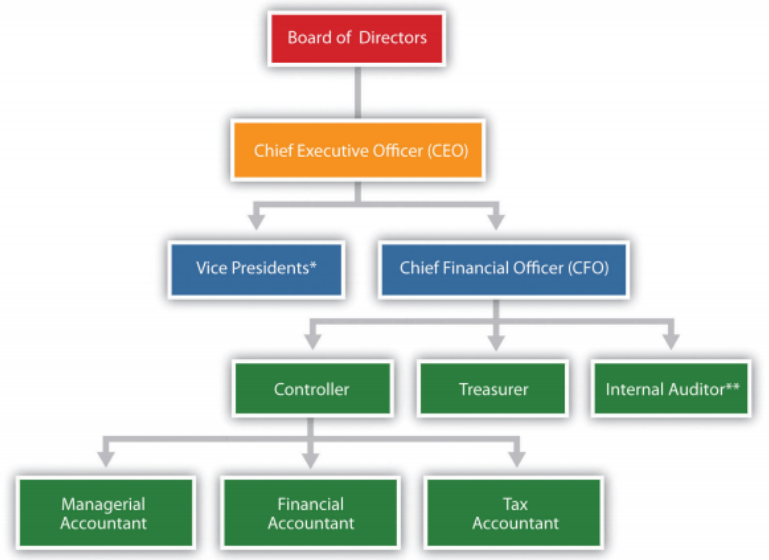


Figure 1.2.1: A Typical Organization Chart

**Represents vice presidents of various departments outside of accounting and finance such as production, personnel, and research and development.*

***In addition to reporting to the chief financial officer, the internal auditor typically reports independently to the board of directors and/or the audit committee (made up of select members of the board of directors).*

Chief Financial Officer

The **chief financial officer (CFO)** is in charge of all the organization's finance and accounting functions and typically reports to

the chief executive officer.

Controller

The **controller** is responsible for managing the accounting staff that provides managerial accounting information used for internal decision making, financial accounting information for external reporting purposes, and tax accounting information to meet tax filing requirements. The three accountants the controller manages are as follows:

- **Managerial accountant**. The **managerial accountant** reports directly to the controller and assists in preparing information used for decision-making within the organization. Reports prepared by managerial accountants include operational budgets, cost estimates for existing products, budgets for new product lines, and profit and loss reports by division. (Note that some people use the term cost accountant interchangeably with *managerial accountant*. Others consider cost accounting a specific function of managerial accounting that focuses on measuring costs. In this text, we use the term managerial accountant and assume that cost accountants focus on measuring costs.)
- **Financial accountant**. The **financial accountant** reports directly to the controller and assists in preparing financial information, in accordance with U.S. GAAP, for those outside the company. Reports prepared by financial accountants include a quarterly report filed with the Securities and Exchange Commission (SEC) that is called a 10Q and an annual report filed with the SEC that is called a 10K.
- **Tax accountant**. The tax **accountant** reports directly to the controller and assists in preparing tax reports for governmental agencies, including the Internal Revenue Service.

Treasurer

The **treasurer** reports directly to the CFO. A treasurer's primary duties include obtaining sources of financing for the organization (e.g., from banks and shareholders), projecting cash flow needs, and managing cash and short-term investments.

Internal Auditor

An **internal auditor** reports to the CFO and is responsible for confirming that the company has controls that ensure accurate financial data. The internal auditor often verifies the financial information provided by the managerial, financial, and tax accountants (all of whom report to the controller and ultimately to the CFO). If conflicts arise with the CFO, an internal auditor can report directly to the board of directors or to the audit committee, which consists of select board members.

Exercise 1.2.2: Not All Organizations Are Alike!

The organization chart in Figure 1.2.1 is intended to serve as a guide. However, all organizations are not the same, particularly smaller organizations. How might the organizational structure differ for a small organization?

Answer available at the end of this section.

BUSINESS IN ACTION 1.2.1

The Organizational Structure of a Not-for-Profit Symphony

Financial limitations prevent a small not-for-profit symphony in California from hiring full-time finance and accounting employees. In spite of having annual revenues approaching $200,000, all financial transactions are processed and recorded by a part-time bookkeeper hired by the symphony. The bookkeeper also inputs budget information and provides monthly financial reports to the treasurer. The treasurer, a volunteer member of the board of directors, is responsible for establishing the annual budget and providing monthly financial reports to the board of directors. An outside firm prepares and processes all tax filings, assembles annual financial statements, and performs a review of the accounting operations at the end of each fiscal year.

Notice how the symphony does not have any of the formal positions identified in Figure 1.1, with the exception of the treasurer. This illustrates how financial constraints and reporting requirements may require an organization to be creative in establishing its organizational structure.

KEY TAKEAWAY

It is important to understand the key accounting and finance positions within a typical company and how each position fits into the organizational structure. The chief financial officer (CFO) oversees all accounting and finance personnel, including the controller, treasurer, and internal auditor. The controller is responsible for the managerial, financial, and tax accounting staff.

Answers

Exercise 1.2.1

Let's look at an example to answer this question. Suppose you are the president of Sportswear Company, mentioned earlier in the chapter, which produces hats and jerseys for fans of professional sports teams. Assume this is a large public company. (The term **public company** refers to a company whose shares of stock are publicly traded—that is, the general investing public can purchase and sell ownership in the company.) As president of Sportswear, you ask the following questions:

How much will we owe the government in income taxes for the year? What was total net income for the last fiscal year?

The challenge is to determine who within Sportswear would be best suited to answer each of these questions. An organization chart will help in finding a solution.

- Should we expand into new geographic markets?
- If we do decide to expand into new markets, should we obtain financing by issuing bonds, obtaining a loan from a bank, or issuing common stock?
- How profitable is each segment of our business (hats and jerseys)?
- How effective are our internal controls over cash?

Exercise 1.2.2**: Not All Organizations Are Alike!**

Smaller organizations tend to have only one or two key finance and accounting personnel who perform the functions described previously. For example, one accountant might perform the financial and managerial accounting duties while another takes care of the tax work (or the tax work might be contracted out to a tax firm). Instead of employing its own internal auditor, an organization might hire one from an outside consulting firm. Some organizations may not have a CFO, or they may have a CFO but not a controller. An organization's structure depends on many different factors, including its size and reporting requirements, as indicated in the Note "Business in Action 1.2.1".

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1.3: Ethical Issues Facing the Accounting Industry

Learning Objectives

- Use standards of ethical conduct to resolve ethical conflicts facing accountants.

Imagine you are the accountant for Drive Write, a company that produces computer disk drives, and you are in charge of all accounting functions within the company. The president has informed you that if the company's profits grow by 20 percent this year, you will receive a $20,000 bonus, and she will receive a $50,000 bonus. No bonuses will be awarded if profit growth is less than 20 percent. Because the company's profits have grown 20 percent annually for the last 10 years, investors have come to expect significant growth from one year to the next. Near the end of this fiscal year, the president and you have the following conversation:

President:	We are awfully close to hitting our numbers and getting to the 20 percent target. With two weeks remaining, projections show we will come in at 18 percent for the year. What can we do on the accounting side to increase current year profits?
Accountant:	Well, I'm not sure there is anything we can do. Our accounting is squeaky clean, as confirmed by our independent auditors. Perhaps our sales will improve next year.
President:	There has to be something we can do—I could sure use the bonus money, and our investors would appreciate an increase in their investment! I know we have a large customer order to be filled the first week of next year. Why not include that sale in this year's numbers?
Accountant:	I'm not comfortable recording sales in the wrong fiscal year.
President:	We're only talking about moving sales by a few days! I would like you to consider this carefully. If you can't do this, I may have to find an accountant who can! Let's talk about our options later this week.

Exercise 1.3.1

The situation at Drive Write creates a serious ethical dilemma. (The Drive Write example is based on a real company called MiniScribe Corporation, subsequently purchased by a competitor.) Companies are constantly under pressure to meet sales and profit goals. Employees who succeed in meeting these goals often reap huge monetary rewards; those who fail may be penalized with lower pay or may even lose their jobs. What would you do if asked to record information in a way that distorts the company's financial results?

Answer available at the end of this section.

To help guide accounting professionals through ethical dilemmas like the one at Drive Write, the Institute of Management Accountants (IMA) has established a *Statement of Ethical Professional Practice*, which appears in Figure 1.3.1. The standards outlined in this statement are guidelines that can help accountants choose an ethically acceptable course of action. As you review Figure 1.3.1, notice that the IMA specifies four core responsibilities (competence, confidentiality, integrity, and credibility) as well as guidelines on how to resolve ethical conflicts. The "Resolution of Ethical Conflict" section provides specific guidance on how to resolve the conflict at Drive Write.

IMA Statement of Ethical Professional Practice

Members of IMA shall behave ethically. A commitment to ethical professional practice includes overarching principles that express our values and standards that guide our conduct.

Principles

IMA's overarching principles include honesty, fairness, objectivity, and responsibility. Members shall act in accordance with these principles and shall encourage others within their organizations to adhere to them.

Standards

A member's failure to comply with the following standards may result in disciplinary action.

I. Competence

Each member has a responsibility to

1. Maintain an appropriate level of professional expertise by continually developing knowledge and skills.
2. Perform professional duties in accordance with relevant laws, regulations and technical standards.
3. Provide decision support information and recommendations that are accurate, clear, concise, and timely.
4. Recognize and communicate professional limitations or other constraints that would preclude responsible judgment or successful performance of an activity.

II. Confidentiality

Each member has a responsibility to:

1. Keep information confidential except when disclosure is authorized or legally required.
2. Inform all relevant parties regarding appropriate use of confidential information. Monitor subordinates' activities to ensure compliance.
3. Refrain from using confidential information for unethical or illegal advantage.

III. Integrity

Each member has a responsibility to:

1. Mitigate actual conflicts of interest. Regularly communicate with business associates to avoid apparent conflicts of interest. Advise all parties of potential conflicts.
2. Refrain from engaging in any conduct that would prejudice carrying out duties ethically.
3. Disclose delays or deficiencies in information, timeliness, processing, or internal controls in conformance with organization policy and/or applicable law.

Resolution of Ethical Conflict

In applying the Standards of Ethical Professional Practice, you may encounter problems identifying unethical behavior or resolving an ethical conflict. When faced with significant ethical issues, you should follow your organization's established policies on the resolution of such conflict. If these policies do not resolve the ethical conflict, you should consider the following courses of action:

1. Discuss the issue with your immediate supervisor except when it appears that the supervisor is involved. In that case, present the issue to the next level. If you cannot achieve a satisfactory resolution, submit the issue to the next management level. If you immediate superior is the chief executive officer or equivalent, the acceptable review authority may be a group such as the audit committee, executive committee, board of directors, board of trustees, or owners. Contact with levels above the immediate superior should be initiated only with your superior's knowledge, assuming he or she is not involved. Communication of such problems to authorities or individuals not employed or engaged by the organization is not considered appropriate, unless you believe there is a clear violation of law.
2. Clarify relevant ethical issues by initiating a confidential discussion with an IMA Ethics Counselor or other impartial advisor to obtain a better understanding of possible courses of action
3. Consult your own attorney as to legal obligations and rights concerning the ethical conflict.

Figure 1.3.1: IMA Statement of Ethical Professional Practice, Source: Adapted from the Institute of Management Accountants, http://www.imanet.org.

Exercise 1.3.2

The IMA is just one of many professional accounting organizations. Do other professional accounting organizations also provide guidance regarding ethics in accounting?

Answer available at the end of this section.

Because of alleged wrongdoing, such as that reported in Note "Business in Action 1.3.1", improving ethics is a top priority for most businesses as shown in Note "Business in Action 1.3.2". As a result, professional organizations like those we have cited have become instrumental in providing ethical guidelines.

BUSINESS IN ACTION 1.3.1: Production Firm Employees Charged with Fraud

The Securities and Exchange Commission (SEC) filed three actions against **Diebold, Inc.**, a manufacturer and seller of automated teller machines, for improperly inflating earnings over a five-year period. Three former employees—the CFO, controller, and director of accounting—were accused of improperly inflating revenue on factory orders, improperly recognizing revenue on a lease transaction, manipulating reserves and accruals, improperly capitalizing expenses, and improperly increasing the value of inventory. These actions allegedly resulted in over 40 misstated annual, quarterly, and other reports filed with the SEC, along with numerous inaccurate press releases.

The company agreed to pay a $25,000,000 civil penalty, and the three former employees remain in litigation. Although the CEO was not accused of wrongdoing, he settled with the SEC and agreed to pay back cash bonuses, stock, and stock options received during the periods when the financial fraud was committed.

Source: Securities and Exchange Commission, “SEC Charges Diebold and Former Executives with Accounting Fraud,” news release, June 2, 2010.

BUSINESS IN ACTION 1.3.2: The Code of Ethics at Home Depot and Hewlett-Packard

Ethics policies are becoming increasingly important to organizations. **Home Depot, Inc.**, has an ethics code that “provides the basic principles for associates to make business decisions consistent with how Home Depot operates” and “forms the groundwork for our ethical behavior.”

Hewlett-Packard Company has established “business ethics guided by enduring values.” The company states it is committed to the following principles: honesty, excellence, responsibility, compassion, citizenship, fairness, and respect.

Sources: Home Depot, “Home Page,” http://www.homedepot.com; Hewlett Packard, “Home Page,” http://www.hp.com.

KEY TAKEAWAY

Should you encounter ethical conflicts during your career, use the resources provided by internal company policies, by professional organizations such as the IMA and AICPA, and by governmental organizations such as the SEC as a guide to ethical behavior and the resolution of ethical conflicts.

Review Problem 1.3.1

1. Describe the four key standards of ethical conduct for IMA members outlined in Figure 1.2.
2. What steps does the IMA recommend for resolving ethical conflicts?
3. Using Figure 1.2 as a guide, discuss your options as the accountant at Drive Write.

Answer available at the end of this section.

Answers

Exercise 1.3.1

As the accountant for Drive Write, your response to the president's request would likely affect your reputation as a professional and your future as an accountant. The unethical behavior at corporations like **Xerox, Enron,** and **WorldCom** in recent years makes it imperative that we know both how to act ethically and how to resolve ethical conflicts.

Exercise 1.3.2

Yes, other professional organizations do provide ethical guidance. Several are listed as follows:

- The American Institute for Certified Public Accountants (AICPA) has a Code of Professional Conduct (see http://www.aicpa.org).
- Financial Executives International provides a Model Code of Ethical Conduct for Financial Managers (see http://www.financialexecutives.org).
- The International Federation of Accountants has a Code of Ethics and Statement of Policy Implementation & Enforcement of Ethical Requirements (see http://www.ifac.org).
- The Securities and Exchange Commission (SEC), in compliance with the Sarbanes-Oxley Act of 2002, requires a company to disclose whether it has adopted a code of ethics (see http://www.sec.gov).
- The Institute of Management Accountants even provides an ethics helpline to give financial professionals a resource to provide guidance in making the right decisions (see http://www.imanet.org).

Review Problem 1.3.1

1. The four key standards shown in Figure 1.2 are outlined as follows:
    1. **Competence**. Members of the IMA must maintain an adequate level of skill to perform duties in an accurate and professional manner.
    2. **Confidentiality**. Members of the IMA must not disclose confidential information for any reason unless legally obligated to do so.
    3. **Integrity**. Members of the IMA must avoid any actual or apparent conflict of interest, including receiving gifts or favors, and must not engage in any activity that would discredit the profession.
    4. **Credibility**. Members of the IMA must disclose all relevant information fairly and objectively.
2. Several options exist for resolving ethical conflicts. The IMA suggests the following courses of action:
    1. Follow the policies of the organization involving the resolution of ethical conflicts.
    2. If following the organization's policies does not effectively resolve the conflict, discuss the problem with your immediate supervisor unless the supervisor is involved.
    3. If the immediate superior cannot reach a satisfactory resolution, the problem should be presented to the next higher managerial level.
    4. If all higher levels of management do not reach a satisfactory resolution, an acceptable reviewing authority may be a group, such as the audit committee, executive committee, board of directors, board of trustees, or owners. Another option includes consulting an objective advisor (e.g., IMA ethics counseling service or an attorney).
3. Several options are available. The IMA suggests first following the organization's policies with regard to resolving ethical conflicts. If Drive Write does not have policies in place or if following the organization's policies does not resolve the conflict, the next step is to discuss the conflict with the immediate supervisor. However, the president of Drive Write (the immediate supervisor) is involved in the conflict, so approaching the president's superiors would be best. This could be the audit committee, executive committee, board of directors, or owners. If after pursuing these different courses of action the ethical conflict still exists, it may be appropriate to consult an objective advisor (e.g., the IMA helpline) and perhaps consult an attorney as to legal obligations and rights concerning the ethical conflict. (Many would argue that regardless of the outcome, one would not want to work for a company where this type of unethical behavior occurs at the top, or anywhere within the organization, and that resigning is the best course of action.)

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1.4: Computerized Accounting Systems

Learning Objectives

- Understand how accounting systems can help organizations.

Exercise 1.4.1

Many companies today are growing out of their accounting systems. In the old days, accounting systems were designed primarily to track daily transactions and provide reports to external users on a monthly, quarterly, or annual basis. But times have changed, and companies now need more information internally to make good decisions. Accounting systems are currently used for both external reporting (financial accounting) and internal reporting (managerial accounting). Even relatively small accounting packages, such as QuickBooks and Peachtree, provide features that are important for managerial accounting. However, most agree that no single accounting system will meet the needs of every organization and that two important factors must be considered when choosing a system. What are the two factors that must be considered when deciding on an accounting system?

Answer available at the end of this section.

How Big Is Your Company?

Accounting software is designed to serve different-sized companies. The size of a company is commonly measured in sales revenue. Experts express varying opinions on what constitutes a small, midsized, or large company. Some believe that small companies have sales up to $10,000,000, midsized companies have sales up to $100,000,000, and large companies have sales greater than $100,000,000. Others prefer different amounts. Regardless of the number used, the goal is to find an accounting system that best meets the needs of the organization, and the size of the organization plays a big part in finding the best-fitting system.

What Information Is Needed?

Before selecting an accounting system, an organization must determine its accounting needs. Some organizations simply need the equivalent of a check register, which provides easy tracking of expense codes as checks are issued and makes bank reconciliations a snap. Other organizations require more than a check register; they may demand a system that can create invoices, process payroll, and track inventory. More complex organizations will want the ability to perform more advanced functions. Such organizations might need to customize reports (e.g., create an income statement by division or customer), modify input screens, send financial reports via e-mail, export reports to spreadsheet software such as Excel, and create reports with graphics (e.g., tables, pie charts, and line charts).

Enterprise Resource Planning System

Exercise 1.4.2

Clearly the size and information needs of a company will drive the selection of an accounting system for the company. As the need for accounting data has become more complex, accounting systems have been developed that perform a wide variety of tasks. These systems are called enterprise resource planning systems. What is an enterprise resource planning system, and how does this system help companies utilize accounting data?

Answer available at the end of this section.

The idea behind ERP software, and a central theme in managerial accounting, is that accurate and up-to-date financial information will help organizations make better decisions. Better decisions typically lead to improvements in profitability, efficiency, and customer satisfaction.

ERP systems are expensive. Annual costs for large organizations can easily exceed $10,000,000. However, smaller systems for midsized companies are available at a much lower cost. Most ERP software is offered in modules for functional accounting areas, such as accounts receivable, accounts payable, payroll, inventory, and job costing. The more modules included, the higher the cost will be. Popular makers of ERP systems include **Microsoft, Oracle**, and **SAP Corporation**.

In deciding whether to upgrade to an ERP system, organizations must be sure that the benefits of using the data from a new system outweigh the costs of implementing the system. If management does not intend to use the information to improve planning and decision making, then going with a less sophisticated accounting system may be the better approach.

Using Spreadsheet Software

Exercise 1.4.3

ERP systems commonly provide a means to download data to spreadsheets for further analysis. How can spreadsheet software help us to analyze financial information?

Answer available at the end of this section.

	A	B	C	D
1	SOUTHWEST AIRLINES CO.			
2	CONSOLIDATED STATEMENT OF INCOME			
3	Years Ended December 31, 2010, 2009, 2008			
4	(In millions)			
5		2010	2009	2008
6	Operating revenues:			
7	Passenger	$11,489	$9,892	$10,549
8	Freight	125	118	145
9	Other	490	340	329
10	Total operating revenues	$12,104	$10,350	$11,023
11	Operating expenses:			
12	Salaries, wages, and benefits	$3,704	$3,468	$3,340
13	Fuel and oil	3,620	3,044	3,713
14	Maintenance materials and repairs	751	719	721
15	Aircraft rentals	180	186	154
16	Landing fees and other rentals	807	718	662
17	Depreciation and amortization	628	616	599
18	Other operating expenses	1,426	1,337	1,385
19	Total operating expenses	$11,116	$10,088	$10,574
20	Operating income	$988	$262	$449
21	Other expenses (income):			
22	Interest expense	$167	$186	$130
23	Capitalized interest	(18)	(21)	(25)
24	Interest income	(12)	(13)	(26)
25	Other (gains) losses, net	106	(54)	92
26	Total other expenses (income)	$243	$98	$171
27	Income before income taxes	$745	$164	$278
28	Provision for income taxes	286	65	100
29	Net income	$459	$99	$178
30				

Figure 1.4.1: Excel Spreadsheet for Southwest Airlines

Exercise 1.4.4

Let's assume you are asked to prepare an income statement showing revenue and expense projections for next year. How might you use Excel to prepare your projections?

Answer available at the end of this section.

Imagine the work involved if you did not use a computer but instead had to write the information down by hand. If there were any changes to the information, you would have to make time-consuming calculations, and once the data were finalized, you would be faced with the manual preparation of formal reports. With the relatively recent advances in business technology, the days of preparing information manually are over. Most organizations require their accounting and finance personnel to have advanced computer spreadsheet skills. Our goal is to provide you with an opportunity to use spreadsheets in a way that mirrors the real world.

KEY TAKEAWAY

Throughout this text, you will learn about different methods of recording, sorting, analyzing, and reporting financial information for internal users. Before deciding to implement one of these methods, ask yourself the following question: Will the benefits derived from a new system, such as an ERP system, exceed the costs of putting the system in place? If the answer is "yes," then go for it! If the answer is "no," consider other alternatives.

Review Problem 1.4

Assume you are the CFO for an electronics consulting firm with annual revenues of $30,000,000 and annual profit of $5,000,000. The current accounting system is used for basic functions, such as issuing checks, creating invoices, and processing payroll. The company is considering upgrading its accounting system by purchasing an ERP system. Describe the factors to be considered by the company in making this decision.

Answer available at the end of this section.

Answers

Exercise 1.4.1

The two factors are (1) the size of the organization and (2) the information needs of the organization. Each factor is discussed next.

Exercise 1.4.2

Enterprise resource planning (ERP) systems are designed to record and share information across functional areas (e.g., accounting, marketing, human resources, and shipping) and across geographical areas (e.g., from a sales office in California to headquarters in Hong Kong). ERP systems continually update information to provide real-time data to all users, and the data can be organized in different formats to meet the needs of internal and external users. For example, in his book Onward, Howard Schultz describes how as CEO of **Starbucks** he reviews comparative financial data for **Starbucks** stores daily. This information comes from the ERP system at **Starbucks**.

Exercise 1.4.3

Since managers make extensive use of spreadsheets to organize and analyze data, most computerized accounting systems are designed to export data to spreadsheet software programs such as Excel. For example, Figure 1.4.1 shows how a spreadsheet was used to import data directly from **Southwest Airlines**' 2010 annual report. This allows the user to analyze the data more easily. Notice that in Figure 1.3 the total operating revenue increased over the three years shown. We could use Excel to quickly determine the exact percentage increase from 2008 to 2009 and from 2009 to 2010.

Exercise 1.4.4

You could start by exporting this year's results from the accounting system to an Excel spreadsheet. Then you could set up a new column to show estimates for next year. You would likely discuss different aspects of the income statement with various personnel in the organization—making changes as you go—before finalizing your projections.

Review Problem 1.4

This company is a midsized company with $30,000,000 in revenues, although some would argue that this is a small company. Going to an ERP system is probably not appropriate if management is simply looking for a few reports beyond what most financial accounting systems can provide.

If management has a need for more detailed and complex financial information—other than processing checks, invoices, and payroll—then a low-end ERP system might be appropriate. However, the benefits derived from such a system must outweigh the costs.

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2: TYPES OF COSTS

Learning Objectives

- Define and illustrate various cost terms, concepts, and behaviors
- Evaluate the relevance of various cost terms for decision-making purposes
- Distinguish between product and period costs

2.1: Distinguish between Merchandising, Manufacturing, and Service Organizations
2.2: Identify and Apply Basic Cost Behavior Patterns
2.3: Cost Terminology

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2.1: Distinguish between Merchandising, Manufacturing, and Service Organizations

Most businesses can be classified into one or more of these three categories: manufacturing, merchandising, or service. Stated in broad terms, manufacturing firms typically produce a product that is then sold to a merchandising entity (a retailer) For example, **Proctor and Gamble** produces a variety of shampoos that it sells to retailers, such as **Walmart**, **Target**, or **Walgreens**. A service entity provides a service such as accounting or legal services or cable television and internet connections.

Some companies combine aspects of two or all three of these categories within a single business. If it chooses, the same company can both produce and market its products directly to consumers. For example, **Nike** produces products that it directly sells to consumers and products that it sells to retailers. An example of a company that fits all three categories is Apple, which produces phones, sells them directly to consumers, and also provides services, such as extended warranties.

Regardless of whether a business is a manufacturer of products, a retailer selling to the customer, a service provider, or some combination, all businesses set goals and have strategic plans that guide their operations. Strategic plans look very different from one company to another. For example, a retailer such as Walmart may have a strategic plan that focuses on increasing same store sales. **Facebook's** strategic plan may focus on increasing subscribers and attracting new advertisers. An accounting firm may have long-term goals to open offices in neighboring cities in order to serve more clients. Although the goals differ, the process all companies use to achieve their goals is the same. First, they must develop a plan for how they will achieve the goal, and then management will gather, analyze, and use information regarding costs to make decisions, implement plans, and achieve goals.

Table 2.1.1 lists examples of these costs. Some of these are similar across different types of businesses; others are unique to a particular business.

Table 2.1.1: Costs

Type of Business	Costs Incur
Manufacturing Business	• Direct l • Plant ar • Manufa • Raw ma
Merchandising Business	• Lease o • Mercha • Retail s
Service Business	• Billing a • Comput • Profess

Some costs, such as raw materials, are unique to a particular type of business. Other costs, such as billing and collections, are common to most businesses, regardless of the type.

Knowing the basic characteristics of each cost category is important to understanding how businesses measure, classify, and control costs.

Merchandising Organizations

A merchandising firm is one of the most common types of businesses. A **merchandising firm** is a business that purchases

finished products and resells them to consumers. Consider your local grocery store or retail clothing store. Both of these are merchandising firms. Often, merchandising firms are referred to as *resellers* or *retailers* since they are in the business of reselling a product to the consumer at a profit.

Think about purchasing toothpaste from your local drug store. The drug store purchases tens of thousands of tubes of toothpaste from a wholesale distributor or manufacturer in order to get a better per-tube cost. Then, they add their mark-up (or profit margin) to the toothpaste and offer it for sale to you. The drug store did not manufacture the toothpaste; instead, they are reselling a toothpaste that they purchased. Virtually all of your daily purchases are made from merchandising firms such as **Walmart**, **Target**, **Macy's**, **Walgreens**, and **AutoZone**.

Merchandising firms account for their costs in a different way from other types of business organizations. To understand merchandising costs, Figure 2.1.1 shows a simplified income statement for a merchandising firm:

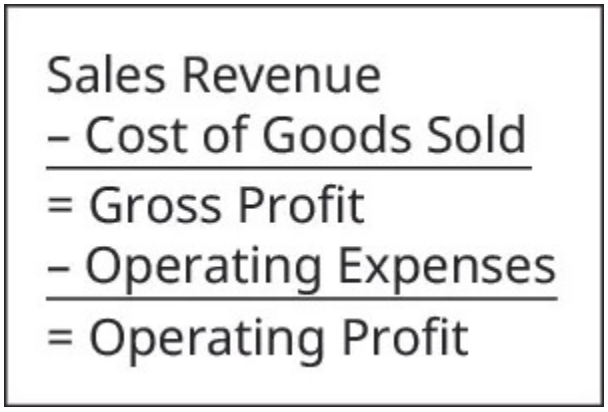


Figure 2.1.1: Simplified Income Statement for a Merchandising Firm. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

This simplified income statement demonstrates how merchandising firms account for their sales cycle or process. *Sales revenue* is the income generated from the sale of finished goods to consumers rather than from the manufacture of goods or provision of services. Since a merchandising firm has to purchase goods for resale, they account for this cost as *cost of goods sold*—what it cost them to acquire the goods that are then sold to the customer. The difference between what the drug store paid for the toothpaste and the revenue generated by selling the toothpaste to consumers is their *gross profit*. However, in order to generate sales revenue, merchandising firms incur expenses related to the process of operating their business and selling the merchandise. These costs are called *operating expenses*, and the business must deduct them from the gross profit to determine the *operating profit*. (Note that while the terms "operating profit" and "operating income" are often used interchangeably, in real-world interactions you should confirm exactly what the user means in using those terms.) Operating expenses incurred by a merchandising firm include insurance, marketing, administrative salaries, and rent.



Figure 2.1.2: Shopping Mall. Merchandising firms must identify and manage their costs to remain competitive and attract customers to their business. (credit: "stairs shopping mall" by "jarmoluk"/Pixabay, CC0)

CONCEPTS IN PRACTICE

Balancing Revenue and Expenses

Plum Crazy is a small boutique selling the latest in fashion trends. They purchase clothing and fashion accessories from several distributors and manufacturers for resale. In 2017, they reported these revenue and expenses:

Rent	$12,000	Sales revenue	$150,000
Advertising	4,000	Cost of goods sold	60,000
Utilities	1,500	Supplies	3,000
Salaries and wages	35,000	Miscellaneous	1,200

Before examining the income statement, let's look at Cost of Goods Sold in more detail. Merchandising companies have to account for inventory. As you recall, merchandising companies carry inventory from one period to another. When they prepare their income statement, a crucial step is identifying the actual cost of goods that were sold for the period. For Plum Crazy, their Cost of Goods Sold was calculated as shown in Figure 2.1.3.

PLUM CRAZY Cost of Goods Sold For the Year Ended December 31, 2017	
Beginning Merchandise Inventory	$ 23,500
+ Purchases	115,000
Goods Available for Sale	138,500
– Ending Merchandise Inventory	(78,500)
Cost of Goods Sold	$ 60,000

Figure 2.1.3: Plum Crazy's Cost of Goods Sold Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Once the calculation of the Cost of Goods Sold has been completed, Plum Crazy can now construct their income statement, which would appear as shown in Figure 2.1.4.

PLUM CRAZY Income Statement For the Year Ended December 31, 2017		
Sales Revenue		$150,000
Cost of Goods Sold		60,000
Gross Profit		90,000
Advertising	$ 4,000	
Rent	12,000	
Salaries and Wages	35,000	
Supplies	3,000	
Utilities	1,500	
Miscellaneous	1,200	
Operating Expenses	56,700	56,700
Net Income		$ 33,300

Figure 2.1.4: Plum Crazy's Income Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Since merchandising firms must pass the cost of goods on to the consumer to earn a profit, they are extremely cost-sensitive. Large merchandising businesses like Walmart, Target, and **Best Buy** manage costs by buying in bulk and negotiating with manufacturers and suppliers to drive the per-unit cost.

CONTINUING APPLICATION

Introduction to the Gearhead Outfitters Story

Gearhead Outfitters, founded by Ted Herget in 1997 in Jonesboro, AR, is a retail chain which sells outdoor gear for men, women, and children. The company's inventory includes clothing, footwear for hiking and running, camping gear, backpacks, and accessories, by brands such as The North Face, Birkenstock, Wolverine, Yeti, Altra, Mizuno, and Patagonia. Ted fell in

love with the outdoor lifestyle while working as a ski instructor in Colorado and wanted to bring that feeling back home to Arkansas. And so, Gearhead was born in a small downtown location in Jonesboro. The company has had great success over the years, expanding to numerous locations in Ted's home state, as well as Louisiana, Oklahoma, and Missouri.

While Ted knew his industry when starting Gearhead, like many entrepreneurs he faced regulatory and financial issues which were new to him. Several of these issues were related to accounting and the wealth of decision-making information which accounting systems provide.

For example, measuring revenue and expenses, providing information about cash flow to potential lenders, analyzing whether profit and positive cash flow is sustainable to allow for expansion, and managing inventory levels. Accounting, or the preparation of financial statements (balance sheet, income statement, and statement of cash flows), provides the mechanism for business owners such as Ted to make fundamentally sound business decisions.

LINK TO LEARNING

Walmart is inarguably a retail giant, but how did the company become so successful? Read the article about how low costs have allowed Walmart to keep prices low while still making a large profit to learn more.

Manufacturing Organizations

A **manufacturing organization** is a business that uses parts, components, or raw materials to produce finished goods (Figure 2.1.5). These finished goods are sold either directly to the consumer or to other manufacturing firms that use them as a component part to produce a finished product. For example, **Diehard** manufactures automobile batteries that are sold directly to consumers by retail outlets such as AutoZone, **Costco**, and **Advance Auto**. However, these batteries are also sold to automobile manufacturers such as **Ford**, **Chevrolet**, or **Toyota** to be installed in cars during the manufacturing process. Regardless of who the final consumer of the final product is, Diehard must control its costs so that the sale of batteries generates revenue sufficient to keep the organization profitable.



Figure 2.1.5: Manufacturing firms apply direct labor to raw materials in order to produce the finished goods purchased from retailers. (credit: "work manufactures" by "dodaning0"/Pixabay, CC0)

Manufacturing firms are more complex organizations than merchandising firms and therefore have a larger variety of costs to control. For example, a merchandising firm may purchase furniture to sell to consumers, whereas a manufacturing firm must acquire raw materials such as lumber, paint, hardware, glue, and varnish that they transform into furniture. The manufacturer incurs additional costs, such as direct labor, to convert the raw materials into furniture. Operating a physical plant where the production process takes place also generates costs. Some of these costs are tied directly to production, while others are general expenses necessary to operate the business. Because the manufacturing process can be highly complex, manufacturing firms

constantly evaluate their production processes to determine where cost savings are possible.

CONCEPTS IN PRACTICE

Cost Control

Controlling costs is an integral function of all managers, but companies often hire personnel to specifically oversee cost control. As you've learned, controlling costs is vital in all industries, but at **Hilton Hotels**, they translate this into the position of Cost Controller. Here is an excerpt from one of Hilton's recent job postings.

Position Title: Cost Controller

Job Description: "A Cost Controller will work with all Heads of Departments to effectively control all products that enter and exit the hotel."

Job Requirements:

"As Cost Controller, you will work with all Heads of Departments to effectively control all products that enter and exit the hotel. Specifically, you will be responsible for performing the following tasks to the highest standards:

- Review the daily intake of products into the hotel and ensure accurate pricing and quantity of goods received
- Control the stores by ensuring accuracy of inventory and stock control and the pricing of goods received
- Alert relevant parties of slow-moving goods and goods nearing expiry dates to reduce waste and alter product purchasing to accommodate
- Manage cost reporting on a weekly basis
- Attend finance meetings, as required
- Maintain good communication and working relationships with all hotel areas
- Act in accordance with fire, health and safety regulations and follow the correct procedures when required"

As you can see, the individual in this position will interact with others across the organization to find ways to control costs for the benefit of the company. Some of the benefits of cost control include:

- Lowering overall company expenses, thereby increasing net income.
- Freeing up financial resources for investment in research & development of new or improved products, goods, or services
- Providing funding for employee development and training, benefits, and bonuses
- Allowing corporate earnings to be used to support humanitarian and charitable causes

Manufacturing organizations account for costs in a way that is similar to that of merchandising firms. However, as you will learn, there is a significant difference in the calculation of cost of goods sold. Figure 2.1.6 shows a simplification of the income statement for a manufacturing firm:

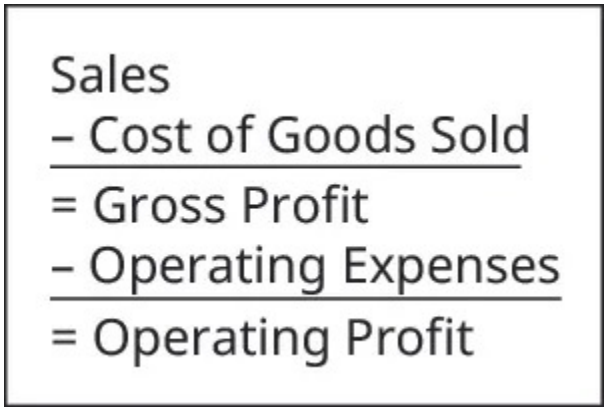


Figure 2.1.6: Simplified Income Statement for a Manufacturing Firm. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

At first, it appears that there is no difference between the income statements of the merchandising firm and the manufacturing firm. However, the difference is in how these two types of firms account for the cost of goods sold. Merchandising firms determine their cost of goods sold by accounting for both existing inventory and new purchases, as shown in the Plum Crazy example. It is typically easy for merchandising firms to calculate their costs because they know exactly what they paid for their merchandise.

Unlike merchandising firms, manufacturing firms must calculate their cost of goods sold based on how much they manufacture and how much it costs them to manufacture those goods. This requires manufacturing firms to prepare an additional statement before they can prepare their income statement. This additional statement is the *Cost of Goods Manufactured* statement. Once the cost of goods manufactured is calculated, the cost is then incorporated into the manufacturing firm's income statement to calculate its cost of goods sold.

One thing manufacturing firms must consider in their cost of goods manufactured is that, at any given time, they have products at varying levels of production: some are finished and others are still process. The cost of goods manufactured statement measures the cost of the goods actually finished during the period, whether or not they were started during that period.

Before examining the typical manufacturing firm's process to track cost of goods manufactured, you need basic definitions of three terms in the schedule of Costs of Goods Manufactured: direct materials, direct labor, and manufacturing overhead. **Direct materials** are the components used in the production process whose costs can be identified on a per item-produced basis. For example, if you are producing cars, the engine would be a direct material item. The direct material cost would be the cost of one engine. **Direct labor** represents production labor costs that can be identified on a per item-produced basis. Referring to the car production example, assume that the engines are placed in the car by individuals rather than by an automated process. The direct labor cost would be the amount of labor in hours multiplied by the hourly labor cost. **Manufacturing overhead** generally includes those costs incurred in the production process that are not economically feasible to measure as direct material or direct labor costs. Examples include the department manager's salary, the production factory's utilities, or glue used to attach rubber molding in the auto production process. Since there are so many possible costs that can be classified as manufacturing overhead, they tend to be grouped and then allocated in a predetermined manner to the production process.

Figure 2.1.7 is an example of the calculation of the Cost of Goods Manufactured for Koeller Manufacturing. It demonstrates the relationship between cost of goods manufactured and cost of goods in progress and includes the three main types of manufacturing costs.

KOELLER MANUFACTURING
Schedule of Cost of Goods Manufactured
For the Month Ended March 31, 2017

Work in Process Inventory (beginning balance)		$ 75,000
Current Manufacturing Costs:		
Direct Material	$15,000	
Direct Labor	25,000	
Manufacturing Overhead	23,000	
Total Manufacturing Costs		63,000
Total Cost of Work in Process		138,000
– Work in Process, ending balance		43,000
Cost of Goods Manufactured		$ 95,000

Figure 2.1.7: Koeller Manufacturing's Cost of Goods Manufactured. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

As you can see, the manufacturing firm takes into account its work-in-process (WIP) inventory as well as the costs incurred during the current period to finish not only the units that were in the beginning WIP inventory, but also a portion of any production that was started but not finished during the month. Notice that the current manufacturing costs, or the additional costs incurred during the month, include direct materials, direct labor, and manufacturing overhead. Direct materials are calculated as:

Materials Inventory (beginning balance)
+ Net Material Purchases
= Materials Available for Use
− Materials Inventory (ending balance)
= Direct Materials Used in Production

All of these costs are carefully tracked and classified because the cost of manufacturing is a vital component of the schedule of cost of goods sold. To continue with the example, Koeller Manufacturing calculated that the cost of goods sold was $95,000, which is carried through to the Schedule of Cost of Goods Sold (Figure 2.1.8).

KOELLER MANUFACTURING Schedule of Cost of Goods Sold For the Month Ended March 31, 2017	
Beginning Finished Goods Inventory	$ 65,000
+ Cost of Goods Manufactured	95,000
Goods Available for Sale	160,000
– Ending Finished Goods Inventory	58,000
Cost of Goods Sold	$102,000

Figure 2.1.8: Koeller Manufacturing's Cost of Goods Sold. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Now when Koeller Manufacturing prepares its income statement, the simplified statement will appear as shown in Figure 2.1.9.

KOELLER MANUFACTURING Income Statement For the Month Ended March 31, 2017	
Sales	$214,000
– Cost of Goods Sold	102,000
Gross Profit	112,000
– Operating Expenses	80,000
Operating Income	$ 32,000

Figure 2.1.9: Koeller Manufacturing's Income Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

So, even though the income statements for the merchandising firm and the manufacturing firm appear very similar at first glance, there are many more costs to be captured by the manufacturing firm. Figure 2.1.10 compares and contrasts the methods merchandising and manufacturing firms use to calculate the cost of goods sold in their income statement.

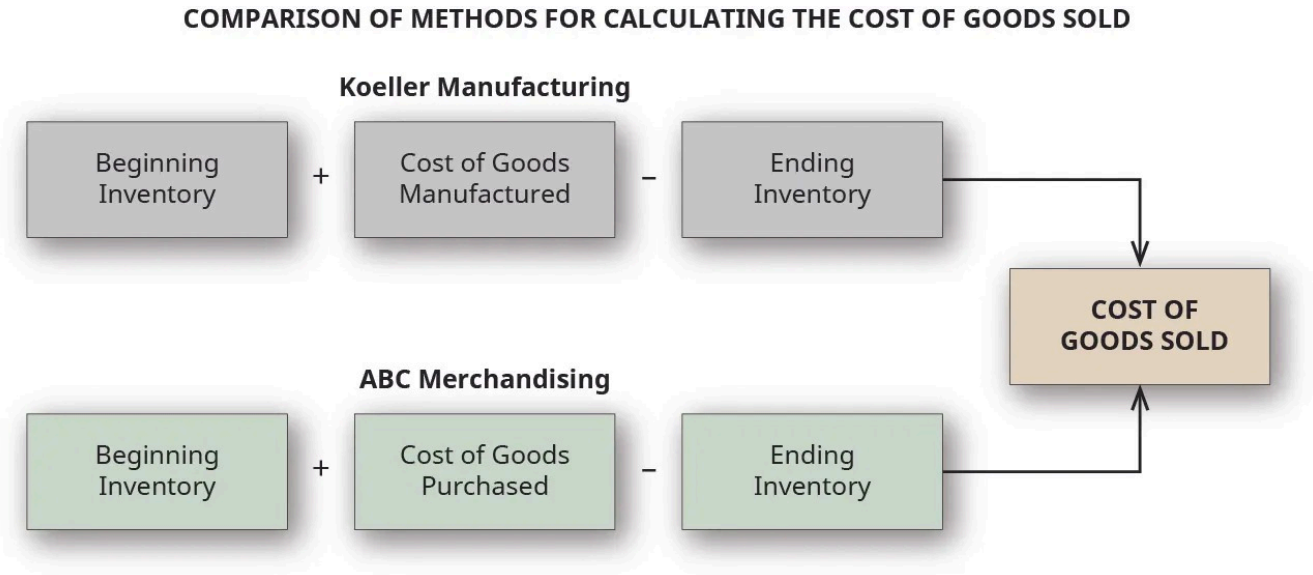


Figure 2.1.10: Merchandising firms consider the cost of goods purchased, and manufacturing firms consider the cost of goods manufactured in order to determine the cost of goods sold. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

CONCEPTS IN PRACTICE

Calculating Cost of Goods Sold in Manufacturing

Just Desserts is a bakery that produces and sells cakes and pies to grocery stores for resale. Although they are a small manufacturer, they incur many of the costs of a much larger organization. In 2017, they reported these revenue and expenses:

Office rent	$20,000	Sales revenue	$150,000
Office utilities	1,500	Cost of goods sold	70,000
Administrative salaries	35,000	Administrative expenses	12,000

Their income statement is shown in Figure 2.1.11.

JUST DESSERTS Income Statement For the Year Ended December 31, 2017		
Sales Revenue		$150,000
Cost of Goods Sold		70,000
Gross Profit		80,000
Administrative Expenses	$12,000	
Administrative Salaries	35,000	
Office Utilities	1,500	
Office Rent	20,000	
Operating Expenses		68,500
Net Income		$ 11,500

Figure 2.1.11: Just Desserts' Income Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

You'll learn more about the flow of manufacturing costs later. For now, recognize that, unlike a merchandising firm, calculating cost of goods sold in manufacturing firms can be a complex task for management.

Service Organizations

A **service organization** is a business that earns revenue by providing **intangible products**, those that have no physical substance. The service industry is a vital sector of the U.S. economy, providing 65% of the U.S. private-sector gross domestic product and more than 79% of U.S. private-sector jobs. If **tangible products**, physical goods that customers can handle and see, are provided by a service organization, they are considered ancillary sources of revenue. Large service organizations such as airlines, insurance companies, and hospitals incur a variety of costs in the provision of their services. Costs such as labor, supplies, equipment, advertising, and facility maintenance can quickly spiral out of control if management is not careful. Therefore, although their cost drivers are sometimes not as complex as those of other types of firms, cost identification and control are every bit as important in the service industry.

For example, consider the services that a law firm provides its clients. What clients pay for are services such as representation in legal proceedings, contract negotiations, and preparation of wills. Although the true value of these services is not contained in their physical form, they are of value to the client and the source of revenue to the firm. The managing partners in the firm must be as cost-conscious as their counterparts in merchandising and manufacturing firms. Accounting for costs in service firms differs from merchandising and manufacturing firms in that they do not purchase or produce goods. For example, consider a medical practice. Although some services provided are tangible products, such as medications or medical devices, the primary benefits the physicians provide their patients are the intangible services that are comprised of his or her knowledge, experience, and expertise.

Service providers have some costs (or revenue) derived from tangible goods that must be taken into account when pricing their services, but their largest cost categories are more likely to be administrative and personnel costs rather than product costs.

Service Revenue
– Operating Expenses
= Operating Profit

For example, Whichard & Klein, LLP, is a full-service accounting firm with their primary offices in Baltimore, Maryland. With two senior partners and a small staff of accountants and payroll specialists, the majority of the costs they incur are related to personnel. The value of the accounting and payroll services they provide to their clients is intangible in comparison to goods sold by a merchandiser or produced by a manufacturer but has value and is the primary source of revenue for the firm. At the end of 2019, Whichard and Klein reported the following revenue and expenses:

Revenue from services provided	$412,000	Utilities	$11,000
Accounting personnel salaries	210,000	Miscellaneous expenses	7,500
Office expense	35,000	Administrative salaries	45,000
Office equipment	9,000		

Their Income Statement for the period is shown in Figure 2.1.12.

WHICHARD & KLEIN, LLP
Income Statement
For the Year Ended December 31, 2019

Service Revenue	$412,000
Operating Expenses	
Salaries	210,000
Office Expense	35,000
Office Equipment	9,000
Administrative Salaries	45,000
Utilities	11,000
Miscellaneous	7,500
Total Operating Expenses	317,500
Operating Income	$ 94,500

Figure 2.1.12: Whichard & Klein's Income Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The bulk of the expenses incurred by Whichard & Klein are in personnel and administrative/office costs, which are very common among businesses that have services as their primary source of revenue.

CONCEPTS IN PRACTICE

Revenue and Expenses for a Law Office

The revenue and expenses for a law firm illustrate how the income statement for a service firm differs from that of a merchandising or manufacturing firm.

Welch & Graham is a well-established law firm that provides legal services in the areas of criminal law, real estate transactions, and personal injury. The firm employs several attorneys, paralegals, and office support staff. In 2017, they reported the following revenue and expenses:

Office rent	$ 20,000	Paralegal salaries	$ 100,000
Office utilities	12,500	Service revenue	1,500,000
Administrative salaries	150,000	Office expenses	12,000
Attorneys' salaries	750,000		

Their income statement is shown in Figure 2.1.13.

WELCH & GRAHAM, ATTORNEYS AT LAW
Income Statement
For the Year Ended December 31, 2017

Service Revenue		$1,500,000
Operating Expenses		
Administrative Salaries	$ 150,000	
Attorney Salaries	750,000	
Office Expenses	12,000	
Office Rent	20,000	
Paralegal Salaries	100,000	
Office Utilities Expenses	12,500	
Total Operating Expenses		1,044,500
Net Income		$ 455,500

Figure 2.1.13: Welch & Graham's Income Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

As you can see, the majority of the costs incurred by the law firm are personnel-related. They may also incur costs from equipment and materials such computer networks, phone and switchboard equipment, rent, insurance, and law library materials necessary to support the practice, but these costs represent a much smaller percentage of total cost than the administrative and personnel costs.

THINK IT THROUGH

Expanding a Business

Margo is the owner of a small retail business that sells gifts and home decorating accessories. Her business is well established, and she is now considering taking over additional retail space to expand her business to include gourmet foods and gift baskets. Based on customer feedback, she is confident that there is a demand for these items, but she is unsure how large that demand really is. Expanding her business this way will require that she incur not only new costs but also increases in existing costs.

Margo has asked for your help in identifying the impact of her decision to expand in terms of her costs. When discussing these cost increases, be sure to specifically identify those costs that are directly tied to her products and that would be considered overhead expenses.

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2.2: Identify and Apply Basic Cost Behavior Patterns

Now that we have identified the three key types of businesses, let's identify cost behaviors and apply them to the business environment. In managerial accounting, different companies use the term *cost* in different ways depending on how they will use the cost information. Different decisions require different costs classified in different ways. For instance, a manager may need cost information to plan for the coming year or to make decisions about expanding or discontinuing a product or service. In practice, the classification of costs changes as the use of the cost data changes. In fact, a single cost, such as rent, may be classified by one company as a fixed cost, by another company as a committed cost, and by even another company as a period cost. Understanding different cost classifications and how certain costs can be used in different ways is critical to managerial accounting.

ETHICAL CONSIDERATIONS

Institute of Management Accountants and Certified Management Accountant Certification

Managerial accountants provide businesses with clear and direct insight into the monetary effects of any particular operational action under consideration. They are expected to report financial information in a transparent and ethical fashion. The Institute of Management Accountants (IMA) offers the Certified Management Accountant (CMA) certification. IMA members and CMAs agree to uphold a set of ethical principles that includes honesty, fairness, objectivity, and responsibility. Any managerial accountant, even if not an IMA member or certified CMA, should act in accordance with these principles and encourage coworkers to follow ethical principles for reporting financial results and monetary effects of financial decisions related to their organization. The IMA Committee on Ethics encourages organizations and individuals to adopt, promote, and execute business practices consistent with high ethical standards.

Major Cost Behavior Patterns

Any discussion of costs begins with the understanding that most costs will be classified in one of three ways: fixed costs, variable costs, or mixed costs. The costs that don't fall into one of these three categories are hybrid costs, which are examined only briefly because they are addressed in more advanced accounting courses. Because fixed and variable costs are the foundation of all other cost classifications, understanding whether a cost is a fixed cost or a variable cost is very important.

Fixed versus Variable Costs

A **fixed cost** is an unavoidable operating expense that does not change in total over the short term, even if a business experiences variation in its level of activity. Table 2.2.1 illustrates the types of fixed costs for merchandising, service, and manufacturing organizations.

Table 2.2.1: Examples of Fixed Costs

Type of Business	Fixed Cost
Merchandising	Rent, insurance, managers' salaries
Manufacturing	Property taxes, insurance, equipment leases
Service	Rent, straight-line depreciation, administrative salaries, and insurance

We have established that fixed costs do not change in total as the level of activity changes, but what about fixed costs on a *per-unit* basis? Let's examine Tony's screen-printing company to illustrate how costs can remain fixed in total but change on a per-unit basis.

Tony operates a screen-printing company, specializing in custom T-shirts. One of his fixed costs is his monthly rent of $1,000. Regardless of whether he produces and sells any T-shirts, he is obligated under his lease to pay $1,000 per month. However, he can consider this fixed cost on a per-unit basis, as shown in Figure 2.2.1.

Monthly Rent	Number of T-Shirts Manufactured	Average Rent Cost per T-Shirt
$1,000	200	$5.00
1,000	400	2.50
1,000	600	1.67

Figure 2.2.1: Individual Rent Cost per T-Shirt Produced. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Tony's information illustrates that, despite the unchanging fixed cost of rent, as the level of activity increases, the per-unit fixed cost falls. In other words, fixed costs remain fixed in total but can increase or decrease on a per-unit basis.

Two specialized types of fixed costs are committed fixed costs and discretionary fixed costs. These classifications are generally used for long-range planning purposes and are covered in upper-level managerial accounting courses, so they are only briefly described here.

Committed fixed costs are fixed costs that typically cannot be eliminated if the company is going to continue to function. An example would be the lease of factory equipment for a production company.

Discretionary fixed costs generally are fixed costs that can be incurred during some periods and postponed during other periods but which cannot normally be eliminated permanently. Examples could include advertising campaigns and employee training. Both of these costs could potentially be postponed temporarily, but the company would probably incur negative effects if the costs were permanently eliminated. These classifications are generally used for long-range planning purposes.

In addition to understanding fixed costs, it is critical to understand variable costs, the second fundamental cost classification. A **variable cost** is one that varies in direct proportion to the level of activity within the business. Typical costs that are classified as variable costs are the cost of raw materials used to produce a product, labor applied directly to the production of the product, and overhead expenses that change based upon activity. For each variable cost, there is some activity that drives the variable cost up or down. A **cost driver** is defined as any activity that causes the organization to incur a variable cost. Examples of cost drivers are direct labor hours, machine hours, units produced, and units sold. Table 2.2.2 provides examples of variable costs and their associated cost drivers.

Table 2.2.2: Variable Costs and Associated Cost Drivers

	Variable Cost
Merchandising	Total monthly hourly wages for sales staff
Manufacturing	Direct materials used to produce one unit of product
Service	Cost of laundering linens and towels

Unlike fixed costs that remain fixed in total but change on a per-unit basis, variable costs remain the same per unit, but change in total relative to the level of activity in the business. Revisiting Tony's T-Shirts, Figure 2.2.2 shows how the variable cost of ink behaves as the level of activity changes.

Cost of Ink per T-Shirt	Number of T-Shirts Produced	Total Variable Cost of Ink
$0.15	2,000	$300
0.15	4,000	600
0.15	6,000	900

Figure 2.2.2: Variable Costs per Unit. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

As Figure 2.2.2 shows, the variable cost per unit (per T-shirt) does not change as the number of T-shirts produced increases or decreases. However, the variable costs change in total as the number of units produced increases or decreases. In short, total variable costs rise and fall as the level of activity (the cost driver) rises and falls.

Distinguishing between fixed and variable costs is critical because the **total cost** is the sum of all fixed costs (the **total fixed costs**) and all variable costs (the **total variable costs**). For every unit produced, every customer served, or every hotel room rented, for example, managers can determine their total costs both per unit of activity and in total by combining their fixed and variable costs together. The graphic in Figure 2.2.3 illustrates the concept of total costs.

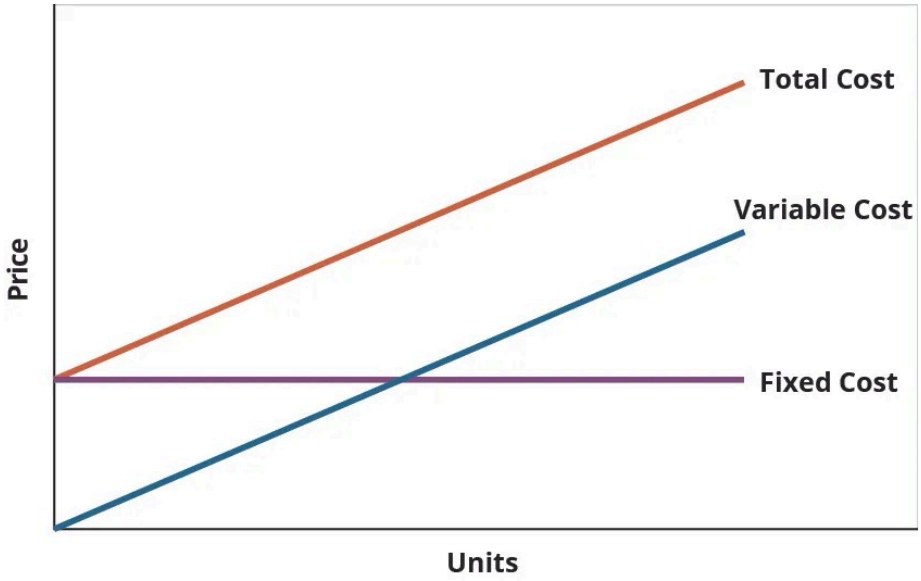


Figure 2.2.3: Total Cost as the Sum of Total Fixed Costs and Total Variable Costs. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Remember that the reason that organizations take the time and effort to classify costs as either fixed or variable is to be able to control costs. When they classify costs properly, managers can use cost data to make decisions and plan for the future of the business.

CONCEPTS IN PRACTICE

Boeing

If you've ever flown on an airplane, there's a good chance you know Boeing. The Boeing Company generates around $90 billion each year from selling thousands of airplanes to commercial and military customers around the world. It employs around 200,000 people, and it's indirectly responsible for more than a million jobs through its suppliers, contractors, regulators, and others. Its main assembly line in Everett, WA, is housed in the largest building in the world, a colossal facility that covers nearly a half-trillion cubic feet. Boeing is, simply put, a massive enterprise.

And yet, Boeing's managers know the exact cost of everything the company uses to produce its airplanes: every propeller, flap, seat belt, welder, computer programmer, and so forth. Moreover, they know how those costs would change if they produced more airplanes or fewer. They also know the price at which they sold each plane and the profit the company made on each sale. Boeing's executives expect their managers to know this information, in real-time, if the company is to remain profitable.

Table 2.2.3: Link between Business Decision and Cost Information Utilized

Decision	Cost Information
Discontinue a product line	Variable costs, overhead directly tied to product, potential reduction in fixed co
Add second production shift	Labor costs, cost of fringe benefits, potential overhead increases (utilities, secu
Open additional retail outlets	Fixed costs, variable operating costs, potential increases in administrative expe

Average Fixed Costs versus Average Variable Costs

Another way management may want to consider their costs is as average costs. Under this approach, managers can calculate both average fixed and average variable costs. **Average fixed cost (AFC)** is the total fixed costs divided by the total number of units produced, which results in a per-unit cost. The formula is:

$$\text{Average Fixed Cost (AFC)} = \frac{\text{Total Fixed Costs}}{\text{Total Number of Units Produced}}$$

To show how a company would use AFC to make business decisions, consider Carolina Yachts, a company that manufactures sportfishing boats that are sold to consumers through a network of marinas and boat dealerships. Carolina Yachts produces 625 boats per year, and their total annual fixed costs are $1,560,000. If they want to determine an average fixed cost per unit, they will find it using the formula for AFC:

$$\text{AFC} = \$1{,}560{,}000 / 625 = \$2{,}496 \text{ per boat}$$

When they produce 625 boats, Carolina Yachts has an AFC of $2,496 per boat. What happens to the AFC if they increase or decrease the number of boats produced? Figure 2.2.4 shows the AFC for different numbers of boats.

Number of Boats Produced	Total Fixed Costs	Average Fixed Cost (per boat)
500	$1,560,000	$3,120
625	1,560,000	2,496
700	1,560,000	2,229

Figure 2.2.4: Average Fixed Costs for Carolina Yachts. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

We see that total fixed costs remain unchanged, but the average fixed cost per unit goes up and down with the number of boats produced. As more units are produced, the fixed costs are spread out over more units, making the fixed cost per unit fall. Likewise, as fewer boats are manufactured, the average fixed costs per unit rises. We can use a similar approach with variable costs.

Average variable cost (AVC) is the total variable costs divided by the total number of units produced, which results in a per-unit cost. Like ATC, we can use this formula:

$$\text{Average Variable Cost (AVC)} = \frac{\text{Total Variable Costs}}{\text{Total Number of Units Produced}}$$

To demonstrate AVC, let's return to Carolina Yachts, which incurs total variable costs of $6,875,000 when they produce 625 boats per year. They can express this as an average variable cost per unit:

AVC = $6,875,000 / 625 = $11,000 per boat

Because average variable costs are the average of all costs that change with production levels on a per-unit basis and include both direct materials and direct labor, managers often use AVC to determine if production should continue or not in the short run. As long as the price Carolina Yachts receives for their boats is greater than the per-unit AVC, they know that they are not only covering the variable cost of production, but each boat is making a contribution toward covering fixed costs. If, at any point, the average variable cost per boat rises to the point that the price no longer covers the AVC, Carolina Yachts may consider halting production until the variable costs fall again.

These changes in variable costs per unit could be caused by circumstances beyond their control, such as a shortage of raw materials or an increase in shipping costs due to high gas prices. In any case, average variable cost can be useful for managers to get a big picture look at their variable costs per unit.

LINK TO LEARNING

Watch the video from Khan Academy that uses the scenario of computer programming to teach fixed, variable, and marginal cost to learn more.

Mixed Costs and Stepped Costs

Not all costs can be classified as purely fixed or purely variable. **Mixed costs** are those that have both a fixed and variable component. It is important, however, to be able to separate mixed costs into their fixed and variable components because, typically, in the short run, we can only change variable costs but not most fixed costs. To examine how these mixed costs actually work, consider the Ocean Breeze hotel.

The Ocean Breeze is located in a resort area where the county assesses an occupancy tax that has both a fixed and a variable component. Ocean Breeze pays $2,000 per month, regardless of the number of rooms rented. Even if it does not rent a single room during the month, Ocean Breeze still must remit this tax to the county. The hotel treats this $2,000 as a fixed cost. However, for every night that a room is rented, Ocean Breeze must remit an additional tax amount of $5.00 per room per night. As a result, the occupancy tax is a mixed cost. Figure 2.2.5 further illustrates how this mixed cost behaves.

Number of Rooms Rented per Month (Cost Driver)	Fixed Cost Component ($2,000 per month)	Variable Cost Component ($5 per room)	Total Cost (Fixed + Variable)
0	$2,000	$ 0	$2,000
60	2,000	300	2,300
85	2,000	425	2,425
100	2,000	500	2,500

Figure 2.2.5: Mixed Costs Example for Ocean Breeze. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Notice that Ocean Breeze cannot control the fixed portion of this cost and that it remains fixed in total, regardless of the activity level. On the other hand, the variable component is fixed per unit, but changes in total based upon the level of activity. The fixed portion of this cost plus the variable portion of this cost combine to make the total cost. As a result, the formula for total cost looks like this:

$$Y = a + bx$$

...where Y is the total mixed cost, a is the fixed cost, b is the variable cost per unit, and x is the level of activity.

Graphically, mixed costs can be explained as shown in Figure 2.2.6.

A graph shows the mixed costs for Ocean Breeze. The x-axis lists the number of rooms, ranging from 0 to 100. The y-axis lists this mixed occupancy tax, ranging from $0 to $3,500. Fixed costs points are marked at the points of 0 rooms and $2,000, 60 rooms and $2,000, 85 rooms and $2,000, and 100 rooms and $2,000. Variable costs are marked at the points of 0 rooms and $2,000, 60 rooms and $2,300, 85 rooms and $2,425, and 100 rooms and $2,500. The section of the graph that includes both fixed and variable costs is labeled as total mixed costs.

Figure 2.2.6: Ocean Breeze's Mixed Cost Graph. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The graph shows that mixed costs are typically both fixed and linear in nature. In other words, they will often have an initial cost, in Ocean Breeze's case, the $2,000 fixed component of the occupancy tax, and a variable component, the $5 per night occupancy tax. Note that the Ocean Breeze mixed cost graph starts at an initial $2,000 for the fixed component and then increases by $5 for each night their rooms are occupied.

Some costs behave less linearly. A cost that changes with the level of activity but is not linear is classified as a **stepped cost**. Step costs remain constant at a fixed amount over a range of activity. The range over which these costs remain unchanged (fixed) is referred to as the **relevant range**, which is defined as a specific activity level that is bounded by a minimum and maximum amount. Within this relevant range, managers can predict revenue or cost levels. Then, at certain points, the step costs increase to a higher amount. Both fixed and variable costs can take on this stair-step behavior. For instance, wages often act as a stepped variable cost when employees are paid a flat salary and a commission or when the company pays overtime. Further, when additional machinery or equipment is placed into service, businesses will see their fixed costs stepped up. The "trigger" for a cost to step up is the relevant range. Graphically, step costs appear like stair steps (Figure 2.2.7).

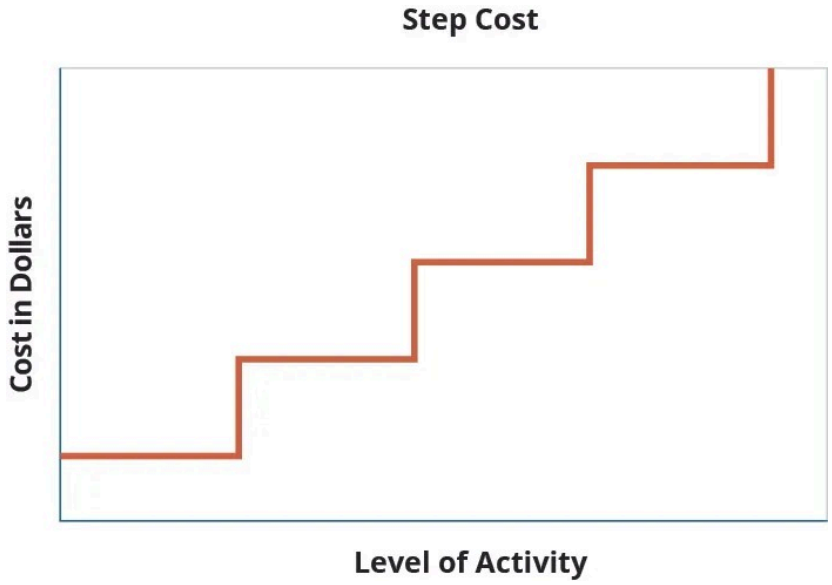


Figure 2.2.7: Step Cost Graph. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

For example, suppose a quality inspector can inspect a maximum of 80 units in a regular 8-hour shift and his salary is a fixed cost. Then the relevant range for QA inspection is from 0–80 units per shift. If demand for these units increases and more than 80 inspections are needed per shift, the relevant range has been exceeded and the business will have one of two choices:

(1) Pay the quality inspector overtime in order to have the additional units inspected. This overtime will "step up" the variable cost per unit. The advantage to handling the increased cost in this way is that when demand falls, the cost can quickly be "stepped down" again. Because these types of step costs can be adjusted quickly and often, they are often still treated as variable costs for planning purposes.

(2) "Step up" fixed costs. If the company hires a second quality inspector, they would be stepping up their fixed costs. In effect, they will double the relevant range to allow for a maximum of 160 inspections per shift, assuming the second QA inspector can inspect an additional 80 units per shift. The downside to this approach is that once the new QA inspector is hired, if demand falls again, the company will be incurring fixed costs that are unnecessary. For this reason, adding salaried personnel to address a short-term increase in demand is not a decision most businesses make.

Step costs are best explained in the context of a business experiencing increases in activity beyond the relevant range. As an example, let's return to Tony's T-Shirts.

Tony's cost of operations and the associated relevant ranges are shown in Table 2.2.4.

Table 2.2.4: Tony's T-Shirts Cost Options

	Cost	Type of Cost	Relev
Lease on Screen-Printing Machine	$2,000 per month	Fixed	0–2,0
Employee	$10 per hour	Variable	20 sh
Tony's Salary	$2,500 per month	Fixed	N/A
Screen-Printing Ink	$0.25 per shirt	Variable	N/A
Building Rent	$1,500 per month	Fixed	2 scr

As you can see, Tony has both fixed and variable costs associated with his business. His one screen-printing machine can only produce 2,000 T-shirts per month and his current employee can produce 20 shirts per hour (160 per 8-hour workday). The space that Tony leases is large enough that he could add an additional screen-printing machine and 1 additional employee. If he expands beyond that, he will need to lease a larger space, and presumably, his rent would increase at that point. It is easy for Tony to predict his costs as long as he operates within the relevant ranges by applying the total cost equation $Y = a + bx$. So, for Tony, as long as he produces 2,000 or fewer T-shirts, his total cost will be found by $Y = \$6{,}000 + \$0.75x$, where the variable cost

of $0.75 is the $0.25 cost of the ink per shirt and $0.50 per shirt for labor ($10 per hour wage/20 shirts per hour). As soon as his production passes the 2,000 T-shirts that his one employee and one machine can handle, he will have to add a second employee and lease a second screen-printing machine. In other words, his fixed costs will rise from $6,000 to $8,000, and his variable cost per T-shirt will rise from $0.75 to $1.25 (ink plus 2 workers). Thus, his new cost equation is $Y = \$8{,}000 + \$1.25x$ until he "steps up" again and adds a third machine *and* moves to a new location with a presumably higher rent. Let's take a look at this in chart form to better illustrate the "step" in cost Tony will experience as he steps past 2,000 T-shirts.

Tony's cost information is shown in the chart for volume between 500 and 4,000 shirts.

Number of T-shirts, Total Cost (rounded), respectively: 500, $6,375; 750, 6,563; 1,000, 6,750; 1,250, 6,938; 1,500, 7,125; 1,750, 7,313; 2,000, 7,500; 2,250, 10,813; 2,500, 11,125; 2,750, 11,438; 3,000, 11,750; 3,250, 12,063; 3,500, 12,375; 3,750, 12,688.

When presented graphically, notice what happens when Tony steps outside of his original relevant range and has to add a second employee and a second screen-printing machine:

Graph with Total cost as the y axis (0 to $14,000) and number of T-Shirts as the x axis (500 to 4,000.) The line hits the y axis at just above $6,375 for 500 shirts, heads in a straight line to slightly up and to the right until it gets to 2,000 shirts at $7,500. Then the line takes a sharp turn up to 2,250 shirts at $10,813, then levels off in a straight line slightly up and to the right to 3,750 shirts at $12,688.

Figure 2.2.8: Stepped Variable Costs for Tony's T-Shirts. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

It is important to remember that even though Tony's costs stepped up when he exceeded his original capacity (relevant range), the *behavior* of the costs did not change. His fixed costs still remained fixed in total and his total variable cost rose as the number of T-shirts he produced rose. Table 2.2.5 summarizes how costs behave within their relevant ranges.

Table 2.2.5: Summary of Fixed and Variable Cost Behaviors

Cost	In Total	Per Unit
Variable Cost	Changes in response to the level of activity	Remains fixed per unit regardless of the level of activity
Fixed Cost	Does not change with the level of activity, within the relevant range, but does change when the relevant range changes	Changes based upon activity within the relevant range: increased activity decreases per-unit cost; decreased activity increases per-unit cost

Product versus Period Costs

Many businesses can make decisions by dividing their costs into fixed and variable costs, but there are some business decisions that require grouping costs differently. Sometimes companies need to consider how those costs are reported in the financial statements. At other times, companies group costs based on functions within the business. For example, a business would group administrative and selling expenses by the period (monthly or quarterly) so that they can be reported on an Income Statement. However, a manufacturing firm may carry product costs such as materials from one period to the other in order to have the costs "travel" with the units being produced. It is possible that both the selling and administrative costs and materials costs have both fixed and variable components. As a result, it may be necessary to analyze some fixed costs together with some variable costs. Ultimately, businesses strategically group costs in order to make them more useful for decision-making and planning. Two of the broadest and most common grouping of costs are product costs and period costs.

Product costs are all those associated with the acquisition or production of goods and products. When products are purchased for resale, the cost of goods is recorded as an asset on the company's balance sheet. It is not until the products are sold that they become an expense on the income statement. By moving product costs to the expense account for the cost of goods sold, they are easily matched to the sales revenue income account. For example, Bert's Bikes is a bicycle retailer who purchases bikes from several wholesale distributors and manufacturers. When Bert purchases bicycles for resale, he places the cost of the bikes into his inventory account, because that is what those bikes are—his inventory available for sale. It is not until someone purchases a bike that it creates sales revenue, and in order to fulfill the requirements of double-entry accounting, he must match that income with an expense: the cost of goods sold (Figure 2.2.9).

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cost of Goods Sold	25,000	
	Finished Goods Inventory		25,000
	To record the cost of products sold		

Figure 2.2.9: Journal Entry for Cost of Goods Sold. Product costs are collected in the finished goods inventory, where they remain until the goods are sold. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Some product costs have both a fixed and variable component. For example, Bert purchases 10 bikes for $100 each. The distributor charges $10 per bike for shipping for 1 to 10 bikes but $8 per bike for 11 to 20 bikes. This shipping cost is fixed per unit but varies in total. If Bert wants to save money and control his cost of goods sold, he can order an 11th bike and drop his shipping cost by $2 per bike. It is important for Bert to know what is fixed and what is variable so that he can control his costs as much as possible.

What about the costs Bert incurs that are not product costs? **Period costs** are simply all of the expenses that are not product costs, such as all selling and administrative expenses. It is important to remember that period costs are treated as expenses in the period in which they occur. In other words, they follow the rules of accrual accounting practice by recognizing the cost (expense) in the period in which they occur regardless of when the cash changes hands. For example, Bert pays his business insurance in January of each year. Bert's annual insurance premium is $10,800, which is $900 per month. Each month, Bert will recognize 1/12 of this insurance cost as an expense in the period in which it is incurred (Figure 2.2.10).

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Insurance Expense	900	
	Prepaid Insurance		900
	To recognize current period insurance expense		

Figure 2.2.10: Journal Entry for Insurance Expense. Bert applies 1/12 of the prepaid insurance premium per month to the expense account in order to match period costs with period revenues. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Why is it so important for Bert to know which costs are product costs and which are period costs? Bert may have little control over his product costs, but he maintains a great deal of control over many of his period costs. For this reason, it is important that Bert be able to identify his period costs and then determine which of them are fixed and which are variable. Remember that fixed costs are fixed over the relevant range, but variable costs change with the level of activity. If Bert wants to control his costs to make his bike business more profitable, he must be able to differentiate between the costs he can and cannot control.

Just like a merchandising business such as Bert's Bikes, manufacturers also classify their costs as either product costs or period costs. For a manufacturing business, product costs are the costs associated with making the product, and period costs are all other costs. For the purposes of external reporting, separating costs into period and product costs is not all that is necessary. However, for management decision-making activities, refinement of the types of product costs is helpful.

In a manufacturing firm, the need for management to be aware of the types of costs that make up the cost of a product is of paramount importance. Let's look at Carolina Yachts again and examine how they can classify the product costs associated with building their sportfishing boats. Just like automobiles, every year, Carolina Yachts makes changes to their boats, introducing new models to their product line. When the engineers begin to redesign boats for the next year, they must be careful not to make changes that would drive the selling price of their boats too high, making them less attractive to the customer. The engineers need to know exactly what the addition of another feature will do to the cost of production. It is not enough for them to get total product cost data; instead, they need specific information about the three classes of product costs: materials, labor, and overhead.

As you've learned, direct materials are the raw materials and component parts that are directly economically traceable to a unit of production.

Table 2.2.6 provides some examples of direct materials.

Table 2.2.6: Examples of Direct Materials

Manufacturing Business	Product	Direct Materials
Bakery	Birthday cakes	Flour, sugar, eggs, r
Automobile manufacturer	Cars	Glass, steel, tires, c
Furniture manufacturer	Recliners	Wood, fabric, cotton

In each of the examples, managers are able to trace the cost of the materials directly to a specific unit (cake, car, or chair) produced. Since the amount of direct materials required will change based on the number of units produced, direct materials are almost always classified as a variable cost. They remain fixed per unit of production but change in total based on the level of activity within the business.

It takes more than materials for Carolina Yachts to build a boat. It requires the application of labor to the raw materials and component parts. You've also learned that direct labor is the work of the employees who are directly involved in the production of goods or services. In fact, for many industries, the largest cost incurred in the production process is labor. For Carolina Yachts, their direct labor would include the wages paid to the carpenters, painters, electricians, and welders who build the boats. Like direct materials, direct labor is typically treated as a variable cost because it varies with the level of activity. However, there are some companies that pay a flat weekly or monthly salary for production workers, and for these employees, their compensation could be classified as a fixed cost. For example, many auto mechanics are now paid a flat weekly or monthly salary.

While in the example Carolina Yachts is dependent upon direct labor, the production process for companies in many industries is moving from human labor to a more automated production process. For these companies, direct labor in these industries is becoming less significant. For example, you can research the current production process for the automobile industry.

The third major classification of product costs for a manufacturing business is overhead. Manufacturing overhead (sometimes referred to as *factory overhead*) includes all of the costs that a manufacturing business incurs, other than the variable costs of direct materials and direct labor required to build products. These overhead costs are not directly attributable to a specific unit of production, but they are incurred to support the production of goods. Some of the items included in manufacturing overhead include supervisor salaries, depreciation on the factory, maintenance, insurance, and utilities. It is important to note that manufacturing overhead does not include any of the selling or administrative functions of a business. For Carolina Yachts, costs like the sales, marketing, CEO, and clerical staff salaries will not be included in the calculation of manufacturing overhead costs but will instead be allocated to selling and administrative expenses.

As you have learned, much of the power of managerial accounting is its ability to break costs down into the smallest possible trackable unit. This also applies to manufacturing overhead. In many cases, businesses have a need to further refine their overhead costs and will track indirect labor and indirect materials.

When labor costs are incurred but are not directly involved in the active conversion of materials into finished products, they are classified as **indirect labor** costs. For example, Carolina Yachts has production supervisors who oversee the manufacturing process but do not actively participate in the construction of the boats. Their wages generally support the production process but cannot be traced back to a single unit. For this reason, the production supervisors' salary would be classified as indirect labor. Similar to direct labor, on a product or department basis, indirect labor, such as the supervisor's salary, is often treated as a fixed cost, assuming that it does not vary with the level of activity or number of units produced. However, if you are considering the supervisor's salary cost on a per unit of production basis, then it could be considered a variable cost.

Similarly, not all materials used in the production process can be traced back to a specific unit of production. When this is the case, they are classified as **indirect material** costs. Although needed to produce the product, these indirect material costs are not traceable to a *specific* unit of production. For Carolina Yachts, their indirect materials include supplies like tools, glue, wax, and cleaning supplies. These materials are required to build a boat, but management cannot easily track how much of a bottle of glue they use or how often they use a particular drill to build a specific boat. These indirect materials and their associated cost represent a small fraction of the total materials needed to complete a unit of production. Like direct materials, indirect materials are classified as a variable cost since they vary with the level of production. Table 2.2.7 provides some examples of manufacturing costs and their classifications.

Table 2.2.7: Examples of Classifications of Manufacturing Costs

Cost	Classification
Production supervisor salary	Indirect labor
Raw materials used in production	Direct materials
Wages of production employees	Direct labor
Straight-line depreciation on factory equipment	General manufacturing overhead
Glue and adhesives	Indirect materials

Prime Costs versus Conversion Costs

In certain production environments, once a business has separated the costs of the product into direct materials, direct labor, and overhead, the costs can then be gathered into two broader categories: prime costs and conversion costs. **Prime costs** are the direct material expenses and direct labor costs, while **conversion costs** are direct labor and general factory overhead combined. Please note that these two categories of costs are examples of cost categories where a particular cost can be included in both. In this case, direct labor is included in both prime costs and conversion costs.

These cost classifications are common in businesses that produce large quantities of an item that is then packaged into smaller, sellable quantities such as soft drinks or cereal. In these types of production environments, it easier to lump the costs of direct labor and overhead into one category, since these costs are what are needed to convert raw materials into a finished product.

Although it seems as if there are many classifications or labels associated with costs, remember that the purpose of cost classification is to assist managers in the decision-making process. Since this type of data is not used for external reporting purposes, it is important to understand that (1) a single cost can have many different labels; (2) the terms are used independently, not simultaneously; and (3) each classification is important to understand in order to make business decisions. Figure 2.2.11 uses some example costs to demonstrate these principles.

						Product				
Cost	Fixed	Variable	Mixed	Step	Period	DM	DL	OH	Prime	Conversion
Rent on production facility	√						OH			√
Plant supervisor salary	√						OH			√
Raw materials		√					DM		√	
Administrative salaries	√				√					
Commissioned sales staff		√	√		√					
Delivery truck			√		√					
Advertising	√				√					
Plant utilities			√				OH			√
Income tax		√		√	√					

Figure 2.2.11: Classification Based on Cost Function. Costs can fall into more than one category, sometimes making the process of cost identification complex. DM, direct materials; DL, direct labor; OH, overhead. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Effects of Changes in Activity Level on Unit Costs and Total Costs

We have spent considerable time identifying and describing the various ways that businesses categorize costs. However, categorization itself is not enough. It is important not only to understand the categorization of costs but to understand the relationships between changes in activity levels and the changes in costs in total. It is worth repeating that when a cost is considered to be fixed, that cost is only fixed for the relevant range. Once the boundary of the relevant range has been reached or moved beyond, fixed costs will change and then remain fixed for the new relevant range. Remember that, within a relevant range of activity, where the relevant range refers to a specific activity level that is bounded by a minimum and maximum amount, total fixed costs are constant, but costs change on a per-unit basis. Let's examine an example that demonstrates how changes in

activity can affect costs.

ETHICAL CONSIDERATIONS

Cost Accounting Helps Reduce Fraud and Promotes Ethical Behavior

Managerial and related cost accounting systems assist managers in making ethical and sound business decisions. Managerial accountants implement accounting reporting systems to minimize or prevent fraud and promote ethical decision-making. For example, tracking changes in costing activity and ensuring that activity remains in a relevant range, helps ensure that an organization's business activity is properly bounded within a reasonable range of expense. If the minimum or maximum expense range is exceeded, this can indicate that management is acting without authority or is pursuing unauthorized activities. Excessive costs may even be a red flag that possible fraud is occurring. Cost accounting helps ensure that financial costs are within an acceptable range and helps an organization make reliable forward-looking financial decisions.

Comprehensive Example of the Effect on Changes in Activity Level on Costs

Pat is planning a three-day ski trip on his spring break after he works on a **Habitat for Humanity** project in Dallas. The costs for the trip are as follows:

Car rental (up to five passengers)	$200
Condo rental (up to five occupants)	400
Gasoline	120
Food (per day)	40
Lift tickets (per day)	30

He is considering his costs for the trip if he goes alone, or if he takes one, two, three, or four friends. However, before he can begin his analysis, he needs to consider the characteristics of the costs. Some of the costs will stay the same no matter how many people go, and some of the costs will fluctuate, based on the number of participants.

Those costs that do not change are the fixed costs. Once you incur a fixed cost, it does not change within a given range. For example, Pat can take up to five people in one car, so the cost of the car is fixed for up to five people. However, if he took more friends, then he would need more cars. The condo rental and the gasoline expenses would also be considered fixed costs, because they are not going to change in the reference range.

The costs that do change as the number of participants change are the variable costs. The food and lift ticket expenses are examples of variable costs, since they fluctuate based upon the number of participants and the number of days of activities.

In analyzing the costs, Pat also needs to consider the total costs and average costs. The analysis will calculate the average fixed costs, the total fixed costs, the average variable costs, and the total variable costs.

In the analysis of total costs versus average costs, both total and average fixed costs will stay the same and total and average variable costs will change. Here are the total fixed costs:

Car rental	$200
Condo	400
Gasoline	120
Total fixed costs	$720

The total fixed costs for the trip will be $720.00, no matter whether Pat goes alone or takes up to 4 friends. However, the average fixed costs will be the total fixed costs divided by the number of participants. The average fixed cost could range from $720 (720/1) to $144 (720/5).

Here are the variable costs:

Food (per day)	$40
Lift tickets (per day)	30
Average variable cost (per day)	$70

The average variable cost will be $70.00 per person per day, no matter how many people go on the trip. However, the total variable costs will range from $70.00, if Pat goes alone, to $350.00, if five people go. Figure 2.2.12 shows the relationships of the various costs, based on the number of participants.

Number of Skiers	Average Variable Cost	Total Variable Cost	Total Fixed Cost	Average Fixed Cost	Average Cost per Skier
1	$210	$ 210	$720	$720	$930
2	210	420	720	360	570
3	210	630	720	240	450
4	210	840	720	180	390
5	210	1,050	720	144	354

Figure 2.2.12: Comprehensive Ski Trip Cost Classification. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Looking at this analysis, it is clear that, if there is an activity that you think that you cannot afford, it can become less expensive if you are creative in your cost-sharing techniques.

YOUR TURN

Spring Break Trip Planning

Margo is planning an 8-day spring break trip from Atlanta, Georgia, to Tampa, Florida, leaving on Sunday and returning the following Sunday. She has located a condominium on the beach and has put a deposit down on the unit. The rental company has a maximum occupancy for the condominium of seven adults. There is an amusement park that she plans to visit. She is going to use her parents' car, an SUV that can carry up to six people and their luggage. The SUV can travel an average of 20

miles per gallon, the total distance is approximately 1,250 miles (550 miles each way plus driving around Tampa every day), and the average price of gas is $3 per gallon. A season pass for an amusement park she wants to visit is $168 per person. Margo estimates spending $40 per day per person for food. She estimates the costs for the trip as follows:

Condo Rental	$1,400
Gasoline	188
Food (per person per day)	40
Amusement Park Season Pass (per person)	168

Now that she has cost estimates, she is trying to decide how many of her friends she wants to invite. Since the car can only seat six people, Marg made a list of five other girls to invite. Use her data to answer the following questions and fill out the cost table:

1. What are the total variable costs for the trip?
2. What are the average variable costs for the trip?
3. What are the total fixed costs for the trip?
4. What are the average fixed costs for the trip?
5. What are the average costs per person for the trip?
6. What would the trip cost Margo if she were to go alone?

Number of People, Including Margo	Total Variable Cost	Average Variable Cost	Total Fixed Cost	Average Fixed Cost	Average Cost per Person
1					
2					
3					
4					
5					
6					

7. What additional costs would be incurred if a seventh girl was invited on the trip? Would this be a wise decision (from a cost perspective)? Why or why not?
8. Which cost will *not* be affected if a seventh girl was invited on the trip?

Answer available at the end of this section.

Answers

YOUR TURN

Number of People, Including Margo	Total Variable Cost	Average Variable Cost	Total Fixed Cost	Average Fixed Cost	Average Cost per Person
1	$488	$488	$1,588	$1,588	$2,076
2	976	488	1,588	794	1,282
3	1,464	488	1,588	529	1,017
4	1,952	488	1,588	397	885
5	2,440	488	1,588	318	806
6	2,928	488	1,588	265	753

Answers will vary. All responses should recognize that there is no room in the car for the seventh girl and her luggage, although the condominium will accommodate the extra person. This means they will have to either find a larger vehicle and incur higher gas expenses or take a second car, which will at least double the fixed gas cost.

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2.3: Cost Terminology

Learning Objectives

- Understand the terms used for costing purposes.

Exercise 2.3.1

Much of what we discuss in this book relates to companies that manufacture products, such as Nike and Apple, and terminology is a key component of accounting for manufacturing companies. The challenge is in classifying costs correctly for items such as production materials, production labor, marketing department labor, rent for production facilities, and rent for the administrative services facilities. These costs must be classified accurately so that they appear correctly in company financial reports. The starting point for learning how to classify costs correctly is in understanding two broad categories of costs. What are the two broad terms used to categorize cost information in a manufacturing setting?

Answer available at the end of this section.

Manufacturing Costs

All costs related to the production of goods are called **manufacturing costs**; they are also referred to as **product costs**. A manufacturer purchases materials, employs workers who use the materials to assemble the goods, provides a building where the materials are stored and goods are assembled, and sells the goods. We classify the costs associated with these activities into three categories: *direct materials*, *direct labor*, and *manufacturing overhead*.

To help clarify which costs are included in these three categories, let's look at a furniture company that specializes in building custom wood tables called Custom Furniture Company. Each table is unique and built to customer specifications for use in homes (coffee tables and dining room tables) and offices (boardroom and meeting room tables). The sales price of each table varies significantly, from $1,000 to more than $30,000. Figure 2.3.1 shows examples of production activities at Custom Furniture Company for each of the three categories.



Figure 2.3.1: Direct Materials, Direct Labor, and Manufacturing Overhead at Custom Furniture Company © Thinkstock

Exercise 2.3.2: Direct Materials

Raw materials used in the production process that are easily traced to the product are called **direct materials**. What materials used in the production process at Custom Furniture would be classified as direct materials?

Answer available at the end of this section.

Exercise 2.3.3: Direct Labor

Workers who convert materials into a finished product and whose time is easily traced to the product are called **direct labor**. Who represents direct labor at Custom Furniture?

Answer available at the end of this section.

Exercise 2.3.4: Manufacturing Overhead

All costs associated with the production process other than direct material costs and direct labor costs are called **manufacturing overhead**. Terms synonymous with manufacturing overhead include factory overhead, factory burden, and overhead. What items are included in manufacturing overhead?

Answer available at the end of this section.

Table 2.3.1 provides several examples of manufacturing costs at Custom Furniture Company by category.

Table 2.3.1: Manufacturing Costs at Custom Furniture Company

Direct Materials	• Wood: cherry, maple, oak, and mahogany • Hardware: drawer handles
Direct Labor	• Workers who cut, plane, and glue wood • Workers who fill and sand tables • Workers who stain and finish tables
Manufacturing Overhead	• Indirect materials: glue, screws, nails, sandpaper, stain, and lacquer • Indirect labor: factory supervisors • Other manufacturing costs: equipment maintenance, equipment depreciation, factory utilities, factory insurance, factory building depreciation, and factory property taxes

Note "Business in Action 2.3.1" details the materials, labor, and manufacturing overhead at a company that has been producing boats since 1968.

BUSINESS IN ACTION 2.3.1

Manufacturing Costs at MasterCraft

MasterCraft produces boats for water skiers and wakeboarders. Each boat produced incurs significant manufacturing costs. MasterCraft records these manufacturing costs as inventory on the balance sheet until the boats are sold, at which time the costs are transferred to cost of goods sold on the income statement.



Figure 2.3.2: Photo courtesy of Brian Miller, http://www.flickr.com/photos/13233728@N00/5155012186/

Examples of direct materials for each boat include the hull, engine, transmission, carpet, gauges, seats, windshield, and swim platform. Examples of indirect materials (part of manufacturing overhead) include glue, paint, and screws. Direct labor includes the production workers who assemble the boats and test them before they are shipped out. Indirect labor (part of manufacturing overhead) includes the production supervisors who oversee production for several different boats and product lines.

Manufacturing overhead includes the indirect materials and indirect labor mentioned previously. Other manufacturing overhead items are factory building rent, maintenance and depreciation for production equipment, factory utilities, and quality control testing.

Source: MasterCraft, "Home Page," http://www.mastercraft.com.

Nonmanufacturing Costs

Costs that are not related to the production of goods are called **nonmanufacturing costs**; they are also referred to as **period costs**. These costs have two components—*selling costs and general and administrative costs*—which are described next. Examples of nonmanufacturing costs appear in Figure 2.3.3.

Exercise 2.3.5: Selling Costs

Costs incurred to obtain customer orders and provide customers with a finished product are called **selling costs**. (They are also often called marketing costs or selling and advertising costs.) What activities would be classified as selling costs at Custom Furniture?

Answer available at the end of this section.

Exercise 2.3.6: General and Administrative Costs

Costs related to the overall management of an organization are called **general and administrative costs**. What activities would be classified as general and administrative costs at Custom Furniture?

Answer available at the end of this section.



Figure 2.3.3: Examples of Nonmanufacturing Costs at Custom Furniture Company

Although selling costs and general and administrative costs are considered nonmanufacturing costs, managers often want to assign some of these costs to products for decision-making purposes. For example, sales commissions and shipping costs for a specific product could be assigned to the product. This does not comply with U.S. GAAP because, under U.S. GAAP, only product costs can be assigned to products. However, as we noted earlier, managerial accounting information is tailored to meet the needs of the users and need not follow U.S. GAAP.

Distinguishing between manufacturing and nonmanufacturing costs is not always simple. For example, if legal staff works on an issue associated with production personnel and if human resources staff hires assembly line workers, are the costs involved manufacturing or nonmanufacturing costs? It is up to each organization to determine how to handle such costs for product costing purposes. The advantage of managerial accounting over financial accounting is that costs can be organized in any manner that helps managers make decisions. However, in this chapter, to avoid ambiguity, we follow the definitions provided by U.S. GAAP.

Exercise 2.3.7: Presentation of Manufacturing and Nonmanufacturing Costs in Financial Statements

At this point, you should be able to distinguish between manufacturing costs and nonmanufacturing costs. Why is it important to make this distinction?

Answer available at the end of this section.

Table 2.3.2 clarifies the relationship between manufacturing and nonmanufacturing costs. It also describes the point at which these costs are recorded as expenses on the income statement. (Remember that the terms manufacturing cost and product cost are interchangeable, as are the terms nonmanufacturing cost and period cost.)

Table 2.3.2: Manufacturing Versus Nonmanufacturing Costs

Manufacturing Costs (Also Called Product Costs)	Nonmanufacturing Costs (Also Called Period Costs)
• Direct materials • Direct labor • Manufacturing overhead	• Selling • General and administrative
Timing of expense: Costs are expensed when goods are sold.	**Timing of expense**: Costs are expensed during the time period incurred.

Note "Business in Action 2.3.2" provides examples of nonmanufacturing costs at **PepsiCo, Inc**.

BUSINESS IN ACTION 2.3.2

Nonmanufacturing Costs at PepsiCo



Source: Photo courtesy of JeffBedord, http://www.flickr.com/photos/jeffbedford/6218820224/in/photostream/.

PepsiCo, Inc., produces more than 500 products under several different brand names, including Frito-Lay, Pepsi-Cola, Gatorade, Tropicana, and Quaker. Net sales for 2010 totaled $57,800,000,000, resulting in operating profits of $6,300,000,000. Cost of sales represented the highest cost on the income statement at $26,600,000,000. The second highest cost on the income statement—selling and general and administrative expenses—totaled $22,800,000,000. These expenses are period costs, meaning they must be expensed in the period in which they are incurred.

Examples of selling costs for PepsiCo include television advertising (probably the biggest piece of the $22,800,000,000), promotional coupons, costs of shipping products to customers, and salaries of marketing and advertising personnel.

Examples of general and administrative costs include salaries and bonuses of top executives and the costs of administrative departments, including personnel, accounting, legal, and information technology.

Source: PepsiCo, “PepsiCo 2010 Annual Report,” http://www.pepsico.com.

KEY TAKEAWAY

All manufacturing costs that are easily traceable to a product are classified as either direct materials or direct labor. All other manufacturing costs are classified as manufacturing overhead. All nonmanufacturing costs are not related to production and are classified as either selling costs or general and administrative costs.

Review Problems 2.3

1. The following manufacturing items are for a construction company working on several custom homes. Identify whether each item should be categorized as direct materials, direct labor, or manufacturing overhead.
   a. Nails
   b. Lumber
   c. Drywall
   d. Workers building the house frame
   e. Supervisor responsible for three homes
   f. Light bulbs
   g. Cabinets
   h. Depreciation of construction equipment
2. Identify whether each item in the following should be categorized as a product (manufacturing) cost or as period (nonmanufacturing) cost. Also indicate whether the cost should be recorded as an expense when the cost is incurred or as an expense when the goods are sold.
   a. Advertising
   b. Shipping costs for raw materials coming from a supplier
   c. Shipping costs for goods shipped to a customer
   d. Chief executive officer's salary
   e. Production supervisor's salary
   f. Depreciation on production equipment
   g. Raw materials used in production
   h. Paper used by the accounting staff
   i. Commissions paid to salespeople
   j. Janitorial services provided for production facility
   k. Supplies used by human resources personnel
   l. Utility costs for retail store
   m. Insurance costs for production facility
   n. Assembly line workers
   o. Clerical support for chief executive officer
   p. Maintenance of production equipment
3. Identify whether each item listed in item 2 should be categorized as direct materials, direct labor, manufacturing overhead, selling cost, or general and administrative cost.

Answer available at the end of this section.

Answers

Exercise 2.3.1

The two broad categories of costs are *manufacturing costs* and *nonmanufacturing costs*. Each category is described in detail as follows.

Exercise 2.3.2**: Direct Materials**

The wood used to build tables and the hardware used to attach table legs would be considered direct materials. Small, inexpensive items like glue, nails, and masking tape are typically not included in direct materials because the cost of tracing these items to the product outweighs the benefit of having accurate cost data. These minor types of materials, often called *supplies* or indirect *materials*, are included in manufacturing overhead, which we define later.

Exercise 2.3.3**: Direct Labor**

Direct labor would include the workers who use the wood, hardware, glue, lacquer, and other materials to build tables.

Exercise 2.3.4**: Manufacturing Overhead**

Manufacturing overhead consists of the following:

- **Indirect material costs**. The cost of materials necessary to manufacture a product that are not easily traced to the product or not worth tracing to the product.

- **Indirect labor costs**. The cost of workers who are involved in the production process but whose time cannot easily be traced to the product. For example, supervisors in the production process who oversee several different products and are responsible for hiring employees, scheduling employees, and ordering materials are considered indirect labor.
- **Other manufacturing costs**. These are all other costs for items associated with the factory, including equipment maintenance, insurance, utilities, and depreciation.

Exercise 2.3.5: Selling Costs

Examples of selling costs include advertising, sales commissions, salaries for marketing and advertising personnel, office space for marketing and advertising personnel, finished goods storage costs, and shipping costs paid by the seller for products shipped to customers.

Exercise 2.3.6: General and Administrative Costs

Examples include personnel and support staff in the following areas: accounting, human resources, legal, executive, and information technology. Depreciation of office equipment and buildings associated with these areas would also be included as general and administrative costs. General and administrative costs are often simply called *administrative costs*.

Exercise 2.3.7: Presentation of Manufacturing and Nonmanufacturing Costs in Financial Statements

Distinguishing between the two categories is critical because the category determines where a cost will appear in the financial statements. All manufacturing costs (direct materials, direct labor, and manufacturing overhead) are attached to inventory as an asset on the balance sheet until the goods are sold, at which point the costs are transferred to cost of goods sold on the income statement as an expense. As we indicated earlier, nonmanufacturing costs are also called period costs; that is because they are expensed on the income statement in the time period in which they are incurred.

Review Problems 2.3

1. a. Manufacturing overhead
   b. Direct materials
   c. Direct materials
   d. Direct labor
   e. Manufacturing overhead
   f. Manufacturing overhead (You might call this a direct material, but the benefit of tracking this item as a direct material probably does not outweigh the cost.)
   g. Direct materials
   h. Manufacturing overhead
2. a. Period cost, expensed when incurred
   b. Product cost, expensed when goods are sold
   c. Period cost, expensed when incurred
   d. Period cost, expensed when incurred
   e. Product cost, expensed when goods are sold
   f. Product cost, expensed when goods are sold
   g. Product cost, expensed when goods are sold
   h. Period cost, expensed when incurred
   i. Period cost, expensed when incurred
   j. Product cost, expensed when goods are sold
   k. Period cost, expensed when incurred
   l. Period cost, expensed when incurred
   m. Product cost, expensed when goods are sold
   n. Product cost, expensed when goods are sold
   o. Period cost, expensed when incurred
   p. Product cost, expensed when goods are sold
3. a. Selling
   b. Direct materials or manufacturing overhead, depending on if the materials are easily traced to the product (direct) or not (indirect manufacturing overhead)
   c. Selling
   d. General and administrative
   e. Manufacturing overhead
   f. Manufacturing overhead
   g. Direct materials or manufacturing overhead, depending on if the materials are easily traced to the product (direct) or not (indirect manufacturing overhead)
   h. General and administrative
   i. Selling
   j. Manufacturing overhead
   k. General and administrative
   l. Selling
   m. Manufacturing overhead
   n. Direct labor
   o. General and administrative
   p. Manufacturing overhead

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3: MANUFACTURING FLOW

Learning Objectives

- Determine the flow of costs through the manufacturing process
- Prepare and evaluate the Schedule of Cost of Goods Manufactured, Schedule of Cost of Goods Manufactured, Schedule of Cost of Goods Sold, the Inventory section of the Balance Sheet, and the Income Statement

3.1: How Product Costs Flow through Accounts

3.2: Income Statements for Manufacturing Companies

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3.1: How Product Costs Flow through Accounts

Learning Objectives

- Identify how costs flow through the three inventory accounts and cost of goods sold account.

Exercise 3.1.1

In the last unit, we looked at the costs for Custom Furniture Company. Direct materials include items such as wood and hardware. Direct labor involves the employees who build the custom tables. Manufacturing overhead includes items such as indirect materials (glue, screws, nails, sandpaper, and stain), indirect labor (production supervisor), and other manufacturing costs, such as factory equipment maintenance and factory utilities. What accounts are used to record the costs associated with these items, and where do these accounts appear in the financial statements?

Answer available at the end of this section.

Answer available at the end of this section.

Table 3.1.1 summarizes the accounts used to track product costs. Figure 3.1.1 shows how product costs flow through the balance sheet and income statement. Lastly, Note "Business in Action" provides an example of how the accounts shown in Table 3.1.1 and Figure 3.1.1 appear in financial statements. Take time to review these items carefully. Your understanding of them will help clarify how product costs flow through the accounts and where product costs appear in the financial statements. The following discussion provides further clarification.

Product Costs on the Balance Sheet

Exercise 3.1.2

What is the difference between raw materials inventory, work-in-process inventory, and finished goods inventory?

Answer available at the end of this section.

Raw Materials

The **raw materials inventory** account records the cost of materials not yet put into production. For Custom Furniture Company, this account includes items such as wood, brackets, screws, nails, glue, lacquer, and sandpaper.

Work in Process

The **work-in-process (WIP) inventory** account records the costs of products that have not yet been completed. Suppose Custom Furniture Company has eight tables that are still in production at the end of the year. All manufacturing costs associated with these incomplete eight tables—direct materials, direct labor, and manufacturing overhead—are included in the WIP inventory account.

Once goods in WIP inventory are completed, they are transferred into finished goods inventory. The cost of completed goods that are transferred out of WIP inventory into finished goods inventory is called the **cost of goods manufactured**.

Finished Goods

The **finished goods inventory** account records the manufacturing costs of products that are completed and ready to sell.

Suppose Custom Furniture Company has five completed tables at the end of the year (in addition to the eight partially completed tables in work-in-process inventory). The manufacturing costs of these five tables—direct materials, direct labor, and manufacturing overhead—are included in the finished goods inventory account until the tables are sold. (For the purposes of this example, assume the tables are "sold" when delivered to the customer.)

Product Costs on the Income Statement

Exercise 3.1.3

The costs of materials not yet put into production are included in raw materials inventory. The costs associated with products that are not yet complete are included in WIP inventory. And the costs associated with products that are completed and ready to sell are included in finished goods inventory. What happens to the product costs in finished goods inventory when the products are sold?

Answer available at the end of this section.

For example, suppose Custom Furniture Company sells one table that cost $3,000 to produce (i.e., direct materials, direct labor, and manufacturing overhead costs incurred to produce the table total $3,000). The $3,000 cost is in finished goods inventory until the entry is made to record the sale, at which time finished goods inventory is reduced by $3,000 (the table is no longer in inventory) and cost of goods sold is increased by $3,000.

Table 3.1.1: Accounts Used to Record Product Costs

Account Name	Description	Financial Statement
Raw materials inventory	Cost of unused production materials	Balance sheet (asset)
Work-in-process inventory	Cost of incomplete products	Balance sheet (asset)
Finished goods inventory	Cost of completed products not yet sold	Balance sheet (asset)
Cost of goods sold	Cost of products sold	Income statement (expense)

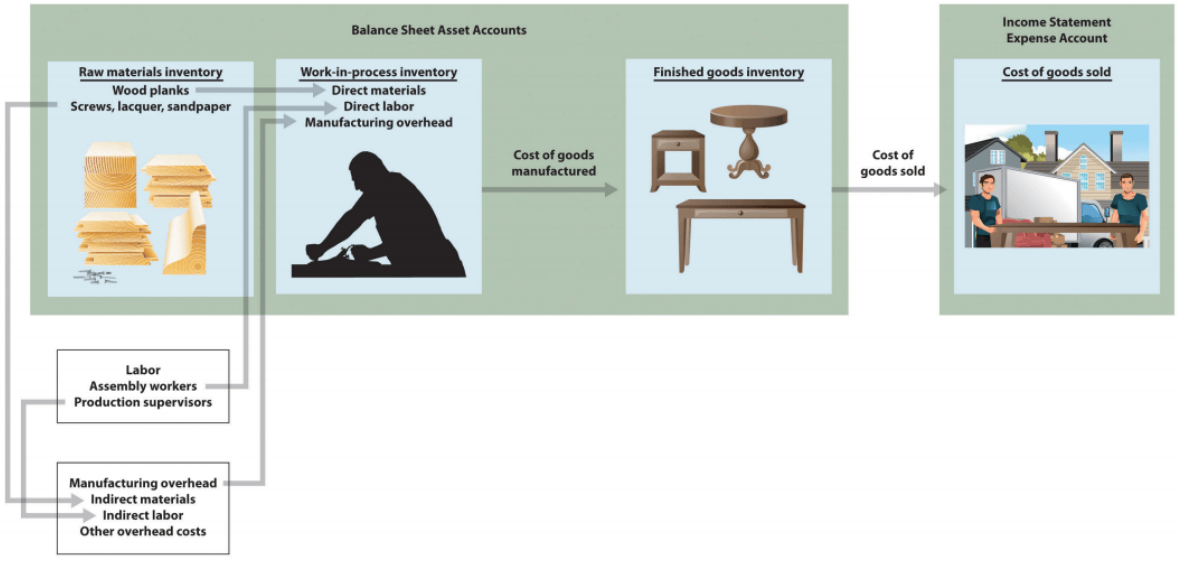


Figure 3.1.1: Flow of Product Costs through Balance Sheet and Income Statement Accounts

BUSINESS IN ACTION 3.1.1

Presentation of Product Costs at Advanced Micro Devices



Figure 3.1.2: Source: Photo courtesy of Matthew Rutledge, www.flickr.com/photos/rutlo/4252743250//

Advanced Micro Devices (AMD), a producer of microprocessors and flash memory devices for personal and networked computers, has annual revenues of $6,500,000,000. A summarized version of **AMD's** balance sheet appears as follows (all amounts are in millions). Notice that three inventory accounts, totaling $632,000,000, support the total inventory amount that appears in the asset section of the balance sheet. The raw materials inventory account ($28,000,000) is used to record the cost of materials not yet put into production. The work-in-process inventory account ($441,000,000) is used to record costs associated with microprocessors and flash memory devices in the production process that are not yet complete. The finished goods inventory account ($163,000,000) is used to record the product costs associated with **AMD's** products that are completed and ready to sell.

Advanced Micro Devices
Balance Sheet
December 25, 2010

Assets			**Liabilities**	
Cash and short-term investments		$ 1,789	Accounts payable	$ 581
Accounts receivable, net		968	Accrued liabilities	698
Inventories:			Other liabilities	2,672
Raw materials	$ 28			
Work in process	441		**Stockholders' Equity**	
Finished goods	163		Common stock	6,481
Total inventories		632	Accumulated deficit	(5,468)
Property, plant and equipment		700	Total liabilities and	
Other assets		875	stockholders' equity	$ 4,964
Total assets		$4,964		

Figure 3.1.3: Source: Advanced Micro Devices, "Advanced Micro Devices 2010 Annual Report," www.amd.com.

When **AMD** sells finished goods, the cost of these goods is transferred out of finished goods inventory into the cost of goods sold account, which this company calls *cost of sales*, as many companies do. The operating portion of AMD's income statement follows—again, all amounts are in millions. Notice that cost of sales appears below net sales and above all other operating expenses.

Advanced Micro Devices
Income Statement
Year Ended December 25, 2010

Net sales	$ 6,494
Expenses:	
Cost of sales	*3,533*
Research and development	1,405
Marketing, general and administrative	934
Legal settlement (income)	(283)
Other operating expenses	57
Operating income	$ 848

Figure 3.1.4: Source: Advanced Micro Devices, "Advanced Micro Devices 2010 Annual Report," www.amd.com.

KEY TAKEAWAY

The raw materials inventory account is used to record the cost of materials not yet put into production. The work-in-process inventory account is used to record the cost of products that are in production but that are not yet complete. The finished goods inventory account is used to record the costs of products that are complete and ready to sell. These three inventory accounts are assets accounts that appear on the balance sheet. The costs of completed goods that are sold are recorded in the cost of goods sold account. This account appears on the income statement as an expense.

Review Problem 3.1

Match each of the following accounts with the appropriate description that follows.

- _____ Raw materials inventory
- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

1. Used to record product costs of goods that are completed and ready to sell
2. Used to record product costs of goods that have been sold
3. Used to record product costs of goods that are still in production
4. Used to record the cost of materials not yet put into production

Answer available at the end of this section.

Answers

Exercise 3.1.1

Exercise 3.1.1

All the costs mentioned previously for Custom Furniture are product costs (also called manufacturing costs). Product costs are recorded as an asset on the balance sheet until the products are sold, at which point the costs are recorded as an expense on the income statement. To record product costs as an asset, accountants use one of three inventory accounts: raw materials inventory, work-in-process inventory, or finished goods inventory. The account they use depends on the product's level of completion. They use one expense account—cost of goods sold—to record the product costs when the goods are sold.

Exercise 3.1.2

Each of these accounts is used to record product costs depending on where the product is in the production process, and each account is an asset account on the balance sheet.

Exercise 3.1.3

When completed goods are sold, their costs are transferred out of finished goods inventory into the **cost of goods sold** account. Cost of goods sold is an expense account on the income statement that represents the product costs of all goods sold during the period.

Review Problem 3.1

Raw materials inventory	4. Used to record cost of materials not yet put into production.
Work-in-process inventory	3. Used to record product costs associated with incomplete goods in the production process.
Finished goods inventory	1. Used to record product costs associated with goods that are completed and ready to sell.
Cost of goods sold	2. Used to record product costs associated with goods that are sold.

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3.2: Income Statements for Manufacturing Companies

Learning Objectives

- Describe how to prepare an income statement for a manufacturing company.

Exercise 3.2.1

Companies that provide services, such as Ernst & Young (accounting) and Accenture LLP (consulting), do not sell goods and therefore have no inventory. The accounting process and income statement for service companies are relatively simple. Merchandising companies (also called retail companies) like Macy's and Home Depot buy and sell goods but typically do not manufacture goods. Since merchandising companies must account for the purchase and sale of goods, their accounting systems are more complex than those of service companies. Manufacturing companies, such as Johnson & Johnson and Honda Motor Company, produce and sell goods. Such companies require an accounting system that goes well beyond accounting solely for the purchase and sale of goods. Why are accounting systems more complex for manufacturing companies?

Answer available at the end of this section.

Inventory Cost Flow Equation

Exercise 3.2.2

How do companies use the cost flow equation to calculate unknown balances?

Answer available at the end of this section.

Raw materials used in production shows the cost of direct and indirect materials placed into the production process. *Cost of goods manufactured* represents the cost of goods completed and transferred out of work-in-process (WIP) inventory into finished goods inventory. *Cost of goods sold* represents the cost of goods that are sold and transferred out of finished goods inventory into cost of goods sold.

Accountants need all these amounts—raw materials placed in production, cost of goods manufactured, and cost of goods sold—to prepare an income statement for a manufacturing company. We describe how to calculate these amounts using three formal schedules in the following order:

1. Schedule of raw materials placed in production
2. Schedule of cost of goods manufactured
3. Schedule of cost of goods sold

Exercise 3.2.3

The basic cost flow equation can be used in three supporting schedules to help us determine the cost of goods sold amount on the income statement for manufacturing companies. What information is included in these schedules, and what do they look like for Custom Furniture Company?

Answer available at the end of this section.

The goal of going through the process shown in Figure 3.2.1 is to arrive at a cost of goods sold amount, which is presented on the income statement. Custom Furniture Company's income statement for the month ended May 31 is shown in Figure 3.2.2. As you

review Figure 3.2.1 and Figure 3.2.2, look back at Figure 3.1.1 to see how costs flow through the three inventory accounts and the cost of goods sold account.

Later, we will provide the detailed information necessary to prepare the schedules and income statement presented in Figure 3.2.1 and Figure 3.2.2. At this point, your job is to understand how we use the inventory cost flow equation to calculate raw materials placed in production, cost of goods manufactured, and cost of goods sold. (Note: Companies using a perpetual inventory system do not necessarily prepare these formal schedules because perpetual systems update records immediately when inventory is transferred from one inventory account to another. However, these companies take a physical count periodically to ensure the accuracy of inventory accounts and use the cost flow equation and similar schedules to ensure their perpetual system balances are accurate.

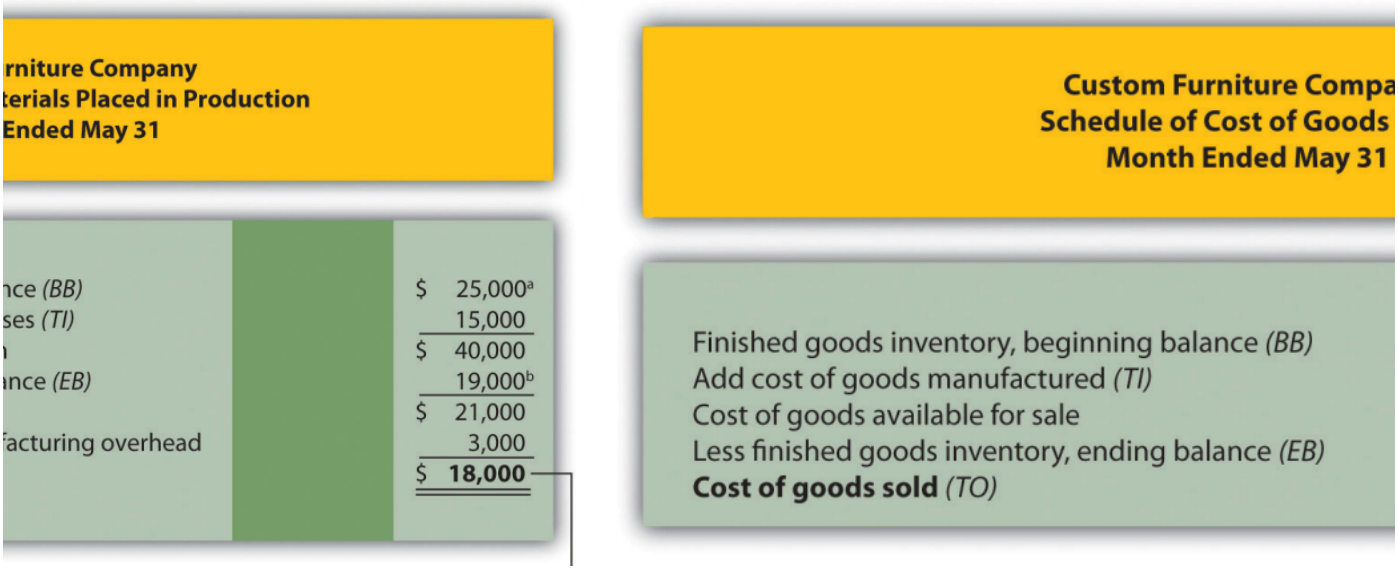
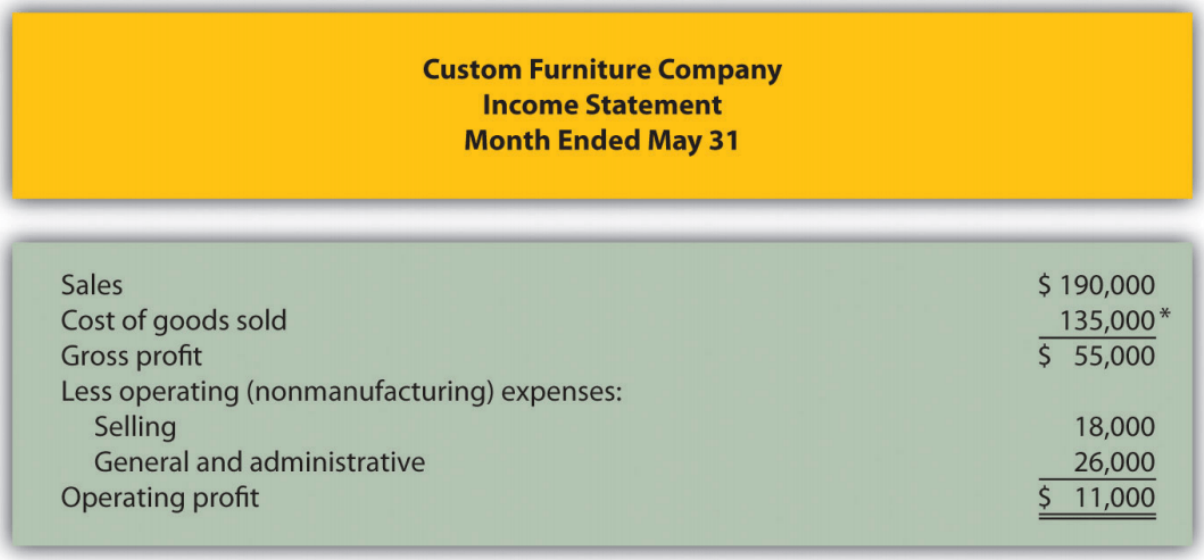


Figure 3.2.1: Income Statement Schedules for Custom Furniture Company

[a] From the company's balance sheet at April 30 (April 30 ending balance is the same as May 1 beginning balance).

[b] From the company's balance sheet on May 31.

[c] This is actual manufacturing overhead for the period and includes indirect materials, indirect labor, factory rent, factory utilities, and other factory-related expenses for the month. Later, we will look at an alternative approach to recording manufacturing overhead called normal costing.



Custom Furniture Company
Income Statement
Month Ended May 31

Sales	$ 190,000
Cost of goods sold	135,000*
Gross profit	$ 55,000
Less operating (nonmanufacturing) expenses:	
Selling	18,000
General and administrative	26,000
Operating profit	$ 11,000

Figure 3.2.2: Income Statement for Custom Furniture Company

Answers

Exercise 3.2.1

Accounting systems are more complex for manufacturing companies because they need a system that tracks manufacturing costs throughout the production process to the point at which goods are sold. Since income statements for manufacturing companies tend to be more complex than for service or merchandising companies, we devote this section to income statements for manufacturing companies. Understanding income statements in a manufacturing setting begins with the inventory cost flow equation.

Exercise 3.2.2

We can use the basic cost flow equation to calculate unknown balances for just about any balance sheet account (e.g., cash, accounts receivable, and inventory). The equation is as follows: Beginning balance (BB) + Transfers in (TI) – Ending balance (EB) = Transfers out (TO)

We will apply this equation to the three inventory asset accounts discussed earlier (raw materials, work in process, and finished goods) to calculate the cost of raw materials used in production, cost of goods manufactured, and cost of goods sold.

Exercise 3.2.3

Figure 3.2.1 shows these three schedules for Custom Furniture Company for the month of May. As you review these schedules, note that each schedule provides information required for the next schedule, as indicated by the arrows. Remember the inventory cost flow equation is used for each schedule. This is why you see abbreviations for each element of the equation: beginning balance (BB), transfers in (TI), ending balance (EB), and transfers out (TO).

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4: JOB COSTING

Learning Objectives

- Describe the traditional types of product cost systems, including job order costing and process costing
- Illustrate the flow of costs in the job-order costing system
- Prepare related accounting records and reports, including the journal entries to reflect the flow of costs

4.1: Why It Matters

4.2: Distinguish Between Job Order Costing and Process Costing

4.3: Describe and Identify the Three Major Components of Product Costs under Job Order Costing

4.4: Use the Job Order Costing Method to Trace the Flow of Product Costs through the Inventory Accounts

4.5: Compute a Predetermined Overhead Rate and Apply Overhead to Production

4.6: Compute the Cost of a Job Using Job Order Costing

4.7: Determine and Dispose of Underapplied or Overapplied Overhead

4.8: Prepare Journal Entries for a Job Order Cost System

4.9: Explain How a Job Order Cost System Applies to a Nonmanufacturing Environment

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4.1: Why It Matters

Hallie graduated from college last year and moved to Tempe, Arizona, to begin her career. Before moving, she purchased a secondhand dresser for $35 and spent $25 on refinishing materials. After two hours of work, she posted a picture of the dresser on social media, and a friend offered her $100 to refinish another dresser exactly the same way.

Fortunately, Hallie understands cost accounting and knew she needed to calculate the cost to refinish another dresser. She found a similar dresser for $65. She knows that the refinishing materials will cost $25, and thus before adding in any cost for labor she is already at a cost of $90, without considering any overhead, such as electricity to run her sander.

Hallie estimated that her labor costs should be $20 per hour. The total cost then would be $130, and accepting less would mean accepting less for her labor. For a business in this situation, agreeing to the $100 offer would be considered a loss. If Hallie accepts the $100 price before checking her costs, she would have received only $10 for her labor (the sales price of $100 less the $90 cost of the dresser and materials).

Hallie didn't know if she would lose a potential customer by raising the price, so she found a different style dresser costing $25. A sales price of $100 would be fair with the two hours to refinish at $20 per hour and a materials cost of $25. She offered her friend the original style dresser for $130 or the alternate style dresser for $100.

As this example illustrates, it was essential for Hallie to know the cost to complete her project. It is also essential for all types and sizes of organizations to know the costs to complete their project. Manufacturing organizations need to know the costs of production, retail organizations need to know the cost to sell their products, and service organizations need to know the cost of providing their services. Management strives to eliminate unnecessary costs and needs to know the costs associated with using large pieces of equipment as well as seemingly insignificant office supplies. Cost accounting involves measuring and reporting the cost of production or service, while also providing data to determine the cost of the individual unit produced.

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4.2: Distinguish Between Job Order Costing and Process Costing

Pet Smart, **H&R Block**, **Chili's**, and **Marshalls** are popular chains often found at the same shopping center, even though they are very different businesses. Although they have a retail store, the Pet Smart Corporation also manufactures large volumes of its own products, whereas H&R Block prepares taxes for individual customers. Chili's prepares food, and its wait staff provides a service, whereas Marshalls sells a variety of products at retail.

The management of each business relies on knowing each cost when making decisions, such as setting the sales price, planning production and staffing schedules, and ordering materials. Although these companies share a common location, which suggests similar rental costs, all the other costs vary significantly. Because of these cost differences, each company must have a system for gathering its cost data. For example, Pet Smart manufactures Great Choice squeaker balls in large batches and collects cost data through a process costing system. A process costing system is often used to trace and determine production costs when similar products or services are provided.

Since a typical tax return can vary significantly from one taxpayer to the next, H&R Block provides a service that they customize for each customer. Its cost data are collected via a job order cost system, which is designed to allow for individualized products or services.

Marshalls does not produce a product yet still needs a system to assign overhead costs to the products it sells. And while Chili's has the same nationwide menu, it needs a system to collect the costs for each menu item within each location.

While companies may choose different cost accounting systems, each system must be capable of accumulating the costs incurred and allocating the costs to the product. Each costing system also requires the ability to obtain and analyze the cost data, and the more detailed the information needed, the higher the cost of collecting the data. The choice of cost accumulation system depends on the variety and type of products or services sold, or the type of manufacturing processes employed. The system used should be determined by weighing the cost of collecting the data and the benefit of having that information.

Companies use different costing systems for determining the cost of custom products than they do for determining the cost of mass-produced products. When products are custom ordered, knowing the cost of the materials, labor, and overhead is critical to determining the sales price. As an easy example, think of a tailor who alters, repairs, and makes custom clothes for customers. If a customer orders a custom-made suit, the specific fabric, detail of any special features, and the time involved in sewing are all factors that will determine the total cost and, therefore, the selling price of the garment. Each component of the cost of producing the clothing will be tracked as it occurs, thus improving the accuracy of determining the price. However, in mass production, wherein one batch leads to a second batch, stopping the process to properly identify the materials, labor, and overhead costs used for each batch does not provide enough valuable data to justify determining the individual costing of each product. For example, in the case of a mass-produced clothing item, such as jeans, a company like **Levi's** will track costs for a batch of jeans rather than for a pair of jeans. Levi's had over $4.9 billion in revenue in 2017 generated from the many different styles and brands of clothing items they produce and sell. It would be difficult, and not cost-effective, to track the cost of each individual clothing item; rather, it is more efficient to track the costs in each phase of the clothing-making process. Levi's can then accumulate the costs of the phases of production to determine the total cost of production for a batch and allocate those costs over the number of pairs of jeans made. This process allows them to determine the cost of each item.

Even retail companies need to know the cost of the purchased products before the sales price is set. While it seems simple to think of the sales price as the purchase price plus a markup, determining the markup costs needs to be an accurate process in order to ensure the sale price is higher than the product cost. To properly capture the information necessary for decision-making, there are different costing systems that track costs in order to determine sales prices, and to measure profits and manufacturing efficiency.

As previously mentioned, the two traditional types of costing systems are job order costing and process costing. Each anticipates or determines unit costs of products being manufactured and/or services being provided prior to year-end. Companies may decide to use only one or a combination of methods. This chapter examines job order costing and demonstrates how it differs from process costing.

In this chapter, you will also learn the terminology used to track costs within the job order cost system and how to segregate and

aggregate these costs to determine the costs of production in a job order costing environment. You will also learn how to record these job costs and where they appear on financial statements.

Job Order Costing versus Process Costing

Job order costing is an accounting system that traces the individual costs directly to a final job or service, instead of to the production department. It is used when goods are made to order or when individual costs are easy to trace to individual jobs, assuming that the additional information provides value. In these circumstances, the individual costs are easy to trace to the individual jobs.

For example, assume that a homeowner wants to have a custom deck added to her home. Also assume that in order to fit her lot's topography and her anticipated uses for the addition, she needs a uniquely designed deck. Her contractor will design the deck, price the necessary components (in this case, the direct materials, direct labor, and overhead), and construct it.

The final cost will be unique to this project. If another homeowner wanted the contractor to construct a deck, the contractor would go through the same design and pricing process, and you would expect that the design and costs would not be the same as those of the deck in the first example, since the decks would differ from one another.

The job order costing method also works well for companies such as movie production companies, print service providers, advertising agencies, building contractors, accounting firms, consulting entities, and repair service providers. For example, *Star Wars: The Last Jedi* is believed to have cost $200 million to produce, whereas *Logan* only cost $97 million. The production processes for both films differed significantly, so that the accumulated costs for each job also differed significantly. Both were made in 2017.

In contrast, process costing is used when the manufacturing process is continuous, so it is difficult to establish how much of each material is used and exactly how much time is invested in each unit of finished product. Therefore, in process costing, costs are accounted for by the production process or production department instead of by the product or by the job. This method works well for manufacturers of products such as **Titleist** golf balls, **Kellogg's** cereal, **Turkey Hill** ice cream, **CITGO** gasoline, **Dow** Chemicals, or **Sherwin Williams**' paints. However, process costing is not limited to basic manufacturing activities: It can also be used in the manufacturing of more complex items, such as small engines. A process costing system assigns costs to each department as the costs are incurred, and the costs to produce one unit are calculated based on the information from the production department. Unit costs are determined after total production costs are determined.

One factor that can complicate the choice between job order costing and process costing is the growth of automation in the production process, which typically is accompanied by a reduction in direct labor. The cost of the increase in equipment (typically reflected as a depreciation expense) is allocated to overhead, while the decreased need for labor usually reduces the direct labor cost. Because of these issues, some companies choose a hybrid system, using process costing to account for mass-producing a part and using job order costing to account for assembling some of those individual parts into a custom product. Table 4.2.1 summarizes the use of these two systems.

Table 4.2.1: Job Order and Process Cost Systems

	Job Order Cost System	Process C
Product type	Custom order	Mass prod
Examples	Signs, buildings, tax returns	Folding tal
Cost accumulation	Job lot	Accumulat
Work in process inventory	Individual job cost sheets	Separate v
Record keeping	Individual job cost sheets	Productior

This table shows some of the differences between job order costing and process costing.

To illustrate how a company can determine whether to use job order costing or process costing, consider the cost accounting options for a local restaurant. Macs & Cheese makes specialty macaroni and cheese, and the company wants to erect a special sign on an already constructed billboard outside a stadium. It wants to use this space to target stadium customers; thus, the company wants a sign built specifically for that site. Dinosaur Vinyl is secured as the sign manufacturer and would use job

order costing to account for the associated manufacturing costs because of the unique nature of the sign, including the artwork involved. However, if Macs & Cheese was designing a costing system for the specialty food product they market, they typically would use a process costing approach because their product is made and marketed in homogeneous, similar batches.

LINK TO LEARNING

Both job order and process costing are used to track costs with a goal of improved cost measurement efficiency. Bar codes can help with either type of costing. **Verified Label, Print & Promotions, Inc.** provides a list of how barcodes contribute to efficiency in cost tracking for more information.

Organization of Flow of Goods through Production

Regardless of the costing method used (job order costing, process costing, or another method), manufacturing companies are generally similar in their organizational structure and have a similar flow of goods through production. The diagram in Figure 4.2.1 shows a partial organizational chart for sign manufacturer Dinosaur Vinyl. The CEO has several direct reporting units—Financing, Production, Information Technology, Marketing, Human Resources, and Maintenance—each with a director responsible for several departments.

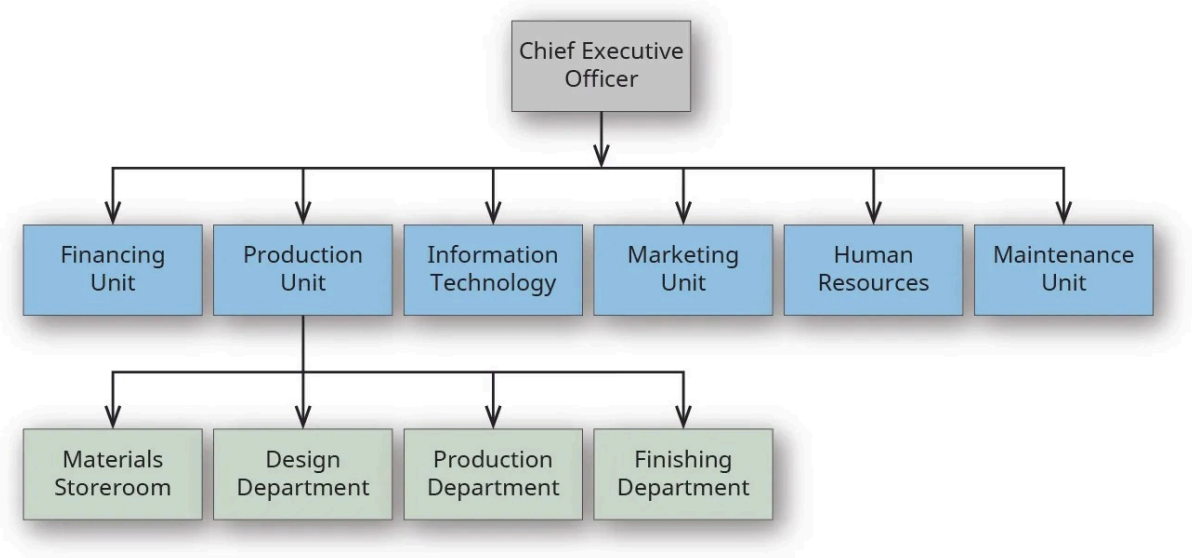


Figure 4.2.1: Organizational Chart for a Manufacturing Company. The different units within Dinosaur Vinyl illustrate the two main cost categories of a manufacturing company: manufacturing costs (the production unit), and selling and administrative costs. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The diagram also shows the departments that report to the production unit director and gives an indication as to the flow of goods through production. The flow of goods through production is more evident in Figure 4.2.2, which depicts Dinosaur Vinyl as a simple factory with three stages of production.

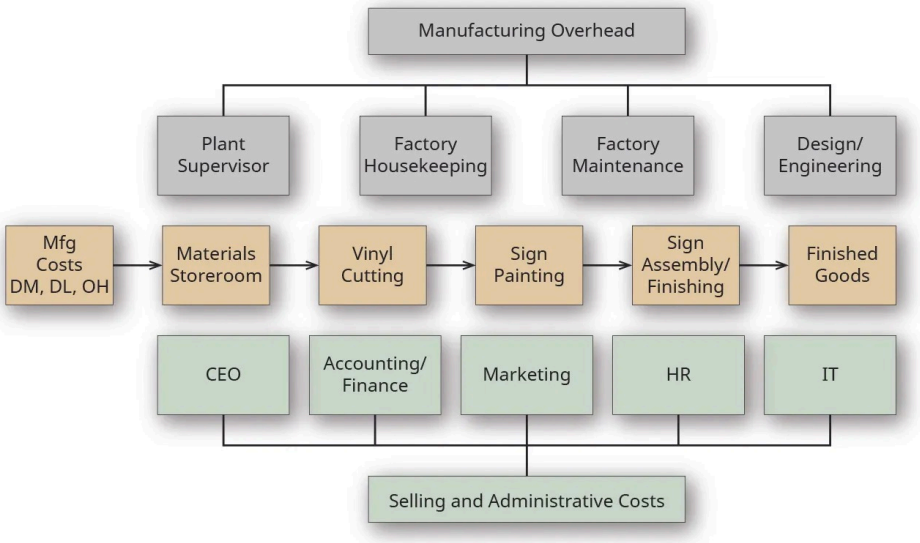


Figure 4.2.2: Factory Layout for Dinosaur Vinyl. The flow of goods and areas of manufacturing versus administrative costs are more easily seen by looking at the factory layout for Dinosaur Vinyl. The departments across the bottom represent administrative costs, whereas the departments in the middle represent manufacturing costs—although Design/Engineering can sometimes be considered part of administrative costs, depending on how management chooses to categorize those costs. The departments listed across the top represent examples of manufacturing overhead. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Raw materials are stored in the materials storeroom and delivered to the appropriate production department—cutting, painting, or assembly/finishing. The design department uses direct labor to create the design specifications, and, when completed, it sends them to the production department. The production department uses the material and design specifications and adds additional labor to create the sign. The sign is transferred to the finishing department for final materials and labor before the sign is installed or delivered to the customer.

Manufacturing Costs

In a manufacturing environment, the **manufacturing costs** are also called *product costs* and include all expenses used to manufacture the product: direct materials, direct labor, and manufacturing overhead. The total of these costs becomes the cost of ending inventory and later becomes the cost of goods sold when the product is sold. Both job order costing and process costing use categorized cost information to make decisions and evaluate the effectiveness of the cost tracking process. Because of the difference in how each of the two costing systems track costs, different terminology is used. Thus, it is important to separate product costs from period costs, and it is sometimes important to separate product costs into **prime costs** and **conversion costs**. Prime costs are costs that include the primary (or direct) product costs: direct materials and direct labor. Conversion costs are costs that include the expenses necessary to convert direct materials into a finished product: direct labor and manufacturing overhead. Their relationship is shown in Figure 4.2.3.

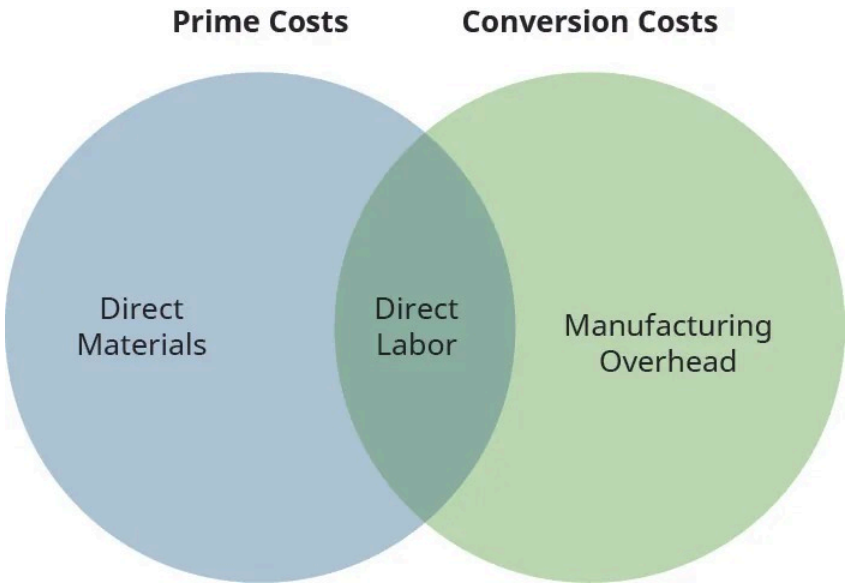


Figure 4.2.3: Manufacturing Costs. Management sometimes needs additional information to make decisions and needs the costs categorized as prime costs or conversion costs. Prime costs and conversion costs are not included together as direct labor is included in both categories. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Job order costing systems assign costs directly to the product by assigning direct materials and direct labor to the work in process (WIP) inventory. Direct materials are the components that can be directly traced to the products produced, whereas direct labor is the labor cost that can be directly traced to the products produced.

Material and labor costs that cannot be traced directly to the product produced are included in the overhead costs that are allocated in the production costing process. Overhead is applied to each product based on an activity base.

The assignment of direct materials and direct labor to each production unit illustrates the job order costing system's focus on prime costs, in contrast to the process costing system, which assigns costs to the department and focuses on direct materials and conversion costs, which are composed of a combination of direct labor and overhead.

Selling and Administrative Costs

Selling and administrative costs (S&A) are period costs, and these costs are expensed as incurred, instead of being included in the product's costs, as they move through the relevant inventory accounts. A **period cost** is a cost tied to a specific time period, such as a month, quarter, or year, instead of being associated with a particular job order. For example, if a company paid an insurance company $12,000 for one year's liability insurance coverage, the first month's expense would be $1,000. This expense would not be related to a particular job order, but instead would be classified as a period cost, and in this case recorded monthly as an administrative expense. Selling costs are the expenses related to the promotion and sale of the company's products, whereas administrative costs are the expenses related to the operations of the company. The S&A costs are considered period costs because they include costs of departments not directly associated with manufacturing but necessary to operate the business. Some examples include research and development costs, marketing costs, sales commissions, administration building rent, the CEO's salary expense, and accounting, payroll, and IT department expenses.

YOUR TURN

Maria's Market

A grocery store's analysis of a recent customer survey finds an increasing number of customers interested in being able to custom-order meals to go. Maria sees this as an opportunity to enter a niche market for busy families or individuals who want home-cooked meals with a variety of options and combinations, but who have little time. Maria already has an expansive deli, bakery, and prepared foods section in the store and sees this opportunity as a viable option to increase sales and its

customer base. With meals to go, customers can choose from an array of options and can indicate the quantity of each item and the time of pickup. The customer simply pulls up in a designated spot at Maria's and the food is brought to their car, packaged, and ready to take home to enjoy.

What type of costing system will work best for the Maria's Market? What sales price information, cost information, and other options are important to this decision?

Answer available at the end of this section.

Recording Costs in Job Order Costing versus Process Costing

Both job order costing and process costing track the costs of materials, labor, and overhead as components of virtually all products. The process of production does not change because of the costing method: The costing method is chosen based on the process of production and is intended to provide the most accurate representation of the costs incurred in the production process.

Maintaining accounting records for each system has its advantages. A job order costing system uses a **job cost sheet** to keep track of individual jobs and the direct materials, direct labor, and overhead associated with each job. The focus of a job order costing system is tracking costs per job, since each job is unique and therefore has different costs relative to other jobs. Maintaining this information is typically more expensive than process costing, and it is often used for the production of smaller, more individualized jobs because the benefit of knowing the cost of each product outweighs the additional cost of maintaining a job order costing system.

In contrast, a process costing system does not need to maintain the cost for individual jobs because the jobs use a continual system of production, and the items are typically not significantly unique but instead are basically equivalent. The accounting emphasis is in keeping records for the individual departments, which is useful for large batches or runs. Process costing is the optimal system to use when the production process is continuous and when it is difficult to trace a particular input cost to an individual product. Process costing systems assign costs to each department as the costs are incurred. The costs to produce one unit are calculated, based on the information from the production department. Therefore, the focus of process costing systems is on measuring and assigning the conversion costs to the proper department in order to best determine the cost of individual units.

Under either costing method, accounting theory explains why it is important to understand when costs become expenses. A primary reason for separating production costs from other company expenses is the **expense recognition principle**, which requires costs to be expensed when they match the revenue being earned and to separate the costs of production from other costs for the proper timing of recognition of expenses. Think about measuring the profit from the sale of an item, say a TV, in a nonmanufacturing environment. It is logical to subtract the costs associated with buying the TV in order to determine the profit, before applying other costs from that sale. Suppose the TV was purchased as inventory by the store in January and sold to a customer in March. This requires that the cost of the TV not be recorded as an expense (cost of goods sold) until March, when the sale from the TV is recorded, thus matching the revenue with the expense. Until that time, the TV and its cost are considered inventory. This same idea applies to the manufacturing process.

Per the expense recognition principle, product costs—the direct materials, direct labor, and manufacturing overhead incurred to produce the job—are expensed on the income statement for the period of the sale as cost of goods sold when the completed job is sold. If the products are not sold, their costs remain in ending inventory.

Prior to the sale of the product, separating production costs and assigning them to the product results in these costs remaining with the inventory. Until they are sold, the costs incurred are reflected in an assortment of inventory accounts, such as raw materials inventory, work-in-process inventory, and finished goods inventory.

In contrast, period costs are not directly related to the production process and are expensed during the period in which they are incurred. This approach matches administrative and other expenses shown on the income statement in the same period in which the company earns income.

Answers

YOUR TURN

A job order cost system will work well for this store. In addition to specific price and cost, these are other important considerations.

- The optimal sales price should be set to encourage customers to purchase the meals.
- The materials, labor, and overhead cost should be considered for each meal option.
  - Direct material costs may include the cost of the protein, grain, and vegetable option, as well as the cost of the packing containers.
  - The direct labor cost is for employees who are directly involved in preparing the meals.
  - Manufacturing overhead includes the cost of gloves used when preparing the meals, the cost of employees who support but are not directly involved in preparing the meals, and the cost to operate the oven.
- The cost of the various meal options should all be less than the sales price.
- The meal options should change to take advantage of seasonal items.
- There may be a need to vary the sales price, depending on the combinations selected.

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4.3: Describe and Identify the Three Major Components of Product Costs under Job Order Costing

In order to set an appropriate sales price for a product, companies need to know how much it costs to produce an item. Just as a company provides financial statement information to external stakeholders for decision-making, they must provide costing information to internal managerial decision-makers. Virtually every tangible product has direct materials, direct labor, and overhead costs that can include indirect materials and indirect labor, along with other costs, such as utilities and depreciation on production equipment. To account for these and inform managers making decisions, the costs are tracked in a cost accounting system.

While the flow of costs is generally the same for all costing systems, the difference is in the details: Product costs have material, labor, and overhead costs, which may be assessed differently. In most production facilities, the raw materials are moved from the raw materials inventory into the work-in-process inventory. The work-in-process involves one or more production departments and is where labor and overhead convert the raw materials into finished goods. The movement of these costs through the work-in-process inventory is shown in Figure 4.3.1.

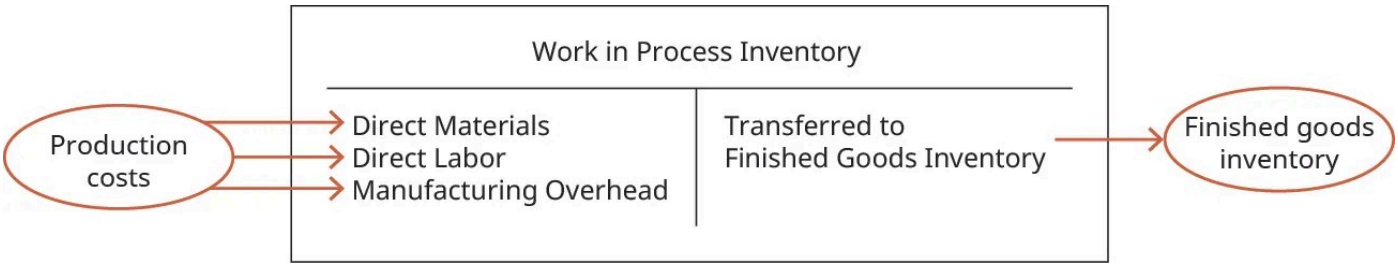


Figure 4.3.1: Work-in-Process Inventory. Direct materials, direct labor, and manufacturing overhead enter the work in process inventory as the costs associated with the products that are in production. Once the products are completed, their costs are transferred to the finished goods inventory. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

At this stage, the completed products are transferred into the finished goods inventory account. When the product is sold, the costs move from the finished goods inventory into the cost of goods sold.

While many types of production processes could be demonstrated, let's consider an example in which a contractor is building a home for a client. The accounting system will track direct materials, such as lumber, and direct labor, such as the wages paid to the carpenters constructing the home. Along with these direct materials and labor, the project will incur manufacturing overhead costs, such as indirect materials, indirect labor, and other miscellaneous overhead costs. Samples of these costs include indirect materials, such as nails, indirect labor, such as the supervisor's salary, assuming that the supervisor is overseeing several projects at the same time, and miscellaneous overhead costs such as depreciation on the equipment used in the construction project.

As direct materials, direct labor, and overhead are introduced into the production process, they become part of the work-in-process inventory value. When the home is completed, the accumulated costs become part of the finished goods inventory value, and when the home is sold, the finished goods value of the home becomes the cost of goods sold. Figure 4.3.2 illustrates the flow of these costs through production.

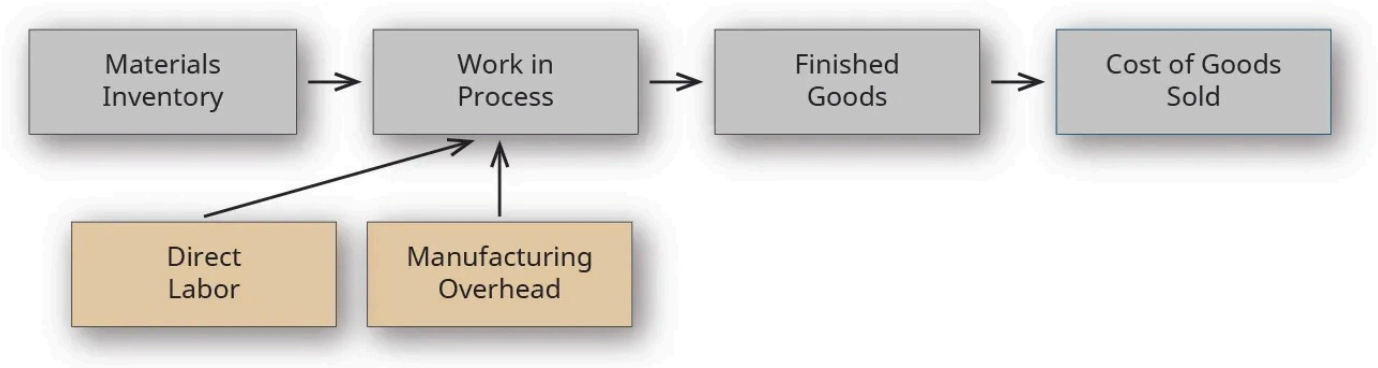


Figure 4.3.2: Flow of Materials from Raw Materials to Finished Goods. Accounting methods track a product's material, labor, and overhead costs, as it moves through production. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The three general categories of costs included in manufacturing processes are direct materials, direct labor, and overhead. Note that there are a few exceptions, since some service industries do not have direct material costs, and some automated manufacturing companies do not have direct labor costs. For example, a tax accountant could use a job order costing system during tax season to trace costs. The one major difference between the home builder example and this one is that the tax accountant will not have direct material costs to track. The few assets used will typically be categorized as overhead.

A benefit of knowing the production costs for each job in a job order costing system is the ability to set appropriate sales prices based on all the production costs, including direct materials, direct labor, and overhead. The unique nature of the products manufactured in a job order costing system makes setting a price even more difficult. For each job, management typically wants to set the price higher than its production cost. Even if management is willing to price the product as a loss leader, they still need to know how much money will be lost on each product. To achieve this, management needs an accounting system that can accurately assign and document the costs for each product.

If you're not familiar with the concept of a loss leader, a simple example might help clarify the concept. A **loss leader** is a product that is sold at a price that is often less than the cost of producing it in order to entice you to buy accessories that are necessary for its use. For example, you might pay $50 or $60 for a printer (for which the producer probably does not make any profit) in order to then sell you extremely expensive printer cartridges that only print a few pages before they have to be replaced. However, even pricing a product as a loss leader requires analysis of the three categories of costs: direct materials, direct labor, and overhead.

Direct Materials

Direct materials are those materials that can be directly traced to the manufacturing of the product. Some examples of direct materials for different industries are shown in Table 4.3.1. In order to respond quickly to production needs, companies need raw materials inventory on hand. While production volume might change, management does not want to stop production to wait for raw materials to be delivered. Further, a company needs raw materials on hand for future jobs as well as for the current job. The materials are sent to the production department as it is needed for production of the products.

Table 4.3.1: Common Direct Materials by Industry

Industry	Direct Materials
Automotive	Iron, aluminum, glass, rubber
Cell phones	Glass, various metals, plastic
Furniture	Wood, leather, vinyl
Jewelry	Gold, silver, diamonds, rubies
Pharmaceuticals	Natural or synthetic biological ingredients

Each job begins when raw materials are put into the work in process inventory. When the materials are requested for production, a materials requisition slip is completed and shows the exact items and quantity requested, along with the associated cost. The completed form is signed by the requestor and approved by the manager responsible for the budget.

Returning to the example of Dinosaur Vinyl's order for Macs & Cheese's stadium sign, Figure 4.3.3 shows the **materials requisition form** for Job MAC001. This form indicates the quantity and specific items to be put into the work in process. It also transfers the cost of those items to the work-in-process inventory and decreases the raw materials inventory by the same amount. The raw materials inventory department maintains a copy to document the change in inventory levels, and the accounting department maintains a copy to properly assign the costs to the particular job.

MATERIALS REQUISITION FORM
Dinosaur Vinyl, Inc.

Material Requisition No.: 3392
Job No.: MAC001
Date of Request: 4/5/2017
Date Needed: 4/5/2017

Description	Quantity	Unit Cost	Total Cost
Raw materials inventory: Vinyl	1	$300	$300
Raw materials inventory: Black ink	2	50	100
Raw materials inventory: Red ink	1	60	60
Raw materials inventory: Gold ink	1	60	60
Raw materials inventory: Grommets	12	10	120
Raw materials inventory: Framing wood	40	1.50	60
			$700

Requested by: john ming Date: 4/5/17
Authorized by: Isla Clark Date: 4/5/17

Figure 4.3.3: Materials Requisition Form for Job MAC001. The materials requisition form allows different departments to track and account for the direct materials needed to manufacture the product. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Dinosaur Vinyl has a beginning inventory of $1,000 in *raw materials: vinyl*, and $300 in each of its ink inventories: *raw materials: black ink*, *raw materials: red ink*, and *raw materials: gold ink*. In order to have enough inventory on hand for all of its jobs, it purchases $10,000 in vinyl and $500 in black ink. The T-accounts in Figure 4.3.4 show the stated beginning debit balances. An additional $10,000 of vinyl and $500 of black ink were then purchased for anticipated use, providing the demonstrated final account balances. The red ink and gold ink balances did not change, since no additional quantities were purchased.

The beginning balances and purchases in each of these accounts are illustrated in Figure 4.3.4.

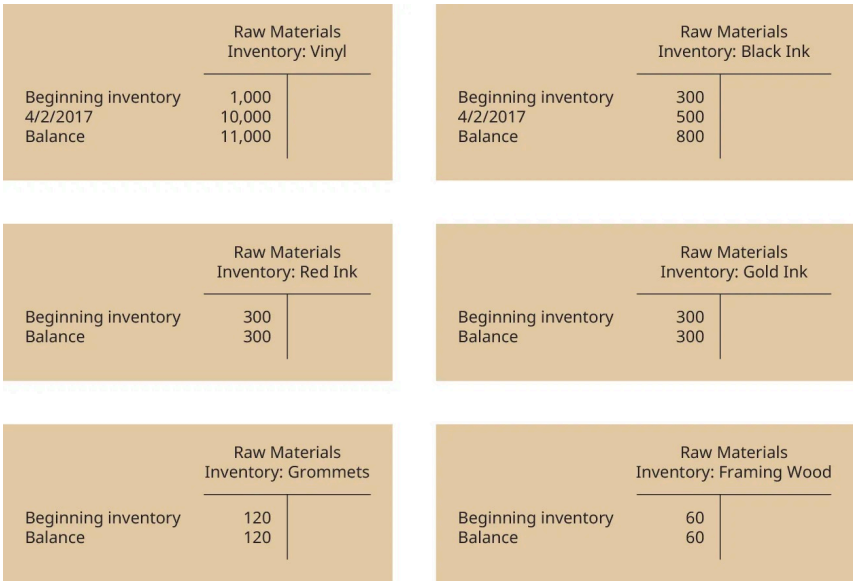


Figure 4.3.4: Beginning Balances and Purchases. These T-accounts show the balances for the raw materials inventory. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Traditional billboards with the design printed on vinyl include direct materials of vinyl and printing ink, plus the framing materials,

which consist of wood and grommets. The typical billboard sign is 14 feet high by 48 feet wide, and Dinosaur Vinyl incurs a vinyl cost of $300 per billboard. The price for the ink varies by color. For this job, Dinosaur Vinyl needs two units of black ink at a cost of $50 each, one unit of red ink and one unit of gold ink at a cost of $60 each, twelve grommets at a cost of $10 each, and forty units of wood at a cost of $1.50 per unit. The total cost of direct materials is $700, as shown in Figure 4.3.5.

Item	Units	Cost per Unit	Item Cost	Total Cost
Production Department				
Vinyl	1	$ 300	$300	
Black ink	2	50	100	
Red ink	1	60	60	
Gold ink	1	60	60	$520
Finishing Department				
Grommets	12	$ 10	$120	
Framing wood	40	1.50	60	180
Total Direct Materials				$700

Figure 4.3.5: Direct Materials Needed for Job MAC001. The costs for direct materials needed by both the production and finishing departments are shown. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Some items are more difficult to measure per unit, such as adhesives and other materials not directly traceable to the final product. Their costs are assigned to the product as part of manufacturing overhead as indirect materials.

When Dinosaur Vinyl requests materials to complete Job MAC001, the materials are moved from raw materials inventory to work in process inventory. We will use the beginning inventory balances in the accounts that were provided earlier in the example. The requisition is recorded on the job cost sheet along with the cost of the materials transferred. The costs assigned to job MAC001 are $300 in vinyl, $100 in black ink, $60 in red ink, and $60 in gold ink. During the finishing stages, $120 in grommets and $60 in wood are requisitioned and put into work in process inventory. The costs are tracked from the materials requisition form to the work in process inventory and noted specifically as part of Job MAC001 on the preceding job order cost sheet. The movement of goods is illustrated in Figure 4.3.6.

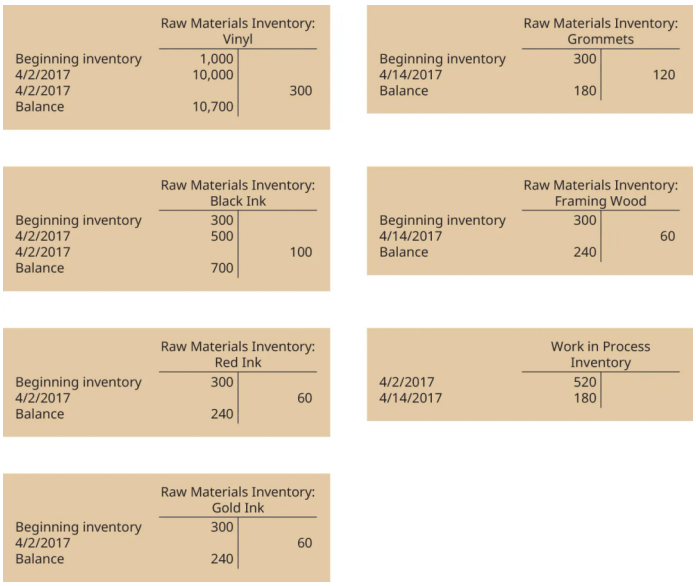


Figure 4.3.6: Movement of Goods. These T-accounts illustrate the tracking of costs from raw materials inventory to the work-in-process inventory as the product moves through the manufacturing process. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Each of the T-accounts traces the movement of the raw materials from inventory to work in process. The vinyl and ink were used first to print the billboard, and then the billboard went to the finishing department for the grommets and frame, which were moved

to work in process after the vinyl and ink. The final T-account shows the total cost for the raw materials placed into work in process on April 2 (vinyl and ink) and on April 14 (grommets and wood).

Direct Labor

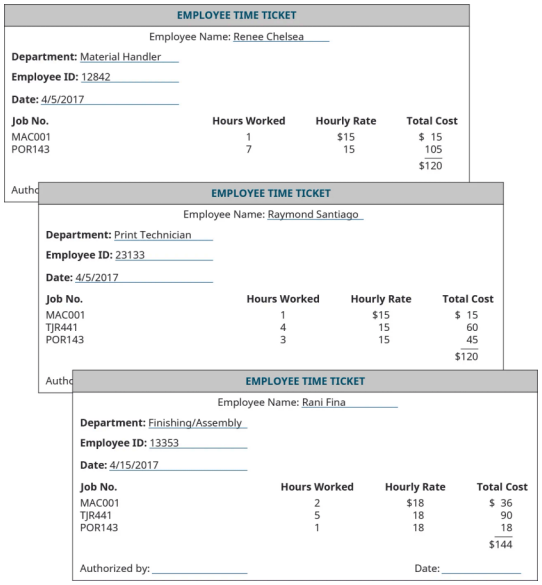
Direct labor is the total cost of wages, payroll taxes, payroll benefits, and similar expenses for the individuals who work directly on manufacturing a particular product. The direct labor costs for Dinosaur Vinyl to complete Job MAC001 occur in the production and finishing departments. In the production department, two individuals each work one hour at a rate of $15 per hour, including taxes and benefits. The finishing department's direct labor involves two individuals working one hour each at a rate of $18 per hour. Figure 4.3.7 shows the direct labor costs for Job MAC001.

Item	Hours	Rate per Hour	Item Cost	Total Cost
Production Department				
Material Handler	1	$15	$15	
Print Technician	1	15	15	$30
Finishing Department				
Production Assistant	1	$18	$18	
Production Assistant	1	18	18	36
Total Direct Labor				$66

Figure 4.3.7: Direct Labor for Job MAC001. Labor costs account for individuals working directly on the product. Individuals whose contributions are indirect will be tracked under manufacturing overhead. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Job MAC001 is also manufactured with the work of individuals whose contributions cannot be directly traced to the product: These indirect labor costs are assigned to the product as part of manufacturing overhead.

A company can use various methods to trace employee wages to specific jobs. For example, employees may fill out **time tickets** that include job numbers and time per job, or workers may scan bar codes of specific jobs when they begin a job task. Figure 4.3.8 shows what time tickets might look like on Job MAC001. Please note that in the employee time tickets that are displayed, each employee worked on more than one job. However, we are only going to track the expenses for Job MAC001.



EMPLOYEE TIME TICKET

Employee Name: Renee Chelsea

Department: Material Handler

Employee ID: 12842

Date: 4/5/2017

Job No.	Hours Worked	Hourly Rate	Total Cost
MAC001	1	$15	$ 15
POR143	7	15	105
			$120

Autho

EMPLOYEE TIME TICKET

Employee Name: Raymond Santiago

Department: Print Technician

Employee ID: 23133

Date: 4/5/2017

Job No.	Hours Worked	Hourly Rate	Total Cost
MAC001	1	$15	$ 15
TJR441	4	15	60
POR143	3	15	45
			$120

Autho

EMPLOYEE TIME TICKET

Employee Name: Rani Fina

Department: Finishing/Assembly

Employee ID: 13353

Date: 4/15/2017

Job No.	Hours Worked	Hourly Rate	Total Cost
MAC001	2	$18	$ 36
TJR441	5	18	90
POR143	1	18	18
			$144

Authorized by: _____ Date: _____

Figure 4.3.8: Employee Time Tickets. Time tickets (or time cards) are one method a company can use to track direct labor costs per individual and per job. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

When the accounting department processes time tickets, the costs are assigned to the individual jobs, resulting in labor costs

being recorded on the work in process inventory, as shown in Figure 4.3.9.

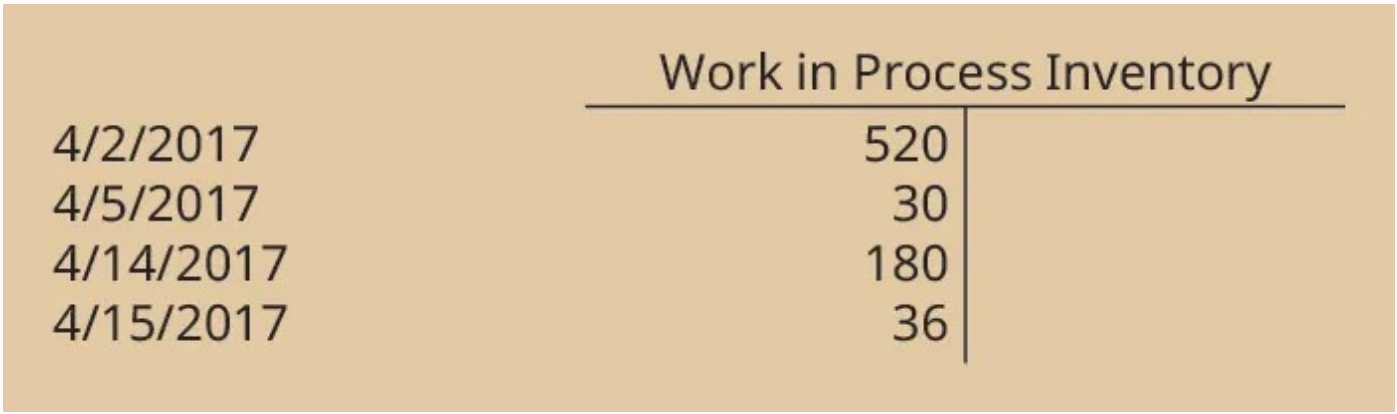


Figure 4.3.9: Costs Accounted for in the Work in Process Inventory. The direct material costs of $520 and $180, and the direct labor costs of $30 and $36 assigned to Job MAC001 are shown. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Manufacturing Overhead

Recall that the costs of a manufactured item are direct materials, direct labor, and manufacturing overhead. Costs that support production but are not direct materials or direct labor are considered overhead. **Manufacturing overhead** has three components: indirect materials, indirect labor, and overhead.

Indirect Materials

Indirect material costs are derived from the goods not directly traced to the finished product, like the sign adhesive in the Dinosaur Vinyl example. Tracking the exact amount of adhesive used would be difficult, time-consuming, and expensive, so it makes more sense to classify this cost as an indirect material.

Indirect materials are materials used in production but not traced to specific products because the net informational value from the time and effort to trace the cost to each individual product produced is impossible or inefficient. For example, a furniture factory classifies the cost of glue, stain, and nails as indirect materials. Nails are often used in furniture production; however, one chair may need 15 nails, whereas another may need 18 nails. At a cost of less than one cent per nail, it is not worth keeping track of each nail per product. It is much more practical to track how many pounds of nails were used for the period and allocate this cost (along with other costs) to the overhead costs of the finished products.

Indirect Labor

Indirect labor represents the labor costs of those employees associated with the manufacturing process, but whose contributions are not directly traceable to the final product. These would include the costs of the factory floor supervisor, the factory housekeeping staff, and factory maintenance workers. For Dinosaur Vinyl, for example, labor costs for the technician who maintains the printers would be indirect labor. It would be too time-consuming to determine how much of the technician's time is attributable to each sign being produced. It makes much more sense to classify that labor expense as indirect labor.

It is important to understand that the allocation of costs may vary from company to company. What may be a direct labor cost for one company may be an indirect labor cost for another company or even for another department within the same company. Deciding whether the expense is direct or indirect depends on its task. If the employee's work can be directly tied to the product, it is direct labor. If it is tied to the factory but not to the product, it is indirect labor. If it is tied to the marketing department, it is a sales and administrative expense, and not included in the cost of the product. For example, salaries of factory employees assembling parts are direct labor, salaries of factory employees performing maintenance are indirect labor, and salaries of employees in the marketing department are sales and administration expenses.

Overhead

The last category of manufacturing overhead is the overhead itself. These costs are necessary for production but not efficient to

assign to individual product production. Examples of typical overhead costs are production facility electricity, warehouse rent, and depreciation of equipment.

But note that while production facility electricity costs are treated as overhead, the organization's administrative facility electrical costs are not included as overhead costs. Instead, they are treated as period costs, as office rent or insurance would be.

When both administrative and production activities occur in a common building, the production and period costs would be allocated in some predetermined manner. For example, if a 10,000 square foot building were physically allocated at 4,000 square feet for administrative purposes and 6,000 square feet for production, a company might allocate its annual $30,000 property tax expense on a 40%/60% basis, or $12,000 as a period cost for the administrative offices and a production (overhead) cost of $18,000.

LINK TO LEARNING

Do you know of a restaurant that was doing really well until it moved into a larger space? Often this happens because the owners thought their profits could handle the costs of the increased space. Unfortunately, they were not really aware of the production costs. Keeping track of product costs is critical for pricing and cost control. Read advice from restaurant owner John Gutekanst about the importance of understanding food costs and his approach to account for these in his pizzeria.

Accounting for Manufacturing Overhead

In all costing systems, the expense recognition principle requires costs to be recorded in the period in which they are incurred. The costs are expensed when matched to the revenue with which they are associated; this is commonly referred to as *having the expenses follow the revenues*. This explains why raw material purchases are not assigned to the job until the materials are requested. When companies use an inventory account, the product costs are expensed when the inventory is sold. It is common to have an item produced in one year, such as 2017, and expensed as cost of goods sold in a later year, such as 2018. In addition to the previously mentioned *revenue recognition* treatment, this treatment is justified under GAAP's *matching principle*. If the inventory has not been sold, the company has an inventory asset rather than an expense.

The expense recognition principle also applies to manufacturing overhead costs. The manufacturing overhead is an expense of production, even though the company is unable to trace the costs directly to each specific job. For example, the electricity needed to run production equipment typically is not easily traced to a particular product or job, yet it is still a cost of production. As a cost of production, the electricity—one type of manufacturing overhead—becomes a cost of the product and part of inventory costs until the product or job is sold. Fortunately, the accounting system keeps track of the manufacturing overhead, which is then applied to each individual job in the overhead allocation process.

ETHICAL CONSIDERATIONS

Ethical Job Order Costing

Job order costing requires the assignment of direct materials, direct labor, and overhead to each production unit. The primary focus on costs allows some leeway in recording amounts because the accountant assigns the costs. When jobs are billed on a cost-plus-fee basis, management may be tempted to overcharge the cost of the job. Cost-based contracts may include a guaranteed maximum, time and materials, or cost reimbursable contract. An example is the design and delivery of a corporate training program. The training company may charge for the hours worked by instructors in preparation and delivery of the course, plus a fee for the course materials.

One major issue in all of these contracts is adding too much overhead cost and fraudulent invoicing for unused materials or unperformed work by subcontractors. Management might be tempted to direct the accountant to avoid the appearance of going over the original estimate by manipulating job order costing. It is the accountant's job to ensure that the amounts recorded in the accounting system fairly represent the economic activity of the company, and the fair and proper allocation of costs.

Managers use the information in the manufacturing overhead account to estimate the overhead for the next fiscal period. This estimated overhead needs to be as close to the actual value as possible, so that the allocation of costs to individual products can be accurate and the sales price can be properly determined.

Properly allocating overhead to the individual jobs depends on finding a cost driver that provides a fair basis for the allocation. A **cost driver** is a production factor that causes a company to incur costs. An example would be a bakery that produces a line of apple pies that it markets to local restaurants. To make the pies requires that the bakery incur labor costs, so it is safe to say that pie production is a cost driver. It should also be safe to assume that the more pies made, the greater the number of labor hours experienced (also assuming that direct labor has not been replaced with a greater amount of automation). We assume, in this case, that one of the marketing advantages that the bakery advertises is 100% handmade pastries.

In traditional costing systems, the most common activities used as cost drivers are direct labor in dollars, direct labor in hours, or machine hours. Often in the production process, there is a correlation between an increase in the amount of direct labor used and an increase in the amount of manufacturing overhead incurred. If the company can demonstrate such a relationship, they then often allocate overhead based on a formula that reflects this relationship, such as the upcoming equation. In the case of the earlier bakery, the company could determine an overhead allocation amount based on each hour of direct labor or, in other cases, based on the ratio of anticipated total direct labor costs to total manufacturing overhead costs.

For example, assume that the company estimates total manufacturing overhead for the year to be $400,000 and the direct labor costs for the year to be $200,000. This relationship would lead to $2.00 of applied overhead for each $1.00 of direct labor incurred. The manufacturing overhead cost can be calculated and applied to each specific job, based on the direct labor costs. The formula that represents the overhead allocation relationship is shown, and it is the formula for overhead allocation:

$$\frac{\text{Estimated Annual Overhead Costs (\$)}}{\text{Expected Annual Activity (DL \$)}} = \text{Overhead Allocation Rate}$$

For example, Dinosaur Vinyl determined that the direct labor cost is the appropriate driver to use when establishing an overhead rate. The estimated annual overhead cost for Dinosaur Vinyl is $250,000. The total direct labor cost is estimated to be $100,000, so the allocation rate is computed as shown:

$$\frac{\text{Estimated Annual Overhead Costs (\$250,000)}}{\text{Expected Annual Activity (\$100,000)}} = \text{\$2.50 per \$1.00 Direct Labor Expense}$$

Since the direct labor expense for MAC001 is $66, the overhead allocated is $66 times the overhead application rate of $2.50 per direct labor dollar, or $165, as shown:

$$\text{Overhead Allocated} = \text{\$66 (Direct Labor)} \times \text{\$2.50 (Overhead Application Rate)} = \text{\$165}$$

Figure 4.3.10 shows the journal entry to record the overhead allocation.

JOURNAL			
Date	**Account**	**Debit**	**Credit**
4/18/17	Work in Process Inventory Manufacturing Overhead *To assign overhead to Job MAC001*	165	165

Work in Process Inventory	
4/2/2017	520
4/5/2017	30
4/14/2017	180
4/15/2017	36
4/18/2017	165

Figure 4.3.10: Overhead Allocation. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

THINK IT THROUGH

Franchise or Unique Venture?

You are deciding whether to purchase a pizza franchise or open your own restaurant specializing in pizza. List the expenses necessary to sell pizza and identify them as a fixed cost or variable cost; as a manufacturing cost or sales and administrative costs; and as a direct materials, direct labor, or overhead. For each overhead item, state whether it is an indirect material expense, indirect labor expense, or other. For each cost, identify its origination in a job order costing environment.

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4.4: Use the Job Order Costing Method to Trace the Flow of Product Costs through the Inventory Accounts

Job order costing can be used for many different industries, and each industry maintains records for one or more inventory accounts. The manufacturing industry keeps track of the costs of each inventory account as the product is moved from raw materials inventory into work in process, through work in process, and into the finished goods inventory.

Conversely, typical companies in the merchandising industry sell products they do not manufacture and purchase their inventory in an already completed state. It is relatively easy to keep track of the inventory cost for a merchandising company through its application of first-in/first-out (FIFO), last-in/last-out (LIFO), weighted average, or specific identification inventory techniques on the unsold items. The primary difference in the four methods is the valuation of the cost of goods sold and the remaining ending inventory valuation, assuming that the company did not sell 100% of the inventory that they had available for sale during a given period. Companies are allowed to choose the method that they feel best represents their cost flows through their cost of goods sold and their ending inventory balances.

Not all service companies have inventory, and those companies do not have direct materials nor do they consider their work-in-process their inventory, since their final product is often an intangible asset, such as a legal document or tax return. Regardless of whether the service has inventory accounts, service companies all keep track of the direct labor and overhead costs incurred while completing each job in progress.

Inventory is an asset reported on the balance sheet, and each company needs to maintain accurate records for the cost of each type of inventory: raw materials inventory, work in process inventory, and finished goods inventory. All three costs are computed in a similar manner. You can see in Figure 4.4.1 that the general format is the same for maintaining all accounts, whether the company uses a job order, process, or hybrid cost system.

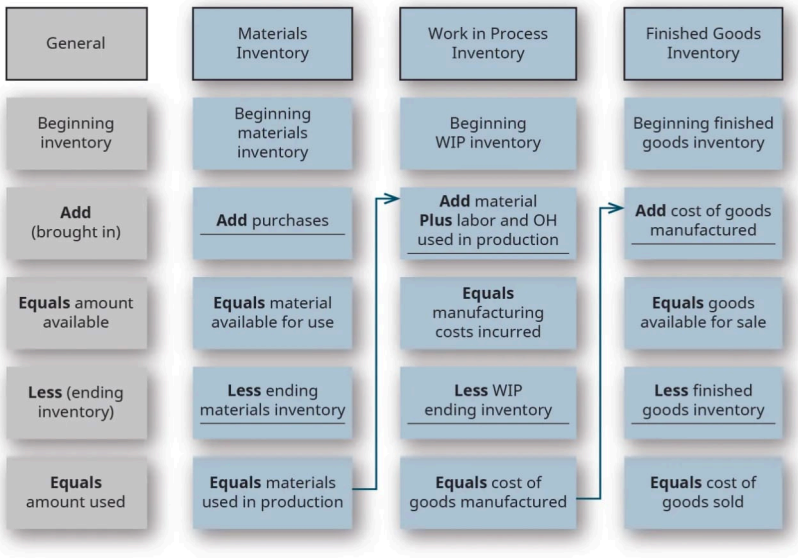


Figure 4.4.1: Cost of Inventory Accounts. Inventory is accounted for across the flow through production. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Each inventory account starts with a beginning balance at the start of an accounting period. During the period, if additional inventory is purchased, the new inventory amount is added to the beginning balance to calculate the total inventory available for use or sale. The ending inventory balance at the end of the accounting period can then be subtracted from the inventory available for use, and the total represents the cost of the inventory used during the period.

For example, if the beginning inventory balance were $400, and the company bought an additional $1,000, it would have $1,400 of inventory available for use. If the ending inventory balance were $500, the amount of inventory used during the period would be $900 ($400 + $1,000 = $1,400 – $500 = $900).

Raw Materials Inventory

Raw materials inventory is the total cost of materials that will be used in the production process. Usually, several accounts make up the raw materials inventory, and these can be actual accounts or accounts subsidiary to the general raw materials inventory account. In our example, Dinosaur Vinyl has several raw materials accounts: vinyl, red ink, black ink, gold ink, grommets, and wood.

Within the raw materials inventory account, purchases increase the inventory, whereas raw materials sent into production reduce it. It is easy to reconcile the amount of ending inventory and the cost of direct materials used in production, since the materials requisition form (Figure 4.3.3) keeps track of the inventory requested and sent into each specific job. Since the costs are transferred with production, the calculation shows the amount of materials used in production:

Beginning materials inventory
+ Net materials purchased
= Materials available for use
− Ending raw materials inventory
= Materials used in production

Note: this equation can be easily modified with algebra to compute the cost of the ending raw materials inventory.

Materials available for use
− Materials used in production
= Ending raw materials inventory

Work in Process Inventory

In a job order cost system, the balance in the work in process inventory account is continually updated as job costs are recorded and is the total of all unfinished jobs, as shown on the individual job cost sheets.

The production cycle is a continuous cycle that begins with raw materials being transferred to work in process, moving through production, and ending as finished goods inventory. Typically, as goods are being produced, additional jobs are being started and finished, and the work in process inventory includes unit costs of jobs still in production at the end of the accounting period. At the end of the accounting cycle, there will be jobs that remain unfinished in the production cycle, and these represent the work in process inventory. The costs on the job order cost sheet help reconcile the cost of the items transferred to the finished goods inventory and the cost of the work in process inventory.

For example, Dinosaur Vinyl has completed Job MAC001. The total cost of $931 is transferred to the finished goods inventory:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Finished Goods Inventory	931	
	Work in Process Inventory		931
	To transfer Job MAC001 to Finished Goods		

At this point, we need to examine an important component of the costing process. The **cost of goods manufactured** (COGM) is the costs of all of the units that a company completed and transferred to the finished goods inventory during an accounting period. Obviously, the cost of goods manufactured is not just a single number that can be pulled from one location. We have to look at all costs included in the manufacturing process to determine the cost of goods manufactured. The calculation begins with the beginning balance in the work in process inventory, incorporates the new production costs incurred during the current period (typically a year), and then subtracts the ending balance in the work in process inventory since these costs will be included in the subsequent accounting period's cost of goods manufactured, as shown:

Beginning work in process inventory
+ Current manufacturing costs
Direct materials used in production
Direct labor
Overhead
= Manufacturing costs incurred
− Ending work in process inventory
= Cost of goods manufactured during the period (completed)

Note: this equation can be easily modified with algebra to compute the cost of the ending work in process inventory.

Manufacturing costs incurred
− Cost of goods manufactured
= Ending work in process inventory

Finished Goods Inventory

After each job has been completed and overhead has been applied, the product is transferred to the finished goods inventory where it stays until it is sold. As each job is transferred, the costs are summarized and transferred as well, and the job cost sheet is completed to show the actual production cost of the product and the sales price of the items produced.

A job order cost system continually updates each job cost sheet as materials, labor, and overhead are added. As a result, all inventory accounts are constantly maintained. The materials inventory balance is continually updated, as materials are purchased and requisitioned for individual jobs. The work-in-process inventory and finished goods inventory are master accounts, and their balances are determined by adding the total of the job cost sheets. The total of the incomplete jobs becomes the total work in process inventory, and the total of the completed and unsold jobs becomes the total of the finished goods inventory.

Similar to the raw materials and work in process inventories, the cost of goods sold can be calculated as shown:

Beginning finished goods
+ Cost of goods manufactured
= Goods available for sale
− Ending finished goods inventory
= Cost of goods sold

Note: this equation can be easily modified with algebra to compute the cost of the finished goods inventory.

Cost of goods available for sale
− Cost of goods sold
= Ending finished goods inventory

Cost of Goods Sold

The **cost of goods sold** is the manufacturing cost of the items sold during the period. It is calculated by adding the beginning finished goods inventory and the cost of goods manufactured to arrive at the cost of goods available for sale. The cost of goods available for sale less the ending inventory results in the cost of goods sold.

In our example, when the sale has occurred, the goods are transferred to the buyer, and the product is transferred from the finished goods inventory to the cost of goods sold. A corresponding entry is also made to record the sale. Dinosaur Vinyl's sales price for Job MAC001 was $2,000, and its cost of goods sold was $931:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cost of Goods Sold	931	
	Finished Goods Inventory		931
	To transfer sold Job MAC001		
	Accounts Receivable	2,000	
	Sales		2,000
	To record sale of Job MAC001		

Figure 4.4.2 shows the flow to cost of goods sold.

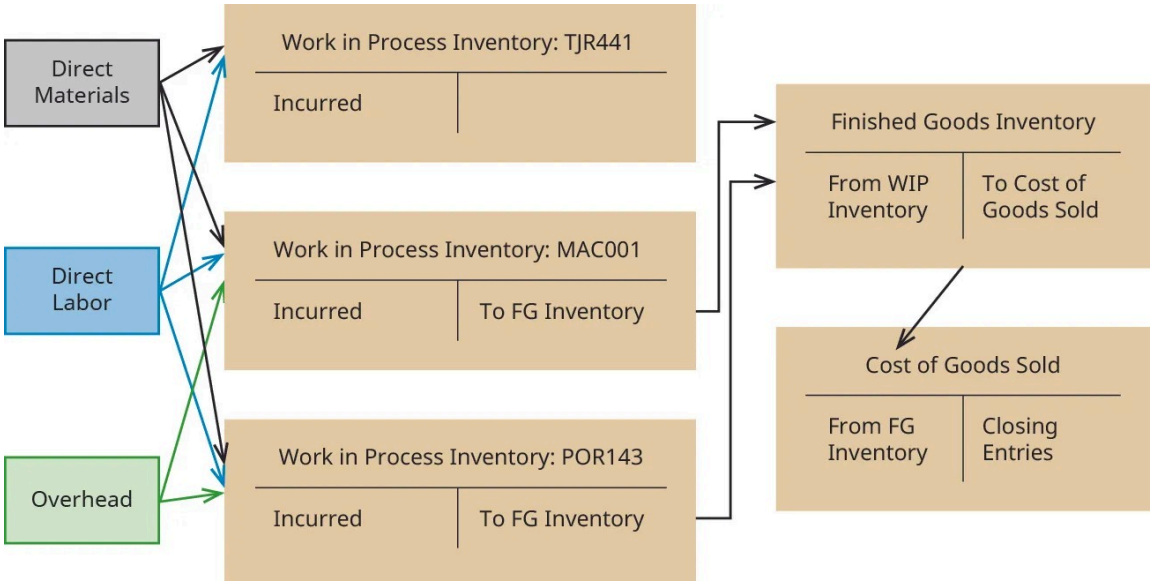
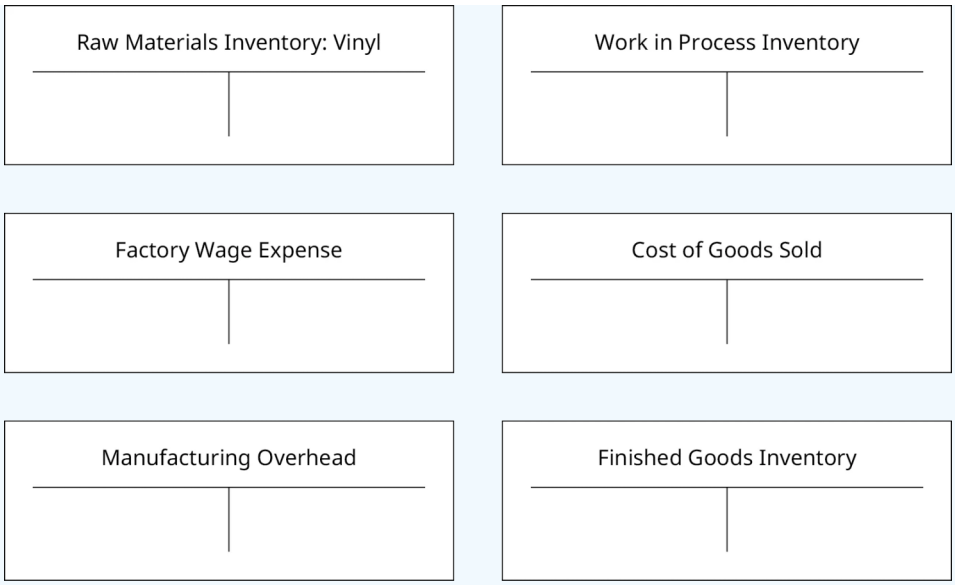


Figure 4.4.2: Flow of Manufacturing Costs under the Job Order Costing Method. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

YOUR TURN

Tracking the Flow with Selected T-Accounts

Use the transaction letters to show the flow in and out of the T-accounts. Note: some items may be used more than once. Also, not every possible T-account entry is required in this exercise. For example, for the purchase of raw materials, the credit entry for either cash or accounts payable is not required.

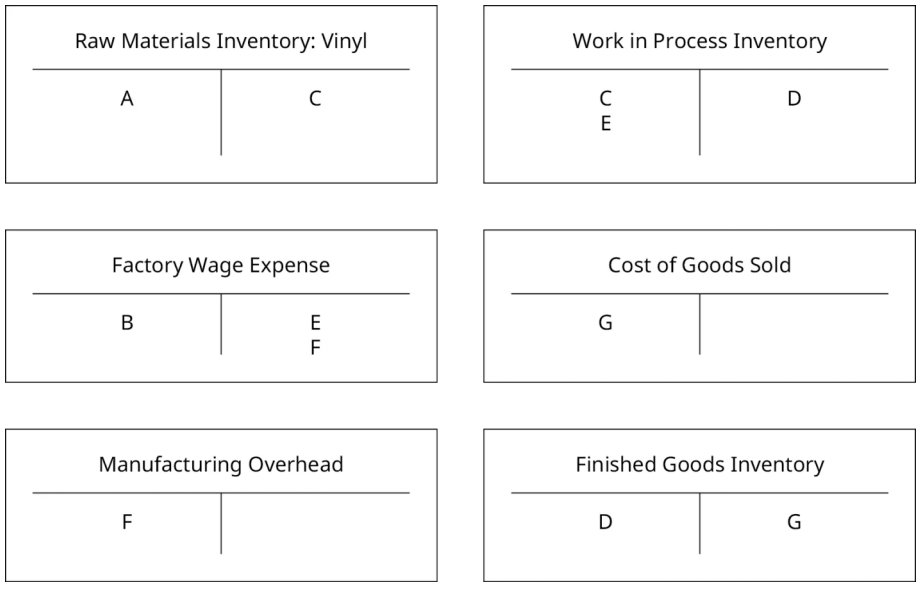


A. Purchase raw materials inventory
B. Factory wage expense incurred
C. Issue raw materials inventory to Job P33
D. Factory wage allocated to Job P33
E. Factory wage allocated to overhead
F. Job P33 completed
G. Job P33 sold

Answer available at the end of this section.

Answers

YOUR TURN



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4.5: Compute a Predetermined Overhead Rate and Apply Overhead to Production

Job order cost systems maintain the actual direct materials and direct labor for each individual job. Since production consists of overhead—indirect materials, indirect labor, and other overhead—we need a methodology for applying that overhead. Unfortunately, the nature of indirect material, indirect labor, and other overhead expenses makes it impossible to determine the exact amount of overhead for each specific job. For example, how do you know the cost of electricity and heat for manufacturing one job? And, if you did, is it fair to say products manufactured in January are more expensive than the same product manufactured in March because of heat expense?

Fundamental Characteristics of the Overhead Determination Environment

Added to these issues is the nature of establishing an overhead rate, which is often completed months before being applied to specific jobs. Establishing the overhead allocation rate first requires management to identify which expenses they consider manufacturing overhead and then to estimate the manufacturing overhead for the next year. Manufacturing overhead costs include all manufacturing costs except for direct materials and direct labor. Therefore, in order to estimate manufacturing overhead, management must estimate the future purchase prices of dozens, or sometimes hundreds, of individual components, such as utilities, raw materials, contract labor, or diesel fuel. Estimating overhead costs is difficult because many costs fluctuate significantly from when the overhead allocation rate is established to when its actual application occurs during the production process. You can envision the potential problems in creating an overhead allocation rate within these circumstances.

Before demonstrating the calculation of a predetermined overhead allocation rate, let's review the basic principles of revenue recognition and expense. In accounting, there are three ways to recognize expenses:

1. Direct relationship between the expense and the associated revenue. This method is used for many costs, and the expense is recognized when a direct relationship exists. For example, sales commission expenses can be directly traced to product sales, and a commission expense is recorded when a sale is made.
2. Systematic and rational allocation of expenses. This approach is used when costs exist and there is an expected benefit, even though the costs cannot be directly traced to the benefit. The assigning of expenses to a product or time period must be done in an objective and consistent manner. Examples of such expenses would include equipment rental for a factory or property insurance for the factory.
   Both of these expenses (direct relationship and systematic and rational) are also examples of the types of expenses that compose manufacturing overhead. An example of the current revenue recognition principle is a company paying $4,800 a year for property insurance. Since production rates can vary month to month, most producers would allocate $400 each month for property insurance, and this cost would be incorporated into the total overhead costs anticipated when estimating a manufacturing overhead allocation rate.
   The direct benefit is that the product will be sold and the revenue recognized. The overhead is associated but cannot be directly traced to an individual product, so the overhead expenses need to be assigned in a systematic and rational manner.
3. Immediate recognition. This method is used when expenses exist but there is no direct expected benefit. In this case, the expense is recognized immediately. For example, research and development costs are necessary expenses but cannot be traced to a specific product, so they are expensed as incurred.

The allocation of overhead to the cost of the product is also recognized in a systematic and rational manner. The expected overhead is estimated, and an allocation system is determined. The actual costs are accumulated in a manufacturing overhead account. The overhead is then applied to the cost of the product from the manufacturing overhead account. The overhead used in the allocation is an estimate due to the timing considerations already discussed.

The application rate that will be used in a coming period, such as the next year, is often estimated months before the actual overhead costs are experienced. Often, the actual overhead costs experienced in the coming period are higher or lower than those budgeted when the estimated overhead rate or rates were determined. At this point, do not be concerned about the accuracy of the future financial statements that will be created using these estimated overhead allocation rates. You will learn later how to adjust for the difference between the allocated amount and the actual amount.

Despite improvements in technology and information flow, using the actual overhead to calculate the application rate is usually

not possible because the actual overhead information is available too late for management to make decisions. Also, as you will learn, the results of the actual overhead costs, if they were available, could be misleading. Therefore, most manufacturing companies use predetermined overhead rates for these reasons:

- Overhead costs are not uniform throughout the year. An example is electricity costs that vary by weather and time of day.
- Some overhead costs are fixed, and the cost per unit varies with production. For example, rent may be $1,000 per month. If 500 units were made during one month, and 2,000 units were made the next month, the cost per unit would vary from $2 per unit to $0.50 per unit.
- The total number of units produced varies and is often known sooner than the cost of overhead. For example, a company may know it will have a contract to produce 100 custom units long before it knows the utility costs for the next year.

As previously described, a predetermined overhead rate is established prior to the beginning of the fiscal year and typically is not changed during the year. The predetermined rate is calculated as shown and is used to apply overhead costs to work in process:

$$\frac{\text{Estimated (budgeted) Overhead Cost}}{\text{Expected (budgeted) Level of Activity}} = \text{Predetermined Overhead Rate}$$

CONCEPTS IN PRACTICE

Overhead in the Movie Industry

The movie industry uses job order costing, and studios need to allocate overhead to each movie. Their amount of allocated overhead is not publicly known because while publications share how much money a movie has produced in ticket sales, it is rare that the actual expenses are released to the public.

It has been speculated that *Star Wars: The Force Awakens* cost $201,000,000, with $30,000,000 considered overhead. Studios have estimated that the higher the movie expenses, the more studio overhead is required, and it has also been estimated that 10% of the total cost is assigned to studio overhead.

Determining Estimated Overhead Cost

The estimated or budgeted overhead is the amount of overhead determined during the budgeting process and consists of manufacturing costs but, as you have learned, excludes direct materials and direct labor. Examples of manufacturing overhead costs include indirect materials, indirect labor, manufacturing utilities, and manufacturing equipment depreciation. Another way to view it is overhead costs are those production costs that are not categorized as direct materials or direct labor.

Selecting an Estimated Activity Base

As you have learned, the overhead needs to be allocated to the manufactured product in a systematic and rational manner. This allocation process depends on the use of a cost driver, which drives the production activity's cost. Examples can include labor hours incurred, labor costs paid, amounts of materials used in production, units produced, or any other activity that has a cause-and-effect relationship with incurred costs.

Direct labor hours, direct labor dollars, or machine hours are often chosen as the allocation base because those costs are associated with each product, and as the activity increases, so does the manufacturing overhead. In other words, the products that involve more direct labor hours, direct labor dollars, or machine hours also increase utility expenses, supervisor time (and thus indirect labor), equipment usage and the related depreciation expense, and so forth.

Traditionally, direct labor hours were used as the activity base, but technology continually decreases the amount of direct labor used in production, and machine hours or units produced have become more common activity bases. Management analyzes the costs and selects the activity as the **estimated activity base** because it drives the overhead costs of the unit.

Computing a Predetermined Overhead Rate

Dinosaur Vinyl uses the expenses from the prior two years to estimate the overhead for the upcoming year to be $250,000, as shown in Figure 4.5.1.

	Annual Estimate
Indirect labor	$ 5,000
Indirect materials	20,000
Utilities	75,000
Depreciation	90,000
Insurance	35,000
Interest expense	25,000
	$250,000

Figure 4.5.1: Dinosaur Vinyl's Estimated Overhead. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Dinosaur Vinyl also used its payroll records to estimate that it will spend $100,000 on direct labor. Using the predetermined overhead rate calculation, the overhead rate is $2.50 per direct labor dollar:

$$\frac{\text{Estimated (budgeted) Overhead Cost } (\$250{,}000)}{\text{Expected (budgeted) Level of Activity } (\$100{,}000)} = \$2.50 \text{ per Direct Labor Dollar}$$

Over the fiscal year, the actual costs are recorded as debits into the account called manufacturing overhead. When the overhead is applied to the jobs, the amount is first calculated using the application rate. If the total labor paid for the job is $66, the overhead applied to the job is $2.50 times that amount, or $165. The entry to record the overhead for Job MAC001 is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Work in Process Inventory	165	
	Manufacturing Overhead		165
	To apply overhead to Job MAC001		

That amount is added to the cost of the job, and the amount in the manufacturing overhead account is reduced by the same amount. At the end of the year, the amount of overhead estimated and applied should be close, although it is rare for the applied amount to exactly equal the actual overhead. For example, Figure 4.5.2 shows the monthly costs, the annual actual cost, and the estimated overhead for Dinosaur Vinyl for the year. While the total amounts are close to each other, they are not exact.

	Monthly Actual	Annual Amount	Annual Estimate
Indirect labor	$ 375	$ 4,500	$ 5,000
Indirect materials	1,500	18,000	20,000
Utilities	7,000	84,000	75,000
Depreciation	7,500	90,000	90,000
Insurance	2,917	35,000	35,000
Interest expense	2,083	25,000	25,000
	$21,000	$256,500	$250,000

Figure 4.5.2: Dinosaur Vinyl's Actual and Estimated Overhead. While the total amounts are close to each other, they are not an exact match. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Calculating Manufacturing Overhead Cost for an Individual Job

Figure 4.5.2 shows the monthly manufacturing actual overhead recorded by Dinosaur Vinyl. As explained previously, the overhead is allocated to the individual jobs at the predetermined overhead rate of $2.50 per direct labor dollar when the jobs are complete. When Job MAC001 is completed, overhead is $165, computed as $2.50 times the $66 of direct labor, with the total job cost of $931, which includes $700 for direct materials, $66 for direct labor, and $165 for manufacturing overhead.

LINK TO LEARNING

Companies need to make certain the sales price is higher than the prime costs and the overhead costs. This can be a difficult task in industries in which overhead costs change. In some industries, the company has no control over the costs it must pay, like tire disposal fees. To ensure that the company is profitable, an additional cost is added and the price is modified as necessary. In this example, the guarantee offered by **Discount Tire** does not include the disposal fee in overhead and increases that fee as necessary.

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4.6: Compute the Cost of a Job Using Job Order Costing

To summarize the job order cost system, the cost of each job includes direct materials, direct labor, and manufacturing overhead. While the product is in production, the direct materials and direct labor costs are included in the work-in-process inventory. The direct materials are requested by the production department, and the direct material cost is directly attached to each individual job, as the materials are released from raw materials inventory. The cost of direct labor is recorded by the employees and assigned to each individual job. When the allocation base is known, usually when the product is completed, the overhead is allocated to the product on the basis of the predetermined overhead rate.

LINK TO LEARNING

The construction industry typically uses job order costing and accounts for its costing in a manner similar to the businesses profiled in this chapter.

Determining the Costs of an Individual Job Using Job Order Costing

When a job is completed, the costs of the job—the direct materials, direct labor, and manufacturing overhead—are totaled on the job cost sheet, and the total amount is transferred to finished goods at the same time the product is transferred, either physically or legally, such as in the case of a home built by a contractor. Finally, when the product is sold, the sale is recorded at the sale price, while the cost is transferred from finished goods inventory to the cost of goods sold expense account. Figure 4.6.1 shows the flow of costs from raw materials inventory to cost of goods sold.

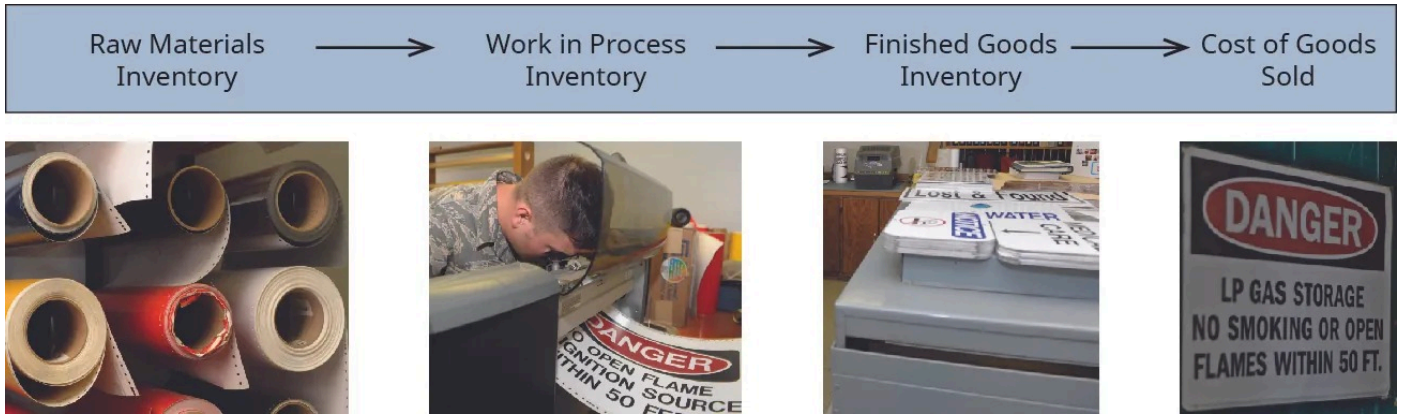


Figure 4.6.1: Flow of Costs during Production and Ultimate Sale or Transfer of Ownership. (credit “Raw Materials Inventory,” “Work in Process Inventory,” “Finished Goods Inventory”: modifications of “160810-F-UY190-027.JPG,” “160810-F-UY190-073.JPG,” and “160810-F-UY190-105.JPG” by Jessica Weissman, Minot Air Force Base Public Affairs, Public Domain; credit Cost of Goods Sold”: “Rustic Sign” by Grace Byrd/Flickr, CC BY 2.0)

At all points in the process, the work in process should include the cost of direct materials and direct labor. When the job is completed and overhead assigned, the overhead allocation increases the cost of the work in process inventory. The cost of each individual job is maintained on a job cost sheet, and the total of all the work in process job cost sheets equals the work in process inventory and the statement of cost of goods manufactured, as you have learned.

A job cost sheet is a subsidiary ledger that identifies the individual costs for each job. Figure 4.6.2 shows the job cost sheet for Job MAC001.

JOB COST SHEET Dinosaur Vinyl, Inc.			
Job No.: 5416		**Customer No.:** 2501723	
Customer: Macs & Cheese		**Date Started:** Dec. 22, 2018	
Units Ordered: 1		**Date Completed:** Feb. 22, 2019	
Direct Material	**Units**	**Price**	**Amount**
Vinyl	1	$300	$ 300
Black printing ink	2	50	100
Red printing ink	1	60	60
Gold printing ink	1	60	60
Grommets	12	10	120
Framing wood	40	1.5	60
Total Direct Materials			$ 700
Direct Labor	**Hours**	**Wage Rate**	**Amount**
Material Handler	1	$ 15	$ 15
Print Technician	1	15	15
Production Assistants	2	18	36
Total Direct Labor			$ 66
Manufacturing Overhead	**Base Units**	**Rate**	**Amount**
Direct Labor Cost	66	$ 2.5	$ 165
Total Manufacturing Overhead			$ 165
Total Job Cost			$ 931
Total Revenue			$2,000

Figure 4.6.2: Job Cost Sheet for Job MAC001. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Sample Cost Information for Dinosaur Vinyl

Dinosaur Vinyl worked on three jobs during the month: POR143, MAC001, and TRJ441, and a fourth Job SWM505 had been finished and moved to the finished goods inventory account during the previous month.

At the beginning of the month, the company had a beginning raw materials inventory balance of $2,500, and during the month, it purchased an additional $10,500, giving it a total of $13,000 in raw materials available for use in production.

The following example will examine four different production jobs. Each of the four will be at beginning stages at either the beginning of the current month or the end of the current month.

1. Job POR 143: This job was the only work in process inventory at the beginning of the current month, and it had $1,000 in direct material costs, and $0 of direct labor costs already allocated to the work in process inventory. During the current month, additional direct materials of $200 and direct labor of $150 were added to POR143. An overhead cost of $375 was applied to POR143 at the predetermined overhead rate of $2.50 per direct labor dollar. It was finished during the month and transferred to the finished goods inventory. The sale was not finalized during the month, so it continues to be part of the finished goods inventory.
2. Job MAC 001: This job was started and completed during the month. Since the job began in and was completed in the same month, there was no beginning balance in the work in process inventory. During the month it incurred $700 in direct materials costs, $66 in direct labor, and $165 of overhead applied to the job before it was transferred to the finished goods inventory upon completion. The sale was finalized during the month at a sale price of $2,000, so the costs were transferred from finished goods inventory to cost of goods sold.
3. Job TRJ441: This job was started during the current month. Its costs consist of $500 in direct material cost, $150 in direct labor expenses, and $375 in applied overhead. The job remains in the work-in-process inventory awaiting assembly.
4. Job SWM505: At the beginning of the month, this job was completed and already in the finished goods inventory at a cost of $1,531. Since it was completed, it did not incur any additional costs in the current month. It was sold during the month for $3,500, and the costs were transferred from the finished goods inventory to cost of goods sold.

The cost of raw materials used is calculated as shown:

Beginning RM inventory	$ 2,500
Purchases	10,500
Materials available for use	13,000
Ending RM inventory	11,600
Materials used in production	$ 1,400

The individual job cost sheets show the $1,400 worth of materials used in production:

POR143	$ 200
MAC001	700
TJR441	500
	$1,400

The cost of goods manufactured is accounted for as shown:

	POR143	MAC001	TJR441	Total
Materials added	$200	$700	$ 500	$1,400
Labor added	150	66	150	366
Overhead applied	375	165	375	915
Total added during month	$725	$931	$1,025	$2,681
	POR143	**MAC001**	**TJR441**	**Total**
Beginning WIP inventory	$1,000	$ 0	$ 0	$1,000
Materials, labor, & OH added	725	931	1,025	2,681
Manufacturing costs incurred	1,725	931	1,025	3,681
Ending WIP inventory	0	0	1,025	1,025
Cost of Goods Manufactured	$1,725	$931	$ 0	$2,656

Notice the costs for Job TJR441 are included in the work-in-process inventory, whereas the costs for POR143 and MAC001 were transferred to the cost of goods manufactured. The costs of the jobs transferred are shown in the cost of goods sold and the finished goods inventory:

	SWM505	POR143	MAC001	TJR441	Total
Beginning FG inventory	$1,531	$ 0	$ 0	$0	$1,531
Cost of Goods Manufactured	0	1,725	931	0	2,656
Goods Available for Sale	1,531	1,725	931	0	4,187
Ending FG inventory	0	1,725	0	0	1,725
Cost of Goods Sold	$1,531	$ 0	$931	$0	$2,462

Mechanics of Job Order Costing for Dinosaur Vinyl

The amounts in raw materials, work in process, and finished goods inventories compose the total cost for each account, whereas the job cost sheets contain the costs for each individual job. A summary of the jobs for Dinosaur Vinyl is given in Figure 4.6.3.

	SWM505	POR143	MAC001	TJR441	Total
Beginning balance	$1,531	$1,000	$ 0	$ 0	$2,531
Direct materials		200	700	500	1,400
Direct labor		150	66	150	366
Overhead applied		375	165	375	915
Total cost	$1,531	$1,725	$931	$1,025	$5,212
Status	Sold	Finished	Sold	Unfinished	
Final account location	COGS	FG	COGS	WIP	



Figure 4.6.3: Summary of Dinosaur Vinyl's Jobs during the Year. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

THINK IT THROUGH

Allocating Costs

A manufacturing company has incurred these costs:

Purchase raw materials inventory	$15,000
Issue raw materials inventory to Job A	3,000
Factory wage expense incurred	23,000
Factory wage allocated to Job A	2,000
Factory wage allocated to overhead	500
Manufacturing overhead incurred	7,500
Manufacturing overhead allocated to Job A	1,000

What is the cost allocated to Job A? For any costs not used, explain why they are not used.

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4.7: Determine and Dispose of Underapplied or Overapplied Overhead

As you've learned, the actual overhead incurred during the year is rarely equal to the amount that was applied to the individual jobs. Thus, at year-end, the manufacturing overhead account often has a balance, indicating overhead was either overapplied or underapplied.

If, at the end of the term, there is a debit balance in manufacturing overhead, the overhead is considered **underapplied overhead**. A debit balance in manufacturing overhead shows either that not enough overhead was applied to the individual jobs or overhead was underapplied. If, at the end of the term, there is a credit balance in manufacturing overhead, more overhead was applied to jobs than was actually incurred. This shows the actual amount was **overapplied overhead**.

The actual overhead costs are recorded through a debit to manufacturing overhead. The same account is credited when overhead is applied to the individual jobs in production, as shown:



Since the overhead is first recorded in the manufacturing overhead account, then applied to the individual jobs, traced through finished goods inventory, and eventually transferred to cost of goods sold, the year-end balance is eliminated through an adjusting entry, offsetting the cost of goods sold. If manufacturing overhead has a debit balance, the overhead is underapplied, and the resulting amount in cost of goods sold is understated. The adjusting entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cost of Goods Sold Manufacturing Overhead	$$$	 $$$

If manufacturing overhead has a credit balance, the overhead is overapplied, and the resulting amount in cost of goods sold is overstated. The adjusting entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Manufacturing Overhead Cost of Goods Sold *Application of overhead to Cost of Goods Sold*	$$$	 $$$

Returning to our example, at the end of the year, Dinosaur Vinyl had actual overhead expenses of $256,500 and applied overhead

expenses of $250,000, as shown:



Since manufacturing overhead has a debit balance, it is underapplied, as it has not been completely allocated. The adjusting journal entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cost of Goods Sold Manufacturing Overhead *Application of underapplied overhead to Cost of Goods Sold*	6,500	6,500

If the overhead was overapplied, and the actual overhead was $248,000 and the applied overhead was $250,000, the entry would be:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Manufacturing Overhead Cost of Goods Sold *Application of overapplied overhead to Cost of Goods Sold*	2,000	2,000

To adjust for overapplied or underapplied manufacturing overhead, some companies have a more complicated, three-part allocation to work in process, finished goods, and cost of goods sold. This method is typically used in the event of larger variances in their balances or in bigger companies. (You will learn more about this in future cost or advanced managerial accounting courses.)

YOUR TURN

Kraken Boardsports



Figure 4.7.1: (credit: modification of images provided courtesy of Kraken Boardsports, CC BY 4.0)

Kraken Boardsports manufactures winches for snow and ski boarders to snow ski without a mountain or water ski without a lake (Figure 4.7.1). End-of-year data show these overhead expenses:

Indirect materials	$25,000
Indirect labor	31,750
Depreciation of factory equipment	50,000
Factory utility expenses	17,500
Factory supervisor salaries	85,000

Kraken Boardsports had 6,240 direct labor hours for the year and assigns overhead to the various jobs at the rate of $33.50 per direct labor hour.

How much overhead was overapplied or underapplied during the year? What would be the journal entry to adjust manufacturing overhead?

Answer available at the end of this section.

LINK TO LEARNING

Job order costing and overhead allocation are not new methods of accounting and apply to governmental units as well. See it applied in this 1992 report on *Accounting for Shipyard Costs and Nuclear Waste Disposal Plans* from the United States General Accounting Office.

Answers

YOUR TURN

The total overhead incurred is the total of:

Indirect materials	$ 25,000
Indirect labor	31,750
Depreciation of factory equipment	50,000
Factory utility expenses	17,500
Supervisor salaries	85,000
Actual overhead incurred	$209,250

The total overhead applied is $209,040, which is calculated as:
$33.50/direct labor hours × 6,240 direct labor hours.
The balance in manufacturing overhead is a debit balance of $210:

Manufacturing Overhead

	Actual Costs	Applied Costs
	$209,250	$209,040
Balance	210	

The adjusting journal entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cost of Goods Sold	210	
	Manufacturing Overhead		210

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4.8: Prepare Journal Entries for a Job Order Cost System

Although you have seen the job order costing system using both T-accounts and job cost sheets, it is necessary to understand how these transactions are recorded in the company's general ledger.

Journal Entries to Move Direct Materials, Direct Labor, and Overhead into Work in Process

Dinosaur Vinyl keeps track of its inventory and orders additional inventory to have on hand when the production department requests it. This inventory is not associated with any particular job, and the purchases stay in raw materials inventory until assigned to a specific job. For example, Dinosaur Vinyl purchased an additional $10,000 of vinyl and $500 of black ink to complete Macs & Cheese's billboard. If the purchase is made on account, the entry is as shown:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Raw Materials Inventory: Vinyl	10,000	
	Raw Materials Inventory: Black ink	500	
	Accounts Payable		10,500
	To record purchase of vinyl and ink inventory		

As shown in Figure 4.6.2, for the production process for job MAC001, the job supervisor submitted a materials requisition form for $300 in vinyl, $100 in black ink, $60 in red ink, and $60 in gold ink. For the finishing process for Job MAC001, $120 in grommets and $60 in finishing wood were requisitioned. The entry to reflect these actions is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Work in Process Inventory	700	
	Raw Materials Inventory: Vinyl		300
	Raw Materials Inventory: Black ink		100
	Raw Materials Inventory: Red ink		60
	Raw Materials Inventory: Gold ink		60
	Raw Materials Inventory: Grommets		120
	Raw Materials Inventory: Finishing wood		60
	To record requisition of vinyl and ink inventory		

The production department employees work on the sign and send it over to the finishing/assembly department when they have completed their portion of the job.

The direct cost of factory labor includes the direct wages paid to the employees and all other payroll costs associated with that labor. Typically, this includes wages and the payroll taxes and fringe benefits directly tied to those wages. The accounting system needs to keep track of the labor and the other related expenses assigned to a particular job. These records are typically kept in a time ticket submitted by employees daily.

On April 10, the labor timesheet totaling $30 is recorded for Job MAC001 through this entry:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Work in Process Inventory (MAC001) Factory Wages Payable *To record labor for Job MAC001*	30	30

The assembly personnel in the finishing/assembly department complete Job MAC001 in two hours. The labor is recorded as shown:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Work in Process Inventory Factory Wages Payable *To record labor for Job MAC001*	36	36

Indirect materials also have a materials requisition form, but the costs are recorded differently. They are first transferred into manufacturing overhead and then allocated to work in process. The entry to record the indirect material is to debit manufacturing overhead and credit raw materials inventory.

Indirect labor records are also maintained through time tickets, although such work is not directly traceable to a specific job. The difference between direct labor and indirect labor is that the indirect labor records the debit to manufacturing overhead while the credit is to factory wages payable.

Dinosaur Vinyl's time tickets indicate that $4,000 in indirect labor costs were incurred during the period. The entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Manufacturing Overhead Factory wages payable *To record indirect labor for WIP inventories*	4,000	4,000

Dinosaur Vinyl also records the actual overhead incurred. As shown in Figure 4.5.2, manufacturing overhead costs of $21,000 were incurred. The entry to record these expenses increases the amount of overhead in the manufacturing overhead account. The entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Manufacturing Overhead Supplies Inventory Utilities Payable Accumulated Depreciation Prepaid Insurance Interest Payable *To record April's overhead expenses*	21,000	 1,500 7,000 7,500 2,917 2,083

The amount of overhead applied to Job MAC001 is $165. The journal entry to record the manufacturing overhead for Job MAC001

is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Work in Process Inventory Manufacturing Overhead *To apply overhead to Job MAC001*	165	165

Journal Entry to Move Work in Process Costs into Finished Goods

When each job and job order cost sheet have been completed, an entry is made to transfer the total cost from the work in process inventory to the finished goods inventory. The total cost of the product for Job MAC001 is $931 and the entry is:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Finished Goods Inventory Work in Process Inventory *To recognize completion of Job MAC001*	931	931

Journal Entries to Move Finished Goods into Cost of Goods Sold

When the sale has occurred, the goods are transferred to the buyer. The product is transferred from the finished goods inventory to cost of goods sold. A corresponding entry is also made to record the sale. The sign for Job MAC001 had a sales price of $2,000 and a cost of $931. These are the entries to record the transfer of goods and sale to the buyer:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cost of Goods Sold Finished Goods Inventory *To recognize sale of Job MAC001*	931	931
	Accounts Receivable Sales *To recognize sale of Job MAC001*	2,000	2,000

The resulting accounting is shown on the company's income statement:

DINOSAUR VINYL, INC. Income Statement	
Sales	$2,000
Cost of Goods Sold	931
Gross profit	$1,069

THINK IT THROUGH

Ongoing Overapplied Overhead

At the end of each year, manufacturing overhead is analyzed, and an adjusting entry is made to dispose of the under- or overapplied overhead. How would you advise a company that has had overapplied overhead for each of the last five years?

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4.9: Explain How a Job Order Cost System Applies to a Nonmanufacturing Environment

Job order cost systems can be used beyond the manufacturing realm and are often used in the production of services. The same cost tracking and journaling techniques apply, as the outcome still consists of materials, labor, and overhead. However, the terminology changes in a nonmanufacturing environment. For example, a movie production studio and an accounting firm produce movies and financial statement audits, respectively, instead of manufacturing units.

Fundamentals of the Job Order Costing Method for Service Entities

Instead of being dependent on materials, service industries depend on labor. Since their work is labor-intensive, it makes sense to use labor as an activity base with billable hours often as the best allocation base. For example, in an audit, there often will be several accountants, with differing levels of experience and expertise involved in the assignment. The accounting firms have more billable hours at the staff level and fewer billable hours at the partner level. And since the firm bills the partner's time at a significantly higher rate than the staff, it makes sense to apply overhead at the billable hours instead of the billable costs.

In service industries, there is no manufacturing overhead because they are not manufacturing a product, but instead are providing a service. Accordingly, overhead is called **operating overhead**.

Another terminology difference is the inventory accounts. The jobs are considered movies or assignments in process, and are transferred to a cost of service sold account instead of to a finished goods inventory.

CONCEPTS IN PRACTICE

Tracking Costs in Healthcare

Healthcare is one of the industries that keeps track of materials, such as medicine. In this industry, direct labor is shown to the patient as the cost of the provider, such as a physician, physician assistant, or nurse practitioner. Indirect labor includes all other personnel from front desk staff to the nurse who gathers vital signs or a technician who performs tests. Patients do not see the overhead cost on their bill, but it is built into the invoice as part of the practitioner or testing fees.

Service Entity Use of a Job Order Costing System

To understand how a service provider uses a job order cost system, let's consider the case of IFixIT. IFixIT Systems is a **Sony**-authorized repair provider that fixes audiovisual equipment brought in by customers. IFixIT requires customers to pay $50 to diagnose the problem. IFixIt pays its employees $25 per hour and assigns overhead equal to its direct labor cost. The customers' bills do not show overhead and are instead itemized as parts plus labor, where the cost for parts is the original cost plus a markup, and the labor rate is $80 per hour.

A customer brought in his TV and paid the $50 diagnostic fee. IFixIT determined a new power cord was needed. To fix it, IFixIT purchases the part from its suppliers at $42 and pays $75 in direct labor for 3 hours at $25 per hour. Overhead is applied equal to the direct labor cost of $75. The customer is charged $310, consisting of $70 for the part and 3 hours of labor at a rate of $80 per hour. IFixIT records the journal entries shown:

JOURNAL			
Date	**Account**	**Debit**	**Credit**
	Cash	50	
	Diagnosis revenue		50
	Diagnosis of Sony Bravia for Job 4740325		
	Repair in process	42	
	Accounts Payable		42
	Purchase of new power cord for Job 4740325		
	Repair in process	75	
	Salaries Payable		75
	Assigning labor to Job 4740325		
	Repair in process	75	
	Operating overhead		75
	Assigning overhead costs to Job 4740325		
	Cost of completed repair	192	
	Repair in Process		192
	Completion of Job 4740325		
	Cash	310	
	Repair revenue		310
	Completion of Job 4740325		

ETHICAL CONSIDERATIONS

Subcontractor Misrepresentation of Costs of Jobs Used to Overbill Clients

Construction is a typical industry where job order costing and related accounting misstatements can be used to commit fraud. A construction subcontractor might overstate the units of production accomplished, the units of labor, or the equipment actually used.[2] This occurs most commonly with subcontractor fraud, where the subcontractor does not perform the work but bills for it anyway.

Another complicating issue is that many subcontractors are disadvantaged business enterprises that are required by law to be included in governmental construction contracts. In Chicago, for example, **McHugh Construction** paid $12 million in fines to settle the claims that its disadvantaged business enterprise subcontractor did not perform work.[3] The subcontractor received a prison sentence, and a related party was put on probation. An accountant had to prepare the invoices that allowed this common type of scheme to operate.

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5: PROCESS COSTING

Learning Objectives

- Illustrate the flow of costs in a process costing system
- Calculate product costs by department or process and per unit using Equivalent Units of Production (EUP)

5.1: Why It Matters

5.2: Compare and Contrast Job Order Costing and Process Costing

5.3: Explain and Identify Conversion Costs

5.4: Explain and Compute Equivalent Units and Total Cost of Production in an Initial Processing Stage

5.5: Explain and Compute Equivalent Units and Total Cost of Production in a Subsequent Processing Stage

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5.1: Why It Matters

David and William's family has used a secret family recipe for generations to make amazing chocolate chip cookies. While in college, they helped their grandmother, who used only locally sourced products, make and sell the cookies to a local restaurant. They helped her become more efficient, discovered how to retain the quality taste while making larger batches, and developed a plate-sized version that could be decorated similar to a birthday cake. After creating an equally successful peanut butter cookie recipe, David and William decided to expand the business and sell to high-end grocers as well as to a second restaurant. They found it was optimal in terms of cost, efficiency, and quality to produce 100 cookies per batch for each regular-sized cookie and 5 cookies per batch for the large cookies. They surveyed restaurants and grocery stores and determined that each flavor should be offered in four different package sizes. They also analyzed the marketability at various sale prices. David and William now know they need to use their information to identify the costs associated with making the cookies. They need to know the cost to produce one unit of their product in order to price their cookies correctly, determine the optimal product mix, manage efficiency and process improvement, and make other management decisions.

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5.2: Compare and Contrast Job Order Costing and Process Costing

As you've learned, job order costing is the optimal accounting method when costs and production specifications are not identical for each product or customer but the direct material and direct labor costs can easily be traced to the final product.

Process costing is the optimal costing system when a standardized process is used to manufacture identical products and the direct material, direct labor, and manufacturing overhead cannot be easily or economically traced to a specific unit. Process costing is used most often when manufacturing a product in batches. Each department or production process or batch process tracks its direct material and direct labor costs as well as the number of units in production. The actual cost to produce each unit through a process costing system varies, but the average result is an adequate determination of the cost for each manufactured unit. Examples of items produced and accounted for using a form of the process costing method could be soft drinks, petroleum products, or even furniture such as chairs, assuming that the company makes batches of the same chair, instead of customizing final products for individual customers.

For example, small companies, such as David and William's, and large companies, such as **Nabisco**, use similar cost-determination processes. In order to understand how much each product costs—for example, Oreo cookies—**Nabisco** uses process costing to track the direct materials, direct labor, and manufacturing overhead used in the manufacturing of its products. Oreo production has six distinct steps or departments: (1) make the cookie dough, (2) press the cookie dough into a molding machine, (3) bake the cookies, (4) make the filling and apply it to the cookies, (5) put the cookies together into a sandwich, and (6) and place the cookies into plastic trays and packages. Each department keeps track of its direct materials used and direct labor incurred, and manufacturing overhead applied to facilitate determining the cost of a batch of Oreo cookies.



As previously mentioned, process costing is used when similar items are produced in large quantities. As such, many individuals immediately associate process costing with assembly-line production. Process costing works best when products cannot be distinguished from each other and, in addition to obvious production line products like ice cream or paint, also works for more complex manufacturing of similar products like small engines. Conversely, products in a job order cost system are manufactured in small quantities and include custom jobs such as custom manufacturing products. They can also be legal or accounting tasks, movie production, or major projects such as construction activities.

The difference between process costing and job order costing relates to how the costs are assigned to the products. In either costing system, the ability to obtain and analyze cost data is needed. This results in the costing system selected being the one that best matches the manufacturing process.

The costing system used typically depends on whether the company can most efficiently and economically trace the costs to the job (favoring job order costing system) or to the production department or batch (favoring a process costing system).

While the costing systems are different from each other, management uses the information provided to make similar managerial decisions, such as setting the sales price. For example, in a job order cost system, each job is unique, which allows management to establish individual prices for individual projects. Management also needs to establish a sales price for a product produced with a process costing system, but this system is not designed to stop the production process and individually cost each batch of a product, so management must set a price that will work for many batches of the product.

In addition to setting the sales price, managers need to know the cost of their products in order to determine the value of inventory, plan production, determine labor needs, and make long- and short-term plans. They also need to know the costs to determine when a new product should be added or an old product removed from production.

In this chapter, you will learn when and why process costing is used. You'll also learn the concepts of conversion costs and equivalent units of production and how to use these for calculating the unit and total cost of items produced using a process costing system.

When assigning costs to departments, it is important to separate the product costs from the period costs, which are those that

are typically related with a particular time period, instead of attached to the production of an asset. Management often needs additional information to make decisions and needs the product costs further categorized as prime costs or conversion costs (Figure 5.2.1). Prime costs are costs that include the primary (or direct) product costs: direct material and direct labor. Conversion costs are the costs necessary to convert direct materials into a finished product: direct labor and manufacturing overhead, which includes other costs that are not classified as direct materials or direct labor, such as plant insurance, utilities, or property taxes. Also, note that direct labor is considered to be a component of both prime costs and conversion costs.

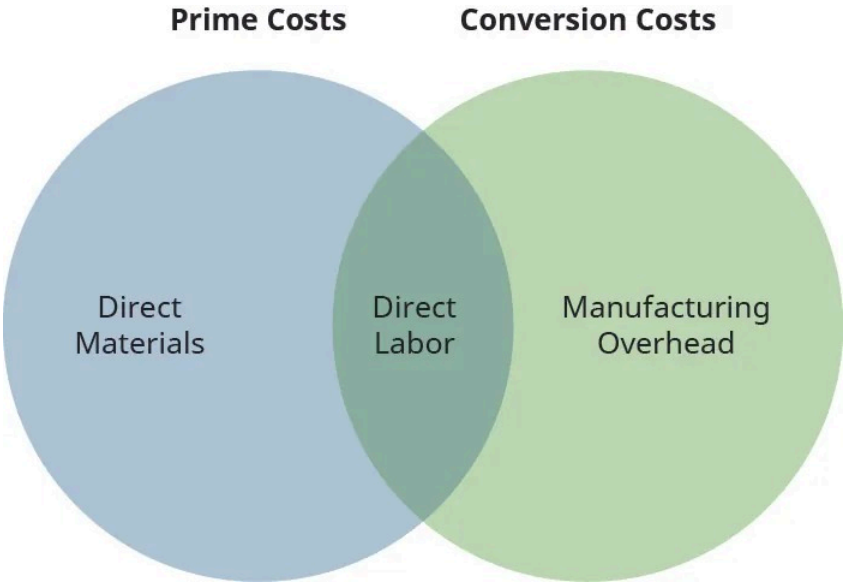


Figure 5.2.1: Prime Costs and Conversion Costs. Product costs can be categorized as prime costs (direct product costs) or conversion costs (costs incurred while converting the materials into a finished product). Direct labor is accounted for in both categories. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Job order costing tracks prime costs to assign direct material and direct labor to individual products (jobs). Process costing also tracks prime costs to assign direct material and direct labor to each production department (batch). Manufacturing overhead is another cost of production, and it is applied to products (job order) or departments (process) based on an appropriate activity base.

Equivalent Units

In a process cost system, costs are maintained by each department, and the method for determining the cost per individual unit is different than in a job order costing system. Rock City Percussion uses a process cost system because the drumsticks are produced in batches, and it is not economically feasible to trace the direct labor or direct material, like hickory, to a specific drumstick. Therefore, the costs are maintained by each department, rather than by job, as they are in job order costing.

How does an organization determine the cost of each unit in a process costing environment? The costs in each department are allocated to the number of units produced in a given period. This requires determination of the number of units produced, but this is not always an easy process. At the end of the accounting period, there typically are always units still in production, and these units are only partially complete. Think of it this way: At midnight on the last day of the month, all accounting numbers need to be determined in order to process the financial statements for that month, but the production process does not stop at the end of each accounting period. However, the number of units produced must be calculated at the end of the accounting period to determine the number of equivalent units, or the number of units that would have been produced if the units were produced sequentially and in their entirety in a particular time period. The number of equivalent units is different from the number of actual units and represents the number of full or whole units that could have been produced given the amount of effort applied. To illustrate, consider this analogy. You have five large pizzas that each contained eight slices. Your friends served themselves, and when they were finished eating, there were several partial pizzas left. In equivalent units, determine how many whole pizzas are left if the remaining slices are divided as shown in Figure 5.2.2.

- Pie 1 had one slice
- Pie 2 had two slices

- Pie 3 had two slices
- Pie 4 had three slices
- Pie 5 had eight slices

Together, there are sixteen slices left. Since there are eight slices per pizza, the leftover pizza would be considered two full equivalent units of pizzas. The equivalent unit is determined separately for direct materials and for conversion costs as part of the computation of the per-unit cost for both material and conversion costs.

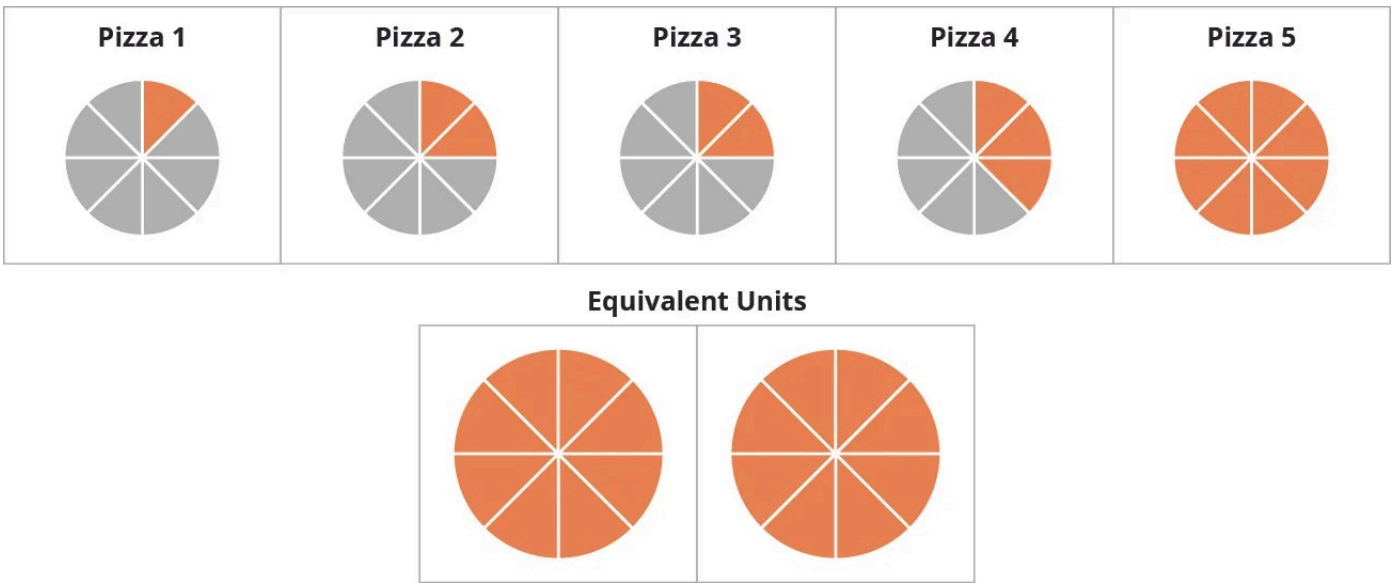


Figure 5.2.2: Equivalent Units. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Major Characteristics of Process Costing

Process costing is the optimal system for a company to use when the production process results in many similar units. It is used when production is continuous or occurs in large batches and it is difficult to trace a particular input cost to a specific individual product.

For example, before David and William found ways to make five large cookies per batch, their family always made one large cookie per batch. In order to make five cookies at a time, they had to gather the ingredients and baking materials, including five bowls and five cookie sheets. The exact amount of ingredients for one large cookie was mixed in each separate bowl and then placed on the cookie sheet. When this method was used, it was easy to establish that exactly one egg, two cups of flour, three-quarter cup of chocolate chips, three-quarter cup of sugar, one-quarter teaspoon salt, and so forth, were in each cookie. This made it easy to determine the exact cost of each cookie. But if David and William used one bowl instead of five bowls, measured the ingredients into it and then divided the dough into five large cookies, they could not know for certain that each cookie has exactly two cups of flour. One cookie may have 1 7/8 cups and another may have 1 15/16 cups, and one cookie may have a few more chocolate chips than another. It is also impossible to trace the chocolate chips from each bag to each cookie because the chips were mixed together. These variations do not affect the taste and are not important in this type of accounting. Process costing is optimal when the products are relatively homogenous or indistinguishable from one another, such as bottles of vegetable oil or boxes of cereal.

Often, process costing makes sense if the individual costs or values of each unit are not significant. For example, it would not be cost-effective for a restaurant to make each cup of iced tea separately or to track the direct material and direct labor used to make each eight-ounce glass of iced tea served to a customer. In this scenario, job order costing is a less efficient accounting method because it costs more to track the costs per eight ounces of iced tea than the cost of a batch of tea. Overall, when it is difficult or not economically feasible to track the costs of a product individually, process costing is typically the best cost system to use.

Process costing can also accommodate increasingly complex business scenarios. While making drumsticks may sound simple,

an immense amount of technology is involved. Rock City Percussion makes 8,000 hickory sticks per day, four days each week. The sticks made of maple and birch are manufactured on the fifth day of the week. It is difficult to tell the first drumstick made on Monday from the 32,000th one made on Thursday, so a computer matches the sticks in pairs based on the tone produced.

Process costing measures and assigns the costs to the associated department. The basic 5A hickory stick consists only of hickory as direct material. The rest of the manufacturing process involves direct labor and manufacturing overhead, so the focus is on properly assigning those costs. Thus, process costing works well for simple production processes such as cereal, rubber, and steel, and for more complicated production processes such as the manufacturing of electronics and watches, if there is a degree of similarity in the production process.

In a process cost system, each department accumulates its costs to compute the value of work in process inventory, so there will be a work in process inventory for each manufacturing or production department as well as an inventory cost for finished goods inventory. Manufacturing departments are often organized by the various stages of the production process. For example, blending, baking, and packaging could each be categorized as manufacturing or production departments for the cookie producer, while cutting, assembly, and finishing could be manufacturing or production departments with accompanying costs for a furniture manufacturer. Each department, or process, will have its own work-in-process inventory account, but there will only be one finished goods inventory account.

There are two methods used to compute the values in the work in process and finished goods inventories. The first method is the weighted-average method, which includes all costs (costs incurred during the current period and costs incurred during the prior period and carried over to the current period). This method is often favored, because in the process cost production method there often is little product left at the end of the period and most has been transferred out. The second method is the first-in, first-out (FIFO) method, which calculates the unit costs based on the assumption that the first units sold come from the prior period's work in process that was carried over into the current period and completed. After these units are sold, the newer completed units can then be sold. The theory is similar to the FIFO inventory valuation process that you learned about in an earlier chapter. (Since the FIFO process costing method is more complicated than the weighted-average method, the FIFO method is typically covered in more advanced accounting courses.) **We will focus on the weighted average method in this course.**

With processing, it is difficult to establish how much of each material, and exactly how much time is in each unit of finished product. This will require the use of the equivalent unit computation.

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5.3: Explain and Identify Conversion Costs

Mechanics of Applying Conversion Costs

Let's return to our drumstick example to learn how to work with conversion costs. Rock City Percussion has two departments critical to manufacturing drumsticks: the shaping and packaging departments.

The shaping department uses only wood as its direct material and water as its indirect material. In the shaping department, the material is added first. Then, machines cut the wood underwater into dowels, separate them, and move them to machines that shape the dowels into drumsticks. These machines need electricity to operate and personnel to monitor and adjust the processes and to maintain the equipment. When the shaping is finished, a conveyer belt transfers the sticks to the finishing department.

Since the drumsticks are made by performing one process on one batch at a time, instead of producing one stick at a time from start to finish, it is difficult to determine the exact materials, labor, and overhead for a single pair of drumsticks. It is easier to track the materials and conversion costs for one batch and have those costs follow the batch to the next process.

Therefore, once the batch of sticks gets to the second process—the packaging department—it already has costs attached to it. In other words, the packaging department receives both the drumsticks and their related costs from the shaping department. For the basic size 5A stick, the packaging department adds material at the beginning of the process. The 5A uses only packaging sleeves as its direct material, while other types may also include nylon, felt, and/or the ingredients for the proprietary handgrip. Direct labor and manufacturing overhead are used to test, weigh, and sound-match the drumsticks into pairs.

Thus, at the end of the accounting period, there are two work-in-process inventories: one in the shaping department and one in the packaging department.

Direct materials are added at the beginning of shaping and packaging departments, so the work-in-process inventory for those departments is 100% complete with regard to materials, but it is not complete with regard to conversion costs. If they were 100% complete with regard to conversion costs, then they would have been transferred to the next department.

LINK TO LEARNING

Management needs to understand its costs in order to set prices, budget for the upcoming year, and evaluate performance. Sometimes individuals become managers due to their knowledge of the production process but not necessarily the costs. Managers can view this information on the importance of identifying prime and conversion costs from Investopedia, a resource for managers.

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5.4: Explain and Compute Equivalent Units and Total Cost of Production in an Initial Processing Stage

As described previously, process costing can have more than one work in process account. Determining the value of the work in process inventory accounts is challenging because each product is at varying stages of completion and the computation needs to be done for each department. Trying to determine the value of those partial stages of completion requires application of the equivalent unit computation. The equivalent unit computation determines the number of units if each is manufactured in its entirety before manufacturing the next unit. For example, forty units that are 25% complete would be ten (40 × 25%) units that are totally complete.

Direct material is added in stages, such as the beginning, middle, or end of the process, while conversion costs are expensed evenly over the process. Often there is a different percentage of completion for materials than there is for labor. For example, if material is added at the beginning of the process, the forty units that are 100% complete with respect to material and 25% complete with respect to conversion costs would be the same as forty units of material and ten units (40 × 25%) completed with conversion costs.

For example, during the month of July, Rock City Percussion purchased raw material inventory of $25,000 for the shaping department. Although each department tracks the direct material it uses in its own department, all material is held in the material storeroom. The inventory will be requisitioned for each department as needed.

During the month, Rock City Percussion's shaping department requested $10,179 in direct material and started into production 8,700 hickory drumsticks of size 5A. There was no beginning inventory in the shaping department, and 7,500 drumsticks were completed in that department and transferred to the finishing department. Wood is the only direct material in the shaping department, and it is added at the beginning of the process, so the work in process (WIP) is considered to be 100% complete with respect to direct materials. At the end of the month, the drumsticks still in the shaping department were estimated to be 35% complete with respect to conversion costs. All materials are added at the beginning of the shaping process. While beginning the size 5A drumsticks, the shaping department incurred these costs in July:

Direct materials	$10,179
Direct labor	15,176
Applied overhead	7,000
Total cost	$32,355

These costs are then used to calculate the equivalent units and total production costs in a four-step process.

Step One: Determining the Units to Which Costs Will Be Assigned

In addition to the equivalent units, it is necessary to track the units completed as well as the units remaining in ending inventory. A similar process is used to account for the costs completed and transferred. Reconciling the number of units and the costs is part of the process costing system. The reconciliation involves the total of beginning inventory and units started into production. This total is called "units to account for," while the total of beginning inventory costs and costs added to production is called "costs to be accounted for." Knowing the total units or costs to account for is helpful since it also equals the units or costs transferred out plus the amount remaining in ending inventory.

When the new batch of hickory sticks was started on July 1, Rock City Percussion did not have any beginning inventory and started 8,700 units, so the total number of units to account for in the reconciliation is 8,700:

Units to Account For	Units
Beginning work in process	0
Units started into production	8,700
Total units to account for	8,700

The shaping department completed 7,500 units and transferred them to the testing and sorting department. No units were lost to **spoilage**, which consists of any units that are not fit for sale due to breakage or other imperfections. Since the maximum number of units that could possibly be completed is 8,700, the number of units in the shaping department's ending inventory must be 1,200. The total of the 7,500 units completed and transferred out and the 1,200 units in ending inventory equal the 8,700 possible units in the shaping department.

Units Accounted For	Units
Completed and transferred out	7,500
Ending work in process	1,200
Total units to account for	8,700

Step Two: Computing the Equivalent Units of Production

All of the materials have been added to the shaping department, but all of the conversion elements have not; the numbers of equivalent units for material costs and for conversion costs remaining in ending inventory are different. All of the units transferred to the next department must be 100% complete with regard to that department's cost or they would not be transferred. So the number of units transferred is the same for material units and for conversion units. The process cost system must calculate the equivalent units of production for units completed (with respect to materials and conversion) and for ending work in process with respect to materials and conversion.

For the shaping department, the materials are 100% complete with regard to materials costs and 35% complete with regard to conversion costs. The 7,500 units completed and transferred out to the finishing department must be 100% complete with regard to materials and conversion, so they make up 7,500 (7,500 × 100%) units. The 1,200 ending work in process units are 100% complete with regard to material and have 1,200 (1,200 × 100%) equivalent units for material. The 1,200 ending work in process units are only 35% complete with regard to conversion costs and represent 420 (1,200 × 35%) equivalent units.

Work in Process Completion %		100%	35%
Units accounted for	Total Units	Material Units	Conversion Units
Completed and transferred out	7,500	7,500	7,500
Ending work in process	1,200	1,200	420
Total equivalent units for shaping	8,700	8,700	7,920

Step Three: Determining the Cost per Equivalent Unit

Once the equivalent units for materials and conversion are known, the cost per equivalent unit is computed in a similar manner

as the units accounted for. The costs for material and conversion need to reconcile with the total beginning inventory and the costs incurred for the department during that month.

Costs to Account For	Materials	Conversion	Total
Beginning work in process	$ 0	$ 0	$ 0
Incurred during the period	$10,179	$22,176	$32,355
Total costs to account for	$10,179	$22,176	$32,355
Equivalent units	8,700	7,920	
Cost per equivalent unit	$ 1.17	$ 2.80	$ 3.97

The total materials costs for the period (including any beginning inventory costs) is computed and divided by the equivalent units for materials. The same process is then completed for the total conversion costs. The total of the cost per unit for material ($1.17) and for conversion costs ($2.80) is the total cost of each unit transferred to the finishing department ($3.97).

Step Four: Allocating the Costs to the Units Transferred Out and Partially Completed in the Shaping Department

Now you can determine the cost of the units transferred out and the cost of the units still in process in the shaping department. To calculate the goods transferred out, simply take the units transferred out times the sum of the two equivalent unit costs (materials and conversion) because all items transferred to the next department are complete with respect to materials and conversion, so each unit brings all its costs. But the ending WIP value is determined by taking the product of the work in process material units and the cost per equivalent unit for materials plus the product of the work in process conversion units and the cost per equivalent unit for conversion.

Transferred out costs	(7,500 units × $1.17) + (7,500 units × $2.80) = $29,775
Ending work in process: materials	(1,200 × $1.17) = $1,404
Ending work in process: conversion	(420 × $2.80) = $1,176
Ending work in process: total	$1,404 + $1,176 = $2,580

This information is accumulated in a **production cost report**. This report shows the costs used in the preparation of a product, including the cost per unit for materials and conversion costs, and the amount of work in process and finished goods inventory. A complete production cost report for the shaping department is illustrated in Figure 5.4.1.

Units to account for	Units		
Beginning work in process	—		
Units started into production	8,700		
Total units to account for	8,700		
Work in process completion %	100%	35%	
Units accounted for	**Materials Units**	**Conversion Units**	**Total**
Completed and transferred out	7,500	7,500	7,500
Ending work in process	1,200	420	1,200
Total units to account for	8,700	7,920	8,700
Costs to account for	**Materials**	**Conversion**	**Total**
Beginning work in process	$ 0	$ 0	$ 0
Incurred during the period	$10,179	$22,176	$32,355
Total costs to account for	$10,179	$22,176	$32,355
Equivalent units	8,700	7,920	
Cost per equivalent unit	$ 1.17	$ 2.80	$ 3.97
	Materials	**Conversion**	**Total**
Value of ending work in process	$ 1,404	$ 1,176	$ 2,580
Completed and transferred	8,775	21,000	29,775
Total costs	$10,179	$22,176	$32,355

Figure 5.4.1: Production Cost Report for the Shaping Department. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

YOUR TURN

Calculating Inventory Transferred and Work in Process Costs

Kyler Industries started a new batch of paint on October 1. The new batch consists of 8,700 cans of paint, of which 7,500 was completed and transferred to finished goods. During October, the manufacturing process recorded the following expenses: direct materials of $10,353; direct labor of $17,970; and applied overhead of $9,000. The inventory still in process is 100% complete with respect to materials and 30% complete with respect to conversion. What is the cost of inventory transferred out and work in process? Assume that there is no beginning work in process inventory.

Answer available at the end of this section.

Answers

YOUR TURN

Units to account for	Units		
Beginning work in process	0		
Units started into production	8,700		
Total units to be account for	8,700		
	Materials	**Conversion**	**Total**
Work in process completion %	100%	30%	
Units accounted for			
Completed and transferred out	7,500	7,500	7,500
Ending work in process	1,200	360	1,200
Total units to account for	8,700	7,860	8,700
Costs to account for	**Materials**	**Conversion**	**Total**
Beginning work in process	0	0	0
Incurred during the period	$10,353	$26,970	$37,323
Total costs to account for	$10,353	$26,970	$37,323
Equivalent units	8,700	7,860	
Cost per equivalent unit	$ 1.19	$ 3.43	$ 4.62

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5.5: Explain and Compute Equivalent Units and Total Cost of Production in a Subsequent Processing Stage

In many production departments, units are typically transferred from the initial stage to the next stage in the process. When the units are transferred, the accumulated cost per unit is transferred along with them. Since the unit being produced includes work from all of the prior departments, the transferred-in cost is the cost of the work performed in all earlier departments.

When the hickory size 5A drumsticks have completed the shaping process, they are transferred to the packaging department along with the inventory costs of $29,775. The inventory costs of $29,775 were $8,775 for materials and $21,000 for conversion costs and were calculated in Figure 5.4.1. During the month of July, Rock City Percussion purchased raw material inventory of $2,000 for the packaging department. As with the shaping department, the packaging department tracks its costs and requisitions the raw material from the material storeroom. The packaging department has computed direct material costs of $2,000, direct labor costs of $13,000, and applied overhead of $9,100, for a total of $22,100 in conversion costs. Equivalent units are computed for this department, and a new cost per unit is computed.

	Materials	Conversion	Total
Beginning work in process	$ 1,600	$ 6,580	$ 8,180
Transferred in	8,775	21,000	29,775
Added this month	2,000	22,100	24,100
Total	$12,375	$49,680	$62,055

As with calculating the equivalent units and total cost of production in the initial processing stage, there are four steps for calculating these costs in a subsequent processing stage.

Step One: Determining the Stage 2 Units to Which Costs Will Be Assigned

In the initial manufacturing department, there is beginning inventory, and units are started in production. In subsequent stages, instead of starting new units, units are transferred in from the prior department, but the accounting process is the same. Returning to the example, Rock City Percussion had a beginning inventory of 750 units in the packaging department. When the 7,500 sticks are transferred into the packaging department from the shaping department, the total number of units to account for in the reconciliation is 8,250, which is the total of the beginning WIP and the units transferred in:

Units to Account For	Units
Beginning work in process	750
Units transferred in	7,500
Total units to account for	8,250

The reconciliation of units to account for are the same for each department. The units that were completed and transferred out plus the ending inventory equal the total units to account for. The packaging department for Rock City Percussion completed 6,500 units and transferred them into finished goods inventory. Since the maximum number of units to possibly be completed is 8,250 and no units were lost to spoilage, the number of units in the packaging department's ending inventory must be 1,750. The total of the 6,500 units completed and transferred out and the 1,750 units in ending inventory equal the 8,250 possible units in

the packaging department.

Units Accounted For	Units
Completed and transferred out	6,500
Ending work in process	1,750
Total units to account for	8,250

Step Two: Computing the Stage 2 Equivalent Units of Production

The only direct material added in the packaging department for the 5A sticks is packaging. The packaging materials are added at the beginning of the process, so all the materials have been added before the units are transferred out, but all of the conversion elements have not. As a result, the number of equivalent units for material costs and for conversion costs remaining in ending inventory is different for the testing and sorting department. As you've learned, all of the units transferred to the next department must be 100% complete with regard to that department's cost, or they would not be transferred. The process cost system must calculate the equivalent units of production for units completed (with respect to materials and conversion) and for ending WIP with respect to materials and conversion.

For the packaging department, the materials are 100% complete with regard to materials costs and 40% complete with regard to conversion costs. The 6,500 units completed and transferred out to the finishing department must be 100% complete with regard to materials and conversion, so they make up 6,500 (6,500 × 100%) units. The 1,750 ending WIP units are 100% complete with regard to material and have 1,750 (1,750 × 100%) equivalent units for material. The 1,750 ending WIP units are only 40% complete with regard to conversion costs and represent 700 (1,750 × 40%) equivalent units.

Work in process completion %		100%	40%
Units accounted for	Total Units	Material Units	Conversion Units
Completed and transferred out	6,500	6,500	6,500
Ending work in process	1,750	1,750	700
Total equivalent units for packaging	8,250	8,250	7,200

Step Three: Determining the Stage 2 Cost per Equivalent Unit

Once the equivalent units for materials and conversion are known for the packaging department, the cost per equivalent unit is computed in a manner similar to the calculation for the units accounted for. The costs for material and conversion need to reconcile with the department's beginning inventory and the costs incurred for the department during that month.

Costs to account for	Materials	Conversion	Total
Beginning work in process	$ 1,600	$ 6,580	$ 8,180
Incurred during the period	$10,775	$43,100	$53,875
Total costs to account for	$12,375	$49,680	$62,055
Equivalent units	8,250	7,200	15,450
Cost per equivalent unit	$ 1.50	$ 6.90	$ 8.40

The total materials costs for the period (including any beginning inventory costs) are computed and divided by the equivalent units for materials. The same process is then completed for the total conversion costs. The total of the cost per unit for materials

($1.50) and for conversion costs ($6.90) is the total cost of each unit transferred to the testing and sorting department.

Step Four: Allocating the Costs to the Units in the Finishing Department

Now you can determine the cost of the units transferred out and the cost of the units still in process in the finishing department. For the goods transferred out, simply take the units transferred out times the sum of the two equivalent unit costs (materials and conversion) because all items transferred to the next department are complete with respect to materials and conversion, so each unit brings all its costs. But the ending WIP value is determined by taking the product of the work in process materials units and the cost per equivalent unit for materials plus the product of the work in process conversion units and the cost per equivalent unit for conversion.

Transferred out costs	(6,500 units × $1.50) + (6,500 units × $6.90) = $54,600
Ending work in process: materials	(1,750 × $1.50) = $2,625
Ending work in process: conversion	(700 × $6.90) = $4,830
Ending work in process: total	$2,625 + $4,830 = $7,455

LINK TO LEARNING

Knowing the cost to produce a unit is critical to management's decisions. Sometimes that knowledge leads to management's decision to stop production, but sometimes that decision isn't as simple as it seems. The cost to produce a penny is more than one cent, and yet, the United States still makes pennies. See this article from *Forbes* that explains the difference among *cost*, *worth*, and *value* to learn more.

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6: ACTIVITY BASED COSTING

Learning Objectives

- Discuss the impact of technology on the business environment and its implications for product and service costs.
- Discuss the advantages and disadvantages of Activity Based Costing
- Prepare financial reports using Activity Based Costing

6.1: Why It Matters

6.2: Calculate Predetermined Overhead and Total Cost under the Traditional Allocation Method

6.3: Describe and Identify Cost Drivers

6.4: Calculate Activity-Based Product Costs

6.5: Compare and Contrast Traditional and Activity-Based Costing Systems

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6.1: Why It Matters

Barry thinks of his education as a job and spends forty hours a week in class or studying. Barry estimates he has about eighty hours per week to allocate between school and other activities and believes everyone should follow his fifty-fifty rule of time allocation. His roommate, Kamil, disagrees with Barry and argues that allocating 50 percent of one's time to class and studying is not a great formula because everyone has different activities and responsibilities. Kamil points out, for example, that he has a job tutoring other students, is involved with student activities, and plays in a band, while Barry spends some of his nonstudy time doing volunteer work and working out.

Kamil plans each week based on how many hours he will need for each activity: classes, studying and coursework, tutoring, and practicing and performing with his band. In essence, he considers the details of each week's needs to budget his time. Kamil explains to Barry that being aware of the activities that consume his limited resources (time, in this example) helps him to better plan his week. He adds that individuals who have activities with lots of time commitments (class, work, study, exercise, family, friends, and so on) must be efficient with their time or they risk doing poorly in one or more areas. Kamil argues these individuals cannot simply assign a percentage of their time to each activity but should use each specific activity as the basis for allocating their time. Barry insists that assigning a set percentage to everything is easy and the better method. Who is correct?

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6.2: Calculate Predetermined Overhead and Total Cost under the Traditional Allocation Method

Both roommates make valid points about allocating limited resources. Ultimately, each must decide which method to use to allocate time, and they can make that decision based on their own analyses. Similarly, businesses and other organizations must create an allocation system for assigning limited resources, such as overhead. Whereas Kamil and Barry are discussing the allocation of hours, the issue of allocating costs raises similar questions. For example, for a manufacturer allocating maintenance costs, which are an overhead cost, is it better to allocate to each production department equally by the number of machines that need to be maintained or by the square footage of space that needs to be maintained?

In the past, overhead costs were typically allocated based on factors such as total direct labor hours, total direct labor costs, or total machine hours. This allocation process, often called the traditional allocation method, works most effectively when direct labor is a dominant component in production. However, many industries have evolved, primarily due to changes in technology, and their production processes have become more complicated, with more steps or components. Many of these industries have significantly reduced their use of direct labor and replaced it with technology, such as robotics or other machinery. For example, a mobile phone production facility in China replaced 90 percent of its workforce with robots.

In these situations, a direct cost (labor) has been replaced by an overhead cost (e.g., depreciation on equipment). Because of this decrease in reliance on labor and/or changes in the types of production complexity and methods, the traditional method of overhead allocation becomes less effective in certain production environments. To account for these changes in technology and production, many organizations today have adopted an overhead allocation method known as activity-based costing (ABC). This chapter will explain the transition to ABC and provide a foundation in its mechanics.

Activity-based costing is an accounting method that recognizes the relationship between product costs and a production activity, such as the number of hours of engineering or design activity, the costs of the set up or preparation for the production of different products, or the costs of packaging different products after the production process is completed. Overhead costs are then allocated to production according to the use of that activity, such as the number of machine setups needed. In contrast, the traditional allocation method commonly uses cost drivers, such as direct labor or machine hours, as the single activity.

Because of the use of multiple activities as cost drivers, ABC costing has advantages over the traditional allocation method, which assigns overhead using a single predetermined overhead rate. Those advantages come at a cost, both in resources and time, since additional information needs to be collected and analyzed. **Chrysler**, for instance, shifted its overhead allocation to ABC in 1991 and estimates that the benefits of cost savings, product improvement, and elimination of inefficiencies have been ten to twenty times greater than the investment in the program at some sites. It believes other sites experienced savings of fifty to one hundred times the cost to implement the system.

As you've learned, understanding the cost needed to manufacture a product is critical to making many management decisions (Figure 6.2.1). Knowing the total and component costs of the product is necessary for price setting and for measuring the efficiency and effectiveness of the organization. Remember that product costs consist of direct materials, direct labor, and manufacturing overhead. It is relatively simple to understand each product's direct material and direct labor cost, but it is more complicated to determine the overhead component of each product's costs because there are a number of indirect and other costs to consider. A company's **manufacturing overhead costs** are all costs other than direct material, direct labor, or selling and administrative costs. Once a company has determined the overhead, it must establish how to allocate the cost. This allocation can come in the form of the traditional overhead allocation method or activity-based costing.

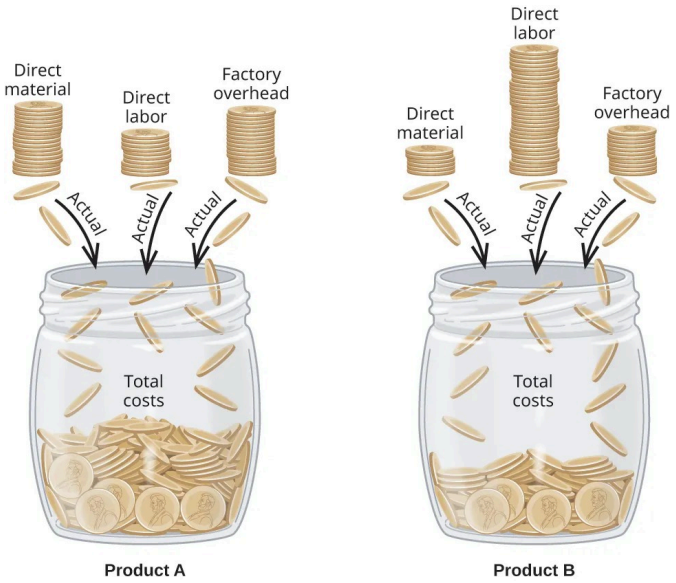


Figure 6.2.1: Allocating Costs among Products. The total cost of a product is based on direct labor, direct material, and factory overhead costs. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Component Categories under Traditional Allocation

Traditional allocation involves the allocation of factory overhead to products based on the volume of production resources consumed, such as the amount of direct labor hours consumed, direct labor cost, or machine hours used. In order to perform the traditional method, it is also important to understand each of the involved cost components: direct materials, direct labor, and manufacturing overhead. Direct materials and direct labor are cost categories that are relatively easy to trace to a product. **Direct material** comprises the supplies used in manufacturing that can be traced directly to the product. **Direct labor** is the work used in manufacturing that can be directly traced to the product. Although the processes for tracing the costs differ, both job order costing and process costing trace the material and labor through materials requisition requests and time cards or electronic mechanisms for measuring labor input. Job order costing traces the costs directly to the product, and process costing traces the costs to the manufacturing department.

ETHICAL CONSIDERATIONS

Ethical Cost Modeling

The proper use of management accounting skills to model financial and non-financial data optimizes the organization's evaluation and use of resources and assists in the proper evaluation of costs and revenues in an organization. The IFAC provides guidance on the use of cost models and how to ethically design proper cost models: "Cost models should be designed and maintained to reflect the cause-and-effect interrelationships and the behavioral dynamics of the way the organization functions. The information needs of decision-makers at all levels of an organization should be taken into account, by incorporating an organization's business and operational models, strategy, structure, and competitive environment."

Estimated Total Manufacturing Overhead Costs

The more challenging product component to track is manufacturing overhead. Overhead consists of indirect materials, indirect labor, and other costs closely associated with the manufacturing process but not tied to a specific product. Examples of other overhead costs include such items as depreciation on the factory machinery and insurance on the factory building. **Indirect material** comprises the supplies used in production that cannot be traced to an individual product, and **indirect labor** is the work done by employees not directly involved in the manufacturing process, such as the supervisors' salaries or the maintenance staff's wages. Because these costs cannot be traced directly to the product like direct costs are, they have to be allocated among all of the products produced and added, or applied, to the production and product cost.

For example, the recipe for shea butter has easily identifiable quantities of shea nuts and other ingredients. Based on the manufacturing process, it is also easy to determine the direct labor cost. But determining the exact overhead costs is not easy, as the cost of electricity needed to dry, crush, and roast the nuts changes depending on the moisture content of the nuts upon arrival.

Until now, you have learned to apply overhead to production based on a predetermined overhead rate typically using an activity base. An **activity base** is considered to be a primary driver of overhead costs, and traditionally, direct labor hours or machine hours were used for it. For example, a production facility that is fairly labor-intensive would likely determine that the more labor hours worked, the higher the overhead will be. As a result, management would likely view labor hours as the activity base when applying overhead costs.

A predetermined overhead rate is calculated at the start of the accounting period by dividing the estimated manufacturing overhead by the estimated activity base. The predetermined overhead rate is then applied to production to facilitate determining a standard cost for a product. This estimated overhead rate will allow a company to determine a cost for the product without having to wait, possibly several months, until all of the actual overhead costs are determined, and to help with issues such as seasonal production or variable overhead costs, such as utilities.

Calculation of Predetermined Overhead and Total Cost under Traditional Allocation

The predetermined overhead rate is set at the beginning of the year and is calculated as the estimated (budgeted) overhead costs for the year divided by the estimated (budgeted) level of activity for the year. This activity base is often direct labor hours, direct labor costs, or machine hours. Once a company determines the overhead rate, it determines the overhead rate per unit and adds the overhead per unit cost to the direct material and direct labor costs for the product to find the total cost.

$$\text{Predetermined Overhead Rate} = \frac{\text{Estimated Overhead Cost (\$)}}{\text{Estimated Activity Base (units or \$)}}$$

To put this method into context, consider this example. Musicality Manufacturing developed a recording device similar to a microphone that allows musicians and music aficionados to record their playing or singing along with any song publicly available. There are three products that vary in features and ability: Solo, Band, and Orchestra. Musicality was started by musicians who majored in math and software engineering while in college. Their main concern was building a quality manufacturing plant, so they used the simpler traditional allocation method. They started by determining their direct costs, which are shown in Figure 6.2.2.

	Solo	Band	Orchestra
Direct Materials per Unit	$ 3.50	$6.00	$11.70
Direct Labor Cost per Unit	10.00	2.75	4.30

Figure 6.2.2: Material and Labor Costs for Musicality. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Musicality determines the overhead rate based on direct labor hours. At the beginning of the year, the company estimates total overhead costs to be $2,500,000 and total direct labor hours to be 1,250,000. The predetermined overhead rate is

$2,500,000 overhead / 1,250,000 labor hours = $2.00 per labor hour

Musicality uses this information to determine the cost of each product. For example, the total direct labor hours estimated for the solo product is 350,000 direct labor hours. With $2.00 of overhead per direct hour, the Solo product is estimated to have $700,000 of overhead applied. When the $700,000 of overhead applied is divided by the estimated production of 140,000 units of the Solo product, the estimated overhead per product for the Solo product is $5.00 per unit. The computation of the overhead cost per unit for all of the products is shown in Figure 6.2.3.

	Solo	Band	Orchestra	Total
Direct Labor Hours per Product	350,000	400,000	500,000	1,250,000
Overhead Rate per Direct Labor Hour	× $2	× $2	× $2	× $2
Overhead Assign per Product	$700,000	$800,000	$1,000,000	$2,500,000
Number Units	140,000	100,000	250,000	490,000
Overhead per Unit	$ 5	$ 8	$ 4	

Figure 6.2.3: Musicality's Overhead per Unit Using Traditional Allocation. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The overhead cost per unit from Figure 6.2.3 is combined with the direct material and direct labor costs as shown in Figure 6.2.2 to compute the total cost per unit as shown in Figure 6.2.4.

	Solo	Band	Orchestra
Direct Materials per Unit	$ 3.50	$ 6.00	$11.70
Direct Labor per Unit	10.00	2.75	4.30
Overhead per Unit	$ 5.00	$ 8.00	$ 4.00
Cost per Unit	$18.50	$16.75	$20.00

Figure 6.2.4: Musicality's Product Costs Using Traditional Allocation. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

After reviewing the product cost and consulting with the marketing department, the sales prices were set. The sales price, cost of each product, and resulting gross profit are shown in Figure 6.2.5.

	Solo	Band	Orchestra
Sales Price	$20.00	$25.00	$30.00
Cost per Unit (traditional)	18.50	16.75	20.00
Gross Profit per Unit	$ 1.50	$ 8.25	$10.00

Figure 6.2.5: Musicality's Gross Profit per Unit Using Traditional Allocation. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Sales of each product have been strong, and the total gross profit for each product is shown in Figure 6.2.6. Using the Solo product as an example, 150,000 units are sold at a price of $20 per unit resulting in sales of $3,000,000. The cost of goods sold consists of direct materials of $3.50 per unit, direct labor of $10 per unit, and manufacturing overhead of $5.00 per unit. With 150,000 units, the direct material cost is $525,000; the direct labor cost is $1,500,000; and the manufacturing overhead applied is $750,000 for a total Cost of Goods Sold of $2,775,000. The resulting Gross Profit is $225,000 or $1.50 per unit.

Traditional Costing	Solo	Band	Orchestra	Total
Number of Units Sold	150,000	110,000	200,000	460,000
Sales	$3,000,000	$2,750,000	$6,000,000	$11,750,000
Less Cost of Goods Sold				
Direct Material	525,000	660,000	2,340,000	3,525,000
Direct Labor	1,500,000	302,500	860,000	2,662,500
Manufacturing Overhead	750,000	880,000	800,000	2,430,000
Cost of Goods Sold	2,775,000	1,842,500	4,000,000	8,617,500
Gross Profit	$ 225,000	$ 907,500	$2,000,000	$ 3,132,500

Figure 6.2.6: Musicality's Gross Profit by Product Line Using Traditional Allocation. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

THINK IT THROUGH

Computing Actual Overhead Costs

As manufacturing technology becomes less expensive and more efficient, the mix between overhead and labor changes so that tasks are more computerized tasks and involve less direct labor; the traditional use of direct labor hours or direct labor dollars changes accordingly. If the predetermined overhead rate is based on direct labor hours and set at the beginning of the year but manufacturing technology leads to a reduction in direct labor during the year, the number of direct labor hours may be less than estimated. This reduces the amount of overhead applied so that the overhead is more likely to be underapplied at the end of the year. Why do companies not wait until the end of the period and compute an actual overhead rate based on actual manufacturing costs and actual units?

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6.3: Describe and Identify Cost Drivers

As you've learned, the most common bases for predetermined overhead are direct labor hours, direct labor dollars, or machine hours. Each of these costs is considered a **cost driver** because of the causal relationship between the base and the related costs: As the cost driver's usage increases, the cost of overhead increases as well. Table 6.3.1 shows various costs and potential cost drivers.

Table 6.3.1: Common Manufacturing Expenses and Potential Cost Drivers

Common Expenses	Potential Cost
• Customer Service • Cleaning Equipment Costs • Marketing Expenses • Office Supplies • Green Floral Tape (indirect material) • Website Maintenance Expense	• Number o • Number o • Number o • Number o • Number o • Number o

The more accurately a company can determine the cost drivers for its products, the more accurate the costing information will be, which in turn allows management to make better use of the cost data in making decisions. As technology changes, however, the mix between materials, labor, and overhead changes. Often, improved technology means less waste of material and fewer direct labor hours, but possibly more overhead. For example, technology has changed the way pharmaceuticals are manufactured. Advancing technology allows for the now smaller labor force to be more productive than a larger labor force from earlier years. While the labor cost has changed, this decrease may only be temporary as a labor force with higher costs and different skills is often needed. Additionally, an increase in technology often raises overhead costs. How accurate, then, is the company's product cost information if it has become more efficient in its production process? Should the company still be using a predetermined overhead application rate based on direct labor hours or machine hours? A detailed analysis of the cost drivers will answer these questions.

Another benefit of looking at cost drivers is that doing so allows a company to analyze all costs. A company can differentiate among costs that drive overhead and have value, those that do not drive overhead but still add value, and those that may or may not drive the overhead but do not add any value. For example, a furniture manufacturer produces and sells wooden tables in various colors. The painting process involves a white base coat, a color coat, and a clear protective topcoat. The three coats are applied in a sealed room using a spraying process followed by an ultraviolet drying process. The depreciation on the spraying machines and the ultraviolet bulbs used in the painting process are overhead costs. These costs drive or increase overhead, and they add value to the product by increasing the quality. Costs associated with repainting or fixing any blemishes are overhead costs that are necessary to sell the product but would not be considered value-added costs. The goal is to eliminate as many of the non-value-added costs as possible and subsequently reduce overhead costs.

Cost Drivers and Overhead

In today's production environment, there are many activities within the production process that can contribute to the cost of the product, but determining the cost drivers may be complicated because some of those activities may change over time. Additionally, the appropriate level of assigning cost drivers needs to be determined. In some cases, overhead costs such as inspection increase with each unit inspected, and the costs need to be allocated on a per-unit level. In other cases, the overhead costs, such as machine setup costs, are incurred each time a batch of products is manufactured and need to be allocated at the batch level.

For example, the labor hours for the staff taking, fulfilling, and inspecting orders may increase as the number of orders increases, driving up the overhead. Furthermore, the costs of taking orders or of quality inspections can vary per product and may not be captured properly. Technology improvements, including switching to automated processes for production, may decrease the labor hours of the production staff, driving the labor-related overhead downward but potentially increasing other overhead expenses. These activities—order taking, fulfillment, and quality inspections—are potential cost drivers associated with production, and they

each drive the overhead at varying rates.

THINK IT THROUGH

Identifying Cost Drivers

Cost drivers vary widely among companies.

1. After costs are accumulated into cost pools, what information would help management select the appropriate cost driver?
2. Name an appropriate cost driver for each of the following cost pools:
   A. Plant cleaning and maintenance
   B. Factory supervision
   C. Machine maintenance
   D. Machine setups

Identify Cost Drivers

How does a company determine its cost drivers for indirect materials, indirect labor, and other overhead costs? To begin the determination of appropriate cost drivers, an accountant analyzes the activities in the product production process that contribute to the cost of that product. An activity is any action that consumes company resources, such as taking orders for a product, setting up machines to produce the product, inspecting the product, and providing customer support before and through the order process. For example, Musicality's direct costs can be traced to the products, but there are indirect costs associated with using various types of material for each product. While the Orchestra product has more intricate materials and labor, it has fewer costs associated with requisitioning and conveying materials to the production line than the other products have. Additionally, examining the inspection costs indicates the Orchestra product is a simple product to inspect, so random quality inspections are sufficient. But individual inspections for both the Solo and Band products are critical, and the overhead related to inspection costs should be based on the number of inspections.

As you can imagine, the unique aspects of the production process for each product affect the overhead cost of each product. However, these costs may not be allocated to the products appropriately when overhead is applied using a predetermined rate based on one activity. While Solo, Band, and Orchestra might appear to be different only in quality, they are actually very different from each other when it comes to manufacturing overhead costs.

Whether the products produced require significantly different overhead resources or not, the company benefits from understanding what its cost drivers are. The more efficiently each product's activities are tracked, the more actual cost drivers are discovered, and the more accurately overhead can be assigned to each product.

CONCEPTS IN PRACTICE

Cost Drivers for Small Businesses

The value of analyzing cost drivers can be used in budgeting beyond allocating overhead to products. **American Express** has forums designed to help small businesses be successful. Knowing the cost drivers for your business can help with budgeting. American Express states that all business activities are related to five main cost drivers:

- Employee headcount is often the driver for office supply expense.
- Salesperson headcount is often the driver for auto and other employee travel expense.
- The number of leads required to reach the target sales goal is often the driver for advertising, public relations, social media, search engine optimization expense, and other expenses associated with generating leads.
- Sales and all related variable expenses are often the driver for commissions, bad debt, insurance expense, and so on.
- Fixed costs, such as postage, web hosting fees, business licenses, and banking fees, are often overlooked as cost drivers.

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6.4: Calculate Activity-Based Product Costs

As technology changes the ratio between direct labor and overhead, more overhead costs are linked to drivers other than direct labor and machine hours. This shift in costs gives companies the opportunity to stop using the traditional single predetermined overhead rate applied to all units of production and instead use an overhead allocation approach based on the actual activities that drive overhead. Making this change allows management to obtain more accurate product cost information, which leads to more informed decisions. **Activity-based costing** (ABC) is the process that assigns overhead to products based on the various activities that drive overhead costs.

Historical Perspective on Determination of Manufacturing Overhead Allocation

All products consist of material, labor, and overhead, and the major cost components have historically been materials and labor. Manufacturing overhead was not a large cost of the product, so an overhead allocation method based on labor or machine hours was logical. For example, as shown in Figure 6.2.2, Musicality determined the direct costs and direct labor for their three products: Solo, Band, and Orchestra. Under the traditional method of costing, the predetermined overhead rate of $2 per direct labor hour was computed by dividing the estimated overhead by the estimated direct labor hours. Based on the number of direct labor hours and the number of units produced for each product, the overhead per product is shown in Figure 6.2.3.

As technology costs decreased and production methods became more efficient, overhead costs changed and became a much larger component of product costs. For many companies, and in many cases, overhead costs are now significantly larger than labor costs. For example, in the last few years, many industries have increased technology, and the amount of overhead has doubled. Technology has changed the manufacturing labor force, and therefore, the type and cost of labor associated with those jobs have changed. In addition, technology has made it easier to track the various activities and their related overhead costs.

Many manufacturing companies use MRP (material requirements planning) or ERP (enterprise resource planning) systems. MRP helps management organize the planning, scheduling, and tracking of materials while ERP systems help plan, organize, and track the materials as well as the accounting, marketing, supply chain, and other management functions.

Costs can be gathered on a unit level, batch level, product level, or factory level. The idea behind these various levels is that at each level, there are additional costs that are encountered, so a company must decide at which level or levels it is best for the company to accumulate costs. A **unit-level cost** is incurred each time a unit of product is produced and includes costs such as materials and labor. A **batch-level cost** is incurred every time a batch of items is manufactured, for example, costs associated with purchasing and receiving materials. A **product-level cost** is incurred each time a product is produced and includes costs such as engineering costs, testing costs, or quality control costs. A **factory-level cost** is incurred because products are being produced and includes costs such as the plant supervisor's salary and rent on the factory building. By definition, indirect labor is not traced to individual products. However, it is possible to track some indirect labor to several jobs or batches. A similar amount of information can be derived for indirect material. An example of an indirect material in some manufacturing processes is cleaning solution. For example, one type of cleaning solution is used in the manufacturing of pop sockets. It is not practical to measure every ounce of cleaning solution used in the manufacture of an individual pop socket; rather, it makes sense to allocate to a particular batch of pop sockets the cost of the cleaning solution needed to make that batch. Likewise, a manufacturer of frozen french fries uses a different type of solution to clean potatoes prior to making the french fries and would allocate the cost of the solution based on how much is used to make each batch of fries.

Establishing an Activity-Based Costing System

ABC is a five-stage process that allocates overhead more precisely than traditional allocation does by applying it to the products that use those activities. ABC works best in complex processes where the expenses are not driven by a single cost driver. Instead, several cost drivers are used as the overhead costs are analyzed and grouped into activities, and each activity is allocated based on each group's cost driver. The five stages of the ABC process are:

1. Identify the activities performed in the organization
2. Determine activity cost pools
3. Calculate activity rates for each cost pool
4. Allocate activity rates to products (or services)
5. Calculate unit product costs

The first step is to identify activities needed for production. An activity is an action or process involved in the production of inventory. There can be many activities that consume resources, and management will need to narrow down the activities to those that have the biggest impact on overhead costs. Examples of these activities include:

- Taking orders
- Setting up machines
- Purchasing material
- Assembling products
- Inspecting products
- Providing customer service

The second step is assigning overhead costs to the identified activities. In this step, overhead costs are assigned to each of the activities to become a cost pool. A **cost pool** is a list of costs incurred when related activities are performed. Table 6.4.1 illustrates the various cost pools along with their activities and related costs.

Table 6.4.1: Cost Pools and Their Activities and Related Costs

Cost Pool	Activities and Related Costs
Production	• Indirect labor setting up machines • Indirect labor cost of accepting and verifying orders • Machine maintenance costs • Costs to operate the machine: utilities, insurance, etc.
Purchasing material	• Preparing purchase requisitions for the material • Cost to move material from receiving department into production • Depreciation of equipment used to move material
Inspect products	• Inspection supervisor costs • Cost to move product to and from the inspection area
Assemble products	• Cost of assembly machine • Cost of label machine • Cost of labels
Technological production	• Website maintenance • Depreciation of computers

For example, the production cost pool consists of costs such as indirect labor for those accepting the order, verifying the customer has credit to pay for the order, maintenance and depreciation on the machines used to produce the orders, and utilities and rent for operating the machines. Figure 6.4.1 illustrates how the costs in each pool are allocated to each product in a different proportion.

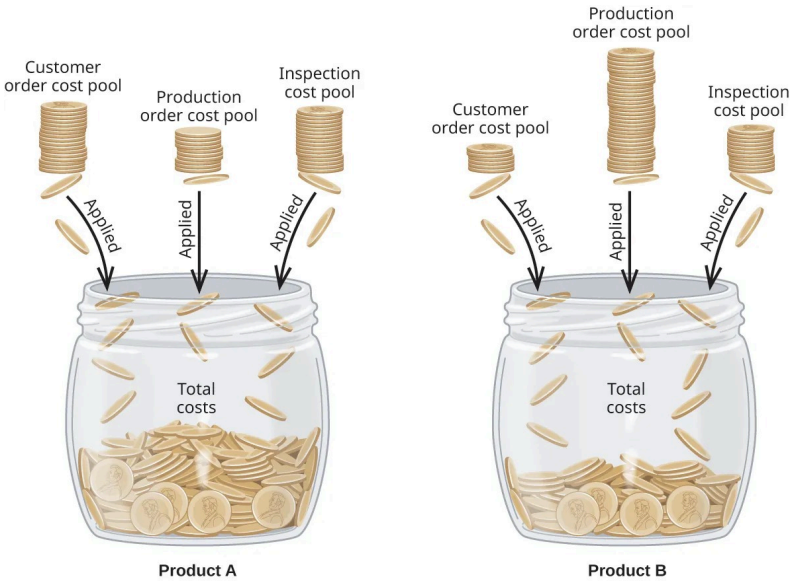


Figure 6.4.1: Allocating Overhead by Cost Pool. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Once the costs are grouped into similar cost pools, the activities in each pool are analyzed to determine which activity "drives" the costs in that pool, leading to the third step of ABC: identify the cost driver for each cost pool and estimate an annual level of activity for each cost driver. As you've learned, the cost driver is the specific activity that drives the costs in the cost pools. Table 6.4.2 shows some activities and cost drivers for those activities.

Table 6.4.2: Activities and Their Common Cost Drivers

Cost Pool	Cost Driver
Customer order	Number of orders
Production	Machine setups
Purchasing materials	Purchase requisitions
Assembling products	Direct labor hours
Inspecting products	Inspection hours
Customer service	Number of contacts with customer

The fourth step is to compute the predetermined overhead rate for each of the cost drivers. This portion of the process is similar to finding the traditional predetermined overhead rate, where the overhead rate is divided by direct labor dollars, direct labor hours, or machine hours. Each cost driver will have its own overhead rate, which is why ABC is a more accurate method of allocating overhead.

Finally, step five is to allocate the overhead costs to each product. The predetermined overhead rate found in step four is applied to the actual level of the cost driver used by each product. As with the traditional overhead allocation method, the actual overhead costs are accumulated in an account called manufacturing overhead and then applied to each of the products in this step.

Notice that steps one through three represent the process of allocating overhead costs to activities, and steps four and five represent the process of allocating the overhead costs that have been assigned to activities to the products to which they pertain. Thus, the five steps of ABC involve two major processes: first, allocating overhead costs to the various activities to get a cost per activity, and then allocating the cost per activity to each product based on that product's usage of the activities.

Now that the steps involved have been detailed, let's demonstrate the calculations using the Musicality example.

YOUR TURN

Comparing Estimates to Actual Costs

A company has determined that its estimated 500,000 machine hours is the optimal driver for its estimated $1,000,000 machine overhead cost pool. The $750,000 in the material overhead cost pool should be allocated using the estimated 15,000 material requisition requests. How much is over- or underapplied if there were actually 490,000 machine hours and 15,500 material requisitions that resulted in $950,000 in the machine overhead cost pool, and $780,000 in the material cost pool? What does this difference indicate?

Answer available at the end of this section.

The Calculation of Product Costs Using the Activity-Based Costing Allocation Method

Musicality is considering switching to an activity-based costing approach for determining overhead and has collected data to help them decide which overhead allocation method they should use. Performing the analysis requires these steps:

1. Identify cost pools necessary to complete the product. Musicality determined its cost pools are:
   - Setting up machines
   - Purchasing material
   - Inspecting products
   - Assembling products
   - Technological production
2. Assign overhead cost to the cost pools. Musicality has estimated the overhead for each cost pool to be:

Activity	Estimated Overhead Costs
Setting Up Machines	$ 200,000
Purchasing Material	500,000
Inspecting Products	300,000
Assembling Products	600,000
Technological Production	900,000
Total	$2,500,000

3. Identify the cost driver for each activity, and estimate an annual activity for each driver. Musicality determined the driver and estimated activity for each product to be the following:

	Expected Cost Driver Activities			
Cost Driver	Solo	Band	Orchestra	Total
Machine Setups	2,000	1,500	1,500	5,000
Number of Purchase Requisitions	5,000	4,000	1,000	10,000
Inspection Hours	10,000	9,000	1,000	20,000
Number of Parts Requiring Labor	15,000	3,000	12,000	30,000
Machine Hours	80,000	60,000	10,000	150,000

4. Compute the predetermined overhead for each cost driver. Musicality determined this predetermined overhead rate for each driver:

Activity	Cost Driver	Estimated Overhead Costs	Total Activity	ABC Rate per Activity
Setting Up Machines	Machine setups	$ 200,000	5,000	$40
Purchasing Material	Number of purchase requisitions	500,000	10,000	50
Inspecting Products	Inspection hours	300,000	20,000	15
Assembling Products	Number of parts requiring labor	600,000	30,000	20
Technological Production	Machine hours	900,000	150,000	6
Total		$ 2,500,000		

5. Allocate overhead costs to products. Assuming Musicality's activities were as estimated, the amount allocated to each product is:

	Expected Cost Driver Activities			
Activity	Solo	Band	Orchestra	Total
Machine Setups	$ 80,000	$ 60,000	$ 60,000	$ 200,000
Number of Purchase Requisitions	250,000	200,000	50,000	500,000
Inspection Hours	150,000	135,000	15,000	300,000
Number of Parts Requiring Labor	300,000	60,000	240,000	600,000
Machine Hours	480,000	360,000	60,000	900,000
Total Overhead	$1,260,000	$815,000	$425,000	$2,500,000

Now that Musicality has applied overhead to each product, they can calculate the cost per unit. Management can review its sales price and make necessary decisions regarding its products. The overhead cost per unit is the overhead for each product divided by the number of units of each product:

Activity	Solo	Band	Orchestra	Total
Total Overhead	$1,260,000	$815,000	$425,000	$2,500,000
Number Units	140,000	100,000	250,000	490,000
Overhead per Unit	$ 9.00	$ 8.15	$ 1.70	

The overhead per unit can be added to the unit cost for direct material and direct labor to compute the total product cost per unit:

	Solo	Band	Orchestra
Direct Materials per Unit	$ 3.50	$ 6.00	$11.70
Direct Labor per Unit	10.00	2.75	4.30
Overhead per Unit	9.00	8.15	1.70
Cost per Unit via ABC	$22.50	$16.90	$17.70

The sales price was set after management reviewed the product cost with traditional allocation along with other factors such as competition and product demand. The current sales price, cost of each product using ABC, and the resulting gross profit are shown in Figure 6.4.2.

	Solo	Band	Orchestra
Sales Price	$20.00	$25.00	$30.00
Cost per Unit (ABC)	22.50	16.90	17.70
Gross Profit (loss) per Unit	$(2.50)	$ 8.10	$12.30

Figure 6.4.2: Solo's Sales Price, ABC Costing, and Gross Profit. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The loss on each sale of the Solo product was not discovered until the company did the calculations for the ABC method, because the sales of the other products were strong enough for the company to retain a total gross profit.

Additionally, the more accurate gross profit for each product calculated using ABC is shown in Figure 6.4.3:

	Solo	Band	Orchestra	Total
Number of Units Sold	150,000	110,000	200,000	460,000
ABC Costing				
Sales	$3,000,000	$2,750,000	$6,000,000	$11,750,000
Cost of Goods Sold	3,375,000	1,859,000	3,540,000	8,774,000
Gross Profit (loss)	$ (375,000)	$ 891,000	$2,460,000	$ 2,976,000

Figure 6.4.3: Solo's Gross Profit by Product. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The calculations Musicality did in order to switch to ABC revealed that the Solo product was generating a loss for every unit sold. Knowing this information will allow Musicality to consider whether they should make changes to generate a profit from the Solo product, such as increase the selling price or carefully analyze the costs to identify potential cost reductions. Musicality could also decide to continue selling Solo at a loss, because the other products are generating enough profit for the company to absorb the Solo product loss and still be profitable. Why would a company continue to sell a product that is generating a loss? Sometimes these products are ones for which the company is well known or that draw customers into the store. For example, companies will sometimes offer extreme sales, such as on Black Friday, to attract customers in the hope that the customers will purchase other products. This information shows how valuable ABC can be in many situations for providing a more accurate picture than traditional allocation.

The Service Industries and Their Use of the Activity-Based Costing Allocation Method

ABC costing was developed to help management understand manufacturing costs and how they can be better managed. However, the service industry can apply the same principles to improve its cost management. Direct material and direct labor costs range from nonexistent to minimal in the service industry, which makes the overhead application even more important. The number and types of cost pools may be completely different in the service industry as compared to the manufacturing industry. For example, the healthcare industry may have different overhead costs and cost drivers for the treatment of illnesses than they have for injuries. Some of the overhead related to monitoring a patient's health status may overlap, but most of the overhead related to diagnosis and treatment differ from each other.

LINK TO LEARNING

Activity-based costing is not restricted to manufacturing. Service industries also have cost drivers and can benefit from analyzing what drives their costs. See this report on activity-based costing at **UPS** for an example.

Answers

YOUR TURN

The predetermined overhead rate is $2 per machine hour ($1,000,000/500,000 machine hours) and $50 per material requisition ($750,000/15,000 requisitions). The actual and applied overhead can then be calculated to determine whether it is over- or underapplied:

	Rate	Actual	Applied	Difference	Overapplied or Underapplied?
Machine Overhead	$ 2*	490,000*	$980,000	$30,000	Overapplied
Material Overhead	$50**	15,500**	$775,000	$(5,000)	Underapplied

* machine hours
**requisitions

The difference is a combination of factors. There were fewer machine hours than estimated, but there was also less overhead than estimated. There were more requisitions than estimated, and there was also more overhead.

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6.5: Compare and Contrast Traditional and Activity-Based Costing Systems

Calculating an accurate manufacturing cost for each product is a vital piece of information for a company's decision-making. For example, knowing the cost to produce a unit of product affects not only how a business budgets to manufacture that product, but it is often the starting point in determining the sales price.

An important component in determining the total production costs of a product or job is the proper allocation of overhead. For some companies, the often less-complicated traditional method does an excellent job of allocating overhead. However, for many products, the allocation of overhead is a more complex issue, and an activity-based costing (ABC) system is more appropriate.

Another factor to consider in determining which of the two major overhead allocation methods to use is the cost associated with collecting and analyzing information. When making their decision regarding which method to use, the company must consider these costs, both in time and money. Table 6.5.1 compares overhead in the two systems. In many cases, the ABC method is more expensive in terms of time and other costs.

The difference between the traditional method (using one cost driver) and the ABC method (using multiple cost drivers) is more complex than simply the number of cost drivers. When direct labor is a large portion of the product cost, the overhead costs tend to be consistently driven by one cost driver, which is typically direct labor or machine hours; the traditional method appropriately allocates those costs. When technology is a large portion of the product cost, the overhead costs tend to be driven by multiple drivers, so using multiple cost drivers in the ABC method allows for a more precise allocation of overhead.

Table 6.5.1: Overhead in Traditional versus ABC Costing

	Traditional	ABC
Overhead assigned	Single cost driver	Multiple cost driv
Optimal usage	When direct labor is a large portion of the product cost	When technology
Orientation	Cost driven	Process driven

As shown with Musicality's products, not only are there different costs for each product when comparing traditional allocation with an activity-based costing, but ABC showed that the Solo product creates a loss for the company. Activity-based costing is a more accurate method, because it assigns overhead based on the activities that drive the overhead costs. It can be concluded, then, that the cost and subsequent gross loss for each unit's sales provide a more accurate picture than the overall cost and gross profit under the traditional method. Table 6.5.1 compares the cost per unit using the different cost systems and shows how different the costs can be depending on the method used.

	Solo	Band	Orchestra
Cost per Unit via ABC	$22.50	$16.90	$17.70
Cost per Unit via Traditional	18.50	16.75	20.00
Difference	$ 4.00	$ 0.15	$(2.30)

Advantages and Disadvantages of the Traditional Method of Calculating Overhead

The traditional allocation system assigns manufacturing overhead based on a single cost driver, such as direct labor hours, direct labor dollars, or machine hours, and is optimal when there is a relationship between the activity base and overhead. This most

often occurs when direct labor is a large part of the product cost. The theory supporting the single cost driver is that the cost driver selected increases as overhead increases, and further analysis is more costly than it is valuable. Each method has its advantages and disadvantages. These are advantages of the traditional method:

- All manufacturing costs are classified as material, labor, or overhead and assigned to products regardless of whether they drive or are driven by production.
- All manufacturing costs are considered to be part of the product cost, whereas nonmanufacturing costs are not considered to be production costs and are not assigned to products, regardless of whether the costs are based on the products. For example, the machines used to receive and process customer orders are necessary because product orders must be taken, but their costs are not allocated to particular products.
- There is only one overhead cost pool and a single measure of activity, such as direct labor hours, which makes the traditional method simple and less costly to maintain. The predetermined overhead rate is based on estimated costs at the budgeted level of activity. Therefore, the overhead rate is consistent across products, but overhead may be over- or underapplied.

Disadvantages of the traditional method include:

- The use of the single cost driver does not allocate overhead as accurately as using multiple cost drivers.
- The use of the single cost driver may overallocate overhead to one product and underallocate overhead to another product, resulting in erroneous total costs and potentially setting an incorrect sales price.
- Traditional allocation assigns costs as period or product costs, and all product costs are included in the cost of inventory, which makes this method acceptable for generally accepted accounting principles (GAAP).

THINK IT THROUGH

ABC Method and Financial Statements

There are pros and cons to both the traditional and the ABC system. One advantage of the ABC system is that it provides more accurate information on the costs to manufacture products, but it does not show up on the financial statements. Explain how this costing information has value if it does not appear on the financial statements.

Advantages and Disadvantages of Creating an Activity-Based Costing System for Allocating Overhead

While ABC systems more accurately allocate the costs based on the various resources used to make the product, they cost more to use and, therefore, are not always the best method. Management needs to consider each system and how it will work within its own organization. Some advantages of activity-based costing include:

- There are multiple overhead cost pools, and each has its own unique measure of activity. This provides more accurate rates for applying overhead, but it takes more time to implement and results in a higher cost.
- The allocation bases (i.e., measures of activity) often differ from those used in traditional allocation. Multiple cost pools allow management to group costs being influenced by similar drivers and to consider cost drivers beyond the typical labor or machine hour. This results in a more accurate overhead application rate.
- The activity rates may consider the level of activity at capacity instead of the budgeted level of activity.
- Both nonmanufacturing costs and manufacturing costs may be assigned to products. The main rationale in assigning costs is the relationship between the cost and the product. If the cost increases as the volume of the product increases, it is considered part of overhead.

There are disadvantages to using ABC costing that management needs to consider when determining which method to use. Those disadvantages include:

- Some manufacturing costs may be excluded from product costs. For example, the cost to heat the factory may be excluded as a product cost because, while it is necessary for production, it does not fit into one of the activity-driven cost pools.
- It is more expensive, as there is a cost to collect and analyze cost driver information as well as to allocate overhead on the basis of multiple cost drivers.
- An ABC system takes much more to implement and operate, as information on cost drivers must be collected in an objective manner.

The advantages and disadvantages of both methods are as previously listed, but what is the practical impact on the product cost? There are several items to consider at the product costs level:

- Adopting an ABC overhead allocation system can allow a company to shift manufacturing overhead costs between products based on their volume.
- Using an ABC method to better assign unit-level, batch-level, product-level, and factory-level costs can increase the per-unit costs of the low-volume products and decrease the per-unit costs of the high-volume products.
- The effects are not symmetrical; there is usually a larger change in the per-unit costs of the low-volume products.
- The cost of the products may include some period costs but not some of the product costs, so it is not considered GAAP compliant. The information is supplemental and very helpful to management, but the company still needs to compute the product's cost under the traditional method for financial reporting.

LINK TO LEARNING

Changing from the traditional allocation method to ABC costing is not as simple as having management dictate that employees follow the new system. There are often challenges that begin with convincing employees that it will provide benefits and that they should buy into the new system. See this 1995 article, *Tapping the Full Potential of ABC*, illustrating some of **Chrysler**'s challenges to learn more.

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7: COST-VOLUME-PROFIT (CVP) ANALYSIS

Learning Objectives

- Explain cost-volume-profit analysis, degree of operating leverage, and safety margin
- Prepare calculations using cost-volume-profit analysis tools
- Analyze business decisions using cost-volume-profit analysis

7.1: Why It Matters

7.2: Explain Contribution Margin and Calculate Contribution Margin per Unit, Contribution Margin Ratio, and Total Contribution Margin

7.3: Calculate a Break-Even Point in Units and Dollars

7.4: Perform Break-Even Sensitivity Analysis for a Single Product Under Changing Business Situations

7.5: Perform Break-Even Sensitivity Analysis for a Multi-Product Environment Under Changing Business Situations

7.6: Calculate and Interpret a Company's Margin of Safety and Operating Leverage

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7.1: Why It Matters

As president of the Accounting Club, you are working on a fundraiser selling T-shirts on campus. You have gotten quotes from several suppliers ranging from $8 to $10 per shirt and now have to select a vendor. The prices vary based on whether the T-shirts have pockets, have long sleeves or short sleeves, and are printed on one side or both. You are confident that you can sell them for $15 each. However, the college charges clubs a $100 “student sale” fee, and your T-shirt sales must cover this cost and still net the club enough money to pay for your spring trip

In addition, several of the vendors will give volume discounts—the more shirts you purchase, the less each shirt costs. In short, you need to know exactly which style of T-shirt, vendor, and quantity will allow you to reach your desired net income and cover your fixed expense of $100. You decide on a short-sleeve shirt with a pocket that costs $10 each and that you can sell for $15.

This $5 per shirt “gross profit” will first go toward covering the $100 student sale fee. That means you will have to sell 20 shirts to pay the fee ($100/$5 = 20 shirts). After selling the first 20 shirts, the $5 profit will be available to start paying for the cost of the trip. Your faculty advisor has calculated that the trip will cost $125 per student, and you have 6 people signed up for the trip. This means the sale will need to generate an additional $750 from the sale (6 students × $125). At $5 per shirt, you will need to sell 150 shirts to cover the student costs ($750/$5). So, you will need to sell a total of 170 shirts: 20 to cover your fixed cost of $100 and an additional 150 to cover the student’s cost of the trip ($750). What you have just completed is a cost-volume-profit analysis. In this chapter, we will explore how managers can use this type of analysis to make a wide range of decisions about their business operations.

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7.2: Explain Contribution Margin and Calculate Contribution Margin per Unit, Contribution Margin Ratio, and Total Contribution Margin

Before examining contribution margins, let's review some key concepts: fixed costs, relevant range, variable costs, and contribution margin. Fixed costs are those costs that will not change within a given range of production. For example, in the current case, the fixed costs will be the student sales fee of $100. No matter how many shirts the club produces within the relevant range, the fee will be locked in at $100. The **relevant range** is the anticipated production activity level. Fixed costs remain constant within a relevant range. If production levels exceed expectations, then additional fixed costs will be required.

For example, assume that the students are going to lease vans from their university's motor pool to drive to their conference. A university van will hold eight passengers, at a cost of $200 per van. If they send one to eight participants, the fixed cost for the van would be $200. If they send nine to sixteen students, the fixed cost would be $400 because they will need two vans. We would consider the relevant range to be between one and eight passengers, and the fixed cost in this range would be $200. If they exceed the initial relevant range, the fixed costs would increase to $400 for nine to sixteen passengers.

Variable costs are those costs that vary per unit of production. Direct materials are often typical variable costs, because you normally use more direct materials when you produce more items. In our example, if the students sold 100 shirts, assuming an individual variable cost per shirt of $10, the total variable costs would be $1,000 (100 × $10). If they sold 250 shirts, again assuming an individual variable cost per shirt of $10, then the total variable costs would $2,500 (250 × $10).

Contribution margin is the amount by which a product's selling price exceeds its total variable cost per unit. This difference between the sales price and the per unit variable cost is called the contribution margin because it is the per-unit contribution toward covering the fixed costs. It typically is calculated by comparing the sales revenue generated by the sale of one item versus the variable cost of the item:

$$\text{Contribution Margin} = \text{Sales} - \text{Variable Costs}$$

In our example, the sales revenue from one shirt is $15 and the variable cost of one shirt is $10, so the individual contribution margin is $5. This $5 contribution margin is assumed to first cover fixed costs first and then realized as profit.

As you will see, it is not just small operations, such as the accounting club scenario provided in Why It Matters, that benefit from cost-volume-profit (CVP) analysis. At some point, all businesses find themselves asking the same basic questions: How many units must be sold in order to reach a desired income level? How much will each unit cost? How much of the sales price from each unit will help cover our fixed costs? For example, **Starbucks** faces these same questions every day, only on a larger scale. When they introduce new menu items, such as seasonal specialty drinks, they must determine the fixed and variable costs associated with each item. Adding menu items may not only increase their fixed costs in the short run (via advertising and promotions) but will bring new variable costs. **Starbucks** needs to price these drinks in a way that covers the variable costs per unit and additional fixed costs and contributes to overall net income. Regardless of how large or small the enterprise, understanding how fixed costs, variable costs, and volume are related to income is vital for sound decision-making.



Figure 7.2.1: Starbucks. Large corporations like **Starbucks** use cost-volume-profit analysis to make decisions about their products and services to ensure that they are maximizing their revenues. (credit: modification of “StarbucksVaughanMills” by “Raysonho”/Wikimedia Commons, CC0)

Understanding how to use fixed costs, variable costs, and sales in CVP analyses requires an understanding of the term margin. You may have heard that restaurants and grocery stores have very low margins, while jewelry stores and furniture stores have very high margins. What does “margin” mean? In the broadest terms, margin is the difference between a product or service's selling price and its cost of production. Recall the accounting club’s T-shirt sale. The difference between the sales price per T-shirt and the purchase price of the T-shirts was the accounting club’s margin:

Sales Price	$15
Cost per T-shirt	10
Margin	$ 5

Earlier, we learned about the characteristics of fixed and variable costs and introduced the basics of cost behavior. Let’s now apply these behaviors to the concept of contribution margin. The company will use this “margin” to cover fixed expenses and hopefully to provide a profit. Let’s begin by examining contribution margin on a per-unit basis.

Unit Contribution Margin

When the contribution margin is calculated on a per-unit basis, it is referred to as the contribution margin per unit or unit contribution margin. You can find the contribution margin per unit using the equation shown below.

Per Unit Sales Price – Variable Cost per Unit = Contribution Margin per Unit

It is important to note that this unit contribution margin can be calculated either in dollars or as a percentage. To demonstrate this principle, let’s consider the costs and revenues of Hicks Manufacturing, a small company that manufactures and sells birdbaths to specialty retailers.

Hicks Manufacturing sells its Blue Jay Model for $100 and incurs variable costs of $20 per unit. In order to calculate their per-unit contribution margin, we use the formula above to determine that on a *per-unit* basis, their contribution margin is:

HICKS MANUFACTURING Blue Jay Model For Year Ended December 31, 2019	
Sales Price per Unit	$100
– Variable Cost per Unit	20
= Contribution Margin per Unit	$ 80

This means that for every Blue Jay model they sell, they will have $80 to *contribute* toward covering fixed costs, such as rent, insurance, and manager salaries. But Hicks Manufacturing manufactures and sells more than one model of birdbath. They also sell a Cardinal Model for $75, and these birdbaths incur variable costs of $15 per unit. For the Cardinal Model, their contribution margin on a per unit basis is the $75 sales price less the $15 per unit variable costs is as follows:

HICKS MANUFACTURING Cardinal Model For Year Ended December 31, 2019	
Sales Price per Unit	$75
– Variable Cost per Unit	15
= Contribution Margin per Unit	$60

This demonstrates that, for every Cardinal model they sell, they will have $60 to *contribute* toward covering fixed costs and, if there is any left, toward profit. Every product that a company manufactures or every service a company provides will have a unique contribution margin per unit. In these examples, the contribution margin per unit was calculated in dollars per unit, but another way to calculate contribution margin is as a ratio (percentage).

Contribution Margin Ratio

The **contribution margin ratio** is the percentage of a unit's selling price that exceeds total unit variable costs. In other words, contribution margin is expressed as a percentage of sales price and is calculated using this formula:

$$\text{Contribution Margin Ratio} = \frac{\text{Contribution Margin per Unit}}{\text{Sales Price per Unit}}$$

For Hicks Manufacturing and their Blue Jay Model, the contribution margin ratio will be:

$$\frac{\$80 \text{ Contribution Margin per Unit}}{\$100 \text{ Sales Price per Unit}} = 0.80$$

At a contribution margin ratio of 80%, approximately $0.80 of each sales dollar generated by the sale of a Blue Jay Model is available to cover fixed expenses and contribute to profit. The contribution margin ratio for the birdbath implies that, for every $1 generated by the sale of a Blue Jay Model, they have $0.80 that contributes to fixed costs and profit. Thus, 20% of each sales dollar represents the variable cost of the item and 80% of the sales dollar is margin. Just as each product or service has its own contribution margin on a per unit basis, each has a unique contribution margin ratio. Although this process is extremely useful for analyzing the profitability of a single product, good, or service, managers also need to see the "big picture" and will examine contribution margin in total across all products, goods, or services.

YOUR TURN

Margin at the Kiosk

You rent a kiosk in the mall for $300 a month and use it to sell T-shirts with college logos from colleges and universities all over the world. You sell each T-shirt for $25, and your cost for each shirt is $15. You also pay your salesperson a commission of $0.50 per T-shirt sold in addition to a salary of $400 per month. Construct a contribution margin income statement for two different months: in one month, assume 100 T-shirts are sold, and in the other, assume 200 T-shirts are sold.

Answer available at the end of this section.

Total Contribution Margin

This "big picture" is gained by calculating **total contribution margin**—the total amount by which total sales exceed total variable costs. We calculate total contribution margin by multiplying per unit contribution margin by sales volume or number of units sold. This approach allows managers to determine how much profit a company is making before paying its fixed expenses. For Hicks Manufacturing, if the managers want to determine how much their Blue Jay Model contributes to the overall profitability of the company, they can calculate total contribution margin as follows:

Hicks Manufacturing Blue Jay Model, For the Month Ended April, 2019. Units Sold 500 times Contribution Margin per Unit $80 equals Total Contribution Margin $40,000.

For the month of April, sales from the Blue Jay Model contributed $36,000 toward fixed costs. Looking at contribution margin in total allows managers to evaluate whether a particular product is profitable and how the sales revenue from that product contributes to the overall profitability of the company. In fact, we can create a specialized income statement called a contribution margin income statement to determine how changes in sales volume impact the bottom line.

To illustrate how this form of income statement can be used, contribution margin income statements for Hicks Manufacturing are shown for the months of April and May.

In April, Hicks sold 500 Blue Jay Models at $100 per unit, which resulted in the operating income shown on the contribution margin income statement:

HICKS MANUFACTURING Contribution Margin Income Statement For Month Ended April, 2019	
Sales (500 units at $100 per unit)	$50,000
Variable Cost (500 units at $20 per unit)	10,000
Contribution Margin	40,000
Fixed Costs	23,000
Operating Income	$17,000

In May, 750 of the Blue Jay models were sold as shown on the contribution margin income statement. When comparing the two statements, take note of what changed and what remained the same from April to May.

HICKS MANUFACTURING Contribution Margin Income Statement For Month Ended May, 2019	
Sales (750 units at $100 per unit)	$75,000
Variable Cost (750 units at $20 per unit)	15,000
Contribution Margin	60,000
Fixed Costs	23,000
Operating Income	$37,000

Using this contribution margin format makes it easy to see the impact of changing sales volume on operating income. Fixed costs remained unchanged; however, as more units are produced and sold, more of the per-unit sales price is available to contribute to the company's net income.

Before going further, let's note several key points about CVP and the contribution margin income statement. First, the contribution margin income statement is used for *internal* purposes and is not shared with external stakeholders. Secondly, in this specialized income statement, when "*operating* income" is shown, it actually refers to "net operating income" *without regard to income taxes*. Companies can also consider taxes when performing a CVP analysis to project both net operating income and net income. (The preparation of contribution margin income statements with regard to taxes is covered in advanced accounting courses; here, we will consider net income as net operating income without regard to taxes.)

Regardless of whether contribution margin is calculated on a per-unit basis, calculated as a ratio, or incorporated into an income statement, all three express how much sales revenue is available to cover fixed expenses and contribute to profit. Let's examine how all three approaches convey the same financial performance, although represented somewhat differently.

You will recall that the per-unit contribution margin was $80 for a Hicks Blue Jay birdbath. When Hicks sold 500 units, each unit

contributed $80 to fixed expenses and profit, which can be verified from April's income statement:

April Total Contribution Margin	$40,000
Per Unit Contribution Margin	$ 80

$$\frac{\text{Total Contribution Margin}}{\text{Per Unit Contribution Margin}} = \text{Number of Units Sold} = \frac{\$40{,}000}{80} = 500 \text{ units}$$

Now, let's use May's Contribution Margin Income Statement as previously calculated to verify the contribution margin based on the contribution margin ratio previously calculated, which was 80%, by applying this formula:

$$\text{Total Sales} \times \text{Contribution Margin Ratio} = \text{Total Contribution Margin}$$

May Total Sales	$75,000
Contribution Margin Ratio	80%

$$\$75{,}000 \times 0.80 = \$60{,}000$$

Regardless of how contribution margin is expressed, it provides critical information for managers. Understanding how each product, good, or service contributes to the organization's profitability allows managers to make decisions such as which product lines they should expand or which might be discontinued. When allocating scarce resources, the contribution margin will help them focus on those products or services with the highest margin, thereby maximizing profits.

The Evolution of Cost-Volume-Profit Relationships

The CVP relationships of many organizations have become more complex recently because many labor-intensive jobs have been replaced by or supplemented with technology, changing both fixed and variable costs. For those organizations that are still labor-intensive, the labor costs tend to be variable costs, since at higher levels of activity there will be a demand for more labor usage. For example, assuming one worker is needed for every 50 customers per hour, we might need two workers for an average sales season, but during the Thanksgiving and Christmas season, the store might experience 250 customers per hour and thus would need five workers.

However, the growing trend in many segments of the economy is to convert labor-intensive enterprises (primarily variable costs) to operations heavily dependent on equipment or technology (primarily fixed costs). For example, in retail, many functions that were previously performed by people are now performed by machines or software, such as the self-checkout counters in stores such as **Walmart**, **Costco**, and **Lowe's**. Since machine and software costs are often depreciated or amortized, these costs tend to be the same or fixed, no matter the level of activity within a given relevant range.

In China, completely unmanned grocery stores have been created that use facial recognition for accessing the store. Patrons will shop, bag the purchased items, leave the store, and be billed based on what they put in their bags. Along with managing the purchasing process, inventory is maintained by sensors that let managers know when they need to restock an item.

In the United States, similar labor-saving processes have been developed, such as the ability to order groceries or fast food online and have it ready when the customer arrives. Another major innovation affecting labor costs is the development of driverless cars and trucks (primarily fixed costs), which will have a major impact on the number of taxi and truck drivers in the future (primarily variable costs). Do these labor-saving processes change the cost structure for the company? Are variable costs decreased? What

about fixed costs? Let's look at this in more detail.

When ordering food through an app, there is no need to have an employee take the order, but someone still needs to prepare the food and package it for the customer. The variable costs associated with the wages of order takers will likely decrease, but the fixed costs associated with additional technology to allow for online ordering will likely increase. When grocery customers place their orders online, this not only requires increased fixed costs for the new technology, but it can also increase variable labor costs, as employees are needed to fill customers' online orders. Many stores may move cashier positions to online order fulfillment rather than hiring additional employees. Other stores may have employees fill online grocery orders during slow or downtimes.

Using driverless cars and trucks decreases the variable costs tied to the wages of the drivers but requires a major investment in fixed-cost assets—the autonomous vehicles—and companies would need to charge prices that allowed them to recoup their expensive investments in the technology as well as make a profit. Alternatively, companies that rely on shipping and delivery companies that use driverless technology may be faced with an increase in transportation or shipping costs (variable costs). These costs may be higher because technology is often more expensive when it is new than it will be in the future, when it is easier and more cost-effective to produce and also more accessible. A good example of the change in cost of a new technological innovation over time is the personal computer, which was very expensive when it was first developed but has decreased in cost significantly since that time. The same will likely happen over time with the cost of creating and using driverless transportation.

You might wonder why a company would trade variable costs for fixed costs. One reason might be to meet company goals, such as gaining market share. Other reasons include being a leader in the use of innovation and improving efficiencies. If a company uses the latest technology, such as online ordering and delivery, this may help the company attract a new type of customer or create loyalty with longstanding customers. In addition, although fixed costs are riskier because they exist regardless of the sales level, once those fixed costs are met, profits grow. All of these new trends result in changes in the composition of fixed and variable costs for a company and it is this composition that helps determine a company's profit.

As you will learn in future chapters, in order for businesses to remain profitable, it is important for managers to understand how to measure and manage fixed and variable costs for decision-making. In this chapter, we begin examining the relationship among sales volume, fixed costs, variable costs, and profit in decision-making. We will discuss how to use the concepts of fixed and variable costs and their relationship to profit to determine the sales needed to break even or to reach a desired profit. You will also learn how to plan for changes in selling price or costs, whether a single product, multiple products, or services are involved.

THINK IT THROUGH

Deciding Between Orders

You are evaluating orders from two new customers, but you will only be able to accept one of the orders without increasing your fixed costs. Management has directed you to choose the one that is most profitable for the company. Customer A is ordering 500 units and is willing to pay $200 per unit, and these units have a contribution margin of $60 per unit. Customer B is ordering 1,000 units and is willing to pay $140 per unit, and these units have a contribution margin ratio of 40%. Which order do you select and why?

LINK TO LEARNING

Watch this video from Investopedia reviewing the concept of contribution margin to learn more. Keep in mind that contribution margin per sale first contributes to meeting fixed costs and then to profit.

Answers

YOUR TURN

Pertinent information		Contribution margin income statement 100 units sold		Contribution margin income statement 200 units sold	
Sales price per unit	$ 25	Sales revenue	$2,500	Sales revenue	$5,000
Variable costs:		Variable costs per unit ($15 + 0.50) x 100 units	1,550	Variable costs per unit ($15 + 0.50) x 200 units	3,100
Per shirt cost	15	Contribution margin	950	Contribution margin	1,900
Per shirt commission	0.50	Fixed costs	700	Fixed costs	700
Fixed costs:		Net operating income	$ 250	Net operating income	$1,200
Kiosk rental	300				
Salary	400				

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7.3: Calculate a Break-Even Point in Units and Dollars

In an earlier chapter, you learned how to determine and recognize the fixed and variable components of costs, and now you have learned about contribution margin. Those concepts can be used together to conduct cost-volume-profit (CVP) analysis, which is a method used by companies to determine what will occur financially if selling prices change, costs (either fixed or variable) change, or sales/production volume changes.

It is important, first, to make several assumptions about operations in order to understand CVP analysis and the associated contribution margin income statement. However, while the following assumptions are typical in CVP analysis, there can be exceptions. For example, while we typically assume that the sales price will remain the same, there might be exceptions where a quantity discount might be allowed. Our CVP analysis will be based on these assumptions:

- Costs are linear and can clearly be designated as either fixed or variable. In other words, fixed costs remain fixed in total over the relevant range and variable costs remain fixed on a per-unit basis. For example, if a company has the capability of producing up to 1,000 units a month of a product given its current resources, the relevant range would be 0 to 1,000. If they decided that they wanted to produce 1,800 units a month, they would have to secure additional production capacity. While they might be able to add an extra production shift and then produce 1,800 units a month without buying an additional machine that would increase production capacity to 2,000 units a month, companies often have to buy additional production equipment to increase their relevant range. In this example, the production capacity between 1,800 and 2,000 would be an expense that currently would not provide additional contribution toward fixed costs.
- Selling price per unit remains constant and does not increase or decrease based on volume (i.e., customers are not given discounts based on quantity purchased).
- In the case of manufacturing businesses, inventory does not change because we make the assumption that all units produced are sold.
- In the case of a company that sells multiple products, the sales mix remains constant. For example, if we are a beverage supplier, we might assume that our beverage sales are 3 units of coffee pods and two units of teabags.

Using these assumptions, we can begin our discussion of CVP analysis with the break-even point.

Basics of the Break-Even Point

The **break-even point** is the dollar amount (total sales dollars) or production level (total units produced) at which the company has recovered all variable and fixed costs. In other words, no profit or loss occurs at break-even because Total Cost = Total Revenue. Figure 7.3.1 illustrates the components of the break-even point:

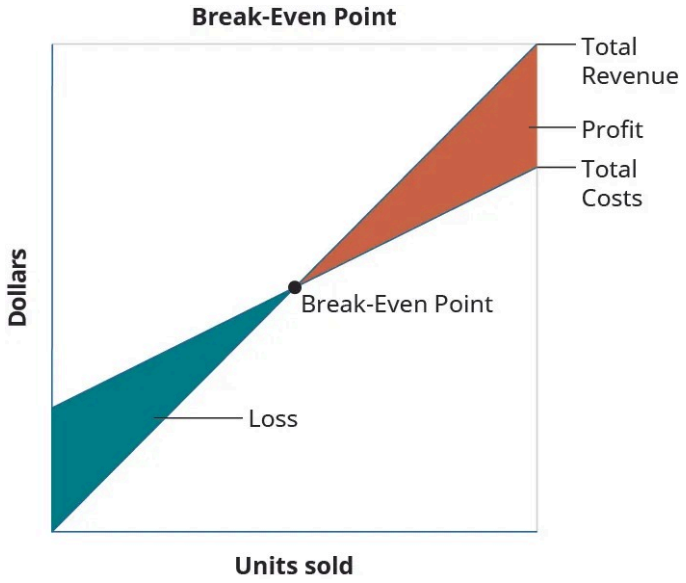


Figure 7.3.1: Break-Even Point. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The basic theory illustrated in Figure 7.3.1 is that, because of the existence of fixed costs in most production processes, in the first stages of production and subsequent sale of the products, the company will realize a loss. For example, assume that in an extreme case the company has fixed costs of $20,000, a sales price of $400 per unit and variable costs of $250 per unit, and it sells no units. It would realize a loss of $20,000 (the fixed costs) since it recognized no revenue or variable costs. This loss explains why the company's cost graph recognized costs (in this example, $20,000) even though there were no sales. If it subsequently sells units, the loss would be reduced by $150 (the contribution margin) for each unit sold. This relationship will be continued until we reach the break-even point, where total revenue equals total costs. Once we reach the break-even point for each unit sold the company will realize an increase in profits of $150.

For each additional unit sold, the loss typically is lessened until it reaches the break-even point. At this stage, the company is theoretically realizing neither a profit nor a loss. After the next sale beyond the break-even point, the company will begin to make a profit, and the profit will continue to increase as more units are sold. While there are exceptions and complications that could be incorporated, these are the general guidelines for break-even analysis.

As you can imagine, the concept of the break-even point applies to every business endeavor—manufacturing, retail, and service. Because of its universal applicability, it is a critical concept to managers, business owners, and accountants. When a company first starts out, it is important for the owners to know when their sales will be sufficient to cover all of their fixed costs and begin to generate a profit for the business. Larger companies may look at the break-even point when investing in new machinery, plants, or equipment in order to predict how long it will take for their sales volume to cover new or additional fixed costs. Since the break-even point represents that point where the company is neither losing nor making money, managers need to make decisions that will help the company reach and *exceed* this point as quickly as possible. No business can operate for very long below break-even. Eventually, the company will suffer losses so great that they are forced to close their doors.

ETHICAL CONSIDERATIONS

Break-Even Analysis and Profitability

The first step in determining the viability of the business decision to sell a product or provide a service is analyzing the true cost of the product or service and the timeline of payment for the product or service. Ethical managers need an estimate of a product or service's cost and related revenue streams to evaluate the chance of reaching the break-even point.

Determining an accurate price for a product or service requires a detailed analysis of both the cost and how the cost changes as the volume increases. This analysis includes the timing of both costs and receipts for payment, as well as how these costs will be financed. An example is an IT service contract for a corporation where the costs will be frontloaded. When costs or activities are frontloaded, a greater proportion of the costs or activities occur in an earlier stage of the project. An IT service contract is typically employee cost-intensive and requires an estimate of at least 120 days of employee costs before a payment will be received for the costs incurred. An IT service contract for $100,000 in monthly services with a 30% profit margin will require 4 months of upfront financing of $280,000 balanced over the four months before a single payment is received.

The overall profit at a specific point in time requires a careful determination of all of the costs associated with creating and selling the product or providing the service. An ethical managerial accountant will provide a realistic cost estimate, regardless of management's desire to sell a product or provide a service. What might be a lucrative product on its face needs additional analysis provided by the managerial accountant.

To illustrate the concept of break-even, we will return to Hicks Manufacturing and look at the Blue Jay birdbath they manufacture and sell.

LINK TO LEARNING

Watch this video of an example of performing the first steps of cost-volume-profit analysis to learn more.

Sales Where Operating Income Is $0

Hicks Manufacturing is interested in finding out the point at which they break even selling their Blue Jay Model birdbath. They will break even when the operating income is $0. The operating income is determined by subtracting the total variable and fixed

costs from the sales revenue generated by an enterprise. In other words, the managers at Hicks want to know how many Blue Jay birdbaths they will need to sell in order to cover their fixed expenses and break even. Information on this product is:

HICKS MANUFACTURING Blue Jay Model For Year Ended December 31, 2019	
Sales Price per Unit	$ 100
Variable Cost per Unit	20
Contribution Margin per Unit	80
Total Fixed Cost per Month	$18,000

In order to find their break-even point, we will use the contribution margin for the Blue Jay and determine how many contribution margins we need in order to cover the fixed expenses, as shown in the formula in Figure 7.3.2.

$$\textbf{Break-Even Point in Units:} \quad \frac{\textbf{Total Fixed Costs}}{\textbf{Contribution Margin per Unit}}$$

Figure 7.3.2: Break-Even Point in Units. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Applying this to Hicks calculates as:

$18,000 / $80= 225 units

What this tells us is that Hicks must sell 225 Blue Jay Model birdbaths in order to cover their fixed expenses. In other words, they will not begin to show a profit until they sell the 226th unit. This is illustrated in their contribution margin income statement.

HICKS MANUFACTURING Contribution Margin Income Statement For Year Ended December 31, 2019	
Sales (225 units at $100 per return)	$22,500
Variable Cost (225 units at $20 per return)	4,500
Contribution Margin	18,000
Fixed Costs	18,000
Operating Income	$ 0

The break-even point for Hicks Manufacturing at a sales volume of $22,500 (225 units) is shown graphically in Figure 7.3.3.

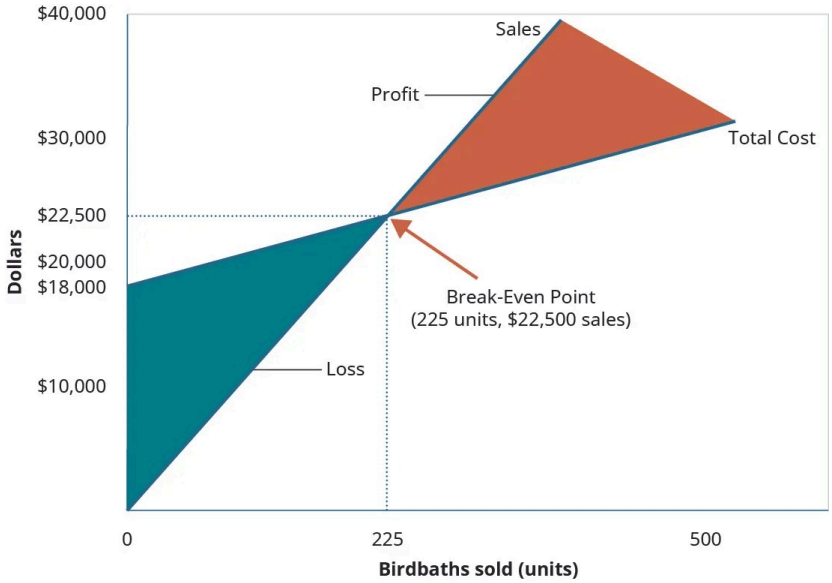


Figure 7.3.3: Hicks Manufacturing Break-Even Point for 225 Units. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

As you can see, when Hicks sells 225 Blue Jay Model birdbaths, they will make no profit, but will not suffer a loss because all of their fixed expenses are covered. However, what happens when they do not sell 225 units? If that happens, their operating income is negative.

Sales Where Operating Income Is Negative

In a recent month, local flooding caused Hicks to close for several days, reducing the number of units they could ship and sell from 225 units to 175 units. The information in Figure 7.3.4 reflects this drop in sales.

HICKS MANUFACTURING
Contribution Margin Income Statement
For Year Ended December 31, 2019

Sales (175 units at $100 per unit)	$17,500
Variable Cost (175 units at $20 per unit)	3,500
Contribution Margin	14,000
Fixed Costs	18,000
Operating Income	$ (4,000)

Figure 7.3.4: Hicks Manufacturing Contribution Margin Income Statement. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

At 175 units ($17,500 in sales), Hicks does not generate enough sales revenue to cover their fixed expenses and they suffer a loss of $4,000. They did not reach the break-even point of 225 units.

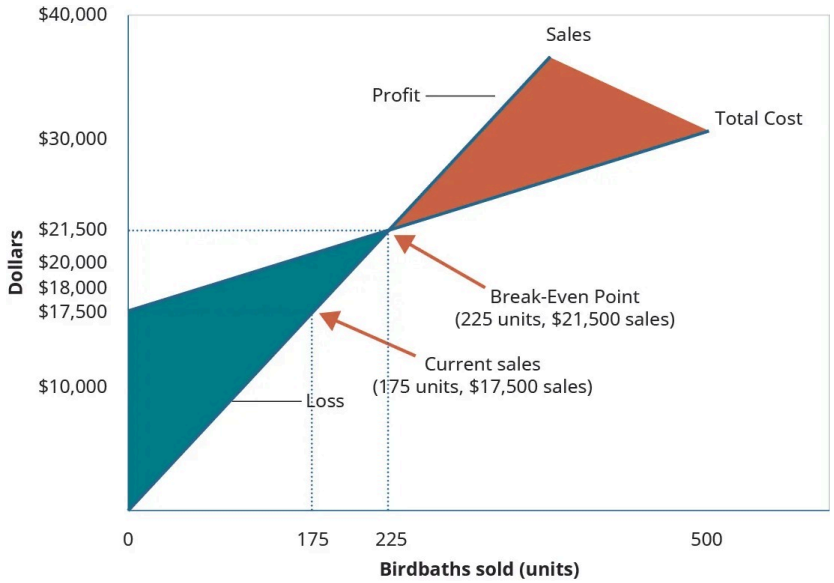


Figure 7.3.5: Hicks Manufacturing Break-Even Point for 175 Units. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Sales Where Operating Income Is Positive

What happens when Hicks has a busy month and sells 300 Blue Jay birdbaths? We have already established that the contribution margin from 225 units will put them at break-even. When sales exceed the break-even point the unit contribution margin from the additional units will go toward profit. This is reflected on their income statement.

HICKS MANUFACTURING
Contribution Margin Income Statement
For Year Ended December 31, 2019

Sales (300 units at $100 per unit)	$30,000
Variable Cost (300 units at $20 per unit)	6,000
Contribution Margin	24,000
Fixed Costs	18,000
Operating Income	$ 6,000

Again, looking at the graph for break-even (Figure 7.3.6), you will see that their sales have moved them beyond the point where total revenue is equal to total cost and into the profit area of the graph.

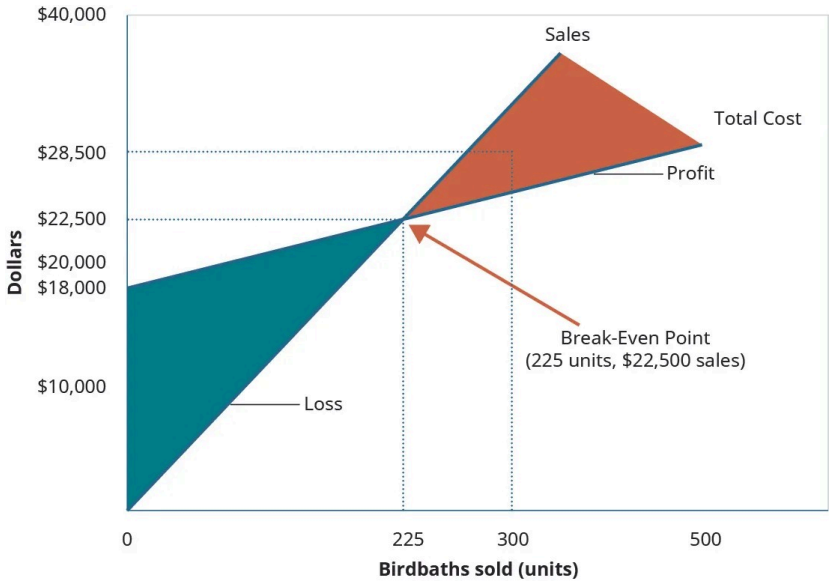


Figure 7.3.6: Hicks Manufacturing Break-Even Point for 300 Units. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Hicks Manufacturing can use the information from these different scenarios to inform many of their decisions about operations, such as sales goals.

However, using the contribution margin per unit is not the only way to determine a break-even point. Recall that we were able to determine a contribution margin expressed in dollars by finding the contribution margin ratio. We can apply that contribution margin ratio to the break-even analysis to determine the break-even point in dollars. For example, we know that Hicks had $18,000 in fixed costs and a contribution margin ratio of 80% for the Blue Jay model. We will use this ratio (Figure 7.3.7) to calculate the break-even point in dollars.

$$\text{Break-Even Point in Dollars} = \frac{\text{Fixed Costs}}{\text{Contribution Margin Ratio}}$$

Figure 7.3.7: Break-Even Point in Dollars. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Applying the formula to Hicks gives this calculation:

$$\$18{,}000 / 0.80 = \$22{,}500$$

Hicks Manufacturing will have to generate $22,500 in monthly sales in order to cover all of their fixed costs. In order for us to verify that Hicks' break-even point is $22,500 (or 225 units) we will look again at the contribution margin income statement at break-even:

HICKS MANUFACTURING Contribution Margin Income Statement For Year Ended December 31, 2019	
Sales (225 units at $100 per unit)	$22,500
Variable Cost (225 units at $20 per unit)	4,500
Contribution Margin	18,000
Fixed Costs	18,000
Operating Income	$ 0

By knowing at what level sales are sufficient to cover fixed expenses is critical, but companies want to be able to make a profit and can use this break-even analysis to help them.

THINK IT THROUGH

The Cost of a Haircut

You are the manager of a hair salon and want to know how many ladies' haircuts your salon needs to sell in a month in order to cover the fixed costs of running the salon. You have determined that, at the current price of $35 per haircut, you have $20 in variable costs associated with each cut. These variable costs include stylist wages, hair product, and shop supplies. Your fixed costs are $3,000 per month. You perform a break-even analysis on a per-unit basis and discover the following:

Sales price per service	$ 35
Variable cost per service	20
Contribution margin per service	15
Break-even (in services)	200

You have 4 stylists plus yourself working in the salon and are open 6 days per week. Considering the break-even point and the number of available stylists, will the salon ever break even? If it does, what will need to happen? What can be done to achieve the break-even point?

Examples of the Effects of Variable and Fixed Costs in Determining the Break-Even Point

Companies typically do not want to simply break even, as they are in business to make a profit. Break-even analysis also can help

companies determine the level of sales (in dollars or in units) that is needed to make a desired profit. The process for factoring a desired level of profit into a break-even analysis is to add the desired level of profit to the fixed costs and then calculate a new break-even point. We know that Hicks Manufacturing breaks even at 225 Blue Jay birdbaths, but what if they have a target profit for the month of July? They can simply add that target to their fixed costs. By calculating a target profit, they will produce and (hopefully) sell enough bird baths to cover both fixed costs and the target profit.

If Hicks wants to earn $16,000 in profit in the month of May, we can calculate their new break-even point as follows:

Target Profit = (Fixed costs + Desired profit) / Contribution margin per unit = ($18,000 + $16,000) / $80 = 425 units

We have already established that the $18,000 in fixed costs is covered at the 225 units mark, so an additional 200 units will cover the desired profit (200 units × $80 per unit contribution margin = $16,000). Alternatively, we can calculate this in terms of dollars by using the contribution margin ratio.

Target Profit = (Fixed costs + Desired profit) / Contribution margin ratio = ($18,000 + $16,000) / 0.80 = $42,500

As done previously, we can confirm this calculation using the contribution margin income statement:

Sales (425 units at $100 per unit)	$42,500
Variable Costs (425 units at $20 per unit)	8,500
Contribution Margin	34,000
Fixed Costs	18,000
Operating Income (loss)	$16,000

Note that the example calculations ignored income taxes, which implies we were finding target operating income. However, companies may want to determine what level of sales would generate a desired after-tax profit. To find the break-even point at a desired after-tax profit, we simply need to convert the desired after-tax profit to the desired pre-tax profit, also referred to as operating income, and then follow through as in the example. Suppose Hicks wants to earn $24,000 after-taxes, what level of sales (units and dollars) would be needed to meet that goal? First, the after-tax profit needs to be converted to a pre-tax desired profit:

Pre-tax desired profit = After-tax profit / (1 – tax rate)

If the tax rate for Hicks is 40%, then the $24,000 after-tax profit is equal to a pre-tax profit of $40,000:

$40,000 = $24,000 / (1 – 0.40)

The tax rate indicates the amount of tax expense that will result from any profits and 1 – tax rate indicates the amount remaining after taking out tax expense. The concept is similar to buying an item on sale. If an item costs $80 and is on sale for 40% off, then the amount being paid for the item is 60% of the sale price, or $48 ($80 × 60%). Another way to find this involves two steps. First find the discount ($80 × 40% = $32) and then subtract the discount from the sales price ($80 – $32 = $48).

Taxes and profit work in a similar fashion. If we know the profit before tax is $100,000 and the tax rate is 30%, then tax expenses are $100,000 × 30% = $30,000. This means the after-tax income is $100,000 – $30,000 = $70,000. However, in most break-even situations, as well as other decision-making areas, the desired after-tax profit is known, and the pre-tax profit must be determined by dividing the after-tax profit by 1 – tax rate.

To demonstrate the combination of both a profit and the after-tax effects and subsequent calculations, let's return to the Hicks Manufacturing example. Let's assume that we want to calculate the target volume in units and revenue that Hicks must sell to generate an after-tax return of $24,000, assuming the same fixed costs of $18,000.

Since we earlier determined $24,000 after-tax equals $40,000 before-tax if the tax rate is 40%, we simply use the break-even at a desired profit formula to determine the target sales.

Target sales = (Fixed costs + Desired profit) / Contribution margin per unit = ($18,000 + $40,000) / $80 = 725 units

This calculation demonstrates that Hicks would need to sell 725 units at $100 a unit to generate $72,500 in sales to earn $24,000 in after-tax profits.

Alternatively, target sales in sales dollars could have been calculated using the contribution margin ratio:

Target sales = (Fixed costs + Desired profit) / Contribution margin per unit = ($18,000 + $40,000) / 0.80 = $72,500

Once again, the contribution margin income statement proves the sales and profit relationships.

Sales (725 units x $100 per unit)	$ 72,500
Variable costs (725 units x $20 per unit)	(14,500)
Contribution margin	$ 58,000
Fixed costs	(18,000)
Pre-tax profit	$ 40,000
Income tax expense (40%)	(16,000)
After-tax profit	$ 24,000

Thus, to calculate break-even point at a particular after-tax income, the only additional step is to convert after-tax income to pre-tax income prior to utilizing the break-even formula. It is good to understand the impact of taxes on break-even analysis as companies will often want to plan based on the after-tax effects of a decision as the after-tax portion of income is the only part of income that will be available for future use.

Application of Break-Even Concepts for a Service Organization

Because break-even analysis is applicable to any business enterprise, we can apply these same principles to a service organization. For example, Marshall & Hirito is a mid-sized accounting firm that provides a wide range of accounting services to its clients but relies heavily on personal income tax preparation for much of its revenue. They have analyzed the cost to the firm associated with preparing these returns. They have determined the following cost structure for the preparation of a standard 1040A Individual Income Tax Return:

Charge to Client (sales price per return)	$400
Variable Cost per Return	150

They have fixed costs of $14,000 per month associated with the salaries of the accountants who are responsible for preparing *Form 1040A*. In order to determine their break-even point, they first determine the contribution margin for *Form 1040A* as shown:

Sales Price per Return	$400
Variable Cost per Return	150
Contribution Margin per Return	250

Now they can calculate their break-even point:

Break-Even Point in Units = Total fixed costs / Contribution margin per unit = $14,000 / $250 = 56 returns

Remember, this is the break-even point in units (the number of tax returns) but they can also find a break-even point expressed in dollars by using the contribution margin ratio. First, they find the contribution margin ratio. Then, they use the ratio to calculate the break-even point in dollars:

Break-Even Point in Dollars = Fixed costs / Contribution margin ratio = $14,000 / 0.625 = $22,400

We can confirm these figures by preparing a contribution margin income statement:

MARSHALL & SON, CPAs
Contribution Margin Income Statement
For Year Ended December 31, 2019

Sales (56 at $400 per return)	$22,400
Variable Costs (56 at $150 per return)	8,400
Contribution Margin	14,000
Fixed costs	14,000
Operating Income (loss)	$ 0

Therefore, as long as Marshall & Hirito prepares 56 *Form 1040* income tax returns, they will earn no profit but also incur no loss. What if Marshall & Hirito has a target monthly profit of $10,000? They can use the break-even analysis process to determine how many returns they will need to prepare in order to cover their fixed expenses and reach their target profit:

Target Profit = (Fixed costs + Desired profit) / Contribution margin per unit = ($14,000 + $10,000) / $250 = 96 returns

They will need to prepare 96 returns during the month in order to realize a $10,000 profit. Expressing this in dollars instead of units requires that we use the contribution margin ratio as shown:

Target Profit = (Fixed costs + Desired profit) / Contribution margin per unit = ($14,000 + $10,000) / 0.625 = $38,400

Marshall & Hirito now knows that, in order to cover the fixed costs associated with this service, they must generate $38,400 in revenue. Once again, let's verify this by constructing a contribution margin income statement:

MARSHALL & SON, CPAs Contribution Margin Income Statement For Year Ended December 31, 2019	
Sales (96 at $400 per return)	$38,400
Variable Costs (96 at $150 per return)	14,400
Contribution Margin	24,000
Fixed Costs	14,000
Operating Income (loss)	$10,000

As you can see, the $38,400 in revenue will not only cover the $14,000 in fixed costs, but will supply Marshall & Hirito with the $10,000 in profit (net income) they desire.

As you've learned, break-even can be calculated using either contribution margin per unit or the contribution margin ratio. Now that you have seen this process, let's look at an example of these two concepts presented together to illustrate how either method will provide the same financial results.

Suppose that Channing's Chairs designs, builds, and sells unique ergonomic desk chairs for home and business. Their bestselling chair is the Spine Saver. Figure 7.3.8 illustrates how Channing could determine the break-even point in sales dollars using either the contribution margin per unit or the contribution margin ratio.

Sales Price per Unit	Cost per Unit	Contribution Margin per Unit	Fixed Costs	Fixed Costs/ Contribution Margin per Unit	Break-Even in Units	Break Even in Dollars
$1,250	$850	$400	$16,800	$16,800/$400	42	42 x $1,250 = $52,500

Contribution Margin per Unit ($1,250 – 850)	Contribution Margin Ratio (CM/Sales or $400 ÷ $1,250)	Break-Even in Sales Dollars (FC ÷ CM or $16,800 ÷ 0.32)	Break-Even in Units (Break Even Sales ÷ Unit Selling Price or $52,500 ÷ $1,250)
$400	32%	$52,500	42 Units

Figure 7.3.8: Channing's Break-Even Point. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Note that in either scenario, the break-even point is the same in dollars and units, regardless of approach. Thus, you can always find the break-even point (or a desired profit) in units and then convert it to sales by multiplying by the selling price per unit. Alternatively, you can find the break-even point in sales dollars and then find the number of units by dividing by the selling price per unit.

YOUR TURN

College Creations

College Creations, Inc (CC), builds a loft that is easily adaptable to most dorm rooms or apartments and can be assembled into a variety of configurations. Each loft is sold for $500, and the cost to produce one loft is $300, including all parts and labor. CC has fixed costs of $100,000.

A. What happens if CC produces nothing?
B. Now, assume CC produces and sells one unit (loft). What are their financial results?
C. Now, what do you think would happen if they produced and sold 501 units?
D. How many units would CC need to sell in order to break even?
E. How many units would CC need to sell if they wanted to have a pretax profit of $50,000?

Answer available at the end of this section.

Answers

YOUR TURN

A. If they produce nothing, they will still incur fixed costs of $100,000. They will suffer a net loss of $100,000.
B. If they sell one unit, they will have a net loss of $99,800.

Sales revenue	$ 500
Variable cost per unit	300
Contribution margin	200
Fixed costs	100,000
Operating income (loss)	$ (99,800)

C. If they produce 501 units, they will have operating income of $200 as shown:

Sales revenue (501 units at $500)	$250,500
Variable cost per unit (501 units at $300)	150,300
Contribution margin	100,200
Fixed costs	100,000
Operating income (loss)	$ 200

D. Break-even can be determined by FC/CM per unit: $100,000 ÷ $200 = 500. Five hundred lofts must be sold to break even.
E. The desired profit can be treated like a fixed cost, and the target profit would be (FC + Desired Profit)/CM or ($100,000 + $50,000) ÷ $200 = 750. Seven hundred fifty lofts need to be sold to reach a desired income of $50,000. Another way to have found this is to know that, after fixed costs are met, the $200 per unit contribution margin will go toward profit. The desired profit of $50,000 ÷ $200 per unit contribution margin = 250. This means that 250 additional units must be sold. To break even requires 500 units to be sold, and to reach the desired profit of $50,000 requires an additional 250 units, for a total of 750 units.

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7.4: Perform Break-Even Sensitivity Analysis for a Single Product Under Changing Business Situations

Finding the break-even point or the sales necessary to meet a desired profit is very useful to a business, but cost-volume-profit analysis also can be used to conduct a **sensitivity analysis**, which shows what will happen if the sales price, units sold, variable cost per unit, or fixed costs change. Companies use this type of analysis to consider possible scenarios that assist them in planning.

LINK TO LEARNING

Watch this video that shows what happens if one or more of the variables in a break-even analysis is changed to learn more.

The Effects on Break-Even under Changing Business Conditions

Circumstances often change within a company, within an industry, or even within the economy that impact the decision-making of an organization. Sometimes, these effects are sudden and unexpected, for example, if a hurricane destroyed the factory of a company's major supplier; other times, they occur more slowly, such as when union negotiations affect your labor costs. In either of these situations, costs to the company will be affected. Using CVP analysis, the company can predict how these changes will affect profits.

Changing a Single Variable

To demonstrate the effects of changing any one of these variables, consider Back Door Café, a small coffee shop that roasts its own beans to make espresso drinks and gourmet coffee. They also sell a variety of baked goods and T-shirts with their logo on them. They track their costs carefully and use CVP analysis to make sure that their sales cover their fixed costs and provide a reasonable level of profit for the owners.

Change in Sales Price

The owner of Back Door has one of her employees conduct a survey of the other coffee shops in the area and finds that they are charging $0.75 more for espresso drinks. As a result, the owner wants to determine what would happen to operating income if she increased her price by just $0.50 and sales remained constant, so she performs the following analysis:

Price Change Analysis		
	With Current Price	With New Price
Sales Price per Unit	$ 3.75	$ 4.25
Variable Cost per Unit	$ 1.50	$ 1.50
Contribution Margin per Unit	$ 2.25	$ 2.75
Fixed Costs	$2,475	$2,475
Break-even (in units)	1,100	900
Break-Even (in dollars)	$4,125	$3,825
Contribution Margin Income Statement Current Price versus New Price		
Unit Sales, Expected	1,500	1,500
Sales	$5,625	$6,375
Variable Costs	2,250	2,250
Contribution Margin	$3,375	$4,125
Fixed Costs	2,475	2,475
Net Income	$ 900	$1,650

The only variable that has changed is the $0.50 increase in the price of their espresso drinks, but the net operating income will increase by $750. Another way to think of this increase in income is that, if the sales price increases by $0.50 per expresso drink and the estimated sales are 1,500 units, then this will result in an increase in overall contribution margin of $750. Moreover, since all of the fixed costs were met by the lower sales price, all of this $750 goes to profit. Again, this is assuming the higher sales price does not decrease the number of units sold. Since the other coffee shops will still be priced higher than Back Door, the owner believes that there will not be a decrease in sales volume.

When making this adjustment to their sales price, Back Door Café is engaging in **target pricing**, a process in which a company uses market analysis and production information to determine the maximum price customers are willing to pay for a good or service in addition to the markup percentage. If the good can be produced at a cost that allows both the desired profit percentage as well as deliver the good at a price acceptable to the customer, then the company should proceed with the product; otherwise, the company will not achieve its desired profit goals.

Change in Variable Cost

In March, the owner of Back Door receives a letter from her cups supplier informing her that there is a $0.05 price increase due to higher material prices. Assume that the example uses the original $3.75 per unit sales price. The owner wants to know what would happen to net operating income if she absorbs the cost increase, so she performs the following analysis:

Variable Cost Change Analysis		
	With Current Price	With Increased Variable Cost
Sales Price per Unit	$ 3.75	$ 3.75
Variable Cost per Unit	$ 1.50	$ 1.55
Contribution Margin per Unit	$ 2.25	$ 2.20
Fixed Costs	$2,475	$ 2,475
Break-even in Units	1,100	1,125
Break-even in Dollars	$4,125	$4,218.75
Monthly Contribution Margin Income Statement Current Variable Costs versus Increased Variable Costs		
Unit Sales, Expected	1,500	1,500
Sales	$5,625	$ 5,625
Variable Costs	2,250	2,325
Contribution Margin	$3,375	$ 3,300
Fixed Costs	2,475	2,475
Net Income	$ 900	$ 825

She is surprised to see that just a $0.05 increase in variable costs (cups) will reduce her net income by $75. The owner may decide that she is fine with the lower income, but if she wants to maintain her income, she will need to find a new cup supplier, reduce other costs, or pass the price increase on to her customers. Because the increase in the cost of the cups was a variable cost, the impact on net income can be seen by taking the increase in cost per unit, $0.05, and multiplying that by the units expected to be sold, 1,500, to see the impact on the contribution margin, which in this case would be a decrease of $75. This also means a decrease in net income of $75.

Change in Fixed Cost

Back Door Café's lease is coming up for renewal. The owner calls the landlord to indicate that she wants to renew her lease for another 5 years. The landlord is happy to hear she will continue renting from him but informs her that the rent will increase $225 per month. She is not certain that she can afford an additional $225 per month and tells him she needs to look at her numbers and will call him back. She pulls out her CVP spreadsheet and adjusts her monthly fixed costs upwards by $225. Assume that the example uses the original $3.75 per unit sales price. The results of her analysis of the impact of the rent increase on her annual net income are:

Fixed Cost Change Analysis		
	With Current Price	With Increased Fixed Cost
Sales Price per Unit	$ 3.75	$ 3.75
Variable Cost per Unit	$ 1.50	$ 1.50
Contribution Margin per Unit	$ 2.25	$ 2.25
Fixed Costs	$2,475	$2,700
Break-even in Units	1,100	1,200
Break-even in Dollars	$4,125	$4,500
Monthly Contribution Margin Income Statement Current Fixed Costs versus Increased Fixed Costs		
Unit Sales, Expected	1,500	1,500
Sales	$5,625	$5,625
Variable Costs	2,250	2,250
Contribution Margin	$3,375	$3,375
Fixed Costs	2,475	2,700
Net Income	$ 900	$ 675

Because the rent increase is a change in a fixed cost, the contribution margin per unit remains the same. However, the break-even point in both units and dollars increase because more units of contribution are needed to cover the $225 monthly increase in fixed costs. If the owner of the Back Door agrees to the increase in rent for the new lease, she will likely look for ways to increase the contribution margin per unit to offset this increase in fixed costs.

In each of the prior examples, only one variable was changed—sales volume, variable costs, or fixed costs. There are some generalizations that can be made regarding how a change in any one of these variables affects the break-even point. These generalizations are summarized in Table 7.4.1.

Table 7.4.1: Generalizations Regarding Changes in Break-Even Point from a Change in One Variable

Condition	Result
Sales Price Increases	Break-Even Point Decreases (Contribution Margin is Higher, Need Fewer Sales to Break Eve
Sales Price Decreases	Break-Even Point Increases (Contribution Margin is Lower, Need More Sales to Break Even)
Variable Costs Increase	Break-Even Point Increases (Contribution Margin is Lower, Need More Sales to Break Even)
Variable Costs Decrease	Break-Even Point Decreases (Contribution Margin is Higher, Need Fewer Sales to Break Eve
Fixed Costs Increase	Break-Even Point Increases (Contribution Margin Does Not Change, but Need More Sales t
Fixed Costs Decrease	Break-Even Point Decreases (Contribution Margin Does Not Change, but Need Fewer Sales

LINK TO LEARNING

Watch this video that walks through, step by step, how to calculate break even in units and dollars and at a desired profit or sales level to learn more.

Changing Multiple Variables

We have analyzed situations in which one variable changes, but often, more than one change will occur at a time. For example, a company may need to lower its selling price to compete, but they may also be able to lower certain variable costs by switching suppliers.

Suppose Back Door Café has the opportunity to purchase a new espresso machine that will reduce the amount of coffee beans required for an espresso drink by putting the beans under higher pressure. The new machine will cost $15,000, but it will decrease the variable cost per cup by $0.05. The owner wants to see what the effect will be on the net operating income and break-even point if she purchases the new machine. She has arranged financing for the new machine and the monthly payment will increase her fixed costs by $400 per month. When she conducts this analysis, she gets the following results:

Variable Cost and Fixed Cost Change Analysis		
	With Current Price	With Decreased VC and Increased FC
Sales Price per Unit	$ 3.75	$ 3.75
Variable Cost per Unit	$ 1.50	$ 1.45
Contribution Margin per Unit	$ 2.25	$ 2.30
Fixed Costs	$ 2,475	$ 2,875
Break-even in Units	1,100	1,250
Break-even in Dollars	$4,125.00	$4,687.50
Monthly Contribution Margin Income Statement Current Fixed Costs versus Increased Fixed Costs		
Unit Sales, Expected	1,500	1,500
Sales	$ 5,625	$ 5,625
Variable Costs	2,250	2,175
Contribution Margin	$ 3,375	$ 3,450
Fixed Costs	2,475	2,875
Net Income	$ 900	$ 575

Looking at the “what-if” analysis, we see that the contribution margin per unit increases because of the $0.05 reduction in variable cost per unit. As a result, she has a higher total contribution margin available to cover fixed expenses. This is good, because the monthly payment on the espresso machine represents an increased fixed cost. Even though the contribution margin ratio increases, it is not enough to totally offset the increase in fixed costs, and her monthly break-even point has risen from $4,125.00 to $4,687.50. If the new break-even point in units is a realistic number (within the relevant range), then she would decide to purchase the new machine because, once it has been paid for, her break-even point will fall and her net income will rise. Performing this analysis is an effective way for managers and business owners to look into the future, so to speak, and see what impact business decisions will have on their financial position.

Let’s look at another option the owner of the Back Door Café has to consider when making the decision about this new machine. What would happen if she purchased the new machine to realize the variable cost savings and also raised her price by just $0.20? She feels confident that such a small price increase will go virtually unnoticed by her customers but may help her offset the increase in fixed costs. She runs the analysis as follows:

Selling price, variable cost, and fixed cost change analysis			
	With Current Price	With decreased VC and increased FC	With increased SP, decreased VC, and increased FC
Sales price per unit	$ 3.75	$ 3.75	$ 3.95
Variable cost per unit	$ 1.50	$ 1.45	$ 1.45
Contribution margin per unit	$ 2.25	$ 2.30	$ 2.50
Fixed costs	$ 2,475	$ 2,875	$ 2,875
Break-even in units	1,100	1,250	1,150
Break-even in dollars	$4,125.00	$4,687.50	$4,542.50
Monthly contribution margin income statement			
Unit sales, expected	1,500	1,500	1,500
Sales	$ 5,625	$ 5,625	$ 5,925
Variable costs	2,250	2,175	2,175
Contribution margin	$ 3,375	$ 3,450	$ 3,750
Fixed costs	2,475	2,875	2,875
Net income	$ 900	$ 575	$ 875

The analysis shows the expected result: an increase in the per-unit contribution margin, a decrease in the break-even point, and an increase in the net operating income. She has changed three variables in her costs—sales price, variable cost, and fixed cost. In fact, the small price increase almost gets her back to the net operating income she realized before the purchase of the new expresso machine.

By now, you should begin to understand why CVP analysis is such a powerful tool. The owner of Back Door Café can run an unlimited number of these what-if scenarios until she meets the financial goals for her company. There are very few tools in managerial accounting as powerful and meaningful as a cost-volume-profit analysis.

CONCEPTS IN PRACTICE

Value Menus

In January 2018, **McDonald's** brought back its $1 value menu. After discontinuing its popular Dollar Menu six years previously, the new version has a list of items priced not only at $1, but at $2 and $3 as well. How can **McDonald's** afford to offer menu items at this discounted price? Volume! Although the margin on each unit is very small, the food chain hopes to make up the difference in quantity. They also hope that consumers will add higher priced (and higher margin) items to their orders.[1] The strategy is not without its risks, however, as rising food or labor costs could put franchisees in a position where the value pricing does not cover their product costs. Rivals **Taco Bell** and **Dunkin' Donuts** have aggressively marketed their value menus, making it almost impossible for **McDonald's** to ignore the growing trend among consumers for "value pricing." Watch this video to see what **McDonald's** is offering consumers.

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7.5: Perform Break-Even Sensitivity Analysis for a Multi-Product Environment Under Changing Business Situations

Up to this point in our CVP analysis, we have assumed that a company only sells one product, but we know that, realistically, this is not the case. Most companies operate in a **multi-product environment**, in which they sell different products, manufacture different products, or offer different types of services. Companies price each one of their products or services differently, and the costs associated with each of those products or services vary as well. In addition, companies have limited resources, such as time and labor, and must decide which products to sell or produce and in what quantities, or which services to offer in order to be the most profitable. These profitability considerations are often what contributes substance to a sales mix decision

The Basics of Break-Even Analysis in a Multi-Product Environment

In order to perform a break-even analysis for a company that sells multiple products or provides multiple services, it is important to understand the concept of a sales mix. A **sales mix** represents the relative proportions of the products that a company sells—in other words, the percentage of the company's total revenue that comes from product A, product B, product C, and so forth. Sales mix is important to business owners and managers because they seek to have a mix that maximizes profit, since not all products have the same profit margin. Companies can maximize their profits if they are able to achieve a sales mix that is heavy with high-margin products, goods, or services. If a company focuses on a sales mix heavy with low-margin items, overall company profitability will often suffer.

Performing a break-even analysis for these multi-product businesses is more complex because each product has a different selling price, a different variable cost, and, ultimately, a different contribution margin. We must also proceed under the assumption that the sales mix remains constant; if it does change, the CVP analysis must be revised to reflect the change in sales mix. For the sake of clarity, we will also assume that all costs are companywide costs, and each product contributes toward covering these companywide costs.

THINK IT THROUGH

Selling Subs

You are the manager of a sub shop located near a college campus. The college has recently added a fast-food style café to the student center, which has reduced the number of students eating at your restaurant. Your highest margin items are drinks (a contribution margin of approximately 90%) and vegetarian subs (a contribution margin of approximately 75%). How can you use CVP analysis to help you compete with the college's café? What would you suggest as possible ways to increase business while maintaining target income levels?

Calculating Break-Even Analysis in a Multi-Product Environment

When a company sells more than one product or provides more than one service, break-even analysis is more complex because not all of the products sell for the same price or have the same costs associated with them: Each product has its own margin. Consequently, the break-even point in a multi-product environment depends on the mix of products sold. Further, when the mix of products changes, so does the break-even point. If demand shifts and customers purchase more low-margin products, then the break-even point rises. Conversely, if customers purchase more high-margin products, the break-even point falls. In fact, even if total sales dollars remain unchanged, the break-even point can change based on the sales mix. Let's look at an example of how break-even analysis works in a multi-product environment.

In multi-product CVP analysis, the company's sales mix is viewed as a **composite unit**, a selection of discrete products associated together in proportion to the sales mix. The composite unit is not sold to customers but is a concept used to calculate a combined contribution margin, which is then used to estimate the break-even point. Think of a composite unit as a virtual basket of fruit that contains the proportion of individual fruits equal to the company's sales mix. If we purchased these items individually to make the fruit basket, each one would have a separate price and a different contribution margin. This is how a composite unit works in CVP analysis. We calculate the contribution margins of all of the component parts of the composite unit

and then use the total to calculate the break-even point. It is important to note that fixed costs are allocated among the various components (products) that make up this composite unit. Should a product be eliminated from the composite unit or sales mix, the fixed costs must be re-allocated among the remaining products.

If we use the fruit basket as an example, we can look at the individual fruits that make up the basket: apples, oranges, bananas, and pears. We see that each individual fruit has a selling price and a cost. Each fruit has its own contribution margin. But how would we determine the contribution margin for a composite of fruit, or in other words, for our basket of fruit?

For our particular baskets, we will use 5 apples, 3 oranges, 2 bananas, and 1 pear. This means that our product mix is 5:3:2:1, as shown in Figure 7.5.1.

Fruit	Number of Units	Selling Price per Unit	Total Selling Price	Cost per Unit	Total Cost	Contribution Margin
Apple	5	$0.60	$3.00	$0.25	$1.25	$1.75
Orange	3	1.00	3.00	0.75	2.25	0.75
Banana	2	0.80	1.60	0.50	1.00	0.60
Pear	1	1.90	1.90	1.50	1.50	0.40
Total			$9.50		$6.00	$3.50

Figure 7.5.1: Contribution Margin Based on Product Mix. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Notice that the composite contribution margin is based on the number of units of each item that is included in the composite item. If we change the composition of the basket, then the composite contribution margin would change even though contribution margin of the individual items would not change. For example, if we only include 4 apples, the contribution margin of a single apple is still $0.35, but the contribution margin of the apples in the basket is $1.40, not $1.75 as it is when 5 apples are included in the basket. Let's look at an additional example and see how we find the break-even point for a composite good.

We will consider West Brothers for an example of a multi-product break-even analysis. West Brothers manufactures and sells 3 types of house siding: restoration vinyl, architectural vinyl, and builder-grade vinyl, each with its own sales price, variable cost, and contribution margin, as shown:

	Sales Price per Square Foot	Variable Cost per Square Foot
Builder Grade	$6.25	$3.25
Architectural	7.75	4.50
Restoration	9.25	6.25

The sales mix for West Brothers is 5 ft^2 of builder grade to 3 ft^2 of architectural-grade to 2 ft^2 of restoration grade vinyl (a ratio of 5:3:2). This sales mix represents one composite unit, and the selling price of one composite unit is:

5 ft^2 of Builder Grade at $6.25	$31.25
3 ft^2 of Architectural at $7.75	23.25
2 ft^2 of Restoration at $9.25	18.50
Selling Price of 1 Composite Unit	$73.00

West Brothers' fixed costs are $145,000 per year, and the variable costs for one composite unit are:

5 ft^2 of Builder Grade at $3.25	$16.25
3 ft^2 of Architectural at $4.50	13.50
2 ft^2 of Restoration at $6.25	12.50
Variable Costs of 1 Composite Unit	$42.25

We will calculate the contribution margin of a composite unit for West Brothers using the same formula as before:

Selling Price per Composite Unit – **Variable Cost per Composite Unit** = **Contribution Margin per Composite Unit**

Applying the formula, we determine that $73 – $42.25 = 30.75. We then use the contribution margin per composite unit to determine West Brothers' break-even point:

Break-Even Point per Composite Unit = Total fixed costs / Contribution margin per composite unit= $145,000 / $30.75 = 4,715.45 composite units

West Brothers will break even when it sells 4,715.45 (or 4,716 since it can't sell a partial unit) composite units. To determine how many of each product West Brothers needs to sell, we apply their sales mix ratio (5:3:2) to the break-even quantity as follows:

Builder Grade	5 × 4,715.45	23,577
Architectural	3 × 4,715.45	14,146
Restoration	2 × 4,715.45	9,431
Total Units		47,154

Using a forecasted or estimated contribution margin income statement, we can verify that the quantities listed will place West Brothers at break-even.

WEST BROTHERS Forecasted Contribution Margin Income Statement at Break-Even For Month Ended December 31, 2019	
Sales	
Builder grade (23,577 at $6.25)	$147,358
Architectural (14,146 at $7.75)	109,634
Restoration (9,431 at $9.25)	87,236
Total Sales	344,228
Variable Costs	
Builder Grade (23,577 at $3.25)	76,626
Architectural (14,146 at $4.50)	63,659
Restoration (9,431 at $9.25)	58,943
Total Variable Costs	199,228
Contribution Margin	145,000
Fixed Costs	145,000
Net Income	0

West Brothers can use this CVP analysis for a wide range of business decisions and for planning purposes. Remember, however, that if the sales mix changes from its current ratio, then the break-even point will change. For planning purposes, West Brothers can change the sales mix, sales price, or variable cost of one or more of the products in the composite unit and perform a "what-if" analysis.

YOUR TURN

Margins in the Sales Mix

The sales mix of a company selling two products, A and B, is 3:1. The per-unit variable costs is $4 for Product A and $5 for Product B. Product A sells for $10 and product B sells for $9. Fixed costs for the company are $220,000.

A. What is the contribution margin per composite unit?
B. What is the break-even point in composite units?
C. How many units of product A and product B will the company sell at the break-even point?

Answer available at the end of this section.

Answers

YOUR TURN

A.

Product	Sales Price per Unit	Variable Cost per Unit	Contribution Margin per Unit
A	$10	$4	$6
B	9	5	4

B.

Product	Composite per Unit Sales (SP × mix)	Composite per Unit Variable Cost (VC × mix)	Composite per Unit Contribution Margin
A	$10 x 3 = $30	$4 × 3 = $12	$18
B	$ 9 x 1 = $ 9	$5 × 1 = $ 5	$4
	$39	$17	$22
Break-even point per composite unit = FC/composite CM 10,000 units - $220,000/$22			

Break-even per composite unit = 15,385.

C.

Number of units per product (mix × units in one composite unit)		
A	3 × 10,000	30,000
B	1 × 10,000	10,000
Composite Sales (unit SP × product composite units)		
A	$10 × 30,000 units	$300,000
B	$ 9 × 10,000 units	$ 90,000
Total sales		$390,000
Composite Variable Cost unit VC × product composite units		
A	$4 × 30,000 units	$120,000
B	$5 × 10,000 units	$ 50,000
Total Variable Cost		$170,000
Contribution Margin (Sales – VC)		$220,000
Fixed Costs		$220,000
Net Income		$ 0

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7.6: Calculate and Interpret a Company's Margin of Safety and Operating Leverage

Our discussion of CVP analysis has focused on the sales necessary to break even or to reach a desired profit, but two other concepts are useful regarding our break-even sales. Those concepts are margin of safety and operating leverage.

Margin of Safety

A company's **margin of safety** is the difference between its current sales and its break-even sales. The margin of safety tells the company how much they could lose in sales before the company begins to lose money, or, in other words, before the company falls below the break-even point. The higher the margin of safety is, the lower the risk is of not breaking even or incurring a loss. In order to calculate margin of safety, we use the following formula:

Margin of Safety in Dollars = Total Budgeted (or actual sales) – Break-Even Sales

Let's look at Manteo Machine, a company that machines parts that are then sold and used in the manufacture of farm equipment. For their core product, the break-even analysis is as follows:

Sales Price per Unit	$	90
Variable Cost per Unit	$	40
Contribution Margin per Unit	$	50
Fixed Costs	$	85,000
Break-Even (in units)		1700
Contribution Margin per Unit	$	50
Selling Price per Unit	$	90
Contribution Margin Ratio		55.55%
Break-Even (in dollars, rounded)		$153,000

Interpreting this information tells Manteo Machine that, when sales equal $153,000, they will be at the break-even point. However, as soon as sales fall below this figure, they will have negative net operating income. They have decided that they want a margin of safety of $10,000. They can add this as if it were a fixed cost (very much the same way we added target profit earlier) and then find a new break-even point that includes a $10,000 margin of safety. If they approached it from this perspective, their new break-even would appear as follows:

Sales Price per Unit	$	90
Variable Cost per Unit	$	40
Contribution Margin per Unit	$	50
Fixed Costs + Margin of Safety	$	95,000
Break-Even (in units)		1900
Contribution Margin per Unit	$	50
Selling Price per Unit	$	90
Contribution Margin Ratio		55.55%
Break-Even (in dollars, rounded)		$170,000

Figure 7.6.1: Manteo Machine's Margin of Safety. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

As shown in Figure 7.6.1, the margin of safety of 1,900 units is found from (FC + Margin of Safety)/CM per unit = $95,000/$50. Thus, 1,900 units must be sold in order to meet fixed cost and have a $10,000 margin of safety. Another way to see this is to realize the $10,000 margin of safety will be met in $50 increments based on the current contribution margin. This means the company will need to sell an additional 200 units, which is an additional $18,000 in sales to have the desired margin of safety. The true break-even, where only fixed costs were met, was 1,700 units, or $153,000 in sales. The point at which the company would have a $10,000 margin of safety is 1,900 units, or $171,000 in sales. Note that the new level of units is the break-even units of 1,700 plus the 200 units for the margin of safety. The same can be seen for the sales dollar. The new level of desired sales dollars is the break-even sales of $153,000 plus the additional $18,000 in sales for the margin of safety.

The margin of safety can also be determined when a company knows its sales volume. For example, Manteo Machine sold 2,500 units in March and wants to know its margin of safety at that sales volume:

Sales (at the current volume of 2,500 units)	$225,000
Break-Even Sales (1,900 units)	153,000
Margin of Safety (in dollars)	72,000

From this analysis, Manteo Machine knows that sales will have to decrease by $72,000 from their current level before they revert to break-even operations and are at risk to suffer a loss.

ETHICAL CONSIDERATIONS

The Importance of Relevant Range Analysis

Ethical managerial decision-making requires that information be communicated fairly and objectively. The failure to include the demand for individual products in the company's mixture of products may be misleading. Providing misleading or inaccurate managerial accounting information can lead to a company becoming unprofitable. Ignoring relevant range(s) in setting assumptions about cost behavior and ignoring the actual demand for the product in the company's market also distorts the information provided to management and may cause the management of the company to produce products that cannot be sold.

Many companies prefer to consider the margin of safety as a percentage of sales, rather than as a dollar amount. In order to

express margin of safety as a percentage, we divide the margin of safety (in dollars) by the total budgeted or actual sales volume. The formula to express margin of safety as a percentage is:

$$\text{Margin of Safety Percentage} = \frac{\text{Margin of Safety (dollars)}}{\text{Total Budget (or Actual) Sales (dollars)}}$$

Previously, we calculated Manteo Machine's margin of safety as $72,000. As a percentage, it would be

$$\$72{,}000 / \$225{,}000 = 0.32 \text{ or } 32\%$$

This tells management that as long as sales do not decrease by more than 32%, they will not be operating at or near the break-even point, where they would run a higher risk of suffering a loss. Often, the margin of safety is determined when sales budgets and forecasts are made at the start of the fiscal year and also are regularly revisited during periods of operational and strategic planning.

Operating Leverage

In much the same way that managers control the risk of incurring a net loss by watching their margin of safety, being aware of the company's operating leverage is critical to the financial well-being of the firm. **Operating leverage** is a measurement of how sensitive net operating income is to a percentage change in sales dollars. Typically, the higher the level of fixed costs, the higher the level of risk. However, as sales volumes increase, the payoff is typically greater with higher fixed costs than with higher variable costs. In other words, the higher the risk the greater the payoff.

First, let's look at this from a general example to understand payoff. Suppose you had $10,000 to invest and you were debating between putting that money in low risk bonds earning 3% or taking a chance and buying stock in a new company that currently is not profitable but has an innovative product that many analysts predict will take off and be the next "big thing." Obviously, there is more risk with buying the stock than with buying the bonds. If the company remains unprofitable, or fails, you stand to lose all or a portion of your investment, whereas the bonds are less risky and will continue to pay 3% interest. However, the risk associated with the stock investment could result in a much higher payoff if the company is successful.

So how does this relate to fixed costs and companies? Companies have many types of fixed costs including salaries, insurance, and depreciation. These costs are present regardless of our production or sales levels. This makes fixed costs riskier than variable costs, which only occur if we produce and sell items or services. As we sell items, we have learned that the contribution margin first goes to meeting fixed costs and then to profits. Here is an example of how changes in fixed costs affects profitability.

Gray Co. has the following income statement:

Sales (10,000 units x $10 SP)	$100,000
Variable Costs (10,000 units x $4 VC)	$ 40,000
Contribution Margin	$ 60,000
Fixed Costs	$ 25,000
Net Income	$ 35,000

What is the effect of switching $10,000 of fixed costs to variable costs? What is the effect of switching $10,000 of variable costs to fixed costs?

Effect of Changing $10,000 of FC to VC	
Sales (10,000 units x $10 SP)	$100,000
Variable Costs	50,000
Contribution Margin	50,000
Fixed Costs	15,000
Net Income	35,000

Effect of Changing $10,000 of VC to FC	
Sales (10,000 units x $10 SP)	$100,000
Variable Costs	30,000
Contribution Margin	70,000
Fixed Costs	35,000
Net Income	35,000

Notice that in this instance, the company's net income stayed the same. Now, look at the effect on net income of changing fixed to variable costs or variable costs to fixed costs as sales volume increases. Assume sales volume increase by 10%.

Effect of Changing $10,000 of FC to VC and 10% Increase in Sales	
Sales (11,000 units x $10 SP)	$110,000
Variable Costs (also increases 10%)	$ 55,000
Contribution Margin	$ 55,000
Fixed Costs	$ 15,000
Net Income	$ 40,000

Effect of Changing $10,000 of VC to FC and 10% Increase in Sales	
Sales (11,000 units x $10 SP)	$110,000
Variable Costs (also increases 10%)	$ 33,000
Contribution Margin	$ 77,000
Fixed Costs	$ 35,000
Net Income	$ 45,000

As you can see from this example, moving variable costs to fixed costs, such as making hourly employees salaried, is riskier in that fixed costs are higher. However, the payoff, or resulting net income, is higher as sales volume increases.

This is why companies are so concerned with managing their fixed and variable costs and will sometimes move costs from one category to another to manage this risk. Some examples include, as previously mentioned, moving hourly employees (variable) to salaried employees (fixed), or replacing an employee (variable) with a machine (fixed). Keep in mind that managing this type of risk not only affects operating leverage but can have an effect on morale and corporate climate as well.

CONCEPTS IN PRACTICE

Fluctuating Operating Leverage: Why Do Stores Add Self-Service Checkout Lanes?

Operating leverage fluctuations result from changes in a company's cost structure. While any change in either variable or fixed costs will change operating leverage, the fluctuations most often result from management's decision to shift costs from one category to another. As the next example shows, the advantage can be great when there is economic growth (increasing sales); however, the disadvantage can be just as great when there is economic decline (decreasing sales). This is the risk that must be managed when deciding how and when to cause operating leverage to fluctuate.

Consider the impact of reducing variable costs (fewer employee staffed checkout lanes) and increasing fixed costs (more self-service checkout lanes). A store with $125,000,000 per year in sales installs some self-service checkout lanes. This increases its fixed costs by 10% but reduces its variable costs by 5%. As Figure 7.6.2 shows, at the current sales level, this could produce a whopping 35% increase in net operating income. And, if the change results in higher sales, the increase in net operating income would be even more dramatic. Do the math and you will see that each 1% increase in sales would produce a 6% increase in net operating income: well worth the change, indeed.

	Without Self-service Checkout Lanes	With Self-service Checkout Lanes
Sales	$125,000	$125,000
Variable Costs	$ 93,750	$ 89,063
Contribution Margin	$ 31,250	$ 35,937
Fixed costs	$ 25,000	$ 27,500
Net Operating Income	$ 6,250	$ 8,437
% Increase in Income		35%

Figure 7.6.2: Impact of Self-service Checkout Lanes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

(in 000s) Without Self-service Checkout Lanes, With Self-service Checkout Lanes (respectively): Sales $125,000, 125,000; Variable Costs 93,750, 89,063; Contribution Margin 31,250, 35,938; Fixed Costs 25,000, 27,500; Net Operating Income 6,250 8,438; Percent Increase in Income 35 percent.

The company in this example also faces a downside risk, however. If customers disliked the change enough that sales decreased by more than 6%, net operating income would drop below the original level of $6,250 and could even become a loss.

Operating leverage has a multiplier effect. A **multiplier effect** is one in which a change in an input (such as variable cost per unit) by a certain percentage has a greater effect (a higher percentage effect) on the output (such as net income). To explain the concept of a multiplier effect, think of having to open a very large, heavy wooden crate. You could pull and pull with your hands all day and still not exert enough force to get it open. But, what if you used a lever in the form of a pry bar to multiply your effort and strength? For every additional amount of force you apply to the pry bar, a much larger amount of force is applied to the crate. Before you know it, you have the crate open. Operating leverage works much like that pry bar: if operating leverage is high, then a very small increase in sales can result in a large increase in net operating income.

How does a company increase its operating leverage? Operating leverage is a function of cost structure, and companies that have a high proportion of fixed costs in their cost structure have higher operating leverage. There is, however, a cautionary side to operating leverage. Since high operating leverage is the result of high fixed costs, if the market for the company's products, goods, or services shrinks, or if demand for the company's products, goods, or services declines, the company may find itself obligated to pay for fixed costs with little or no sales revenue to spare. Managers who have made the decision to chase large increases in net operating income through the use of operating leverage have found that, when market demand falls, their only recourse is to close their doors. In fact, many large companies are making the decision to shift costs *away* from fixed costs to protect them from this very problem.

LINK TO LEARNING

During periods of sales downturns, there are many examples of companies working to shift costs away from fixed costs. This Yahoo Finance article reports that many airlines are changing their cost structure to move away from fixed costs and toward variable costs such as Delta Airlines. Although they are decreasing their operating leverage, the decreased risk of insolvency more than makes up for it.

In order to calculate the degree of operating leverage at a given level of sales, we will apply the following formula:

$$\text{Degree of Operating Leverage} = \frac{\text{Contribution Margin}}{\text{Net Operating Income}}$$

To explain further the concept of operating leverage, we will look at two companies and their operating leverage positions:

	Company A	Company B
Sales	$250,000	$315,000
Variable Costs	102,000	105,000
Contribution Margin (a)	148,000	210,000
Fixed Costs	63,000	125,000
Net Income (loss) (b)	85,000	85,000
Operating Leverage (a) ÷ (b)	**1.74**	**2.47**

Both companies have the same net income of $85,000, but company B has a higher degree of operating leverage because its fixed costs are higher than that of company A. If we want to see how operating leverage impacts net operating income, then we can apply the following formula:

$$\text{Degree of Operating Leverage} \times \text{Percentage Change in Sales} = \text{Percentage Change in Net Operating Income}$$

Let's assume that both company A and company B are anticipating a 10% increase in sales. Based on their respective degrees of operating leverage, what will their percentage change in net operating income be?

Company A: 1.71 × 10% = 17.4%

Company B: 2.47 × 10% = 24.7%

For company A, for every 10% increase in sales, net operating income will increase 17.4%. But company B has a much higher degree of operating leverage, and a 10% increase in sales will result in a 24.7% increase in net operating income. These examples clearly show why, during periods of growth, companies have been willing to risk incurring higher fixed costs in exchange for large percentage gains in net operating income. But what happens in periods where income declines?

We will return to Company A and Company B, only this time, the data shows that there has been a 20% decrease in sales. Note that the degree of operating leverage changes for each company. The reduced income resulted in a higher operating leverage, meaning a higher level of risk.

	Company A	Company B
Sales (20% decrease)	$200,000	$252,000
Variable Costs (20% decrease)	81,600	84,000
Contribution Margin (a)	118,400	168,000
Fixed Costs	63,000	125,000
Net Income (b)	$ 55,400	$ 43,000
Operating Leverage (a ÷ b)	2.14	3.91
% Change in Net Income (Prior Net Income – Current Net Income)/Prior Net Income	34.8% decrease	49.4% decrease

It is equally important to realize the percentage decrease in income for both companies. The decrease in sales by 20% resulted in a 31.9% decrease in net income for Company A. For Company B, the 20% decrease in sales resulted in a 46.9% decrease in net income. This also could have been found by taking the initial operating leverage times the 20% decrease:

Company A: 20% decreases × 1.74 operating leverage = 34.8% decrease in net income

Company B: 20% decreases × 2.47 operating leverage = 49.4% decrease in net income

This example also shows why, during periods of decline, companies look for ways to reduce their fixed costs to avoid large percentage reductions in net operating income.

THINK IT THROUGH

Moving Costs

You are the managerial accountant for a large manufacturing firm. The company has sales that are well above its break-even point, but they have historically carried most of their costs as fixed costs. The outlook for the industry you are in is not positive. How could you move more costs away from fixed costs to put the company in a better financial position if the industry does, in fact, take a downturn?

CONTINUING APPLICATION

Viking Grocery Stores

You might wonder why the grocery industry is not comparable to other big-box retailers such as hardware or large sporting goods stores. Just like other big-box retailers, the grocery industry has a similar product mix, carrying a vast of number of name brands as well as house brands. The main difference, then, is that the profit margin per dollar of sales (i.e., profitability) is smaller than the typical big-box retailer. Also, the inventory turnover and degree of product spoilage is greater for grocery stores. Overall, while the fixed and variable costs are similar to other big-box retailers, a grocery store must sell vast quantities in order to create enough revenue to cover those costs.

This is reflected in the business plan. Unlike a manufacturer, a grocery store will have hundreds of products at one time with various levels of margin, all of which will be taken into account in the development of their break-even analysis. Review a business plan developed by Viking Grocery Stores in consideration of opening a new site in Springfield, Missouri to see how a grocery store develops a business plan and break-even based upon multiple products.

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8: ABSORPTION AND VARIABLE INCOME STATEMENTS

Learning Objectives

- Prepare traditional and contribution margin income statements
- Define related terms
- Compare and contrast absorption costing and variable costing
- Convert Variable income statements to traditional US GAAP income statements.

8.1: Compare and Contrast Variable and Absorption Costing

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8.1: Compare and Contrast Variable and Absorption Costing

ABC costing assigns a proportion of overhead costs on the basis of the activities under the presumption that the activities drive the overhead costs. As such, ABC costing converts the indirect costs into product costs. There are also cost systems with a different approach. Instead of focusing on the overhead costs incurred by the product unit, these methods focus on assigning the fixed overhead costs to inventory.

There are two major methods in manufacturing firms for valuing work in process and finished goods inventory for financial accounting purposes: variable costing and absorption costing. **Variable costing**, also called *direct costing* or *marginal costing*, is a method in which all variable costs (direct material, direct labor, and variable overhead) are assigned to a product and fixed overhead costs are expensed in the period incurred. Under variable costing, fixed overhead is not included in the value of inventory. In contrast, **absorption costing**, also called *full costing*, is a method that applies all direct costs, fixed overhead, and variable manufacturing overhead to the cost of the product. The value of inventory under absorption costing includes direct material, direct labor, and all overhead.

The difference in the methods is that management will prefer one method over the other for internal decision-making purposes. The other main difference is that only the absorption method is in accordance with GAAP.

Variable Costing Versus Absorption Costing Methods

The difference between the absorption and variable costing methods centers on the treatment of fixed manufacturing overhead costs. Absorption costing "absorbs" all of the costs used in manufacturing and includes fixed manufacturing overhead as product costs. Absorption costing is in accordance with GAAP, because the product cost includes fixed overhead. Variable costing considers the variable overhead costs and does not consider fixed overhead as part of a product's cost. It is not in accordance with GAAP, because fixed overhead is treated as a period cost and is not included in the cost of the product.

CONCEPTS IN PRACTICE

Absorbing Costs through Overproduction

While companies use absorption costing for their financial statements, many also use variable costing for decision-making. The Big Three auto companies made decisions based on absorption costing, and the result was the manufacturing of more vehicles than the market demanded. Why? With absorption costing, the fixed overhead costs, such as marketing, were allocated to inventory, and the larger the inventory, the lower was the unit cost of that overhead. For example, if a fixed cost of $1,000 is allocated to 500 units, the cost is $2 per unit. But if there are 2,000 units, the per-unit cost is $0.50. While this was not the only reason for manufacturing too many cars, it kept the period costs hidden among the manufacturing costs. Using variable costing would have kept the costs separate and led to different decisions.

Deferred Costs

Absorption costing considers all fixed overhead as part of a product's cost and assigns it to the product. This treatment means that as inventories increase and are possibly carried over from the year of production to actual sales of the units in the next year, the company allocates a portion of the fixed manufacturing overhead costs from the current period to future periods.

Carrying over inventories and overhead costs is reflected in the ending inventory balances at the end of the production period, which become the beginning inventory balances at the start of the next period. It is anticipated that the units that were carried over will be sold in the next period. If the units are not sold, the costs will continue to be included in the costs of producing the units until they are sold. Finally, at the point of sale, whenever it happens, these deferred production costs, such as fixed overhead, become part of the costs of goods sold and flow through to the income statement in the period of the sale. This treatment is based on the **expense recognition principle**, which is one of the cornerstones of accrual accounting and is why the absorption method follows GAAP. The principle states that expenses should be recognized in the period in which revenues are incurred. Including fixed overhead as a cost of the product ensures the fixed overhead is expensed (as part of cost of goods sold) when the sale is reported.

For example, assume a new company has fixed overhead of $12,000 and manufactures 10,000 units. Direct materials cost is $3 per unit, direct labor is $15 per unit, and the variable manufacturing overhead is $7 per unit. Under absorption costing, the amount of fixed overhead in each unit is $1.20 ($12,000/10,000 units); variable costing does not include any fixed overhead as part of the cost of the product. Figure 8.1.1 shows the cost to produce the 10,000 units using absorption and variable costing.

	Absorption	Variable
Materials ($3 per unit)	$ 30,000	$ 30,000
Labor ($15 per unit)	150,000	150,000
Variable Overhead ($7 per unit)	70,000	70,000
Fixed Overhead ($1.20 per unit)	12,000	
Total Finished Goods Inventory	$262,000	$250,000

Figure 8.1.1: Finished Goods Inventory under Absorption and Variable Costing. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Assume each unit is sold for $33 each, so sales are $330,000 for the year. If the entire finished goods inventory is sold, the income is the same for both the absorption and variable cost methods. The difference is that the absorption cost method includes fixed overhead as part of the cost of goods sold, while the variable cost method includes it as an administrative cost, as shown in Figure 8.1.2. When the entire inventory is sold, the total fixed cost is expensed as the cost of goods sold under the absorption method or it is expensed as an administrative cost under the variable method; net income is the same under both methods.

	Absorption	Variable
Sales	$330,000	$330,000
Cost of Goods Sold	262,000	250,000
Gross Profit	68,000	80,000
– Fixed Overhead	0	12,000
Net Income	$ 68,000	$ 68,000

Figure 8.1.2: Income Statement When the Entire Inventory Is Sold. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Now assume that 8,000 units are sold and 2,000 are still in finished goods inventory at the end of the year. The cost of the fixed overhead expensed on the income statement as cost of goods sold is $9,600 ($1.20/unit × 8,000 units), and the fixed overhead cost remaining in finished goods inventory is $2,400 ($1.20/unit × 2,000 units). The amount of the fixed overhead paid by the company is not totally expensed, because the number of units in ending inventory has increased. Eventually, the fixed overhead cost will be expensed when the inventory is sold in the next period. Figure 8.1.3 shows the cost to produce the 8,000 units of inventory that became cost of goods sold and the 2,000 units that remain in ending inventory.

	Absorption	Variable
Cost of Goods Sold		
Materials	$ 24,000	$ 24,000
Labor	120,000	120,000
Variable Overhead	56,000	56,000
Fixed Overhead	9,600	
Cost of Goods Sold	$209,600	$200,000
Ending Inventory		
Materials	$ 6,000	$ 6,000
Labor	30,000	30,000
Variable Overhead	14,000	14,000
Fixed Overhead	2,400	
Ending Inventory	$ 52,400	$ 50,000

Figure 8.1.3: Cost of Goods Sold and Ending Inventory with the Absorption and Variable Costing Methods. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

If the 8,000 units are sold for $33 each, the difference between absorption costing and variable costing is a timing difference. Under absorption costing, the 2,000 units in ending inventory include the $1.20 per unit share, or $2,400 of fixed cost. That cost will be expensed when the inventory is sold and accounts for the difference in net income under absorption and variable costing, as shown in Figure 8.1.4.

	Absorption	Variable
Sales	$264,000	$264,000
Cost of Goods Sold	209,600	200,000
Gross Profit	54,400	64,000
− Fixed Overhead	0	12,000
Net Income	$ 54,400	$ 52,000

Figure 8.1.4: Net Income under Absorption and Variable Costing When Ending Inventory Remains. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Under variable costing, the fixed overhead is not considered a product cost and would not be assigned to ending inventory. The fixed overhead would have been expensed on the income statement as a period cost.

Inventory Differences

Because absorption costing defers costs, the ending inventory figure differs from that calculated using the variable costing method. As shown in Figure 8.1.3, the inventory figure under absorption costing considers both variable and fixed manufacturing costs, whereas under variable costing, it only includes the variable manufacturing costs.

Suitability for Cost-Volume-Profit Analysis

Using the absorption costing method on the income statement does not easily provide data for cost-volume-profit (CVP) computations. In the previous example, the fixed overhead cost per unit is $1.20 based on an activity of 10,000 units. If the company estimated 12,000 units, the fixed overhead cost per unit would decrease to $1 per unit. This calculation is possible, but it must be done multiple times each time the volume of activity changes in order to provide accurate data, as CVP analysis makes no distinction between variable costing and absorption costing income statements.

YOUR TURN

Comparing Variable and Absorption Methods

A company expects to manufacture 7,000 units. Its direct material costs are $10 per unit, direct labor is $9 per unit, and variable overhead is $3 per unit. The fixed overhead is estimated at $49,000. How much would each unit cost under both the variable method and the absorption method?

Answer available at the end of this section.

Advantages and Disadvantages of the Variable Costing Method

Variable costing only includes the product costs that vary with output, which typically include direct material, direct labor, and variable manufacturing overhead. Fixed overhead is not considered a product cost under variable costing. Fixed manufacturing overhead is still expensed on the income statement, but it is treated as a period cost charged against revenue for each period. It does not include a portion of fixed overhead costs that remains in inventory and is not expensed, as in absorption costing.

If absorption costing is the method acceptable for financial reporting under GAAP, why would management prefer variable costing? Advocates of variable costing argue that the definition of fixed costs holds, and fixed manufacturing overhead costs will be incurred regardless of whether anything is actually produced. They also argue that fixed manufacturing overhead costs are true period expenses and have no future service potential, since incurring them now has no effect on whether these costs will have to be incurred again in the future.

Advantages of the variable approach are:

- **More useful for CVP analysis**. Variable costing statements provide data that are immediately useful for CVP analysis because fixed and variable overhead are separate items. Computations from financial statements prepared with absorption costing need computations to break out the fixed and variable costs from the product costs.
- **Income is not affected by changes in production volume**. Fixed overhead is treated as a period cost and does not vary as the volume of inventory changes. This results in income increasing in proportion to sales, which may not happen under absorption costing. Under absorption costing, the fixed overhead assigned to a cost changes as the volume changes. Therefore, the reported net income changes with production, since fixed costs are spread across the changing number of units. This can distort the income picture and may even result in income moving in an opposite direction from sales.
- **Understandability**. Managers may find it easier to understand variable costing reports because overhead changes with the cost driver.
- **Fixed costs are more visible**. Variable costing emphasizes the impact fixed costs have on income. The total amount of fixed costs for the period is reported after gross profit. This emphasizes the direct impact fixed costs have on net income, whereas in absorption costing, fixed costs are included as product costs and thus are part of cost of goods sold, which is a determinant of gross profit.
- **Margins are less distorted**. Gross margins are not distorted by the allocation of common fixed costs. This facilitates appraisal of the profitability of products, customers, and business segments. **Common fixed costs**, sometimes called allocated fixed costs, are costs of the organization that are shared by the various revenue-generating components of the business, such as divisions. Examples of these costs include the chief executive officer (CEO) salary and corporate headquarter costs, such as rent and insurance. These overhead costs are typically allocated to various components of the organization, such as divisions or production facilities. This is necessary, because these costs are needed for doing business but are generated by a part of the company that does not directly generate revenues to offset these costs. The company's revenues are generated by the goods that are produced and sold by the various divisions of the company.
- **Control is facilitated**. Variable costing considers only variable production costs and facilitates the use of control

mechanisms such as flexible budgets that are based on differing levels of production and therefore designed around variable costs, since fixed costs do not change within a relevant range of production.
- **Incremental analysis is more straightforward**. Variable cost corresponds closely with the current out-of-pocket expenditure necessary to manufacture goods and can therefore be used more readily in incremental analysis.

While the variable cost method helps management make decisions, especially when the number of units in ending inventory fluctuates, there are some disadvantages:

- **Financial reporting**. The variable cost method is not acceptable for financial reporting under GAAP. GAAP requires expenses to be recognized in the same period as the related revenue, and the variable method expenses fixed overhead as a period cost regardless of how much inventory remains.
- **Tax reporting**. Tax laws in the United States and many other countries do not allow variable costing and require absorption costing.

Advantages and Disadvantages of the Absorption Costing Method

Under the absorption costing method, all costs of production, whether fixed or variable, are considered product costs. This means that absorption costing allocates a portion of fixed manufacturing overhead to each product.

Advocates of absorption costing argue that fixed manufacturing overhead costs are essential to the production process and are an actual cost of the product. They further argue that costs should be categorized by function rather than by behavior, and these costs must be included as a product cost regardless of whether the cost is fixed or variable.

The advantages of absorption costing include:

- **Product cost**. Absorption costing includes fixed overhead as part of the inventory cost, and it is expensed as cost of goods sold when inventory is sold. This represents a more complete list of costs involved in producing a product.
- **Financial reporting**. Absorption costing is the acceptable reporting method under GAAP.
- **Tax reporting**. Absorption costing is the method required for tax preparation in the United States and many other countries.

While financial and tax reporting are the main advantages of absorption costing, there is one distinct disadvantage:

- **Difficulty in understanding**. The absorption costing method does not list the incremental fixed overhead costs and is more difficult to understand and analyze as compared to variable costing.

ETHICAL CONSIDERATIONS

Cost Accounting for Ethical Business Managers

An ethical and evenhanded approach to providing clear and informative financial information regarding costing is the goal of the ethical accountant. Ethical business managers understand the benefits of using the appropriate costing systems and methods. The accountant's entire business organization needs to understand that the costing system is created to provide efficiency in assisting in making business decisions. Determining the appropriate costing system and the type of information to be provided to management goes beyond providing just accounting information. The costing system should provide the organization's management with factual and true financial information regarding the organization's operations and the performance of the organization. Unethical business managers can game the costing system by unfairly or unscrupulously influencing the outcome of the costing system's reports.

Comparing the Operating Income Statements for Both Methods Assuming No Ending Inventory in the First Year, and the Existence of Ending Inventory in the Second Year

In order to understand how to prepare income statements using both methods, consider a scenario in which a company has no ending inventory in the first year but does have ending inventory in the second year. Outdoor Nation, a manufacturer of residential, tabletop propane heaters, wants to determine whether absorption costing or variable costing is better for internal

decision-making. It manufactures 5,000 units annually and sells them for $15 per unit. The total of direct material, direct labor, and variable overhead is $5 per unit with an additional $1 in variable sales cost paid when the units are sold. Additionally, fixed overhead is $15,000 per year, and fixed sales and administrative expenses are $21,000 per year.

Production is estimated to hold steady at 5,000 units per year, while sales estimates are projected to be 5,000 units in year 1; 4,000 units in year 2; and 6,000 in year 3.

Under absorption costing, the ending inventory costs include all manufacturing costs, including overhead. If fixed overhead is $15,000 per year and 5,000 units are manufactured each year, the fixed overhead per unit is $3:

$$\$15{,}000 / 5{,}000 \text{ units} = \$3 \text{ per unit}$$

The projected income statement using absorption costing is shown in Figure 8.1.5:

	Year 1	Year 2	Year 3
Sales	$75,000	$60,000	$90,000
Cost of Goods Sold			
Beginning Inventory	0	0	8,000
+ Cost of Goods Manufactured			
Direct Material, Labor, and Overhead			
(5,000 units × $5 per unit)	25,000	25,000	25,000
Fixed Manufacturing Overhead	15,000	15,000	15,000
Cost of Goods Available for Sale	40,000	40,000	48,000
− Ending Inventory	0	8,000	0
Cost of Goods Sold	40,000	32,000	48,000
Gross Margin	35,000	28,000	42,000
− Sales and Administrative Expenses			
Fixed Sales and Administration Expenses	21,000	21,000	21,000
Variable Sales and Administration Expenses	5,000	4,000	6,000
Net Income	$ 9,000	$ 3,000	$15,000

Figure 8.1.5: Outdoor Nation's Income Statement Using Absorption Costing. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

In variable costing, the fixed overhead is not included in the cost of goods sold even if it relates to manufacturing. As a result, the net income under variable costing differs from absorption costing by the same amount as inventory differential. The projected income under variable costing is shown in Figure 8.1.6:

	Year 1	Year 2	Year 3
Sales	$75,000	$60,000	$90,000
− Variable Expenses			
Beginning Inventory	0	0	5,000
+ Variable Manufacturing Overhead	25,000	25,000	25,000
Cost of Goods Available for Sale	25,000	25,000	30,000
− Ending Inventory	0	5,000	0
Variable Cost to Manufacturing	25,000	20,000	30,000
Variable Selling and Administrative Expenses	5,000	4,000	6,000
Cost of Goods Sold	30,000	24,000	36,000
Contribution Margin	45,000	36,000	54,000
− Fixed Expenses			
Fixed Overhead Expenses	15,000	15,000	15,000
Fixed Sales and Administration Expenses	21,000	21,000	21,000
Net Income	$ 9,000	$ 0	$18,000

Figure 8.1.6: Outdoor Nation's Income Statement Using Variable Costing. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The difference between the methods is attributable to the fixed overhead. Therefore, the methods can be reconciled with each other, as shown in Figure 8.1.7.

Reconciliation	Year 1	Year 2	Year 3
Income under Variable Costing	$9,000	$ 0	$18,000
+ Fixed Manufacturing Overhead in Ending Inventory	0	3,000	0
− Fixed Manufacturing Overhead in Beginning Inventory	0	0	3,000
Income under Absorption	$9,000	$3,000	$15,000

Figure 8.1.7: Outdoor Nation's Reconciliation of Net Incomes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Each method results in different amounts for net income when the inventory amounts change. More specifically, the effects on income are:

- **Sales and Production equal.** When a company sells the same quantity of products produced during the period, the resulting net income will be identical whether absorption costing or variable costing is used. When sales equals production, all manufacturing costs are accounted for in net income, and none of the costs are waiting in finished goods inventory to be recognized in a future period. Remember, with absorption costing, all manufacturing costs are added to the cost of the product during the work in process phase; thus, as the goods are sold, all costs have been accounted for. With variable costing, only the variable costs or production are added to the cost of the product during the work in process phase, and the fixed costs are expensed in the period in which they are incurred. Thus, in the example where sales and production are equal, all costs have been accounted for since all of the produced inventory has moved through cost of goods sold. This means that net income under absorption costing would be the same as net income under variable costing.
- **Sales less than Production**. When a company produces more than it sells, net income will be less under variable costing than under absorption costing. In this scenario, there will be a buildup, or an increase, in inventory from the beginning of the period to the end of the period. Under variable costing, fixed manufacturing costs are still in the finished goods inventory account. But under absorption costing, those fixed costs have been expensed during the current production period and thus have reduced net income.
- **Sales greater than Production.** When a company sells more than it produces during the current period, this indicates it is selling goods produced in a prior period. This will result in net income under variable costing being greater than under

absorption costing. With absorption costing, all manufacturing costs are captured in the finished goods inventory account, and as those goods are sold, those costs become expenses. Selling items that were produced in a prior period defers the recognition of the costs of those products until the future period in which they are sold. Variable costing results in all of the variable costs associated with the sold products being in the current period net income, but only the current period fixed expenses would be included in the current period net income. The fixed expenses associated with the items produced in a prior period were recognized in the period in which they were incurred, not the period in which the products are sold. This results in fewer expenses and therefore greater income with the variable cost method.

- **Effect of differences in Sales and Production Long Term.** The differences between net income generated under absorption costing and variable costing will be almost zero over the long run, as all costs associated with the production of goods will eventually be recognized in net income. The use of absorption versus variable costing creates more of a timing issue for the recognition of fixed expenses, and this is why net income would vary from period to period under the two methods but in the long run would not. In addition, absorption costing does allow for manipulation of income by managers through overproduction. Increasing production at year-end results in a higher net income than if the additional goods had not been produced, since increasing the number of units decreases the fixed cost per unit. Under absorption costing, these fixed costs follow the units produced and do not become a part of cost of goods sold until they are sold. Instead, a portion of the fixed costs is in the inventory accounts. Why would a manager want to manipulate income by overproducing? If the manager's annual bonus or other compensation is linked to net income, then the manager may be motivated to overproduce in order to increase the potential for or the amount of a bonus. If the level of sales remain constant while manipulating the production level, such an action would increase the company's expenses (including the amount of bonus) while not increasing its revenue. Barring any other justification for the increase in production, such an action by the manager would typically be considered an ethical violation, since the manager's actions would be in the manager's best interests, but contrary to the best interests of the company.

LINK TO LEARNING

Absorption costing is not as well understood as variable costing because of its financial statement limitations. But understanding how it can help management make decisions is very important. See the Strategic CFO forum on *Absorption Cost Accounting* that helps managers understand its uses to learn more.

Answers

YOUR TURN

The variable cost per unit is $22 (the total of direct material, direct labor, and variable overhead). The absorption cost per unit is the variable cost ($22) plus the per-unit cost of $7 ($49,000/7,000 units) for the fixed overhead, for a total of $29.

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9: MASTER BUDGETS

Learning Objectives

- Explain the purpose of budgeting
- Prepare a master budget and its component schedules
- Relate the budget to planning and control

9.1: Why It Matters
9.2: Describe How and Why Managers Use Budgets
9.3: Prepare Operating Budgets
9.4: Prepare Financial Budgets

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9.1: Why It Matters

Chris and Nikki are studying abroad next semester. Chris wants to spend her weekends sightseeing, but she does not have a lot of extra money. She creates a budget so she can save money to sightsee. She can reliably predict costs such as tuition, books, travel, and much of the sightseeing costs. She can also predict the amount of resources she will have to meet those costs, including scholarships, some savings, and earnings from her job.

Chris developed a budget from this information and planned for emergencies by including extra working hours and listing expenses that could be eliminated. On her trip, Chris was very careful with expenses and visited all the places she budgeted to visit.

Chris's roommate, Nikki, on the other hand, did not plan ahead before going abroad. She did not have any travel funds for the last several weeks and lamented that she should not have purchased so many souvenirs.

Chris and Nikki are clear illustrations of why people and companies prepare budgets. Preparing a budget for future anticipated activities requires a company to look critically at its revenue and expenses. A good budget gives management the ability to evaluate results at the end of the budget cycle. Even well-planned budgets can have emergencies or unplanned financial disruptions, but having a budget provides a company with the information to develop an alternative budget. A good budget can be adjusted to work with changes in income and still produce similar results.

In this chapter, you will learn the basic process companies use to create budgets and the general composition of basic budgets that are summed up in a master budget. You will also learn the importance of the flexible budget and be introduced to the idea of how budgets are used to evaluate company and management performance.

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9.2: Describe How and Why Managers Use Budgets

Implementation of a company's strategic plan often begins by determining management's basic expectations about future economic, competitive, and technological conditions, and their effects on anticipated goals, both long-term and short-term. Many firms at this stage conduct a situational analysis that involves examining their *strengths* and *weaknesses* and the external *opportunities* available and the *threats* that they might face from competitors. This common analysis is often labeled as SWOT.

After performing the situational analysis, the organization identifies potential strategies that could enable achievement of its goals. Finally, the company will create, initiate, and monitor both long-term and short-term plans.

An important step in the initiation of the company's strategic plan is the creation of a budget. A good budgeting system will help a company reach its strategic goals by allowing management to plan and to control major categories of activity, such as revenue, expenses, and financing options. Planning involves developing future objectives, whereas controlling involves monitoring the planning objectives that have been put into place.

There are many advantages to budgeting, including:

- Communication
  - Budgeting is a formal method to communicate a company's plans to its internal stakeholders, such as executives, department managers, and others who have an interest in—or responsibility for—monitoring the company's performance.
  - Budgeting requires managers to plan for both revenues and expenses.
- Planning
  - Preparing a budget requires managers to consider and evaluate
    - The assumptions used to prepare the budget.
    - Long-term financial goals.
    - Short-term financial goals.
    - The company's position in the market.
    - How each department supports the strategic plan.
  - Preparing a budget requires departments to work together to
    - Determine realizable sales goals.
    - Compute the manufacturing or other requirements necessary to meet the sales goals.
    - Solve bottlenecks that are predicted by the budget.
    - Allocate resources so they can be used effectively to meet the sales and manufacturing goals.
    - Compare forecasted or flexible budgets with actual results.
- Evaluation
  - When compared to actual results, budgets are early alerts and they forecast:
    - Cash flows for various levels of production.
    - When loans may be required or when loans may be reduced.
  - Budgets show which areas, departments, units, and so forth, are profitable or meet their appropriate goals. Similarly, they also show which components are unprofitable or do not reach their anticipated goals.
  - Budgets set defined benchmarks that may be used for evaluating company and management performance, including raises and bonuses, as well as negative consequences, such as firing.

To understand the benefits of budgeting, consider Big Bad Bikes, a company that manufactures high-end mountain bikes. The company will begin producing and selling trainers this year. Trainers are stands that allow a rider to ride their bike indoors similar to the way bikes are used in spinning classes. Big Bad Bikes has a 5-year plan and has always been successful in managing its budget. Managers participate in developing the budget and are aware that all expenses must be related to the company's strategic plan. They know that managing their departments is much easier when the budget is developed to support the strategic plan.

The plan for Big Bad Bikes is to introduce itself to the trainer market with a sales price of $70 for the first two quarters of the year and then raise the price to $75 per unit. The marketing department estimates that sales will be 1,000 units for the first two quarters, 1,500 for the third quarter, and 2,500 per quarter through the second year. Management will work with each department to communicate goals and build a budget based on the sales plan. The resulting budget can be evaluated by all departments involved.

ETHICAL CONSIDERATIONS

Break-Even Analysis and Profitability

In the long run, proper budget reporting assists management in making good decisions. Management uses budgets to evaluate the performance of employees and their department. They can also use budgets to evaluate and benchmark the performance of a business unit in a large business organization or of the entire performance of a small company. They can also use budgets to evaluate separate projects. In budgeting situations, employees may feel a tension between reporting actual results and reporting results that reach the predetermined goals created by the budget. This creates a situation where managers may choose to act unethically and pressure accountants to report favorable financial results not supported by the operations.

Accountants need to be aware of this circumstance and use ethical standards when assisting the development and creation of budgets. After a proper budget has been created, the reporting of the actual results will assist in creating a realistic and honest picture of the actual operations for the managers reviewing the budget. The budget accountant needs to take steps to ensure that employees are not trying to misreport the budget results; for example, managers might be tempted to set artificially low standards to ensure that targets are hit and significantly exceeded. Such results could lead to what might be considered as excessive bonuses paid to managers.

The Basics of Budgeting

All companies—large and small—have limits on the amount of money or resources they can receive and pay out. How these resources are used to reach their goals and objectives must be planned. The quantitative plan estimating when and how much cash or other resources will be received and when and how the cash or other resources will be used is the **budget**. As you've learned, some of the benefits of budgeting include improved communication, planning, coordination, and evaluation.

All budgets are quantitative plans for the future and will be constructed based on the needs of the organization for which the budget is being created. Depending on the complexity, some budgets can take months or even years to develop. The most common time period covered by a budget is one year, although the time period may vary from strategic, long-term budgets to very detailed, short-term budgets. Generally, the closer the company is to the start of the budget's time period, the more detailed the budget becomes.

Management begins with a vision of the future. The long-term vision sets the direction of the company. The vision develops into goals and strategies that are built into the budget and are directly or indirectly reflected on the master budget.

The master budget has two major categories: the financial budget and the operating budget. The financial budget plans the use of assets and liabilities and results in a projected balance sheet. The operating budget helps plan future revenue and expenses and results in a projected income statement. The operating budget has several subsidiary budgets that all begin with projected sales. For example, management estimates sales for the upcoming few years. It then breaks down estimated sales into quarters, months, and weeks and prepares the sales budget. The sales budget is the foundation for other operating budgets. Management uses the number of units from the sales budget and the company's inventory policy to determine how many units need to be produced. This information in units and in dollars becomes the production budget.

The production budget is then broken up into budgets for materials, labor, and overhead, which use the standard quantity and standard price for raw materials that need to be purchased, the standard direct labor rate and the standard direct labor hours that need to be scheduled, and the standard costs for all other direct and indirect operating expenses. Companies use the historic quantities of the amount of material per unit and the hours of direct labor per unit to compute a standard used to estimate the quantity of materials and labor hours needed for the expected level of production. Current costs are used to develop standard costs for the price of materials, the direct labor rate, as well as an estimate of overhead costs.

The budget development process results in various budgets for various purposes, such as revenue, expenses, or units produced, but they all begin with a plan. To save time and eliminate unnecessary repetition, management often starts with the current year's budget and adjusts it to meet future needs.

There are various strategies companies use in adjusting the budget amounts and planning for the future. For example, budgets can be derived from a top-down approach or from a bottom-up approach. Figure 9.2.1 shows the general difference between the top-down approach and the bottom-up approach. The top-down approach typically begins with senior management. The goals,

assumptions, and predicted revenue and expenses information are passed from the senior manager to middle managers, who further pass the information downward. Each department must then determine how it can allocate its expenses efficiently while still meeting the company goals. The benefit of this approach is that it ties in to the strategic plan and company goals. Another benefit of passing the amount of allowed expenses downward is that the final anticipated costs are reduced by the *vetting* (fact-checking and information gathering) process.

In the top-down approach, management must devote attention to efficiently allocating resources to ensure that expenses are not padded to create budgetary slack. The drawback to this approach to budgeting is that the budget is prepared by individuals who are not familiar with specific operations and expenses to understand each department's nuances.

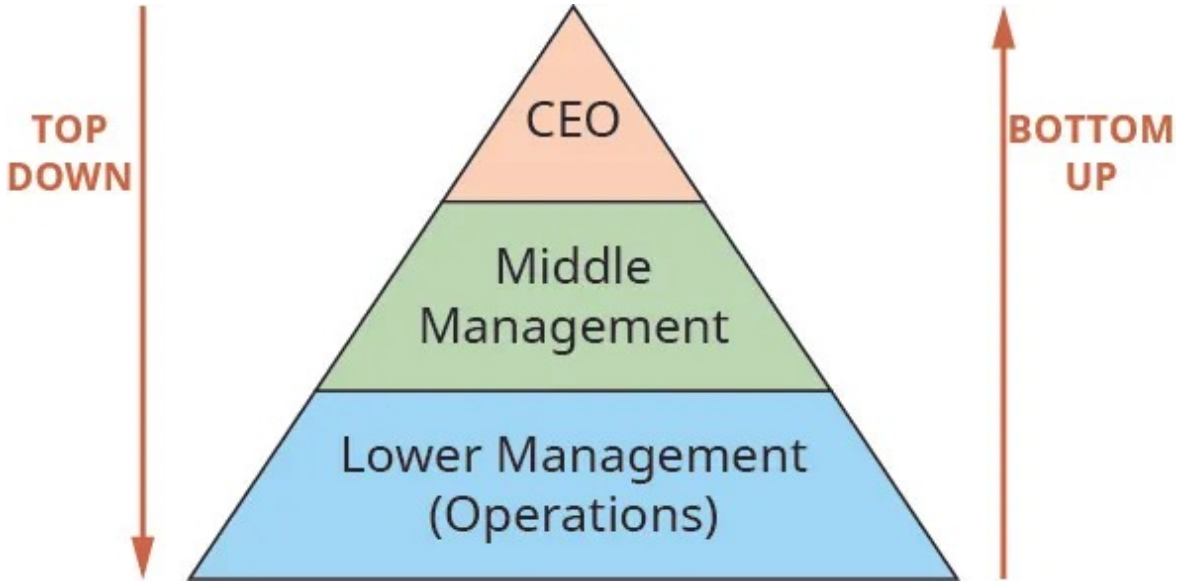


Figure 9.2.1: Top-Down versus Bottom-Up Approach to Budgeting. The top-down approach to budgeting starts with upper-level management, while the bottom-up approach starts with input from lower-level management. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The bottom-up approach (sometimes also named a self-imposed or participative budget) begins at the lowest level of the company. After senior management has communicated the expected departmental goals, the departments then plans and predicts their sales and estimates the amount of resources needed to reach these goals. This information is communicated to the supervisor, who then passes it on to upper levels of management. The advantages of this approach are that managers feel their work is valued and that knowledgeable individuals develop the budget with realistic numbers. Therefore, the budget is more likely to be attainable. The drawback is that managers may not fully understand or may misunderstand the strategic plan.

Other approaches in addition to the top-down and bottom-up approaches are a combination approach and the zero-based budgeting approach. In the combination approach, guidelines and targets are set at the top while the managers work to develop a budget within the targeted parameters.

The Role of the Master Budget

Most organizations will create a master budget—whether that organization is large or small, public or private, or a merchandising, manufacturing, or service company. A **master budget** is one that includes two areas, operational and financial, each of which has its own sub-budgets. The **operating budget** spans several areas that help plan and manage day-to-day business. The **financial budget** depicts the expectations for cash inflows and outflows, including cash payments for planned operations, the purchase or sale of assets, the payment or financing of loans, and changes in equity. Each of the sub-budgets is made up of separate but interrelated budgets, and the number and type of separate budgets will differ depending on the type and size of the organization. For example, the sales budget predicts the sales expected for each quarter. The direct materials budget uses information from the sales budget to compute the number of units necessary for production. This information is used in other budgets, such as the direct materials budget, which plans when materials will be purchased, how much will be purchased, and how much that material should cost.

Figure 9.2.2 shows how operating budgets and financial budgets are related within a master budget.

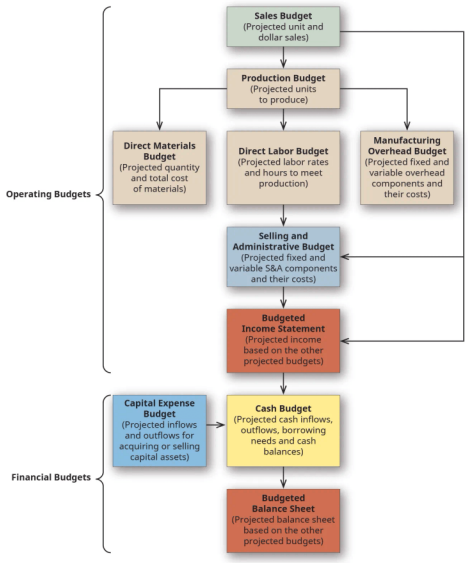


Figure 9.2.2: Operating Budgets, Financial Budgets, and the Relationship between Budgets. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The Role of Operating Budgets

An operating budget consists of the sales budget, production budget, direct material budget, direct labor budget, and overhead budget. These budgets serve to assist in planning and monitoring the day-to-day activities of the organization by informing management of how many units need to be produced, how much material needs to be ordered, how many labor hours need to be scheduled, and the amount of overhead expected to be incurred. The individual pieces of the operating budget collectively lead to the creation of the budgeted income statement. For example, Big Bad Bikes estimates it will sell 1,000 trainers for $70 each in the first quarter and prepares a sales budget to show the sales by quarter. Management understands that it needs to have on hand the 1,000 trainers that it estimates will be sold. It also understands that additional inventory needs to be on hand in the event there are additional sales and to prepare for sales in the second quarter. This information is used to develop a production budget. Each trainer requires 3.2 pounds of material that usually costs $1.25 per pound. Knowing how many units are to be produced and how much inventory needs to be on hand is used to develop a direct materials budget.

The direct materials budget lets managers know when and how much raw materials need to be ordered. The same is true for direct labor, as management knows how many units will be manufactured and how many hours of direct labor are needed. The necessary hours of direct labor and the estimated labor rate are used to develop the direct labor budget. While the materials and labor are determined from the production budget, only the variable overhead can be determined from the production budget. Existing information regarding fixed manufacturing costs are combined with variable manufacturing costs to determine the manufacturing overhead budget. The information from the sales budget is used to determine the sales and administrative budget. Finally, the sales, direct materials, direct labor, fixed manufacturing overhead budget, and sales and administrative budgets are used to develop a pro-forma income statement.

The Role of Financial Budgets

A financial budget consists of the cash budget, the budgeted balance sheet, and the budget for capital expenses. Similar to the individual budgets that make up the operating budgets, the financial budgets serve to assist with planning and monitoring the financing requirements of the organization. Management plans its capital asset needs and states them in the capital expense budget. Management addresses its collection and payment policies to determine when it will receive cash from sales and when it will pay the material, labor, and overhead expenses. The capital expense budget and the estimated payment and collection of cash allow management to build a cash budget and determine when it will need financing or have additional funds to pay back loans. These budgets taken together will be part of the budgeted balance sheet. Figure 9.2.2 shows how these budgets relate.

YOUR TURN

Maintaining a Cash Balance

DaQuan recently began work as a senior accountant at Mad Coffee Company. He learned he would be responsible for monitoring the cash balance because there is a bank loan requirement that a minimum balance of $10,000 be maintained with the bank at all times. DaQuan asked to see the cash budget so he could anticipate when the balance was most likely to go below $10,000. How can DaQuan determine potential cash balance issues by looking at the budget?

Answer available at the end of this section.

LINK TO LEARNING

Budgeting is a task that should be completed by all organizations, not only those limited to manufacturing. Unfortunately, there are many individuals who want to operate a business and know nothing about budgeting. Often, professional organizations or industry trade groups offer information to help their members succeed in business. For example, the real estate profession provides information and suggestions such as this article on preparing a marketing budget to help professionals.

Answers

YOUR TURN

Budgeting helps plan for those times when cash is in short supply and bills need to be paid. Proper budgeting shows when and for how long a cash shortage may exist. DaQuan can see the months when the cash payments exceed the cash receipts and when the company is in danger of having a cash balance below the minimum requirement of $10,000. Knowing the inflow and outflow of cash will help him plan and manage the shortage through a line of credit, delay in purchasing, delay in hiring, or delay in payment of non-essential items.

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9.3: Prepare Operating Budgets

Operating budgets are a primary component of the master budget and involve examining the expectations for the primary operations of the business. Assumptions such as sales in units, sales price, manufacturing costs per unit, and direct material needed per unit involve a significant amount of time and input from various parts of the organization. It is important to obtain all of the information, however, because the more accurate the information, the more accurate the resulting budget, and the more likely management is to effectively monitor and achieve its budget goals.

Individual Operating Budgets

In order for an organization to align the budget with the strategic plan, it must budget for the day-to-day operations of the business. This means the company must understand when and how many sales will occur, as well as what expenses are required to generate those sales. In short, each component—sales, production, and other expenses—must be properly budgeted to generate the operating budget components and the resulting pro-forma budgeted income statement.

The budgeting process begins with the estimate of sales. When management has a solid estimate of sales for each quarter, month, week, or other relevant time period, they can determine how many units must be produced. From there, they determine the expenditures, such as direct materials necessary to produce the units. It is critical for the sales estimate to be accurate so that management knows how many units to produce. If the estimate is understated, the company will not have enough inventory to satisfy customers, and they will not have ordered enough material or scheduled enough direct labor to manufacture more units. Customers may then shop somewhere else to meet their needs. Likewise, if sales are overestimated, management will have purchased more material than necessary and have a larger labor force than needed. This overestimate will cause management to have spent more cash than was necessary.

Sales Budget

The **sales budget** details the expected sales in units and the sales price for the budget period. The information from the sales budget is carried to several places in the master budget. It is used to determine how many units must be produced as well as when and how much cash will be collected from those sales.

For example, Big Bad Bikes used information from competitor sales, its marketing department, and industry trends to estimate the number of units that will be sold in each quarter of the coming year. The number of units is multiplied by the sales price to determine the sales by quarter as shown in Figure 9.3.1.

BIG BAD BIKES
Sales Budget
For the Year Ended December 31, 2019

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Expected Sales (Units)	1,000	1,000	1,500	2,500	6,000
Sales Price per Unit	$ 70	$ 70	$ 75	$ 75	
Total Sales Revenue	$70,000	$70,000	$112,500	$187,500	$440,000

Figure 9.3.1: Sales Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The sales budget leads into the production budget to determine how many units must be produced each week, month, quarter, or year. It also leads into the cash receipts budget.

Production Budget

Estimating sales leads to identifying the desired quantity of inventory to meet the demand. Management wants to have enough inventory to meet production, but they do not want too much in the ending inventory to avoid paying for unnecessary storage.

Management often uses a formula to estimate how much should remain in ending inventory. Management wants to be flexible with its budgeting, wants to create budgets that can grow or shrink as needed, and needs to have inventory on hand. So the amount of ending inventory often is a percentage of the next week's, month's, or quarter's sales.

In creating the production budget, a major issue is how much inventory should be on hand. Having inventory on hand helps the company avoid losing a customer because the product isn't available. However, there are storage costs associated with holding inventory as well as having a lag time between paying to manufacture a product and receiving cash from selling that product. Management must balance the two issues and determine the amount of inventory that should be available.

When determining the number of units needed to be produced, start with the estimated sales plus the desired ending inventory to derive the maximum number of units that must be available during the period. Since the number of units in beginning inventory are already produced, subtracting the beginning inventory from the goods available results in the number of units that need to be produced.

After management has estimated how many units will sell and how many units need to be in ending inventory, it develops the **production budget** to compute the number of units that need to be produced during each quarter. The formula is the reverse of the formula for the cost of goods sold.

Cost of Goods Sold	Number of Units Produced
Beginning Inventory	Goods Sold
+ Purchases (or produced)	+ Ending Inventory
Goods available for sale	Goods available for sale
– Ending Inventory	– Beginning Inventory

The number of units expected to be sold plus the desired ending inventory equals the number of units that are available. When the beginning inventory is subtracted from the number of units available, management knows how many units must be produced during that quarter to meet sales.

In a merchandising firm, retailers do not produce their inventory but purchase it. Therefore, stores such as **Walmart** do not have raw materials and instead substitute the number of units to be purchased in place of the number of units to be produced; the result is the merchandise inventory to be purchased.

To illustrate the steps in developing a production budget, recall that Big Bad Bikes is introducing a new product that the marketing department thinks will have strong sales. For new products, Big Bad Bikes requires a target ending inventory of 30% of the next quarter's sales. Unfortunately, they were unable to manufacture any units before the end of the current year, so the first quarter's beginning inventory is 0 units. As shown in Figure 9.3.1, sales in quarter 2 are estimated at 1,000 units; since 30% is required to be in ending inventory, the ending inventory for quarter 1 needs to be 300 units. With expected sales of 1,000 units for quarter 2 and a required ending inventory of 30%, or 300 units, Big Bad Bikes needs to have 1,300 units available during the quarter. Since 1,300 units needed to be available and there are zero units in beginning inventory, Big Bad Bikes needs to manufacture 1,300 units, as shown in Figure 9.3.2.

BIG BAD BIKES Production Budget For the Year Ended December 31, 2019				
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Expected Sales	1,000	1,000	1,500	2,500
Desired Ending Inventory	300	450	750	1,050
Total Required Units	1,300	1,450	2,250	3,550
– Beginning Inventory	0	300	450	750
Required Production	1,300	1,150	1,800	2,800

Figure 9.3.2: Production Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The ending inventory from one quarter is the beginning inventory for the next quarter and the calculations are all the same. In order to determine the ending inventory in quarter 4, Big Bad Bikes must estimate the sales for the first quarter of the next year. Big Bad Bikes's marketing department believes sales will increase in each of the next several quarters, and they estimate sales as 3,500 for the first quarter of the next year and 4,500 for the second quarter of the next year. Thirty percent of 3,500 is 1,050, so the number of units required in the ending inventory for quarter 4 is 1,050.

The number of units needed in production for the first quarter of the next year provides information needed for other budgets such as the direct materials budget, so Big Bad Bikes must also determine the number of units needed in production for that first quarter. The estimated sales of 3,500 and the desired ending inventory of 1,350 (30% of the next quarter's estimated sales of 4,500) determines that 4,850 units are required during the quarter. The beginning inventory is estimated to be 1,050, which means the number of units that need to be produced during the first quarter of year 2 is 3,800.

The number of units needed to be produced each quarter was computed from the estimated sales and is used to determine the quantity of direct or raw material to purchase, to schedule enough direct labor to manufacture the units, and to approximate the overhead required for production. It is also necessary to estimate the sales for the first quarter of the next year. The ending inventory for the current year is based on the sales estimates for the first quarter of the following year. From this amount, the production budget and direct materials budget are calculated and flow to the operating and cash budget.

Direct Materials Budget

From the production budget, management knows how many units need to be produced in each budget period. Management is already aware of how much material it needs to produce each unit and can combine the direct material per unit with the production budget to compute the **direct materials budget**. This information is used to ensure the correct quantity of materials is ordered and the correct amount is budgeted for those materials.

Similar to the production budget, management wants to have an ending inventory available to ensure there are enough materials on hand. The direct materials budget illustrates how much material needs to be ordered and how much that material costs. The calculation is similar to that used in the production budget, with the addition of the cost per unit.

If Big Bad Bikes uses 3.2 pounds of material for each trainer it manufactures and each pound of material costs $1.25, we can create a direct materials budget. Management's goal is to have 20% of the next quarter's material needs on hand as the desired ending materials inventory. Therefore, the determination of each quarter's material needs is partially dependent on the following quarter's production requirements. The desired ending inventory of material is readily determined for quarters 1 through 3 as those needs are based on the production requirements for quarters 2 through 4. To compute the desired ending materials inventory for quarter 4, we need the production requirements for quarter 1 of year 2. Recall that the number of units to be produced during the first quarter of year 2 is 3,800. Thus, quarter 4 materials ending inventory requirement is 20% of 3,800. That information is used to compute the direct materials budget shown in Figure 9.3.3.

BIG BAD BIKES Direct Materials Budget For the Year Ended December 31, 2019					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Units to be Produced	1,300	1,150	1,800	2,800	7,050
Direct Material per Unit	3.20	3.20	3.20	3.20	3.20
Total Pounds Needed for Production	4,160	3,680	5,760	8,960	22,560
+ Desired Ending Inventory	736	1,152	1,792	2,432	2,432
Total Material Required	4,896	4832	7,552	11,392	24,992
– Beginning Inventory	0	736	1,152	1,792	0
Pounds of Direct Material Required	4,896	4,096	6,400	9,600	24,992
Cost per Pound	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25
Total Cost of Direct Material Purchase	$6,120	$5,120	$8,000	$12,000	$31,240

Figure 9.3.3: Direct Materials Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Management knows how much the materials will cost and integrates this information into the schedule of expected cash disbursements. This information will also be used in the budgeted income statement and on the budgeted balance sheet. With 6,000 units estimated for sale, 3.2 pounds of material per unit, and $1.25 per pound, the direct materials used represent $24,000 of the cost of goods sold. The remaining $7,240 is included in ending inventory as units completed and raw material.

Direct Labor Budget

Management uses the same information in the production budget to develop the **direct labor budget**. This information is used to ensure that the proper amount of staff is available for production and that there is money available to pay for the labor, including potential overtime. Typically, the number of hours is computed and then multiplied by an hourly rate, so the total direct labor cost is known.

If Big Bad Bikes knows that they need 45 minutes or 0.75 hours of direct labor for each unit produced, and the labor rate for this type of manufacturing is $20 per hour, the computation for direct labor simply begins with the number of units in the production budget. As shown in Figure 9.3.4, the number of units produced each quarter multiplied by the number of hours per unit equals the required direct labor hours needed to be scheduled in order to meet production needs. The total number of hours is next multiplied by the direct labor rate per hour, and the labor cost can be budgeted and used in the cash disbursement budget and operating budget.

BIG BAD BIKES Direct Labor Budget For the Year Ended December 31, 2019					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Units to be Produced	1,300	1,150	1,800	2,800	7,050
Direct Labor Hours per Unit	00.75	00.75	00.75	00.75	00.75
Total Required Direct Labor Hours	975	862.50	1,350	2,100	5,287.50
Labor Cost per Hour	$ 20	$ 20	$ 20	$ 20	$ 20
Total Direct Labor Cost	$19,500	$17,250	$27,000	$42,000	$ 105,750

Figure 9.3.4: Direct Labor Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The direct labor of $105,750 will be apportioned to the budgeted income statement and budgeted balance sheet. With 0.75 hours of direct labor per unit and $20 per direct labor hour, each unit will cost $15 in direct labor. Of the 7,050 units produced, 6,000 units will be sold, so $90,000 represents the labor portion of the cost of goods sold and will be shown on the income statement, while the remaining $15,750 will be the labor portion of ending inventory and will be shown on the balance sheet.

Manufacturing Overhead Budget

The **manufacturing overhead budget** includes the remainder of the production costs not covered by the direct materials and direct labor budgets. In the manufacturing overhead budgeting process, producers will typically allocate overhead costs depending upon their cost behavior production characteristics, which are generally classified as either variable or fixed. Based on this allocation process, the variable component will be treated as occurring proportionately in relation to budgeted activity, while the fixed component will be treated as remaining constant. This process is similar to the overhead allocation process you learned in studying product, process, or activity-based costing.

For Big Bad Bikes to create their manufacturing overhead budget, they first determine that the appropriate driver for assigning overhead costs to products is direct labor hours. The overhead allocation rates for the variable overhead costs are: indirect material of $1.00 per hour, indirect labor of $1.25 per hour, maintenance of $0.25 per hour, and utilities of $0.50 per hour. The fixed overhead costs per quarter are: supervisor salaries of $15,000, fixed maintenance salaries of $4,000, insurance of $7,000, and depreciation expenses of $3,000.

Given the direct labor hours for each quarter from the direct labor budget, the variable costs are the number of hours multiplied by the variable overhead application rate. The fixed costs are the same for each quarter, as shown in the manufacturing overhead budget in Figure 9.3.5.

BIG BAD BIKES
Manufacturing Overhead Budget
For the Year Ended December 31, 2019

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Variable Costs					
Indirect Material	$ 975	$ 863	$ 1,350	$ 2,100	$ 5,288
Indirect Labor	1,219	1,078	1,688	2,625	6,609
Maintenance	244	216	338	525	1,322
Utilities	488	431	675	1,050	2,644
Total Variable Manufacturing Costs	$ 2,926	$ 2,588	$ 4,051	$ 6,300	$ 15,863
Fixed Costs					
Supervisory Salaries	$15,000	$15,000	$15,000	$15,000	$ 60,000
Maintenance Salaries	4,000	4,000	4,000	4,000	16,000
Insurance	7,000	7,000	7,000	7,000	28,000
Depreciation	3,000	3,000	3,000	3,000	12,000
Total Fixed Manufacturing Costs	$29,000	$29,000	$29,000	$29,000	$116,000
Total Manufacturing Overhead	$31,925	$31,588	$33,050	$35,300	$131,863

Figure 9.3.5: Manufacturing Overhead Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The total manufacturing overhead cost was $131,863 for 7,050 units, or $18.70 per unit (rounded). Since 6,000 units are sold, $112,200 (6,000 units × $18.70 /unit) will be expensed as cost of goods sold, while the remaining $19,663 will be part of finished goods ending inventory.

Sales and Administrative Expenses Budget

The direct materials budget, the direct labor budget, and the manufacturing overhead budget plan for all costs related to production, while the **selling and administrative expense budget** contains a listing of variable and fixed expenses estimated to be incurred in all areas other than production costs. While this one budget contains all nonmanufacturing expenses, in practice, it actually comprises several small budgets created by managers in sales and administrative positions. All managers must follow the budget, but setting an appropriate budget for selling and administrative functions is complicated and is not always thoroughly understood by managers without a background in managerial accounting.

If Big Bad Bikes pays a sales commission of $2 per unit sold and a transportation cost of $0.50 per unit, they can use these costs to put together their sales and administrative budget. All other costs are fixed costs per quarter: sales salaries of $5,000; administrative salaries of $5,000; marketing expenses of $5,000; insurance of $1,000; and depreciation of $2,000. The sales and administrative budget is shown in Figure 9.3.6, along with the budgeted sales used in the computation of variable sales and

administrative expenses.

BIG BAD BIKES Sales and Administrative Expense Budget For the Year Ended December 31, 2019					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Budgeted Sales in Units	1,000	1,000	1,500	2,500	6,000
Variable Expenses					
Sales Commissions	$ 2,000	$ 2,000	$ 3,000	$ 5,000	$12,000
Transportation	500	500	750	1,250	3,000
Total Variable Expenses	$ 2,500	$ 2,500	$ 3,750	$ 6,250	$15,000
Fixed Expenses					
Sales Salaries	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$20,000
Administrative Salaries	5,000	5,000	5,000	5,000	20,000
Marketing Expenses	5,000	5,000	5,000	5,000	20,000
Insurance Expenses	1,000	1,000	1,000	1,000	4,000
Depreciation Expenses	2,000	2,000	2,000	2,000	8,000
Total Fixed Expenses	$18,000	$18,000	$18,000	$18,000	$72,000
Total Selling and Administrative expenses	$20,500	$20,500	$21,750	$24,250	$87,000

Figure 9.3.6: Sales and Administrative Expense Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Only manufacturing costs are treated as a product cost and included in ending inventory, so all of the expenses in the sales and administrative budget are period expenses and included in the budgeted income statement.

Budgeted Income Statement

A **budgeted income statement** is formatted similarly to a traditional income statement except that it contains budgeted data. Once all of the operating budgets have been created, these costs are used to prepare a budgeted income statement and budgeted balance sheet. The manufacturing costs are allocated to the cost of goods sold and the ending inventory.

Big Bad Bikes uses the information on direct materials (Figure 9.3.3), direct labor (Figure 9.3.4), and manufacturing overhead (Figure 9.3.5) to allocate the manufacturing costs between the cost of goods sold and the ending work in process inventory, as shown in (Figure 9.3.7).

	Cost of Goods Sold	Ending Inventory	Total
Direct Materials	$ 24,000*	$ 7,240	$ 31,240
Direct Labor	90,000**	15,750	105,750
Manufacturing Overhead	112,200	19,639	131,863
Total	$226,224	$42,629	$268,853

*6,000 units × 3.2 lbs/unit × $1.25/lb
**6,000 units × 0.75 hr/unit × $20/hr

Figure 9.3.7: Allocating Costs to Cost of Goods Sold and Ending Work in Process Inventory for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Once they perform this allocation, the budgeted income statement can be prepared. Big Bad Bikes estimates an interest of $954. It also estimates that $22,000 of its income will not be collected and will be reported as uncollectible expense. The budgeted income statement is shown in Figure 9.3.8.

BIG BAD BIKES Budgeted Income Statement For the Year Ended December 31, 2019	
Sales	$440,000
Cost of Goods Sold	226,200
Gross Profit	213,800
Sales and Administrative Expenses	87,000
Uncollectible Expense	22,000
Income before Interest	104,800
Interest Expense	954
Income Tax	4,000
Net Income	$ 99,846

Figure 9.3.8: Budgeted Income Statement for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

THINK IT THROUGH

Errors in a Budgeted Balance Sheet

Which error has the potential to cause more problems with the budgeted balance sheet: overstating sales or understating the cash collected?

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9.4: Prepare Financial Budgets

Now that you have developed an understanding of operating budgets, let's turn to the other primary component of the master budget: financial budgets. Preparing financial budgets involves examining the expectations for financing the operations of the business and planning for the cash needs of the organization. The budget helps estimate the source, amount, and timing of cash collection and cash payments as well as determine if and when additional financing is needed or debt can be paid.

Individual Financial Budgets

Preparing a financial budget first requires preparing the capital asset budget, the cash budgets, and the budgeted balance sheet. The capital asset budget represents a significant investment in cash, and the amount is carried to the cash budget. Therefore, it needs to be prepared before the cash budget. If the cash will not be available, the capital asset budget can be adjusted and, again, carried to the cash budget.

When the budgets are complete, the beginning and ending balance from the cash budget, changes in financing, and changes in equity are shown on the budgeted balance sheet.

Capital Asset Budget

The **capital asset budget**, also called the capital expenditure budget, shows the company's plans to invest in long-term assets. Some assets, such as computers, must be replaced every few years, while other assets, such as manufacturing equipment, are purchased very infrequently. Some assets can be purchased with cash, whereas others may require a loan. Budgeting for these types of expenditures requires long-range planning because the purchases affect cash flows in current and future periods and affect the income statement due to depreciation and interest expenses.

Cash Budget

The **cash budget** is the combined budget of all inflows and outflows of cash. It should be divided into the shortest time period possible, so management can be quickly made aware of potential problems resulting from fluctuations in cash flow. One goal of this budget is to anticipate the timing of cash inflows and outflows, which allows a company to try to avoid a decrease in the cash balance due to paying out more cash than it receives. In order to provide timely feedback and alert management to short-term cash needs, the cash flow budget is commonly geared toward monthly or quarterly figures. Figure 9.4.1 shows how the other budgets tie into the cash budget.

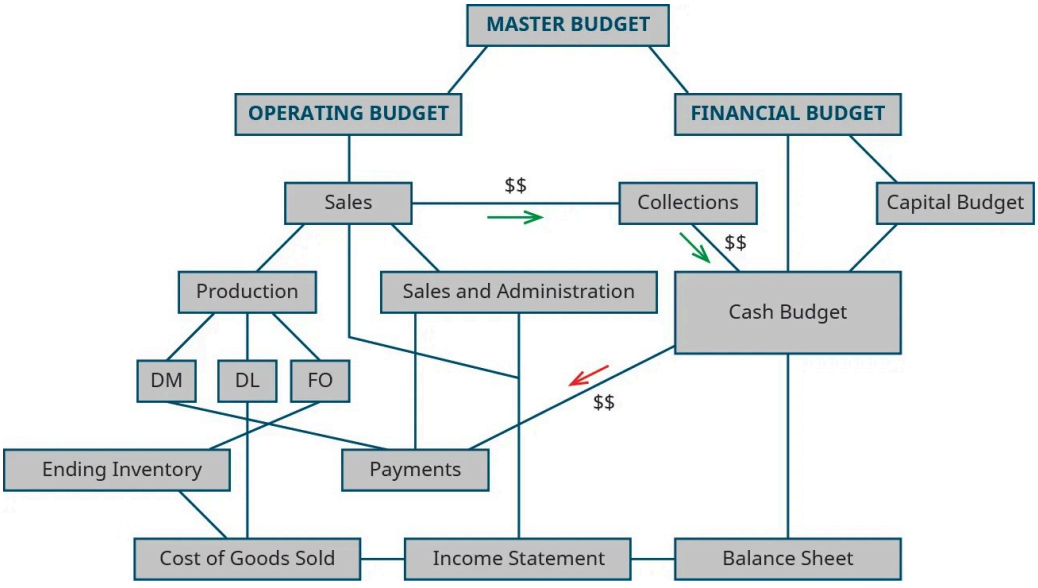


Figure 9.4.1: Relationship between Budgets. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Cash is so important to the operations of a company that, often, companies will arrange to have an emergency cash source, such as a *line of credit*, to avoid defaulting on current payables due and also to protect against other unanticipated expenses, such as major repair costs on equipment. This line of credit would be similar in function to the *overdraft protection* offered on many checking accounts.

Because the cash budget accounts for every inflow and outflow of cash, it is broken down into smaller components. The **cash collections schedule** includes all of the cash inflow expected to be received from customer sales, whether those customers pay at the same rate or even if they pay at all. The cash collections schedule includes all the cash expected to be received and does not include the amount of the receivables estimated as uncollectible. The **cash payments schedule** plans the outflow or payments of all accounts payable, showing when cash will be used to pay for direct material purchases. Both the cash collections schedule and the cash payments schedule are included along with other cash transactions in a cash budget. The cash budget, then, combines the cash collection schedule, the cash payment schedule, and all other budgets that plan for the inflow or outflow of cash. When everything is combined into one budget, that budget shows if financing arrangements are needed to maintain balances or if excess cash is available to pay for additional liabilities or assets.

The operating budgets all begin with the sales budget. The cash collections schedule does as well. Since purchases are made at varying times during the period and cash is received from customers at varying rates, data are needed to estimate how much will be collected in the month of sale, the month after the sale, two months after the sale, and so forth. Bad debts also need to be estimated, since that is cash that will not be collected.

To illustrate, let's return to Big Bad Bikes. They believe cash collections for the trainer sales will be similar to the collections from their bicycle sales, so they will use that pattern to budget cash collections for the trainers. In the quarter of sales, 65% of that quarter's sales will be collected. In the quarter after the sale, 30% will be collected. This leaves 5% of the sales considered uncollectible. Figure 9.4.2 illustrates when each quarter's sales will be collected. An estimate of the net realizable balance of Accounts Receivable can be reconciled by using information from the cash collections schedule:

Quarter 4: Beginning balance of Accounts Receivable (Quarter 3 Sales of $112,500 × 30%)	$ 33,750
+ Quarter 4: Sales	187,500
– Quarter 4: Cash Receipts (65% of Quarter 4 Sales)	121,875
= Quarter 4: Ending Balance in Gross Accounts Receivable	$ 99,375

Note the Ending Balance is gross accounts receivable which includes the 5% estimated uncollectible, but that amount would be excluded from net realizable accounts receivable.

	Percentage of Sales Collected			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Prior year, Quarter 4 Sales	30%			
Quarter 1 Sales	65%	30%		
Quarter 2 Sales		65%	30%	
Quarter 3 Sales			65%	30%
Quarter 4 Sales				65%

Figure 9.4.2: Illustration of a Cash Collections Schedule. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

For example, in quarter 1 of year 2, 65% of the quarter 1 sales will be collected in cash, as well as 30% of the sales from quarter 4 of the prior year. There were no sales in quarter 4 of the prior year so 30% of zero sales shows the collections are $0. Using information from Big Bad Bikes sales budget, the cash collections from the sales are shown in Figure 9.4.3.

BIG BAD BIKES Cash Collections Schedule For the Year Ended December 31, 2019						
	Sales	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total**
Collections from prior year Quarter 4	0	0				
Quarter 1	$ 70,000	$45,500	$21,000			$ 66,500
Quarter 2	70,000		45,500	$21,000		66,500
Quarter 3	112,500			73,125	$ 33,750	106,875
Quarter 4	187,500				121,875	121,875
Total Collections	$440,000	$45,500	$66,500	$94,125	$155,625	$361,750
Accounts Receivable	$ 78,250					

Figure 9.4.3: Cash Collections Schedule for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

When the cash collections schedule is made for sales, management must account for other potential cash collections such as cash received from the sale of equipment or the issuance of stock. These are listed individually in the cash inflows portion of the cash budget.

The cash payments schedule, on the other hand, shows when cash will be used to pay for Accounts Payable. One such example are direct material purchases, which originates from the direct materials budget. When the production budget is determined from the sales, management prepares the direct materials budget to determine when and how much material needs to be ordered. Orders for materials take place throughout the quarter, and payments for the purchases are made at different intervals from the orders. A schedule of cash payments is similar to the cash collections schedule, except that it accounts for the company's purchases instead of the company's sales. The information from the cash payments schedule feeds into the cash budget.

Big Bad Bikes typically pays half of its purchases in the quarter of purchase. The remaining half is paid in the following quarter, so payments in the first quarter include payments for purchases made during the first quarter as well as half of the purchases for the preceding quarter. Figure 9.4.4 shows when each quarter's purchases will be paid. Additionally, the balance of purchases in Accounts Payable can be reconciled by using information from the cash payment schedule as follows:

Quarter 4: Beginning balance of Accounts Payable	$ 4,000*
+ Quarter 4: purchase of direct material	12,000
– Quarter 4: Cash Payments	10,000
= Quarter 4: Ending balance in Accounts Payable	$ 6,000*

* Big Bad Bikes has a policy of paying 50% of purchases in the quarter of purchases, and the remaining 50% the month after the purchase. The beginning balance of accounts payable should be 50% of the prior quarter's purchases.

	Percentage of Cash Payments for Purchases			
	Quarter 1	**Quarter 2**	**Quarter 3**	**Quarter 4**
Prior year, Quarter 4 Purchases	50%			
Quarter 1 Purchases	50%	50%		
Quarter 2 Purchases		50%	50%	
Quarter 3 Purchases			50%	50%
Quarter 4 Purchases				50%

Figure 9.4.4: Cash Payment Schedule. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The first quarter of the year plans cash payments from the prior quarter as well as the current quarter. Again, since the trainers are a new product, in this example, there are no purchases in the preceding quarter, and the payments are $0. Figure 9.4.5.

BIG BAD BIKES
Cash Payments Schedule
For the Year Ended December 31, 2019

Payments	Purchases	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Quarter 4, prior year	$ 0	$ 0				
Quarter 1	6,120	3,060	$3,060			$ 6,120
Quarter 2	5,120		2,560	$2,560		5,120
Quarter 3	8,000			4,000	$ 4,000	8,000
Quarter 4	12,000				6,000	6,000
Total payments	$31,240	$3,060	$5,620	$6,560	$10,000	$25,240
Accounts Payable	$ 6,000					

Figure 9.4.5: Cash Payments Schedule for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

While the cash payments schedule is made for purchases of material on account, there are other outflows of cash for the company, and management must estimate all other cash payments for the year. Typically, this includes the manufacturing overhead budget, the sales and administrative budget, the capital asset budget, and any other potential payments of cash. Since depreciation is an expense not requiring cash, the cash budget includes the amount from the budgets less depreciation. Cash payments are listed on the cash budget following cash receipts. Figure 9.4.6 shows the major components of the cash budget.

JOB COST SHEET
General Overview of Cash Budget Components*

Cash Receipts from Sales
+ Other cash receipts (issuance of stock, borrowing money, receiving interest or dividends, from selling assets such as equipment, etc.)
– Cash Payments for Purchases or Production of Inventory
– Cash Payments for manufacturing expenses**
– Cash Payments for selling and administrative expenses**
– Cash payments for capital asset purchases
– Other cash payments (paying interest, paying loan payments, etc.)
= Net Cash

*This is a general overview of the types of cash transactions that might appear in a cash budget and is representative of the components but not of a typical presentation of those components
**Note that depreciation, a non-cash expense, would be excluded from these expenses

Figure 9.4.6: General Overview of Cash Budget Components. A cash budget will contain all the budgeted cash inflows and out flows from the sub-budgets as well as any cash items that might not appear on one of the sub-budgets. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The cash budget totals the cash receipts and adds it to the beginning cash balance to determine the available cash. From the available cash, the cash payments are subtracted to compute the net cash excess or deficiency of cash for the quarter. This amount is the potential ending cash balance. Organizations typically require a minimum cash balance. If the potential ending cash balance does not meet the minimum amount, management must plan to acquire financing to reach that amount. If the potential ending cash balance exceeds the minimum cash balance, the excess amount may be used to pay any financing loans and interest.

Big Bad Bikes has a minimum cash balance requirement of $10,000 and has a line of credit available for an interest rate of 19%. They also plan to issue additional capital stock for $5,000 in the first quarter, to pay taxes of $1,000 during each quarter, and to purchase a copier for $8,500 cash in the third quarter. The beginning cash balance for Big Bad Bikes is $13,000, which can be

used to create the cash budget shown in Figure 9.4.7.

BIG BAD BIKES Cash Budget For the Year Ended December 31, 2019					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Beginning Cash Balance	$13,000	$10,000	$ 10,000	$ 10,000	$ 13,000
Collections from Customers (Cash Collections Schedule)	45,500	66,500	94,125	155,625	361,750
Issuing of Stock	5,000				5,000
Total Cash Collected during the Period	$50,500	$66,500	$ 94,125	$155,625	$366,750
Total Available Cash	$63,500	$76,500	$104,125	$165,625	$379,750
– Disbursements					
Direct Materials (Cash Payments Schedule)	3,060	5,620	6,560	10,000	25,240
Direct Labor (Direct Labor Budget)	19,500	17,250	27,000	42,000	105,750
Manufacturing Overhead Less Depreciation (MFG OH Budget)	28,925	28,588	30,050	32,300	119,863
Selling and Administrative Expenses Less Depreciation (Sales and Administrative Expense Budget)	18,500	18,500	19,750	22,250	79,000
Income Tax Expense	1,000	1,000	1,000	1,000	4,000
Purchase of Copier (Capital Asset Budget)			8,500		8,500
Total Disbursements	$70,985	$70,958	$ 92,860	$107,550	$342,353
Excess (deficiency) of Available Cash	($ 7,485)	$ 5,542	$ 11,265	$ 58,075	$ 37,397
Financing					
+ Borrowings	17,485	4,458			21,943
– Repayments Including Interest			(1,265)	(21,632)	(22,897)
Ending Cash Balance	$10,000	$10,000	$ 10,000	$ 36,443	$ 36,443

Figure 9.4.7: Cash Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Budgeted Balance Sheet

The cash budget shows how cash changes from the beginning of the year to the end of the year, and the ending cash balance is the amount shown on the budgeted balance sheet. The **budgeted balance sheet** is the estimated assets, liabilities, and equities that the company would have at the end of the year if its performance were to meet its expectations. Table 9.4.1 shows a list of the most common changes to the balance sheet and where the information is derived.

Common Changes in the Budgeted Balance Sheet

Information Source	Balance Sheet Change
Cash balance	ending cash balance from the cash budget
Accounts Receivable balance	uncollected receivables from the cash collections schedul
Inventory	ending balance in inventory as shown from calculations to
Machinery & Equipment	ending balance in the capital asset budget
Accounts Payable	unpaid purchases from the cash payments schedule

Table 7.1

Other balance sheet changes throughout the year are reflected in the income statement and statement of cash flows. For example, the beginning cash balance of Accounts Receivable plus the sales, less the cash collected results in the ending balance of Accounts Receivable. A similar formula is used to compute the ending balance in Accounts Payable. Other budgets and information such as the capital asset budget, depreciation, and financing loans are used as well.

To explain how to use a budgeted balance sheet, let's return to Big Bad Bikes. For simplicity, assume that they did not have accounts receivable or payable at the beginning of the year. They also incurred and paid back their financing during the year, so there is no ending debt. However, the cash budget shows cash inflows and outflows not related to sales or the purchase of materials. The company's capital assets increased by $8,500 from the copier purchase, and their common stock increased by $5,000 from the additional issue as shown in Figure 9.4.8.

Big Bad Bikes, Budgeted Balance Sheet, December 31, 2019 Jan 1 and Dec. 31, respectively: Cash 13,000, 36,443; Accounts Receivable 0, 78250; Less allowance for doubtful accounts 0, (22,000); Inventory 0, 42,629; Machinery and equipment 15,000, 23,500; Accumulated Depreciation (2,000), (22,000); Total assets $26,000, $136,822; Accounts Payable 0, 6,000; Line of credit 0, 0; Common Stock 15,000, 20,000; Retained Earnings 11,000, 110, 822; Total Liabilities and Owner's Equity $26,000, $136,822.

Figure 9.4.8: Budgeted Balance Sheet for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Though there seem to be many budgets, they all fit together like a puzzle to create an overall picture of how a company expects the upcoming business year to look. Figure 9.4.1 detailed the components of the master budget and can be used to summarize the budget process. All budgets begin with the sales budget. This budget estimates the number of units that need to be manufactured and precedes the production budget. The production budget provides the necessary information for the budgets needed to plan how many units will be produced. Knowing how many units need to be produced from the production budget, the direct materials budget, direct labor budget, and the manufacturing overhead budget are all prepared. The sales and administrative budget is a nonmanufacturing budget that relies on the sales estimates to pay commissions and other variable expenses. The sales and expenses estimated in all of these budgets are used to develop a budgeted income statement.

The estimated sales information is used to prepare the cash collections schedule, and the direct materials budget is used to prepare the cash payment schedule. The cash receipts and cash payments budget are combined with the direct labor budget, the manufacturing overhead budget, the sales and administrative budget, and the capital assets budget to develop the cash budget. Finally, all the information is used to flow to the budgeted balance sheet.

YOUR TURN

Creating a Master Budget

Molly Malone is starting her own company in which she will produce and sell Molly's Macaroons. Molly is trying to learn about the budget process as she puts her business plan together. Help Molly by explaining the optimal order for preparing the following budgets and schedules and why this is the optimal order.

- budgeted balance sheet
- budgeted income statement
- capital asset budget
- cash budget
- cash collections schedule
- cash payments schedule
- direct materials budget
- direct labor budget
- master budget
- manufacturing overhead
- production budget
- sales budget
- selling and administrative budget

Answer available at the end of this section.

Answers

YOUR TURN

A master budget always begins with the sales budget must be prepared first as this determines the number of units that will need to be produced. The next step would be to create the production budget, which helps determine the number of units that will need to be produced each period to meet sales goals. Once Molly knows how many units she will need to produce, she will need to budget the costs associated with those units, which will require her to create the direct materials budget, the direct labor budget, and the manufacturing overhead budget. But Molly will have costs other than manufacturing costs so she will need to create a selling and administrative expenses budget. Molly will need to determine what are her capital asset needs and budget for those. Now that Molly has all her revenues budgeted and her costs budgeted, she can determine her budgeted cash inflows and outflows by putting together the cash schedules that lead to the cash budget. Molly will then need to create a cash collections schedule and a cash payments schedule and that information, along with the cash inflow and outflow information from her other budgets, will allow her to create her cash budget. Once Molly has completed her cash budget she will be able to put together her budgeted income statement and budgeted balance sheet.

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10: FLEXIBLE BUDGETS, STANDARD COSTS, VARIANCES

Learning Objectives

- Explain the development and use of standard costs and flexible budgets
- Prepare a flexible budget
- Prepare and interpret variance analysis reports and relate them to responsibility accounting and control

10.1: Prepare Flexible Budgets

10.2: Standard Costs and Variances - Why It Matters

10.3: Explain How and Why a Standard Cost Is Developed

10.4: Compute and Evaluate Materials Variances

10.5: Compute and Evaluate Labor Variances

10.6: Compute and Evaluate Overhead Variances

10.7: Describe How Companies Use Variance Analysis

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10.1: Prepare Flexible Budgets

A company makes a budget for the smallest time period possible so that management can find and adjust problems to minimize their impact on the business. Everything starts with the estimated sales, but what happens if the sales are more or less than expected? How does this affect the budget? What adjustments does a company have to make in order to compare the actual numbers to budgeted numbers when evaluating results? If production is higher than planned and has been increased to meet the increased sales, expenses will be over budget. But is this bad? To account for actual sales and expenses differing from budgeted sales and expenses, companies will often create flexible budgets to allow budgets to fluctuate with future demand.

Flexible Budgets

A **flexible budget** is one based on different volumes of sales. A flexible budget flexes the static budget for each anticipated level of production. This flexibility allows management to estimate what the budgeted numbers would look like at various levels of sales. Flexible budgets are prepared at each analysis period (usually monthly), rather than in advance, since the idea is to compare the operating income to the expenses deemed appropriate at the actual production level.

Big Bad Bikes is planning to use a flexible budget when they begin making trainers. The company knows its variable costs per unit and knows it is introducing its new product to the marketplace. Its estimations of sales and sales price will likely change as the product takes hold and customers purchase it. Big Bad Bikes developed a flexible budget that shows the change in income and expenses as the number of units changes. It also looked at the effect a change in price would have if the number of units remained the same. The expenses that do not change are the fixed expenses, as shown in Figure 10.1.1.

BIG BAD BIKES Flexible Budget For Year Ended December 31, 2019				
Units Sold		1,000	1,500	1,500
Sales Price		$ 70	$ 70	$ 75
Sales		$70,000	$105,000	$112,500
	Per-unit cost			
Cost of Goods Sold				
Direct Material	$ 4	$ 4,000	$ 6,000	$ 6,000
Direct Labor	15	15,000	22,500	22,500
Variable Manufacturing Overhead	3	3,000	4,500	4,500
Fixed Manufacturing Overhead		29,000	29,000	29,000
Total Cost of Goods Sold		51,000	62,000	62,000
Gross Profit		19,000	43,000	50,500
Variable Sales and Admin	2.50	2,500	3,750	3,750
Fixed Sales and Admin		18,000	18,000	18,000
Income Taxes		1,000	1,000	1,000
Total Other Expenses		21,500	22,750	22,750
Net Income (Loss)		$ (2,500)	$ 20,250	$ 27,750

Figure 10.1.1: Flexible Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Static versus Flexible Budgets

A **static budget** is one that is prepared based on a single level of output for a given period. The master budget, and all the budgets included in the master budget, are examples of static budgets. Actual results are compared to the static budget numbers as one means to evaluate company performance. However, this comparison may be like comparing apples to oranges because variable costs should follow production, which should follow sales. Thus, if sales differ from what is budgeted, then comparing actual costs to budgeted costs may not provide a clear indicator of how well the company is meeting its targets. A flexible budget created each period allows for a comparison of apples to apples because it will calculate budgeted costs based on the actual sales activity.

For example, Figure 10.1.2 shows a static quarterly budget for 1,500 trainers sold by Big Bad Bikes. The budget will change if there

are more or fewer units sold.

BIG BAD BIKES Static Quarterly Budget For Each Quarter	
Units Sold	1,500
Sales Price	$ 70
Sales	$ 105,000
Cost of Goods Sold	
Direct Material	6,000
Direct Labor	22,500
Variable Manufacturing Overhead	4,500
Fixed Manufacturing Overhead	29,000
Total Cost of Goods Sold	62,000
Gross Profit	43,000
Variable Sales and Admin	3,750
Fixed Sales and Admin	18,000
Interest Expense	0
Income Taxes	1,000
Total Other Expenses	$ 22,750
Net Income (Loss)	$ 20,250

Figure 10.1.2: Static Budget for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Budget with Varying Levels of Production

Companies develop a budget based on their expectations for their most likely level of sales and expenses. Often, a company can expect that their production and sales volume will vary from budget period to budget period. They can use their various expected levels of production to create a flexible budget that includes these different levels of production. Then, they can modify the flexible budget when they have their actual production volume and compare it to the flexible budget for the same production volume. A flexible budget is more complicated, requires a solid understanding of a company's fixed and variable expenses, and allows for greater control over changes that occur throughout the year. For example, suppose a proposed sale of items does not occur because the expected client opted to go with another supplier. In a static budget situation, this would result in large variances in many accounts due to the static budget being set based on sales that included the potential large client. A flexible budget on the other hand would allow management to adjust their expectations in the budget for both changes in costs and revenue that would occur from the loss of the potential client. The changes made in the flexible budget would then be compared to what actually occurs to result in more realistic and representative variance. This ability to change the budget also makes it easier to pinpoint who is responsible if a revenue or cost target is missed.

Big Bad Bikes used the flexible budget concept to develop a budget based on its expectation that production levels will vary by quarter. By the fourth quarter, sales are expected to be strong enough to pay back the financing from earlier in the year. The budget shown in Figure 10.1.3 illustrates the payment of interest and contains information helpful to management when determining which items should be produced if production capacity is limited.

BIG BAD BIKES Varying Production Budget Flexible Budget					
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
Units Sold		1,000	1,000	1,500	2,500
Sales Price		$ 70	$ 70	$ 75	$ 75
Sales		$70,000	$70,000	$112,500	$187,500
	Per-unit cost				
Cost of Goods Sold					
Direct Material	4	4,000	4,000	6,000	10,000
Direct Labor	15	15,000	15,000	22,500	37,500
Variable Manufacturing Overhead	3	3,000	3,000	4,500	7,500
Fixed Manufacturing Overhead		29,000	29,000	29,000	29,000
Total Cost of Goods Sold		51,000	51,000	62,000	84,000
Gross Profit		19,000	19,000	50,500	103,500
Variable Sales and Admin	2.50	2,500	2,500	3,750	6,250
Fixed Sales and Admin		18,000	18,000	18,000	18,000
Interest Expense					1,653
Income Taxes		1000	1000	1000	1000
Total Other Expenses		21,500	21,500	22,750	26,903
Net Income (Loss)		$ (2,500)	$ (2,500)	$ 27,750	$ 76,597

Figure 10.1.3: Varying Production Levels for Big Bad Bikes. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

CONCEPTS IN PRACTICE

Flexible Budgets and Sustainability

The ability to provide flexible budgets can be critical in new or changing businesses where the accuracy of estimating sales or usage may not be strong. For example, organizations are often reporting their sustainability efforts and may have some products that require more electricity than other products. The reporting of the energy per unit of output has sometimes been in error and can mislead management into making changes that may or may not help the company. For example, based on the energy per unit reported, management may decide to change the product mix, the amount that is outsourced, and/or the amount that is produced. If the energy output isn't correct, the decisions may be wrong and create an adverse impact on the budget.

LINK TO LEARNING

In theory, a flexible budget is not difficult to develop since the variable costs change with production and the fixed costs remain the same. However, planning to meet an organization's goals can be very difficult if there are not many variable costs, if the cash inflows are relatively fixed, and if the fixed costs are high. For example, this article shows some large U.S. cities are faced with complicated budgets because of high fixed costs.

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10.2: Standard Costs and Variances - Why It Matters

Sam saw how much coffee his fellow students were drinking and decided to open a student-run coffee shop on campus. Sam knew that developing a plan for the coffee shop would help make the shop successful. He researched what types of coffee to offer, the hours the shop would be open, and the number of employees needed, by researching other coffee shops near campus. He brewed coffee to determine the cost of the coffee and the time it took to brew. He also served several friends to determine how long it would take to serve customers. He observed, in other coffee shops, how much cream and other additives are used by customers. He talked to several coffee suppliers for prices of his various materials. He looked at empty stores near campus to determine what his rent would be. Now that he has this information, he is not sure how to make it useful to him. How could he use this information to plan and control the operations of the shop? One calculation he can do is determine his standard costs.

What is the difference between a *budget* and a *standard*? A budget usually refers to a company's projections for costs, revenues, and cash flows associated with the overall operations of the organization, or a subsection of the corporation such as a division. A standard usually refers to a company's projected costs for a single unit of a product or service and includes the expected, or standard, cost for the various cost components of each unit, such as materials, labor, and overhead.

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10.3: Explain How and Why a Standard Cost Is Developed

A syllabus is one way an instructor can communicate expectations to students. Students can use the syllabus to plan their studying to maximize their grade and to coordinate the amount and timing of studying for each course. Knowing what is expected, and when it is expected, allows for better plans and performance. When your performance does not match your expectations, a **variance** arises—a difference between the standard and the actual performance. You then need to determine why the difference occurred. You want to know why you did not receive the grade you expected so you can make adjustments for the next assignment to earn a better grade.

Companies operate in a similar manner. They have an expectation, or **standard**, for production. For example, if a company is producing tables, it might establish standards for such components as the amount of board feet of lumber expected to be used in producing each table or the number of hours of direct labor hours it expected to use in the table's production. These standards can then be used in establishing standard costs that can be used in creating an assortment of different types of budgets.

When a variance occurs in its standards, the company investigates to determine the causes, so they can perform better in the future. For example, **General Motors** has standards for each item on a vehicle. It can determine the cost and selling price of a power antenna by knowing the standard material cost for the antenna and the standard labor cost of adding the antenna to the vehicle. **General Motors** also can add up all of the standard times for all vehicles it makes to determine if too much or too little labor was used in production.

LINK TO LEARNING

Developing standards is a complicated and costly process. Review this article on how to develop a standard cost system for more details.

Fundamentals of Standard Costs

It is important to establish standards for cost at the beginning of a period to prepare the budget; manage material, labor, and overhead costs; and create a reasonable sales price for a good. A **standard cost** is an expected cost that a company usually establishes at the beginning of a fiscal year for prices paid and amounts used. The standard cost is an expected amount paid for materials costs or labor rates. The standard quantity is the expected usage amount of materials or labor. A standard cost may be determined by past history or industry norms. The company can then compare the standard costs against its actual results to measure its efficiency. Sometimes when comparing standard costs against actual results, there is a difference.

This difference can be attributed to many reasons. For example, the coffee company mentioned in the opening vignette may expect to pay $0.50 per ounce for coffee grounds. After the company purchased the coffee grounds, it discovered it paid $0.60 per ounce. This variance would need to be accounted for, and possible operational changes would occur as a result. Cost accounting systems become more useful to management when they include budgeted amounts to serve as a point of comparison with actual results.

Many departments help determine standard cost. Product design, in conjunction with production, purchasing, and sales, determines what the product will look like and what materials will be used. Production works with purchasing to determine what material will work best in production and will be the most cost-efficient. Sales will also help decide the material in terms of customer demand. Production will work with personnel to determine labor costs for the product, which is based on how long it will take to make the product, which departments will be involved, and what type and number of employees it will take.

Consider how many different materials can go into a product. For example, there are approximately 14,000 parts that comprise the average automobile. The manufacturer will set a standard price and a quantity used per automobile for each part, and it will determine the labor required to install the part. At **Fiat Chrysler Automobiles**' Belvidere Assembly Plant, for example, there are approximately 5,000 employees assembling automobiles. In addition to having standard costs associated with each part, each employee has standards for the job he or she performs.

Standard costs are typically established for reasonably attainable levels of efficiency (production). They serve as a target and are useful in motivating standard performance. An **ideal standard** level is set assuming that everything is perfect, machines do not

break down, employees show up on time, there are no defects, there is no scrap, and materials are perfect. This level of standard is not the best motivator, because employees may see this level as unattainable. For example, consider whether you would take a course if the letter grades were as follows: an A is 99–100%, a B is 98–99%, a C is 97–98%, a D is 96–97%, and below 96% is an F. These standards are unreasonable and unrealistic, and they would not motivate students to do well in the course.

At the other end of the spectrum, if the standards are too easy, there is little motivation to do better, and products may not be properly built, may be built with inferior materials, or both. For example, consider how you would handle the following grading scale for your course: an A is 50–100%, a B is 35–50%, a C is 10–35%, a D is 2–10%, and below 2% is an F. Would you learn anything? Would you try very hard? The same considerations come into play for employees with standards that are too easy.

Instead of these two extremes, a company would set an **attainable standard**, which is one that employees can reach with reasonable effort. The standards are not so high that employees will not try to reach them and not so low that they do not give any incentive for employees to achieve profitability.

In order for a company to establish its attainable standard cost for each product, it must consider the standard costs for materials, labor, and overhead. The material standard cost consists of a standard price per unit of material and a standard amount of material per unit. Returning to the opening vignette, let us say the coffee shop is trying to establish the standard materials cost for one cup of regular coffee. To keep the example simple, we are not incorporating the cost of water or the ceramic cup cost (since they are reused). Two components for the cup of coffee will need to be considered:

1. Price per ounce of coffee grounds
2. Amount of coffee grounds (materials) used per cup of coffee

To determine the standards for labor, the coffee shop would need to consider two additional components:

1. Labor rate per minute
2. Amount of time to make one cup of regular coffee

To determine the standard for overhead, the coffee shop would first need to consider the fact that it has two types of overhead as shown in Figure 10.3.1.

1. Fixed overhead (does not change in total with production)
2. Variable overhead (does change in total with production)

All of this information is entered on a standard cost card.

STANDARD COST CARD

Product: 1 Cup of Coffee

Manufacturing Cost Information	Standard Quantity	×	Standard Cost per Unit	=	Cost Summary
Direct Materials					
Material (coffee grounds)	0.5 ounces		$.50 per ounce		$0.25
Direct Labor					
Barista	1 minute		$0.20 per minute		$0.20
Manufacturing Overhead					
Variable overhead	1 minute		$0.05 per direct labor minute		$0.05
Fixed overhead	1 minute		$0.10 per direct labor minute		$0.10
Standard Cost per cup of coffee					**$0.60**

Figure 10.3.1: Standard Cost Card for a Coffee Shop. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Once a company determines a standard cost, they can then evaluate any variances. A variance is the difference between a standard cost and actual performance. There are favorable and unfavorable variances. A **favorable variance** involves spending less, or using less, than the anticipated or estimated standard. An **unfavorable variance** involves spending more, or using more, than the anticipated or estimated standard. Before determining whether the variance is favorable or unfavorable, it is often helpful for the company to determine why the variance exists.

YOUR TURN

Developing a Standard Cost Card

Use the information provided to create a standard cost card for production of one deluxe bicycle from Bicycles Unlimited.

To make one bicycle it takes four pounds of material. The material can usually be purchased for $5.25 per pound. The labor necessary to build a bicycle consists of two types. The first type of labor is assembly, which takes 2.75 hours. These workers are paid $11.00 per hour. The second type of labor is finishing, which takes 4 hours. These workers are paid $15.00 per hour. Overhead is applied using labor hours. The variable overhead rate is $5.00 per labor hour. The fixed overhead rate is $3.00 per hour.

Answer available at the end of this section.

ETHICAL CONSIDERATIONS

Ethical Variance Analysis

Variance analysis allows managers to see whether costs are different than planned. Once a difference between expected and actual costs is identified, variance analysis should delve into why the costs differ and what the magnitude of the difference means. To determine why a cost differs, it should be established if the additional cost provides a benefit or detriment to an organization's stakeholders, the people or entities that are affected by the organization's actions or inactions. Not all stakeholders are equal in the analysis, but an organization should recognize each stakeholder's interest in the organization's business and operational decisions, while ranking the importance of the stakeholder in relation to any decision made.

Ranking should look to how stakeholders are affected by costs and any decisions related to cost variance, or why the variance occurred. For example, if a cost variance is due to an additional cost to make a product eco-friendly, then an organization may determine that incurring the cost is a benefit to its stakeholders. However, if the additional cost creates an unfavorable situation for a stakeholder, the process incurring the cost should be investigated. Remember that the owners of a company, including shareholders, are also stakeholders. To determine the best course of action for an organization, cost analysis should help inform stakeholder analysis—the process of systematically gathering and analyzing all of the information related to a business decision.

Different factors may produce a variance. The company could have paid too much or too little for production. It may have purchased the wrong grade of material or hired employees with more or less experience than required. Sometimes the variances are interrelated. For example, purchasing substandard materials may lead to using more time to make the product and may produce more scrap. The substandard material may have been more difficult to work with or had more defects than the proper grade material. In such a situation, a favorable material price variance could cause an unfavorable labor efficiency variance and an unfavorable material quantity variance. Employees who do not have the expected experience level may save money in the wage rate but may require more hours to be worked and more material to be used because of their inexperience.

Another situation in which a variance may occur is when the cost of labor and/or material changes after the standard was established. Toward the end of the fiscal year, standards often become less reliable because time has passed and the environment has changed. It is not reasonable to expect the price of all materials and labor to remain constant for 12 months. For example, the grade of material used to establish the standard may no longer be available.

Manufacturing Cost Variances

As you've learned, the standard price and standard quantity are anticipated amounts. Any change from these budgeted amounts will produce a variance. There can be variances for materials, labor, and overhead. Direct materials may have a variance in price of materials or quantity of materials used. Direct labor may have a variance in the rate paid to workers or the amount of time used to make a product. Overhead may produce a variance in expected fixed or variable costs, leading to possible differences in production capacity and management's ability to control overhead. More specifics on the formulas, processes, and interpretations of the direct materials, direct labor, and overhead variances are discussed in each of this chapter's following sections.

CONCEPTS IN PRACTICE

Qualcomm

Qualcomm Inc. is a large producer of telecommunications equipment focusing mainly on wireless products and services. As with any company, Qualcomm sets labor standards and must address any variances in labor costs to stay on budget, and control overall manufacturing costs.

In 2018, Qualcomm announced a reduction to its labor force, affecting many of its full-time and temporary workers. The reduction in labor was necessary to suppress rising expenses that could not be controlled through overhead or materials cost-cutting measures. The variances between standard labor rates and actual labor rates, and diminishing profit margins will have contributed to this decision. It is important for Qualcomm management to keep labor variances minimal in the future so that large workforce reductions are not required to control costs.

THINK IT THROUGH

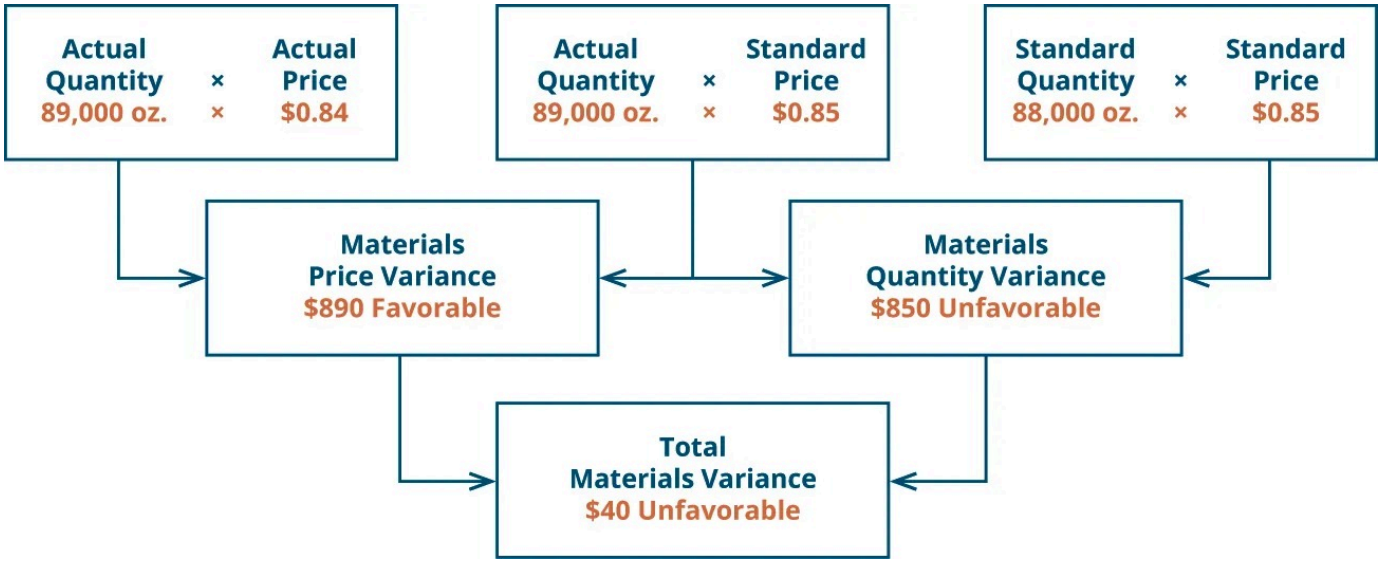
Chocolate Cow Ice Cream Company

The Chocolate Cow Ice Cream Company has grown substantially recently, and management now feels the need to develop standards and compute variances. A consulting firm was hired to develop the standards and the format for the variance computation. One standard in particular that the consulting firm developed seemed too excessive to plant management. The consulting firm's standard was production of 100 gallons of ice cream every 45 minutes. The plant's middle level of management thought the standard should be 100 gallons every 55 minutes, while the top management of the company thought that the consulting firm's standard would provide more motivation to the employees.

1. Why is the company establishing a standard for production?
2. What are some factors the company may need to consider before selecting one of the proposed standards?

Answers

YOUR TURN



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10.4: Compute and Evaluate Materials Variances

As you've learned, direct materials are those materials used in the production of goods that are easily traceable and are a major component of the product. The amount of materials used and the price paid for those materials may differ from the standard costs determined at the beginning of a period. A company can compute these materials variances and, from these calculations, can interpret the results and decide how to address these differences.

CONCEPTS IN PRACTICE

Buttering Popcorn

In a movie theater, management uses standards to determine if the proper amount of butter is being used on the popcorn. They train the employees to put two tablespoons of butter on each bag of popcorn, so total butter usage is based on the number of bags of popcorn sold. Therefore, if the theater sells 300 bags of popcorn with two tablespoons of butter on each, the total amount of butter that should be used is 600 tablespoons. Management can then compare the predicted use of 600 tablespoons of butter to the actual amount used. If the actual usage of butter was less than 600, customers may not be happy, because they may feel that they did not get enough butter. If more than 600 tablespoons of butter were used, management would investigate to determine why. Some reasons why more butter was used than expected (unfavorable outcome) would be because of inexperienced workers pouring too much, or the standard was set too low, producing unrealistic expectations that do not satisfy customers.

Fundamentals of Direct Materials Variances

The direct materials variances measure how efficient the company is at using materials as well as how effective it is at using materials. There are two components to a **direct materials variance**, the direct materials price variance and the direct materials quantity variance, which both compare the actual price or amount used to the standard amount.

Direct Materials Price Variance

The **direct materials price variance** compares the actual price per unit (pound or yard, for example) of the direct materials to the standard price per unit of direct materials. The formula for direct materials price variance is calculated as:

Direct Materials Price Variance equals (Actual Quantity Used times Actual Price Paid) minus (Actual Quantity Used times Standard Price).

Factoring out actual quantity used from both components of the formula, it can be rewritten as:

Direct Materials Price Variance equals (Actual Price per Unit of Materials minus Standard Price per Unit of Materials) times Actual Quantity of Materials Used.

With either of these formulas, the actual quantity used refers to the actual amount of materials used to create one unit of product. The standard price is the expected price paid for materials per unit. The actual price paid is the actual amount paid for materials per unit. If there is no difference between the standard price and the actual price paid, the outcome will be zero, and no price variance exists.

If the actual price paid per unit of material is lower than the standard price per unit, the variance will be a favorable variance. A favorable outcome means you spent less on the purchase of materials than you anticipated. If, however, the actual price paid per unit of material is greater than the standard price per unit, the variance will be unfavorable. An unfavorable outcome means you spent more on the purchase of materials than you anticipated.

The actual price can differ from the standard or expected price because of such factors as supply and demand of the material, increased labor costs to the supplier that are passed along to the customer, or improvements in technology that make the material cheaper. The producer must be aware that the difference between what it expects to happen and what actually happens will affect all of the goods produced using these particular materials. Therefore, the sooner management is aware of a problem, the sooner

they can fix it. For that reason, the material price variance is computed at the time of purchase and not when the material is used in production.

Let us consider an example. Connie's Candy Company produces various types of candies that they sell to retailers. Connie's Candy establishes a standard price for candy-making materials of $7.00 per pound. Each box of candy is expected to use 0.25 pounds of candy-making materials. Connie's Candy found that the actual price of materials was $6.00 per pound. They still actually use 0.25 pounds of materials to make each box. The direct materials price variance computes as:

$$\text{Direct Materials Price Variance} = (\$6.00 - \$7.00) \times 0.25\text{lb.} = \$0.25 \text{ or } \$0.25 \text{ (Favorable)}$$

In this case, the actual price per unit of materials is $6.00, the standard price per unit of materials is $7.00, and the actual quantity used is 0.25 pounds. This computes as a favorable outcome. This is a favorable outcome because the actual price for materials was less than the standard price. As a result of this favorable outcome information, the company may consider continuing operations as they exist, or could change future budget projections to reflect higher profit margins, among other things.

Let us take the same example except now the actual price for candy-making materials is $9.00 per pound. The direct materials price variance computes as:

$$\text{Direct Materials Price Variance} = (\$9.00 - \$7.00) \times 0.25\text{lbs.} = \$0.50 \text{ or } \$0.50 \text{ (Unfavorable)}$$

In this case, the actual price per unit of materials is $9.00, the standard price per unit of materials is $7.00, and the actual quantity used is 0.25 pounds. This computes as an unfavorable outcome. This is an unfavorable outcome because the actual price for materials was more than the standard price. As a result of this unfavorable outcome information, the company may consider using cheaper materials, changing suppliers, or increasing prices to cover costs.

Another element this company and others must consider is a direct materials quantity variance.

THINK IT THROUGH

Don't "Skirt" the Issue

You run a fabric store and order materials through a supplier. At the end of the month, you review your materials cost and discover that your direct materials price and quantity variances produced unfavorable results. What could be attributed to these unfavorable outcomes? How would these unfavorable outcomes impact the total direct materials variance?

Direct Materials Quantity Variance

The **direct materials quantity variance** compares the actual quantity of materials used to the standard materials that were expected to be used to make the actual units produced. The variance is calculated using this formula:

$$\text{Direct Materials Quantity Variance} = \left(\begin{array}{c}\text{Actual Quantity Used} \\ \times \\ \text{Standard Price}\end{array}\right) - \left(\begin{array}{c}\text{Standard Quantity} \\ \times \\ \text{Standard Price}\end{array}\right)$$

Factoring out standard price from both components of the formula, it can be rewritten as:

$$\text{Direct Materials Quantity Variance} = \left(\begin{array}{c}\text{Actual Quantity of} \\ \text{Materials Used} \\ \text{for Units Produced}\end{array} - \begin{array}{c}\text{Standard Quantity} \\ \text{of Materials Expected} \\ \text{for the Units Produced}\end{array}\right) \times \begin{array}{c}\text{Standard} \\ \text{Price}\end{array}$$

With either of these formulas, the actual quantity used refers to the actual amount of materials used at the actual production

output. The standard price is the expected price paid for materials per unit. The standard quantity is the expected amount of materials used at the actual production output. If there is no difference between the actual quantity used and the standard quantity, the outcome will be zero, and no variance exists.

If the actual quantity of materials used is less than the standard quantity used at the actual production output level, the variance will be a favorable variance. A favorable outcome means you used fewer materials than anticipated, to make the actual number of production units. If, however, the actual quantity of materials used is greater than the standard quantity used at the actual production output level, the variance will be unfavorable. An unfavorable outcome means you used more materials than anticipated to make the actual number of production units.

The actual quantity used can differ from the standard quantity because of improved efficiencies in production, carelessness or inefficiencies in production, or poor estimation when creating the standard usage.

Consider the previous example with Connie's Candy Company. Connie's Candy established a standard price for candy-making materials of $7.00 per pound. Each box of candy is expected to use 0.25 pounds of candy-making materials. Connie's Candy found that the actual quantity of candy-making materials used to produce one box of candy was 0.20 per pound. The direct materials quantity variance computes as:

$$\text{Direct Materials Quantity Variance} = (0.20\text{lb.} - 0.25\text{lb.}) \times \$7.00 = -\$0.35 \text{ or } \$0.35 \text{ (Favorable)}$$

In this case, the actual quantity of materials used is 0.20 pounds, the standard price per unit of materials is $7.00, and the standard quantity used is 0.25 pounds. This computes as a favorable outcome. This is a favorable outcome because the actual quantity of materials used was less than the standard quantity expected at the actual production output level. As a result of this favorable outcome information, the company may consider continuing operations as they exist, or could change future budget projections to reflect higher profit margins, among other things.

Let us take the same example except, now, the actual quantity of candy-making materials used to produce one box of candy was 0.50 per pound. The direct materials quantity variance computes as:

$$\text{Direct Materials Quantity Variance} = (0.50\text{lb.} - 0.25\text{lb.}) \times \$7.00 = \$1.75 \text{ or } \$1.75 \text{ (Unfavorable)}$$

In this case, the actual quantity of materials used is 0.50 pounds, the standard price per unit of materials is $7.00, and the standard quantity used is 0.25 pounds. This computes as an unfavorable outcome. This is an unfavorable outcome because the actual quantity of materials used was more than the standard quantity expected at the actual production output level. As a result of this unfavorable outcome information, the company may consider retraining workers to reduce waste or change their production process to decrease materials needs per box.

The combination of the two variances can produce one overall total direct materials cost variance.

LINK TO LEARNING

Watch this video featuring a professor of accounting walking through the steps involved in calculating a material price variance and a material quantity variance to learn more.

Total Direct Materials Cost Variance

When a company makes a product and compares the actual materials cost to the standard materials cost, the result is the **total direct materials cost variance**.

$$\text{Total Direct Materials Variance} = \left(\begin{array}{c}\text{Actual Quantity} \\ \times \\ \text{Actual Price}\end{array}\right) - \left(\begin{array}{c}\text{Standard Quantity} \\ \times \\ \text{Standard Price}\end{array}\right)$$

An unfavorable outcome means the actual costs related to materials were more than the expected (standard) costs. If the

outcome is a favorable outcome, this means the actual costs related to materials are less than the expected (standard) costs.

The total direct materials cost variance is also found by combining the direct materials price variance and the direct materials quantity variance. By showing the total materials variance as the sum of the two components, management can better analyze the two variances and enhance decision-making.

Figure 10.4.1 shows the connection between the direct materials price variance and direct materials quantity variance to total direct materials cost variance.

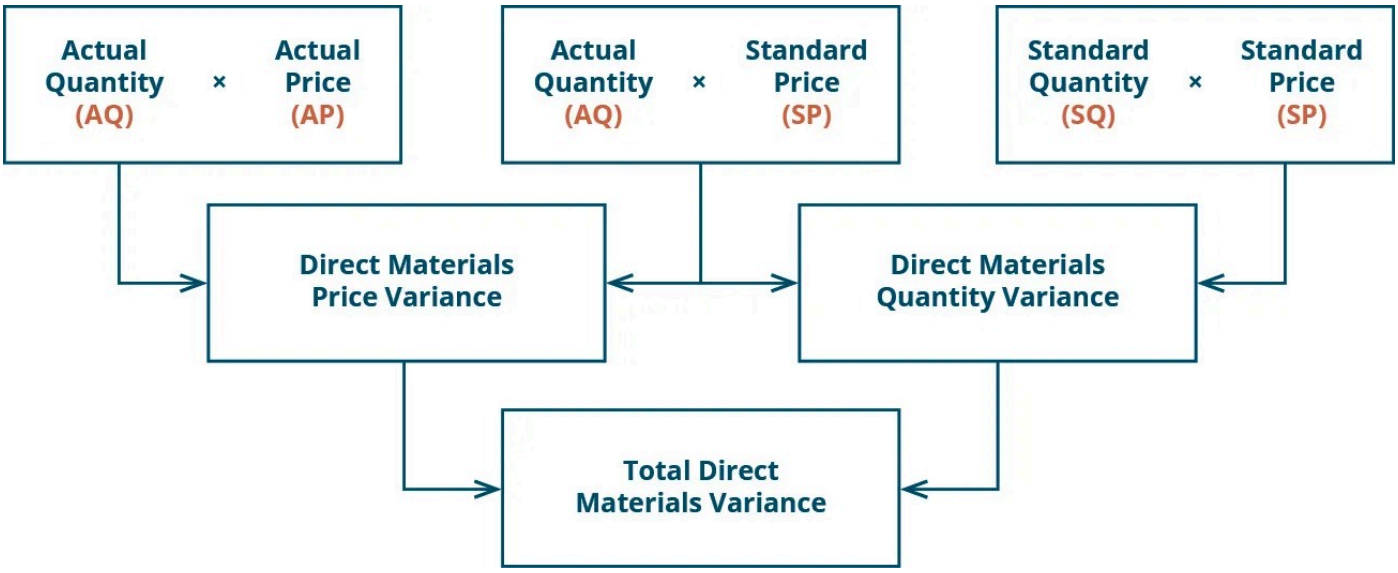


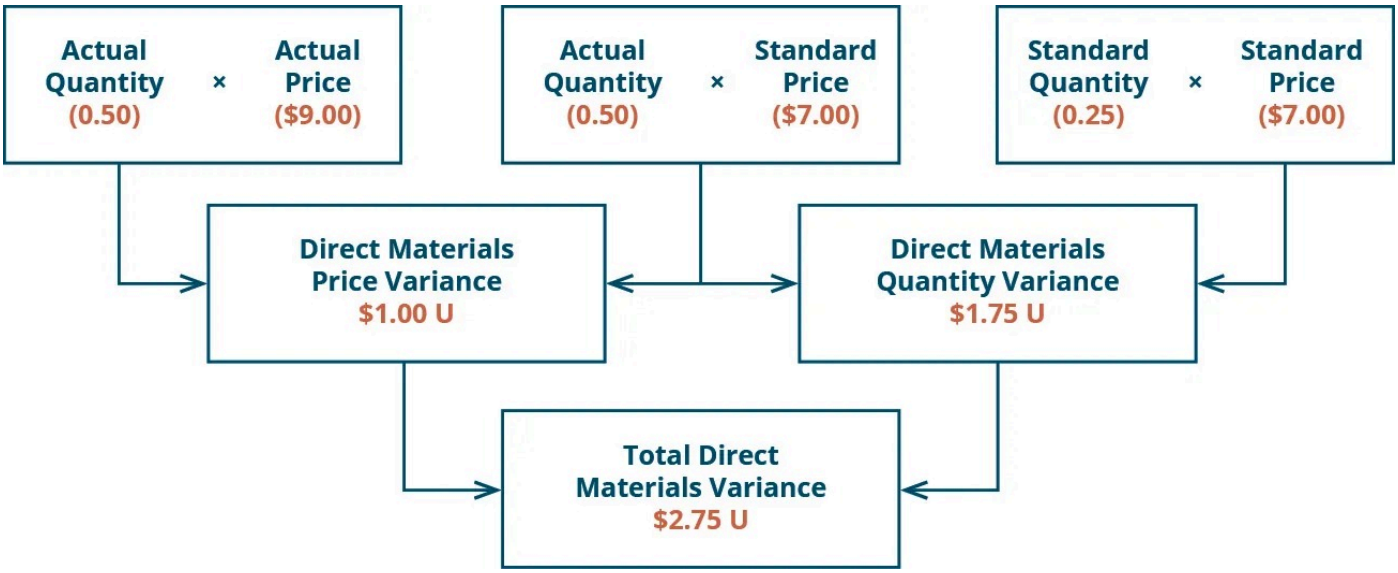
Figure 10.4.1: Direct Materials Variance. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

For example, Connie's Candy Company expects to pay $7.00 per pound for candy-making materials but actually pays $9.00 per pound. The company expected to use 0.25 pounds of materials per box but actually used 0.50 per box. The total direct materials variance is computed as:

Total Direct Materials Variance = (0.50lbs. × $9.00) – (0.25lbs. × $7.00) = $4.50 – $1.75 = $2.75 (Unfavorable)

In this case, two elements contribute to the unfavorable outcome. Connie's Candy paid $2.00 per pound more for materials than expected and used 0.25 pounds more of materials than expected to make one box of candy.

The same calculation is shown using the outcomes of the direct materials price and quantity variances.



As with the interpretations for the materials price and quantity variances, the company would review the individual components contributing to the overall unfavorable outcome for the total direct materials variance, and possibly make changes to production elements as a result.

YOUR TURN

Sweet and Fresh Shampoo Materials

Biglow Company makes a hair shampoo called Sweet and Fresh. Each bottle has a standard material cost of 8 ounces at $0.85 per ounce. During May, Biglow manufactured 11,000 bottles. They bought 89,000 ounces of material at a cost of $74,760. All 89,000 ounces were used to make the 11,000 bottles. Calculate the material price variance and the material quantity variance.

Answer available at the end of this section.

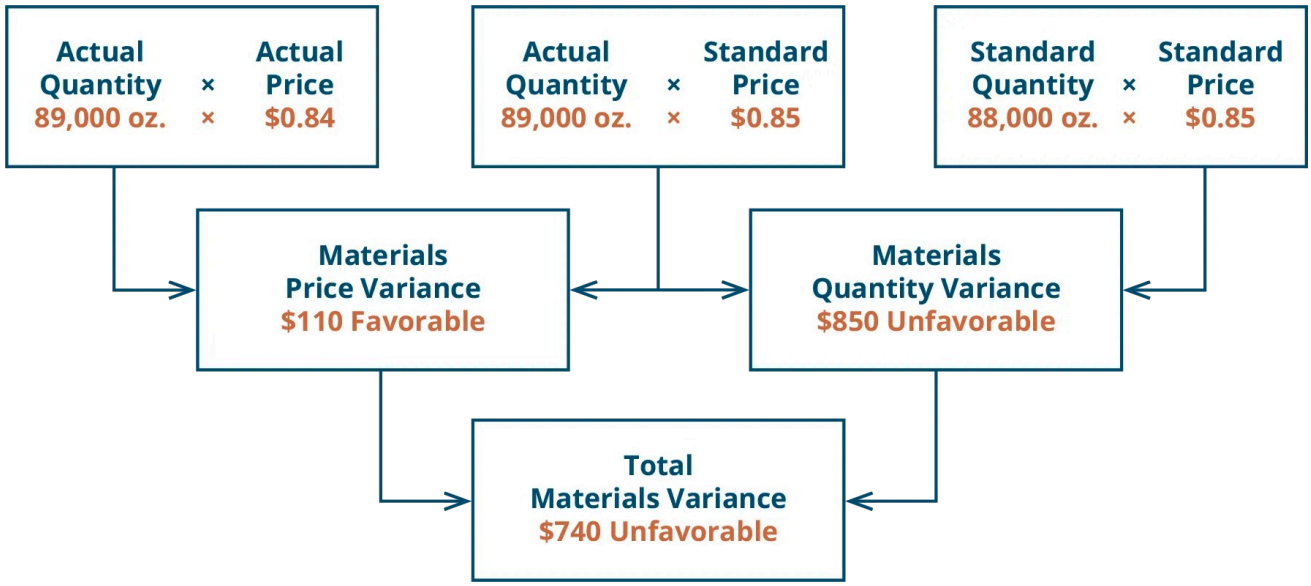
Answers

YOUR TURN

Actual price per pound: 74,760/89,000 = $0.84

Material price variance: 89,000 × (0.84 – 0.85) = $890 (Favorable)

Material quantity variance: 0.85 × (89,000 – 88,000) = $850 (Unfavorable)



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10.5: Compute and Evaluate Labor Variances

In addition to evaluating materials usage, companies must assess how efficiently and effectively they are using labor in the production of their products. Direct labor is a cost associated with workers working directly in the production process. The company must look at both the quantity of hours used and the rate of the labor and compare outcomes to standard costs. Determining efficiency and effectiveness of labor leads to individual labor variances. A company can compute these labor variances and make informed decisions about labor operations based on these differences.

Fundamentals of Direct Labor Variances

The **direct labor variance** measures how efficiently the company uses labor as well as how effective it is at pricing labor. There are two components to a labor variance, the direct labor rate variance and the direct labor time variance.

Direct Labor Rate Variance

The **direct labor rate variance** compares the actual rate per hour of direct labor to the standard rate per hour of labor for the hours worked. The direct labor rate variance is calculated using this formula:

$$\text{Direct Labor Rate Variance} = \left(\begin{matrix}\text{Actual Hours Worked} \\ \times \\ \text{Actual Rate per Hour}\end{matrix}\right) - \left(\begin{matrix}\text{Actual Hours Worked} \\ \times \\ \text{Standard Rate per Hour}\end{matrix}\right)$$

Factoring out the actual hours worked from both components of the formula, it can be rewritten as:

$$\text{Direct Labor Rate Variance} = \left(\begin{matrix}\text{Actual Rate} \\ \text{per Hour}\end{matrix} - \begin{matrix}\text{Standard Rate} \\ \text{per Hour}\end{matrix}\right) \times \begin{matrix}\text{Actual Hours} \\ \text{Worked}\end{matrix}$$

With either of these formulas, the actual rate per hour refers to the actual rate of pay for workers to create one unit of product. The standard rate per hour is the expected rate of pay for workers to create one unit of product. The actual hours worked are the actual number of hours worked to create one unit of product. If there is no difference between the standard rate and the actual rate, the outcome will be zero, and no variance exists.

If the actual rate of pay per hour is less than the standard rate of pay per hour, the variance will be a favorable variance. A favorable outcome means you paid workers less than anticipated. If, however, the actual rate of pay per hour is greater than the standard rate of pay per hour, the variance will be unfavorable. An unfavorable outcome means you paid workers more than anticipated.

The actual rate can differ from the standard or expected rate because of supply and demand of the workers, increased labor costs due to economic changes or union contracts, or the ability to hire employees at a different skill level. Once the manufacturer makes the products, the labor costs will follow the goods through production, so the company should evaluate how the difference between what it expected to happen and what actually happened will affect all the goods produced using these particular labor rates.

Let us again consider Connie's Candy Company with respect to labor. Connie's Candy establishes a standard rate per hour for labor of $8.00. Each box of candy is expected to require 0.10 hours of labor (6 minutes). Connie's Candy found that the actual rate of pay per hour for labor was $7.50. They still actually required 0.10 hours of labor to make each box. The direct labor rate variance computes as:

$$\text{Direct Labor Rate Variance} = (\$7.50 - \$8.00) \times 0.10 \text{ hours} = -\$0.05 \text{ or } \$0.05 \text{ (Favorable)}$$

In this case, the actual rate per hour is $7.50, the standard rate per hour is $8.00, and the actual hour worked is 0.10 hours per

box. This computes as a favorable outcome. This is a favorable outcome because the actual rate of pay was less than the standard rate of pay. As a result of this favorable outcome information, the company may consider continuing operations as they exist, or could change future budget projections to reflect higher profit margins, among other things.

Let us take the same example except now the actual rate of pay per hour is $9.50. The direct labor rate variance computes as:

Direct Labor Rate Variance = ($9.50 – $8.00) × 0.10 hours = $0.15 or $0.15 (Unfavorable)

In this case, the actual rate per hour is $9.50, the standard rate per hour is $8.00, and the actual hours worked per box are 0.10 hours. This computes as an unfavorable outcome. This is an unfavorable outcome because the actual rate per hour was more than the standard rate per hour. As a result of this unfavorable outcome information, the company may consider using cheaper labor, changing the production process to be more efficient, or increasing prices to cover labor costs.

Another element this company and others must consider is a direct labor time variance.

Direct Labor Time Variance

The **direct labor time variance** compares the actual labor hours used to the standard labor hours that were expected to be used to make the actual units produced. The variance is calculated using this formula:

$$\text{Direct Labor Time Variance} = \left(\begin{array}{c}\text{Actual Hours Worked}\\ \times \\ \text{Standard Rate per Hour}\end{array}\right) - \left(\begin{array}{c}\text{Standard Hours}\\ \times \\ \text{Standard Rate per Hour}\end{array}\right)$$

Factoring out the standard rate per hour from both components of the formula, it can be rewritten as:

$$\text{Direct Labor Time Variance} = \left(\begin{array}{c}\text{Actual Hours}\\ \text{Worked}\end{array} - \begin{array}{c}\text{Standard Hours Expected}\\ \text{for the Units Produced}\end{array}\right) \times \begin{array}{c}\text{Standard Rate}\\ \text{per Hour}\end{array}$$

With either of these formulas, the actual hours worked refers to the actual number of hours used at the actual production output. The standard rate per hour is the expected hourly rate paid to workers. The standard hours are the expected number of hours used at the actual production output. If there is no difference between the actual hours worked and the standard hours, the outcome will be zero, and no variance exists.

If the actual hours worked are less than the standard hours at the actual production output level, the variance will be a favorable variance. A favorable outcome means you used fewer hours than anticipated to make the actual number of production units. If, however, the actual hours worked are greater than the standard hours at the actual production output level, the variance will be unfavorable. An unfavorable outcome means you used more hours than anticipated to make the actual number of production units.

The actual hours used can differ from the standard hours because of improved efficiencies in production, carelessness or inefficiencies in production, or poor estimation when creating the standard usage.

Consider the previous example with Connie's Candy Company. Connie's Candy establishes a standard rate per hour for labor of $8.00. Each box of candy is expected to require 0.10 hours of labor (6 minutes). Connie's Candy found that the actual hours worked per box were 0.05 hours (3 minutes). The actual rate per hour for labor remained at $8.00 to make each box. The direct labor time variance computes as:

Direct Labor Time Variance = (0.05 – 0.10) × $8.00 per hour = –$0.40 or $0.40 (Favorable)

In this case, the actual hours worked are 0.05 per box, the standard hours are 0.10 per box, and the standard rate per hour is $8.00. This computes as a favorable outcome. This is a favorable outcome because the actual hours worked were less than the standard hours expected. As a result of this favorable outcome information, the company may consider continuing operations as they exist, or could change future budget projections to reflect higher profit margins, among other things.

Let us take the same example except now the actual hours worked are 0.20 hours per box. The direct labor time variance computes as:

Direct Labor Time Variance = ($0.20 – $0.10) × $8.00 per hour = $0.80 or $0.80 (Unfavorable)

In this case, the actual hours worked per box are 0.20, the standard hours per box are 0.10, and the standard rate per hour is $8.00. This computes as an unfavorable outcome. This is an unfavorable outcome because the actual hours worked were more than the standard hours expected per box. As a result of this unfavorable outcome information, the company may consider retraining its workers, changing the production process to be more efficient, or increasing prices to cover labor costs.

The combination of the two variances can produce one overall total direct labor cost variance.

THINK IT THROUGH

Package Deliveries

UPS drivers are evaluated on how many miles they drive and how quickly they deliver packages. The drivers are given the route and time they are expected to take, so they are expected to complete their route in a timely and efficient manner. They also work until all packages are delivered. A GPS tracking system tracks the trucks throughout the day. The system keeps track of how much they back up and if they take any left turns because right turns are much more time-efficient. Tracking drivers like this does not leave them very much time to deal with customers. Customer service is a major part of the driver's job. Can the driver service the customer and drive the route in the time and distance allotted? Which is more important: customer service or driving the route in a timely and efficient manner?

LINK TO LEARNING

Watch this video presenting an instructor walking through the steps involved in calculating direct labor variances to learn more.

Total Direct Labor Variance

When a company makes a product and compares the actual labor cost to the standard labor cost, the result is the **total direct labor variance**.

$$\text{Total Direct Labor Variance} = (\text{Actual Hours} \times \text{Actual Rate}) - (\text{Standard Hours} \times \text{Standard Rate})$$

If the outcome is unfavorable, the actual costs related to labor were more than the expected (standard) costs. If the outcome is favorable, the actual costs related to labor are less than the expected (standard) costs.

The total direct labor variance is also found by combining the direct labor rate variance and the direct labor time variance. By showing the total direct labor variance as the sum of the two components, management can better analyze the two variances and enhance decision-making.

Figure 10.5.1 shows the connection between the direct labor rate variance and direct labor time variance to total direct labor variance.

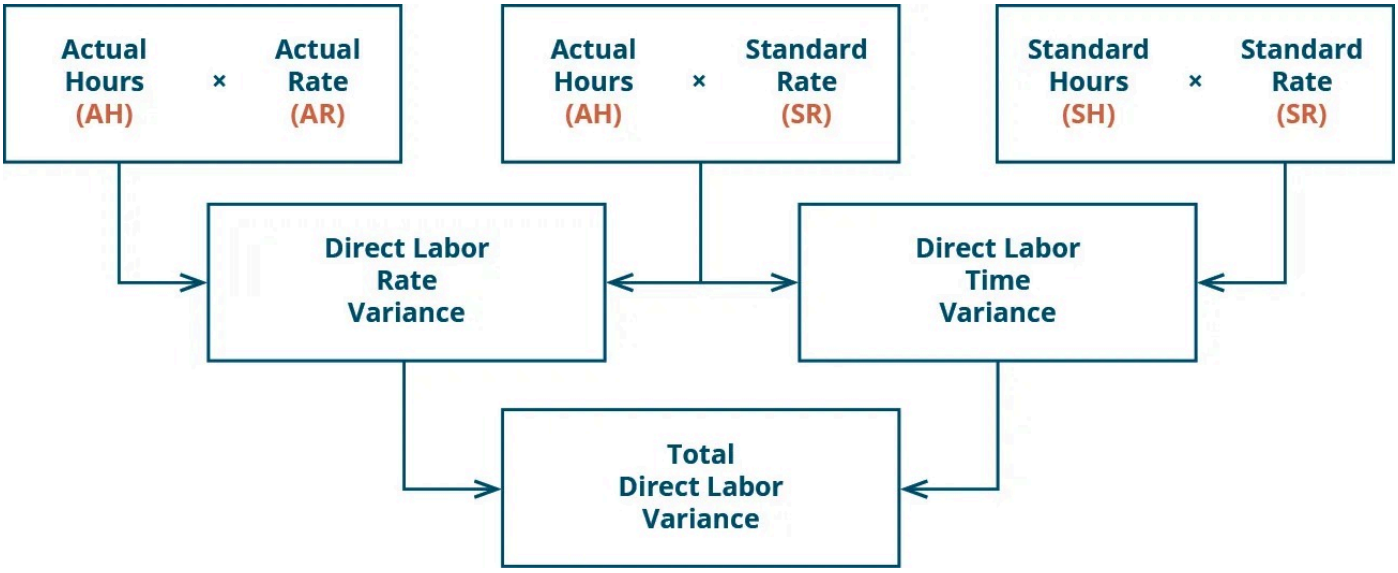
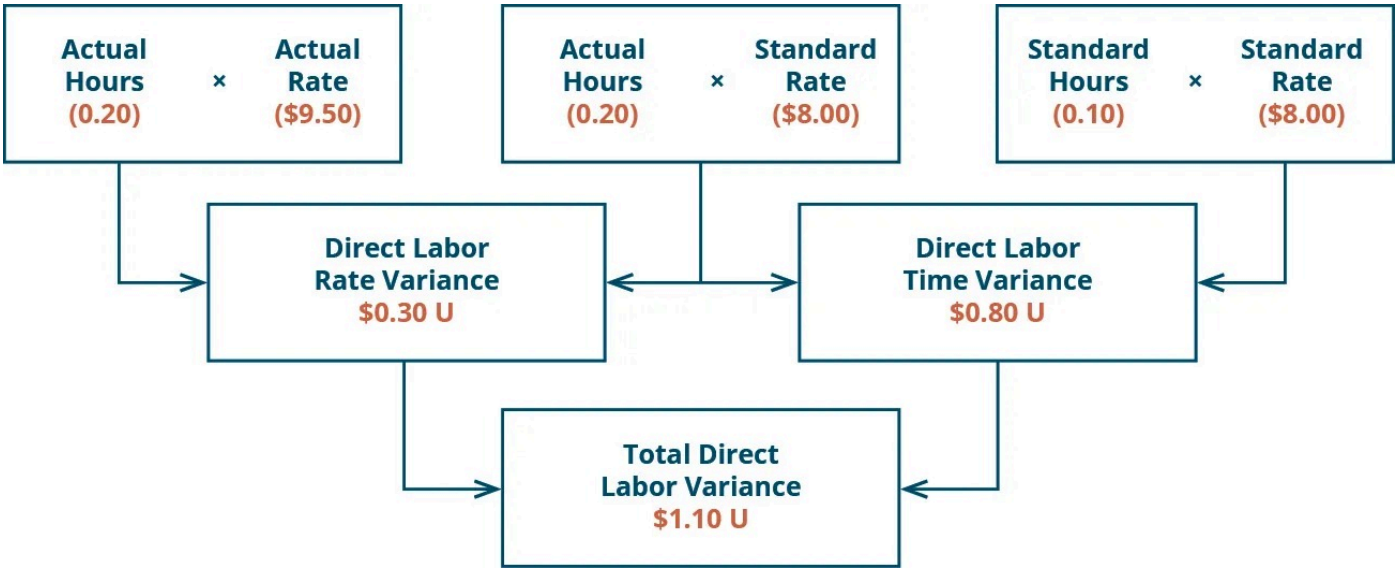


Figure 10.5.1: Direct Labor Variance. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

For example, Connie's Candy Company expects to pay a rate of $8.00 per hour for labor but actually pays $9.50 per hour. The company expected to use 0.10 hours of labor per box but actually used 0.20 hours per box. The total direct labor variance is computed as:

Total Direct Labor Time Variance = (0.20 hours × $9.50) – (0.10 hours × $8.00) = $1.90 – $0.80 = $1.10 (Unfavorable)

In this case, two elements are contributing to the unfavorable outcome. Connie's Candy paid $1.50 per hour more for labor than expected and used 0.10 hours more than expected to make one box of candy. The same calculation is shown as follows using the outcomes of the direct labor rate and time variances.



As with the interpretations for the labor rate and time variances, the company would review the individual components contributing to the overall unfavorable outcome for the total direct labor variance, and possibly make changes to production elements as a result.

YOUR TURN

Sweet and Fresh Shampoo Labor

Biglow Company makes a hair shampoo called Sweet and Fresh. Each bottle has a standard labor cost of 1.5 hours at $35.00 per hour. During May, Biglow manufactured 11,000 bottles. They used 16,000 hours at a cost of $565,600. Calculate the labor rate variance, labor time variance, and total labor variance.

Answer available at the end of this section.

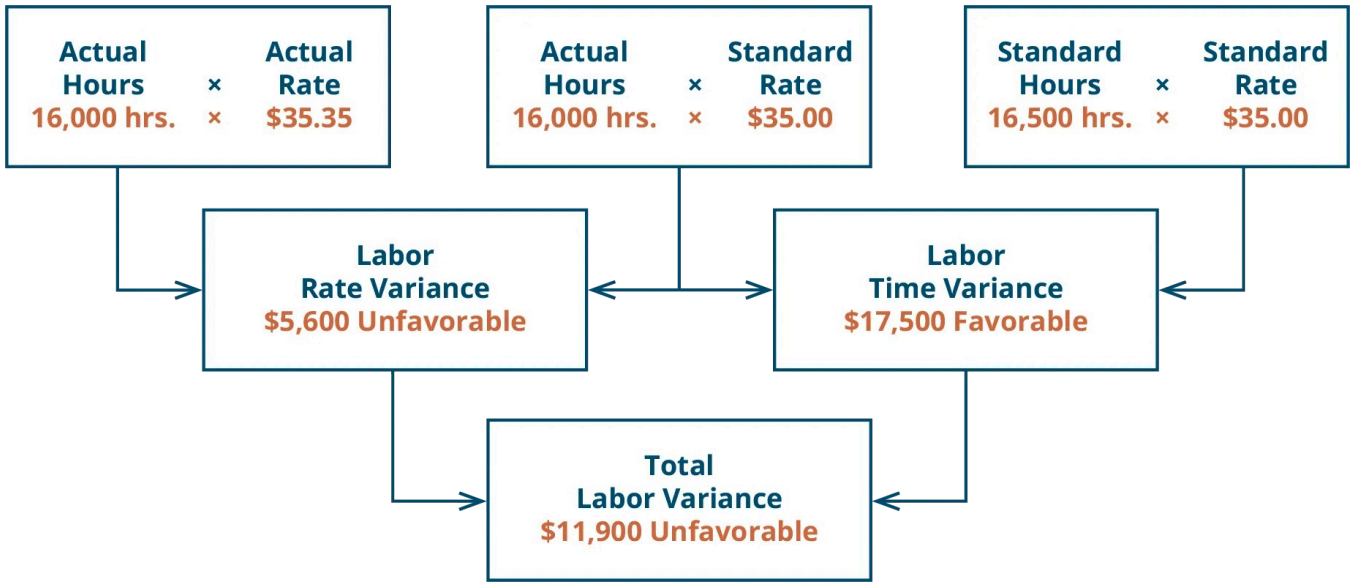
CONCEPTS IN PRACTICE

Labor Costs in Service Industries

In the service industry, labor is the main cost. Doctors, for example, have a time allotment for a physical exam and base their fee on the expected time. Insurance companies pay doctors according to a set schedule, so they set the labor standard. They pay a set rate for a physical exam, no matter how long it takes. If the exam takes longer than expected, the doctor is not compensated for that extra time. This would produce an unfavorable labor variance for the doctor. Doctors know the standard and try to schedule accordingly so a variance does not exist. If anything, they try to produce a favorable variance by seeing more patients in a quicker time frame to maximize their compensation potential.

Answers

YOUR TURN



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10.6: Compute and Evaluate Overhead Variances

Recall that the standard cost of a product includes not only materials and labor but also variable and fixed overhead. It is likely that the amounts determined for standard overhead costs will differ from what actually occurs. This will lead to overhead variances.

Determination and Evaluation of Overhead Variance

In a standard cost system, overhead is applied to the goods based on a standard overhead rate. This is similar to the predetermined overhead rate used previously. The standard overhead rate is calculated by dividing budgeted overhead at a given level of production (known as normal capacity) by the level of activity required for that particular level of production.

$$\text{Standard Overhead Rate} = \frac{\text{Budgeted Overhead Rate}}{\text{Level of Activity}}$$

Usually, the level of activity is either direct labor hours or direct labor cost, but it could be machine hours or units of production.

Creation of Flexible Overhead Budget

To determine the overhead standard cost, companies prepare a **flexible budget** that gives estimated revenues and costs at varying levels of production. The standard overhead cost is usually expressed as the sum of its component parts, fixed and variable costs per unit. Note that at different levels of production, total fixed costs are the same, so the standard fixed cost per unit will change for each production level. However, the variable standard cost per unit is the same per unit for each level of production, but the total variable costs will change.

We continue to use Connie's Candy Company to illustrate. Suppose Connie's Candy budgets capacity of production at 100% and determines expected overhead at this capacity. Connie's Candy also wants to understand what overhead cost outcomes will be at 90% capacity and 110% capacity. The following information is the flexible budget Connie's Candy prepared to show expected overhead at each capacity level.

Percent of capacity	90%	100%	110%
Direct labor hours	1,800	2,000	2,200
Units of output	900	1,000	1,100
Variable overhead	$3,600	$ 4,000	$ 4,400
Fixed overhead	$6,000	$ 6,000	$ 6,000
Total overhead	$9,600	$10,000	$10,400

Normal capacity = 100% and overhead is applied based on direct labor hours
Standard Overhead Rate = $10,000/2,000 = $5 per direct labor hour

Units of output at 100% is 1,000 candy boxes (units). The standard overhead rate is the total budgeted overhead of $10,000

divided by the level of activity (direct labor hours) of 2,000 hours. Notice that fixed overhead remains constant at each of the production levels, but variable overhead changes based on unit output. If Connie's Candy only produced at 90% capacity, for example, they should expect total overhead to be $9,600 and a standard overhead rate of $5.33 (rounded). If Connie's Candy produced 2,200 units, they should expect total overhead to be $10,400 and a standard overhead rate of $4.73 (rounded). In addition to the total standard overhead rate, Connie's Candy will want to know the variable overhead rates at each activity level.

Using the flexible budget, we can determine the standard variable cost per unit at each level of production by taking the total expected variable overhead divided by the level of activity, which can still be direct labor hours or machine hours.

$$\text{Variable Overhead Rate} = \frac{\text{Budgeted Variable Overhead}}{\text{Level of Activity}}$$

Looking at Connie's Candies, the following table shows the variable overhead rate at each of the production capacity levels.

Production Capacity	Variable/Unit
90%	$3,600/1,800 = $2
100%	$4,000/2,000 = $2
110%	$4,400/2,200 = $2

Sometimes these flexible budget figures and overhead rates differ from the actual results, which produces a variance.

Determination of Variable Overhead Variances

There are two components to variable overhead rates: the overhead application rate and the activity level against which that rate was applied. If we compare the actual variable overhead to the standard variable overhead, by analyzing the difference between actual overhead costs and the standard overhead for current production, it is difficult to determine if the variance is due to application rate differences or activity level differences. Thus, there are two variable overhead variances that will better provide these answers: the variable overhead rate variance and the variable overhead efficiency variance.

Determination of Variable Overhead Rate Variance

The **variable overhead rate variance**, also known as the spending variance, is the difference between the actual variable manufacturing overhead and the variable overhead that was expected given the number of hours worked. The variable overhead rate variance is calculated using this formula:

$$\text{Variable Overhead Rate Variance} = \left(\begin{array}{c}\text{Actual Hours Worked} \\ \times \\ \text{Actual Variable Overhead Rate per Hour}\end{array}\right) - \left(\begin{array}{c}\text{Actual Hours Worked} \\ \times \\ \text{Standard Variable Overhead Rate per Hour}\end{array}\right)$$

Factoring out actual hours worked, we can rewrite the formula as:

$$\text{Variable Overhead Rate Variance} = \left(\text{Actual Variable Overhead Rate} - \text{Standard Variable Overhead Rate}\right) \times \text{Actual Hours Worked}$$

If the outcome is favorable (a negative outcome occurs in the calculation), this means the company spent less than what it had anticipated for variable overhead. If the outcome is unfavorable (a positive outcome occurs in the calculation), this means the

company spent more than what it had anticipated for variable overhead.

Connie's Candy Company wants to determine if its variable overhead spending was more or less than anticipated. Connie's Candy had this data available in the flexible budget:

Percent of capacity	**100%**
Direct labor hours	2,000
Units of output	1,000
Variable overhead	$ 4,000
Fixed overhead	$ 6,000
Total overhead	$10,000

Connie's Candy also had this actual output information:

Percent of capacity	**100%**
Direct labor hours	2,500
Units of output	1,000
Variable overhead	$ 7,000
Fixed overhead	$ 6,000
Total overhead	$13,000

To determine the variable overhead rate variance, the standard variable overhead rate per hour and the actual variable overhead rate per hour must be determined. The standard variable overhead rate per hour is $2.00 ($4,000/2,000 hours), taken from the flexible budget at 100% capacity. The actual variable overhead rate is $2.80 ($7,000/2,500), taken from the actual results at 100% capacity. Therefore,

Variable Overhead Rate Variance = ($2.80 – $2.00) × 2,500 = $2,000 (Unfavorable)

This produces an unfavorable outcome. This could be for many reasons, and the production supervisor would need to determine where the variable cost difference is occurring to make production changes.

Let us look at another example producing a favorable outcome. Connie's Candy had this data available in the flexible budget:

Percent of capacity	100%
Direct labor hours	2,000
Units of output	1,000
Variable overhead	$ 4,000
Fixed overhead	$ 6,000
Total overhead	$10,000

Connie's Candy also had this actual output information:

Percent of capacity	100%
Direct labor hours	2,000
Units of output	1,000
Variable overhead	$3,500
Fixed overhead	$6,000
Total overhead	$9,500

To determine the variable overhead rate variance, the standard variable overhead rate per hour and the actual variable overhead rate per hour must be determined. The standard variable overhead rate per hour is $2.00 ($4,000/2,000 hours), taken from the flexible budget at 100% capacity. The actual variable overhead rate is $1.75 ($3,500/2,000), taken from the actual results at 100% capacity. Therefore,

Variable Overhead Rate Variance = ($1.75 – $2.00) × $2,000 = –$500 or $500 (Favorable)

This produces a favorable outcome. This could be for many reasons, and the production supervisor would need to determine where the variable cost difference is occurring to better understand the variable overhead reduction.

Interpretation of the variable overhead rate variance is often difficult because the cost of one overhead item, such as indirect labor, could go up, but another overhead cost, such as indirect materials, could go down. Often, explanation of this variance will need clarification from the production supervisor. Another variable overhead variance to consider is the variable overhead efficiency variance.

Determination of Variable Overhead Efficiency Variance

The **variable overhead efficiency variance**, also known as the controllable variance, is driven by the difference between the actual hours worked and the standard hours expected for the units produced. This variance measures whether the allocation base was efficiently used. The variable overhead efficiency variance is calculated using this formula:

$$\text{Variable Overhead Efficiency Variance} = \left(\begin{array}{c}\text{Actual Hours Worked}\\ \times \\ \text{Standard Variable Overhead Rate per Hour}\end{array}\right) - \left(\begin{array}{c}\text{Standard Hours}\\ \times \\ \text{Standard Variable Overhead Rate per Hour}\end{array}\right)$$

Factoring out standard overhead rate, the formula can be written as:

$$\text{Variable Overhead Efficiency Variance} = (\text{Actual Labor Hours} - \text{Standard Labor Hours}) \times \text{Standard Overhead Rate}$$

If the outcome is favorable (a negative outcome occurs in the calculation), this means the company was more efficient than what it had anticipated for variable overhead. If the outcome is unfavorable (a positive outcome occurs in the calculation), this means the company was less efficient than what it had anticipated for variable overhead.

Connie's Candy Company wants to determine if its variable overhead efficiency was more or less than anticipated. Connie's Candy had the following data available in the flexible budget:

Percent of capacity	**100%**
Direct labor hours	2,000
Units of output	1,000
Variable overhead	$ 4,000
Fixed overhead	$ 6,000
Total overhead	$10,000

Connie's Candy also had the following actual output information:

Percent of capacity	**100%**
Direct labor hours	2,500
Units of output	1,000
Variable overhead	$ 7,000
Fixed overhead	$ 6,000
Total overhead	$13,000

To determine the variable overhead efficiency variance, the actual hours worked and the standard hours worked at the production capacity of 100% must be determined. Actual hours worked are 2,500, and standard hours are 2,000. The standard variable overhead rate per hour is $2.00 ($4,000/2,000 hours), taken from the flexible budget at 100% capacity. Therefore,

Variable Overhead Efficiency Variance = (2,500 – 2,000) × $2.00 = $1,000 (Unfavorable)

This produces an unfavorable outcome. This could be for many reasons, and the production supervisor would need to determine where the variable cost difference is occurring to make production changes.

Let us look at another example producing a favorable outcome. Connie's Candy had the following data available in the flexible budget:

Percent of capacity	**100%**
Direct labor hours	2,000
Units of output	1,000
Variable overhead	$ 4,000
Fixed overhead	$ 6,000
Total overhead	$10,000

Connie's Candy also had the following actual output information:

Percent of capacity	**100%**
Direct labor hours	1,800
Units of output	1,000
Variable overhead	$3,500
Fixed overhead	$6,000
Total overhead	$9,500

To determine the variable overhead efficiency variance, the actual hours worked and the standard hours worked at the production capacity of 100% must be determined. Actual hours worked are 1,800, and standard hours are 2,000. The standard variable overhead rate per hour is $2.00 ($4,000/2,000 hours), taken from the flexible budget at 100% capacity. Therefore,

Variable Overhead Efficiency Variance = (1,800 – 2,000) × $2.00 = –$400 or $400 (Favorable)

This produces a favorable outcome. This could be for many reasons, and the production supervisor would need to determine where the variable cost difference is occurring to better understand the variable overhead efficiency reduction.

The **total variable overhead cost variance** is also found by combining the variable overhead rate variance and the variable overhead efficiency variance. By showing the total variable overhead cost variance as the sum of the two components, management can better analyze the two variances and enhance decision-making.

Figure 10.6.1 shows the connection between the variable overhead rate variance and variable overhead efficiency variance to total variable overhead cost variance.

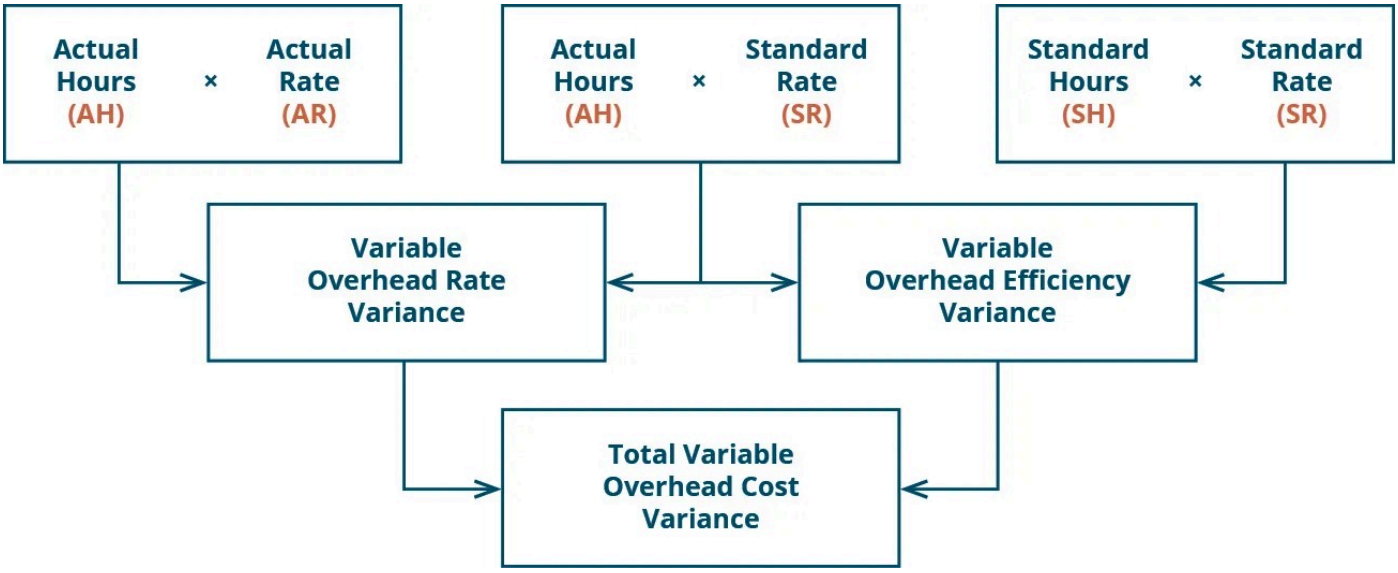


Figure 10.6.1: Variable Overheard Cost Variance. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

For example, Connie's Candy Company had the following data available in the flexible budget:

Percent of capacity	**100%**
Direct labor hours	2,000
Units of output	1,000
Variable overhead	$ 4,000
Fixed overhead	$ 6,000
Total overhead	$10,000

Connie's Candy also had the following actual output information:

Percent of capacity	**100%**
Direct labor hours	1,800
Units of output	1,000
Variable overhead	$3,500
Fixed overhead	$6,000
Total overhead	$9,500

The variable overhead rate variance is calculated as (1,800 × $1.94) – (1,800 × $2.00) = –$108, or $108 (favorable). The variable

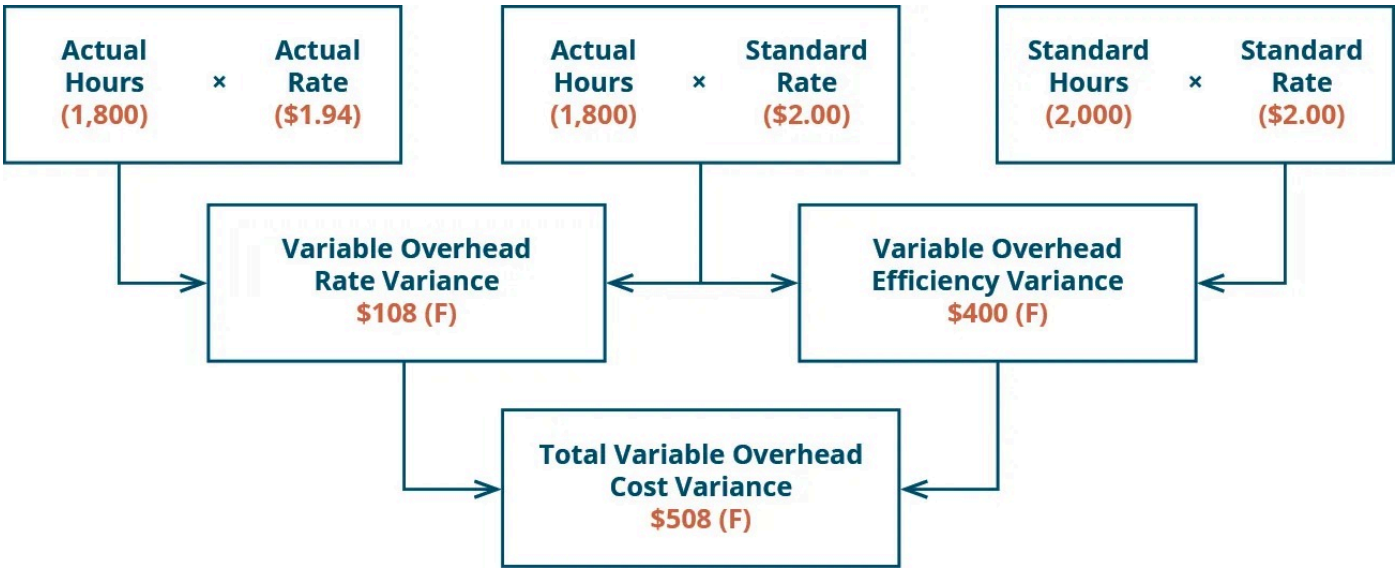
overhead efficiency variance is calculated as (1,800 × $2.00) – (2,000 × $2.00) = –$400, or $400 (favorable).

The total variable overhead cost variance is computed as:

Total Variable Overhead Cost Variance = (–$108) + (–$400) = –$508 or $508 (Favorable)

In this case, two elements are contributing to the favorable outcome. Connie's Candy used fewer direct labor hours and less variable overhead to produce 1,000 candy boxes (units).

The same calculation is shown as follows in diagram format:



As with the interpretations for the variable overhead rate and efficiency variances, the company would review the individual components contributing to the overall favorable outcome for the total variable overhead cost variance, before making any decisions about production in the future. Other variances companies consider are fixed factory overhead variances.

Fundamentals of Fixed Factory Overhead Variances

The **fixed factory overhead variance** represents the difference between the actual fixed overhead and the applied fixed overhead. There are two fixed overhead variances. One variance determines if too much or too little was spent on fixed overhead. The other variance computes whether or not actual production was above or below the expected production level.

YOUR TURN

Sweet and Fresh Shampoo Overhead

Biglow Company makes a hair shampoo called Sweet and Fresh. They have the following flexible budget data:

	90%	100%	110%
Direct labor hours	14,000	16,000	18,000
Units of output	10,000	10,000	10,000
Direct labor	$525,000	$ 346,500	$ 378,000
Variable overhead	$315,000	$ 346,000	$ 378,000
Fixed overhead	$ 45,500	$ 45,500	$ 45,500
Total	$953,500	$1,044,300	$1,135,100

What is the standard variable overhead rate at 90%, 100%, and 110% capacity levels?

Answer available at the end of this section.

THINK IT THROUGH

Purchasing Planes

The XYZ Firm is bidding on a contract for a new plane for the military. As the management team is going over the bid, they come to the conclusion it is too high on a per-plane basis, but they cannot find any costs they feel can be reduced. The information from the military states they will purchase between 50 and 100 planes, but will more likely purchase 50 planes rather than 100 planes. XYZ's bid is based on 50 planes. The controller suggests that they base their bid on 100 planes. This would spread the fixed costs over more planes and reduce the bid price. The lower bid price will increase substantially the chances of XYZ winning the bid. Should XYZ Firm keep the bid at 50 planes or increase its bid to 100 planes? What are the pros and cons to keeping the bid at 50 or increasing to 100 planes?

Answers

YOUR TURN

90% = $315,000/14,000 = $22.50, 100% = $346,000/16,000 = $21.63 (rounded), 110% = $378,000/18,000 = $21.00.

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10.7: Describe How Companies Use Variance Analysis

Companies use variance analysis in different ways. The starting point is the determination of standards against which to compare actual results. Many companies produce variance reports, and the management responsible for the variances must explain any variances outside of a certain range. Some companies only require that unfavorable variances be explained, while many companies require both favorable and unfavorable variances to be explained.

Requiring managers to determine what caused unfavorable variances forces them to identify potential problem areas or consider if the variance was a one-time occurrence. Requiring managers to explain favorable variances allows them to assess whether the favorable variance is sustainable. Knowing what caused the favorable variance allows management to plan for it in the future, depending on whether it was a one-time variance or it will be ongoing.

Another possibility is that management may have built the favorable variance into the standards. Management may overestimate the material price, labor rate, material quantity, or labor hours per unit, for example. This method of overestimation, sometimes called *budget slack*, is built into the standards so management can still look good even if costs are higher than planned. In either case, managers potentially can help other managers and the company overall by noticing particular problem areas or by sharing knowledge that can improve variances.

Often, management will manage "to the variances," meaning they will make decisions that may not be advantageous to the company's best interests over the long run, in order to meet the variance report threshold limits. This can occur when the standards are improperly established, causing significant differences between actual and standard numbers.

ETHICAL CONSIDERATIONS

Ethical Long-Term Decisions in Variance Analysis

The proper use of variance analysis is a significant tool for an organization to reach its long-term goals. When its accounting system recognizes a variance, an organization needs to understand the significant influence of accounting not only in recording its financial results, but also in how reacting to that variance can shape management's behavior toward reaching its goals. Many managers use variance analysis only to determine a short-term reaction, and do not analyze why the variance occurred from a long-term perspective. A more long-term analysis of variances allows an approach that "is responsibility accounting in which authority and accountability for tasks is delegated downward to those managers with the most influence and control over them." It is important for managers to analyze the reported variances with more than just a short-term perspective.

Managers sometimes focus only on making numbers for the current period. For example, a manager might decide to make a manufacturing division's results look profitable in the short term at the expense of reaching the organization's long-term goals. A recognizable cost variance could be an increase in repair costs as a percentage of sales on an increasing basis. This variance could indicate that equipment is not operating efficiently and is increasing overall cost. However, the expense of implementing new, more efficient equipment might be higher than repairing the current equipment. In the short term, it might be more economical to repair the outdated equipment, but in the long term, purchasing more efficient equipment would help the organization reach its goal of eco-friendly manufacturing. If the system use for controlling costs is not aligned to reinforce management of the organization with a long-term perspective, "the manager has no organizational incentive to be concerned with important issues unrelated to anything but the immediate costs" related to the variance. A manager needs to be cognizant of his or her organization's goals when making decisions based on variance analysis.

Management can use standard costs to prepare the budget for the upcoming period, using the past information to possibly make changes to production elements. Standard costs are a measurement tool and can thus be used to evaluate performance. As you've learned, management may manage "to the variances" and can manipulate results to meet expectations. To reduce this possibility, performance should be measured on multiple outcomes, not simply on standard cost variances.

As shown in Table 10.7.1, standard costs have pros and cons to consider when using them in the decision-making and evaluation processes.

Standard Costs

Pros	Cons
• Useful when developing a future budget • Can be used as a benchmark for performance and quality expectations • Can individually identify areas of success and areas for improvement	• Might ignore customer and employee satisfaction rates • Information could be historical data and not useful in real-time decision-making needs • The system to manage and develop standard costs requires a lot of resources, which could be costly and time-consuming

Table 10.7.1

Standard costing provides many benefits and challenges, and a thorough analysis of each variance and the possible unfavorable or favorable outcomes is required to set future expectations and adjust current production goals.

The following is a summary of all direct materials variances (Figure 10.7.1), direct labor variances (Figure 10.7.2), and overhead variances (Figure 10.7.3) presented as both formulas and tree diagrams. Note that for some of the formulas, there are two presentations of the same formula, for example, there are two presentations of the direct materials price variance. While both arrive at the same answer, students usually prefer one formula structure over the other.

$$\text{Direct Materials Price Variance} = (\text{Actual Quantity Used} \times \text{Actual Price Paid}) - (\text{Actual Quantity Used} \times \text{Standard Price})$$

$$\text{Direct Materials Price Variance} = (\text{Actual Price per Unit of Materials} - \text{Standard Price per Unit of Materials}) \times \text{Actual Quantity of Materials Used}$$

$$\text{Direct Materials Quantity Variance} = (\text{Actual Quantity Used} \times \text{Standard Price}) - (\text{Standard Quantity} \times \text{Standard Price})$$

$$\text{Direct Materials Quantity Variance} = (\text{Actual Quantity of Materials Used for Units Produced} - \text{Standard Quantity of Materials Expected for the Units Produced}) \times \text{Standard Price}$$

$$\text{Total Direct Materials Variance} = (\text{Actual Quantity} \times \text{Actual Price}) - (\text{Standard Quantity} \times \text{Standard Price})$$

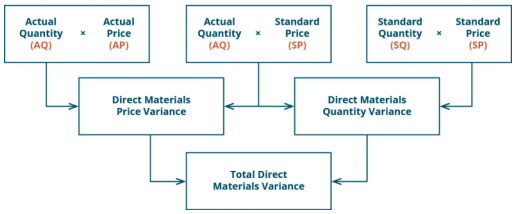


Figure 10.7.1: Direct Materials Variances. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

$$\text{Direct Labor Rate Variance} = \left(\begin{matrix}\text{Actual Hours Worked}\\ \times \\ \text{Actual Rate per Hour}\end{matrix}\right) - \left(\begin{matrix}\text{Actual Hours Worked}\\ \times \\ \text{Standard Rate per Hour}\end{matrix}\right)$$

$$\text{Direct Labor Rate Variance} = \left(\begin{matrix}\text{Actual Rate}\\ \text{per Hour}\end{matrix} - \begin{matrix}\text{Standard Rate}\\ \text{per Hour}\end{matrix}\right) \times \begin{matrix}\text{Actual Hours}\\ \text{Worked}\end{matrix}$$

$$\text{Direct Labor Time Variance} = \left(\begin{matrix}\text{Actual Hours Worked}\\ \times \\ \text{Standard Rate per Hour}\end{matrix}\right) - \left(\begin{matrix}\text{Standard Hours}\\ \times \\ \text{Standard Rate per Hour}\end{matrix}\right)$$

$$\text{Direct Labor Time Variance} = \left(\begin{matrix}\text{Actual Hours}\\ \text{Worked}\end{matrix} - \begin{matrix}\text{Standard Hours Expected}\\ \text{for the Units Produced}\end{matrix}\right) \times \begin{matrix}\text{Standard Rate}\\ \text{per Hour}\end{matrix}$$

$$\text{Total Direct Labor Variance} = (\text{Actual Hours} \times \text{Actual Rate}) - (\text{Standard Hours} \times \text{Standard Rate})$$

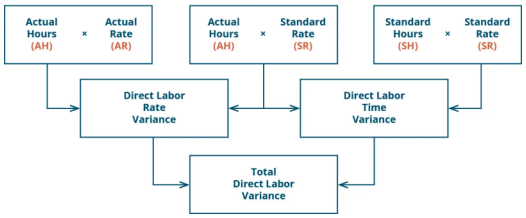


Figure 10.7.2: Direct Labor Variances. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

$$\text{Standard Overhead Rate} = \frac{\text{Budgeted Overhead Rate}}{\text{Level of Activity}}$$

$$\text{Variable Overhead Rate} = \frac{\text{Budgeted Variable Overhead}}{\text{Level of Activity}}$$

$$\text{Variable Overhead Rate Variance} = \left(\begin{matrix}\text{Actual Hours Worked}\\ \times \\ \text{Actual Variable Overhead Rate per Hour}\end{matrix}\right) - \left(\begin{matrix}\text{Actual Hours Worked}\\ \times \\ \text{Standard Variable Overhead Rate per Hour}\end{matrix}\right)$$

$$\text{Variable Overhead Rate Variance} = \left(\begin{matrix}\text{Actual Variable}\\ \text{Overhead Rate}\end{matrix} - \begin{matrix}\text{Standard Variable}\\ \text{Overhead Rate}\end{matrix}\right) \times \begin{matrix}\text{Actual Hours}\\ \text{Worked}\end{matrix}$$

$$\text{Variable Overhead Efficiency Variance} = \left(\begin{matrix}\text{Actual Hours Worked}\\ \times \\ \text{Standard Variable Overhead Rate per Hour}\end{matrix}\right) - \left(\begin{matrix}\text{Standard Hours}\\ \times \\ \text{Standard Variable Overhead Rate per Hour}\end{matrix}\right)$$

$$\text{Variable Overhead Efficiency Variance} = (\text{Actual Labor Hours} - \text{Standard Labor Hours}) \times \begin{matrix}\text{Standard}\\ \text{Overhead Rate}\end{matrix}$$

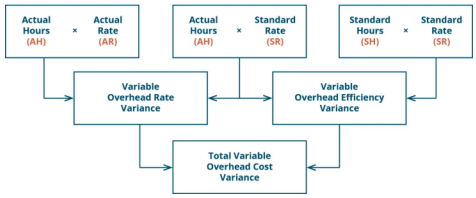


Figure 10.7.3: Overhead Variances. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

YOUR TURN

Barley, Inc. Production

Barley, Inc., produces a product and has the following as standard costs per unit for materials and labor:

Materials	4 pounds @ $15 per pound
Labor	2 hours @ $20 per hour

For the month of October, the following information was gathered related to production:

Beginning inventory	0
Units completed	10,000
Budgeted output units	12,000
Materials used (50,000 pounds)	$800,000
Labor (25,000 hours)	$450,000

Compute:

A. The materials price and quantity variances
B. The labor rate and efficiency variances

Provide possible explanations for each variance.

Answer available at the end of this section.

THINK IT THROUGH

Explaining Differences in Expected and Actual Operational Outcomes

The manager of a plant has called operations, purchasing, and personnel into her office to discuss the results of the last month. She notes that there was more than normal scrap, and employees worked more hours than expected. She is looking for an explanation for these results. What system might she have used to determine these material and labor issues? Why might these variances have occurred? What should she do about it for future periods?

LINK TO LEARNING

Standard Costing Advantages Explained

See this article on the four major advantages of standard costing to learn more.

Answers

YOUR TURN

A.

Materials price variance:

$50,000 unfavorable = ($16* – $15) × 50,000 lb.

*$800,000/50,000

An unfavorable materials price variance occurred because the actual cost of materials was greater than the expected or standard cost. This could occur if a higher-quality material was purchased or the suppliers raised their prices.

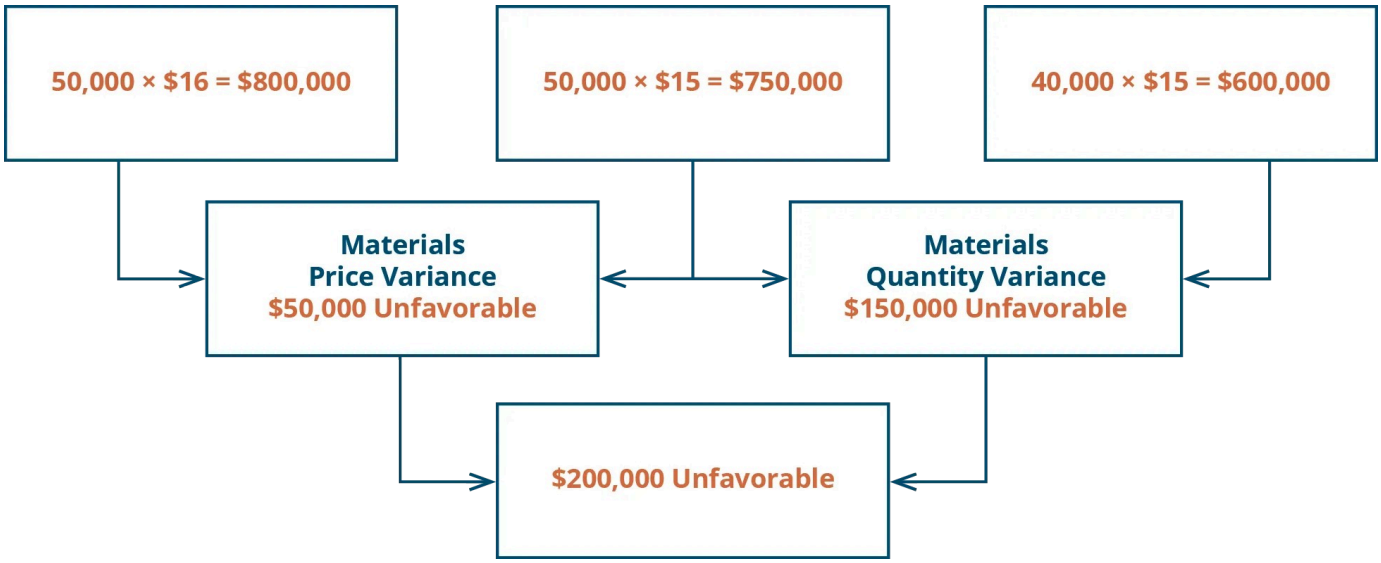
Materials quantity variance:

$150,000 unfavorable = (50,000 lb. – 40,000* lb.) × $15 per lb.

*4 lb. × 10,000 units

An unfavorable materials quantity variance occurred because the pounds of materials used were greater than the pounds expected to be used. This could occur if there were inefficiencies in production or the quality of the materials was such that more needed to be used to meet safety or other standards.

Materials inputs:



B.

Labor rate variance:

$50,000 favorable = ($18* per hour – $20 per hour) × 25,000 hours

*$450,000/25,000

A favorable labor rate variance occurred because the rate paid per hour was less than the rate expected to be paid (standard) per hour. This could occur because the company was able to hire workers at a lower rate, because of negotiated union contracts, or because of a poor labor rate estimate used in creating the standard.

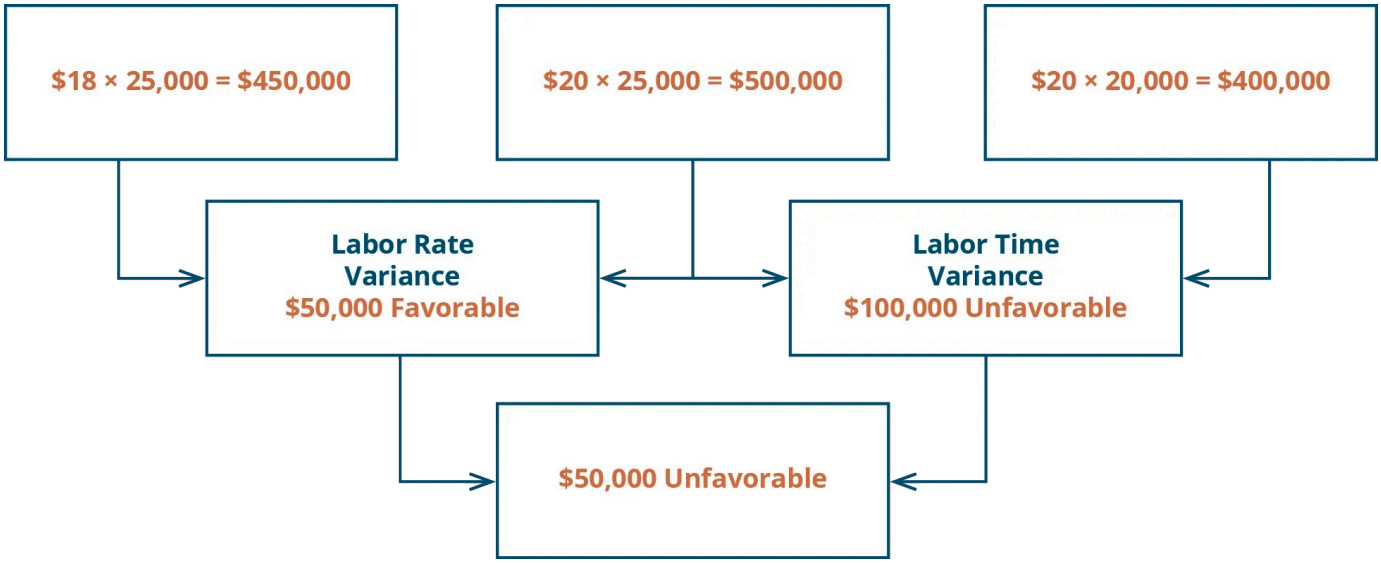
Labor quantity variance:

$100,000 unfavorable = (25,000 hours – 20,000* hours) × $20 per hour

*2 hours × 10,000 units

An unfavorable labor quantity variance occurred because the actual hours worked to make the 10,000 units were greater than the expected hours to make that many units. This could occur because of inefficiencies of the workers, defects and errors that caused additional time reworking items, or the use of new workers who were less efficient.

Labor inputs:



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11: RESPONSIBILITY ACCOUNTING

Learning Objectives

- Explain the nature of and need for segment reporting and its relationship to cost, profit and investment centers.
- Prepare and analyze segment reports

11.1: Differentiate between Centralized and Decentralized Management
11.2: Describe How Decision-Making Differs between Centralized and Decentralized Environments
11.3: Describe the Types of Responsibility Centers
11.4: Describe the Effects of Various Decisions on Performance Evaluation of Responsibility Centers
11.5: Allocation of Service Department Costs

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11.1: Differentiate between Centralized and Decentralized Management

All businesses start with an idea. After putting the idea into action and forming the business, measuring the performance of the business is a crucial next step for the business owners. As the business begins operations, it is fairly easy for the entrepreneur to measure the performance because the owner is heavily involved in the daily activities and decisions of the business. As the business grows through increased sales volume, additional products and locations, and more employees, however, it becomes more complicated to measure the performance of the organization. Owners and managers must design organizational systems that allow for operational efficiency, performance measurement, and the achievement of organizational goals.

In this chapter, you will learn the difference between centralized and decentralized management and how that relates to decision-making. You will learn about responsibility accounting and the type of decision-making authority that may be granted through different responsibility centers. Finally, you will learn how certain types of decisions have differing effects, depending on the type of responsibility center.

Management Control System

It is important for those studying business (and accounting, in particular) to understand the concept of a management control system. A **management control system** is a structure within an organization that allows managers to establish, implement, and monitor progress toward the strategic goals of the organization.

Establishing strategic goals within any organization is important. Strategic goals relate to all facets of the business, including which markets to operate in, what products and services to offer to customers, and how to recruit and retain a talented workforce. It is the responsibility of the organization's management to establish strategic goals and to ensure that all activities of the business help meet goals.

Once an organization establishes its strategic goals, it must implement them. Implementing the strategic goals of the organization requires communication and providing plans that guide the work of those in the organization.

The final factor in creating a management control system is to design mechanisms to monitor the activities of the organization to assess how well they are meeting the strategic goals. This aspect of the management control system includes the accounting system (both financial and managerial). Monitoring the performance of the organization allows management to repeat the activities that lead to good performance and to adjust activities that are not supporting the strategic goals. In addition, monitoring the activities of the organization provides feedback to management as to whether adjustments to the organization's strategy are necessary.

Establishing a management control system is very important to an organization. Organizations must continually evaluate ways to improve and remain competitive in an ever-changing market. This requires the organization to be both forward-looking (via strategic planning) and backward-looking (by evaluating what has occurred), constantly monitoring performance and making necessary adjustments.

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11.2: Describe How Decision-Making Differs between Centralized and Decentralized Environments

Businesses are organized with the intention of creating efficiency and effectiveness in achieving organizational goals. To aid in this, larger businesses use **segments**, uniquely identifiable components of the business. A company often creates them because of the specific activities undertaken within a particular portion of the business. Segments are often categorized within the organization based on the services provided (i.e., departments), products produced, or even by geographic region. The purpose of identifying distinguishable segments within an organization is to provide efficiency in decision-making and effectiveness in operational performance.

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11.3: Describe the Types of Responsibility Centers

You've learned how segments are established within a business to increase decision-making and operational effectiveness and efficiency. In other words, segments allow management to establish a structure of operational accountability.

The terminology changes slightly when we think about accountability relating to the financial performance of the segment. In a decentralized organization, the system of financial accountability for the various segments is administered through what is called responsibility accounting.

Responsibility accounting is a basic component of accounting systems for many companies as their performance measurement process becomes more complex. The process involves assigning the responsibility of accounting for particular segments of the company to a specific individual or group. These segments are often structured as **responsibility centers** in which designated supervisors or managers will have both the responsibility for the performance of the center and the authority to make decisions that affect the center.

Often, businesses will use the segment structure to establish the responsibility accounting framework. You might think of segments and responsibility centers as two sides of the same coin: segments establish the structure for operational accountability whereas responsibility centers establish the structure for financial accountability. Both segments and responsibility centers (which will likely be the same) attempt to accomplish the same goal: ensure all sectors of the business achieve the organization's strategic goals.

Before learning about the five types of responsibility centers in detail, it is important to understand the essence of responsibility accounting and responsibility centers.

Fundamentals of Responsibility Accounting and Responsibility Centers

Recall the discussion of management control systems. These systems allow management to establish, implement, monitor, and adjust the activities of the organization toward attainment of strategic goals. Responsibility accounting and the responsibility centers framework focuses on monitoring and adjusting activities, based on financial performance. This framework allows management to gain valuable feedback relating to the financial performance of the organization and to identify any segment activity where adjustments are necessary.

Types of Responsibility Centers

Organizations must exercise care when establishing responsibility centers. In a responsibility accounting framework, decision-making authority is delegated to a specific manager or director of each segment. The manager or director will, in turn, be evaluated based on the financial performance of that segment or responsibility center. It is important, therefore, to establish a responsibility accounting framework that allows for an adequate and equitable evaluation of the financial performance of the responsibility center (and, by default, the manager of the responsibility center) as well as the attainment of the organization's strategic goals.

This is not an easy task. There are several factors that organizations must consider when developing and using a responsibility accounting framework. Before discussing those factors, let's explore the five types of responsibility centers: cost centers, discretionary cost centers, revenue centers, profit centers, and investment centers.

Cost Centers

A **cost center** is an organizational segment in which a manager is held responsible only for costs. In these types of responsibility centers, there is a direct link between the costs incurred and the product or services produced. This link must be recognized by managers and properly structured within the responsibility accounting framework.

An example of a cost center is the custodial department of a department store called Apparel World. On one hand, since the custodial department is structured as a cost center, the goal of the custodial department manager is to keep costs as low as possible, since this is the basis by which the manager will be evaluated by upper-level management. On the other hand, the

custodial department manager, who is responsible for cleaning the store entrances, also wants to keep the store as clean as possible for the store's customers. If the store appears unclean and disorganized, customers will not continue to shop at the store. Therefore, the custodial department manager and upper-level management must work together to establish goals of the cost center (the custodial department, in this example) that satisfy the strategic goals of the business—maintaining a clean and organized store while minimizing the costs of managing the custodial department.

Figure 11.3.1 shows an example of what the cost center report might look like for the Apparel World custodial department.

APPAREL WORLD DEPARTMENT STORE
Custodial Department Cost Center
For the Month of December 2018

Account Title	Actual Expense	Budgeted Expense	Difference ($)	Difference (%)
Custodian wages	$15,500	$15,000	$500	3.3%
Department manager wages	3,500	3,500	0	0.0%
Cleaning equipment	450	125	325	260.0%
Cleaning supplies	275	120	155	129.2%
Total costs	$19,725	$18,745	$980	5.2%

Figure 11.3.1: Cost Center Report for the Custodial Department. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Let's use this report to explore how the department manager and upper-level management might review and use this information. In total, in December, the custodial department incurred $980 more of actual expenses than budgeted (or expected) expenses. This represents a 5.2% increase in expenses than was expected.

Notice the terminology used to describe the financial information of the custodial department: the department "*incurred* $980 more of actual expenses," rather than the department "*spent* $980 more of actual expenses." Financial statements are typically prepared using *accrual* accounting rather than *cash* accounting. Under accrual accounting, certain transactions are recorded regardless of when the cash is exchanged. Therefore, to say the custodial department "*spent* $19,725" or "*spent* $980 more for expenses" would technically be incorrect, since the cash may not have been spent.

The managers would then review each line item to determine what caused the $980 increase in expenses over what was expected. Keep in mind, the $980 represents the *total* overage from the budget, so it is possible that some expense accounts could have actually been *below* expectations. Unfortunately, that is not the case in the month of December because every line item, with the exception of department manager wages, exceeded the budgeted amount. It was no surprise to management that the department manager's wages were exactly as expected. Even though the custodial department manager worked more hours in the month of December, the manager is a salaried employee, so the wages are the same regardless of the number of hours worked.

Upon further investigation, it was determined that in December, the town where the Apparel World store is located received an unusually high amount of snow. This had an impact on each of the expense amounts in the custodial department. Because of the need to shovel snow more often, some of the custodial staff had to work overtime to ensure customers could easily and safely enter the store. This led to an increase in custodial wages of $500 compared to the budgeted or expected amount, which was established based on the previous year, when snowfall in the area was closer to average.

The research conducted by management also identified that additional cleaning equipment (mop buckets, mops, and "wet floor" signs) were purchased. The increased snowfall also led to the purchase of more salt than usual for the sidewalks outside the store. Because it was important to promptly clean the snow as well as the salt that was brought into the store on customers' shoes, additional equipment was purchased so that each entrance would have a mop and bucket. The custodial department manager decided this was the best course of action. Normally, the store uses a single mop and bucket to clean all entrances. This would have taken more time and increased the risk of an accident.

The increased application of salt partially explains the 129.2% (or $155) overage in the cleaning supplies expense account. Management has learned that the overage in this account was also caused by an increase in purchases of mop head replacements, floor cleaner, and paper towels.

After reviewing the December information and learning the causes of the increased expenses, the company determined that no corrective action was necessary going forward. The area received an unusually high level of snowfall that year, which was not something the custodial department manager could control. In fact, the upper-level managers praised the custodial department manager for taking action that was in the best interest of the store and its customers. The managers commented that they had received numerous compliments from customers regarding how easy and safe it was to enter the store compared to other local stores. The manager noted that, despite the increased snowfall, store sales were higher than expected and attributed much of the success to the work of the custodial department.

Discretionary Cost Centers

A discretionary cost center is similar to a cost center, with one distinguishing factor. A **discretionary cost center** is an organizational segment in which a manager is held responsible for controllable costs when there is not a well-defined relationship between the center's costs and its services or products. Examples include human resources and accounting departments. Human resources departments often establish policies that affect the entire organization. For instance, while a policy requiring all workers to have annual safety training for fires, injuries, and tornadoes is beneficial to the entire company, it is difficult to evaluate the human resources department manager's performance in relation to impacting the products or services the company provides. As you might expect, reviewing the financial performance of a discretionary cost center is similar to that of the review of a cost center.

Revenue Centers

A **revenue center** is an organizational segment in which a manager is held accountable only for revenues. As the name implies, the goal of a revenue center is to generate revenues for the business. In order to accomplish the goal of increasing revenues, the manager of a revenue center would focus on developing specific skillsets of the revenue center's employees. The reservations group of **Southwest Airlines** is an example of a segment that may be structured as a revenue center. The employees should be well-trained in providing excellent customer service, handling customer complaints, and converting customer interactions into actual sales. As the financial performance of cost centers and discretionary cost centers is similar, so is the financial performance of a revenue center and a cost center.

Profit Centers

A **profit center** is an organizational segment in which a manager is responsible for both revenues and costs (such as a **Starbucks** store location). Of the responsibility centers explored so far, a profit center structure is the most complex because a manager must be well-versed in techniques to increase revenues, decrease expenses, and thereby increase profits while also meeting the strategic goals of the organization.

Let's return to the Apparel World department store. Figure 11.3.2 shows an example of what the profit center report might look like for the Apparel World children's clothing department.

APPAREL WORLD DEPARTMENT STORE Children's Clothing Department Profit Center For the Month of December 2018				
Revenues	**Actual**	**Budgeted**	**Difference ($)**	**Difference (%)**
Clothing revenue	$175,000	$145,000	$30,000	20.7%
Clothing accessories revenue	1,400	2,200	(800)	−36.4%
Total revenue	$176,400	$147,200	$29,200	19.8%
Expenses				
Associates wages	$ 22,500	$ 21,750	$ 750	3.4%
Department manager wages	7,200	7,200	0	0.0%
Cost of clothing sold	111,125	87,000	24,125	27.7%
Cost of accessories sold	1,008	1,584	(576)	−36.4%
Equipment/fixture repairs	1,025	290	735	253.4%
Utilities	895	620	275	44.4%
Total expenses	$143,753	$118,444	$25,309	21.4%
Department profit (loss)	$ 32,647	$ 28,756	$ 3,891	13.5%

Figure 11.3.2: Profit Center Report for the Children's Clothing Department. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Just as with the cost center, let's walk through an analysis of the December children's clothing department profit center report. Overall, the department's actual profit exceeded budgeted profit by $3,891, or 13.5%, compared to budgeted (or expected) profit. This increase was driven by a total revenue increase over budget by $29,200 or 19.8%. Variable costs, unlike fixed costs, change in proportion to the level of activity in a business. Therefore, it should be no surprise that the expenses in the children's clothing department also increased. In fact, the expenses increased $25,309 (or 21.4%) versus the budgeted amount. The revenues of the department increased $29,200, while expenses increased $25,309, yielding an increase in profit of $3,891 over expectations.

The increase in revenue could be further analyzed. Because the store also sells accessories such as belts and socks, the children's clothing department tracks two revenue sources (also called *streams*)—clothing and accessories. Management was pleased to learn that clothing revenue exceeded expectations by $30,000, or 20.7%. Given the higher-than-usual level of snowfall in the area, this is an impressive increase, and the company can attribute a portion of the successful month to the employees of the custodial department, who worked extra hard to ensure customers could easily and safely enter the store.

The overall revenue of the department increased by $29,200. Since the clothing department revenue increased by $30,000, the clothing accessories revenue stream must have experienced a decline in revenue. In fact, the accessories revenue dropped by 36.4%. While this is a large percentage, consider the fact that the actual value of revenue decline was relatively minor—only $800 lower (as indicated by the negative amount) than expected. This indicates the employees may not have encouraged customers to also get belts or socks with their clothing purchase. This is an opportunity for the department manager to remind employees to encourage customers to purchase accessories to complement the clothing purchases. Overall, the increase in revenue attained by the children's clothing department is a highlight for the store.

A review of the department's expenses shows increases in all expenses, except department manager wages and cost of accessories sold. When reviewing the profit center report, pay special attention to how the differences between the actual and budgeted expenses are calculated in this analysis. In the revenue section, a positive number indicates the revenue exceeded the budgeted amount, which means a favorable financial performance. In the expense section, a positive number indicates the expense exceeded the budgeted amount, which means an unfavorable financial performance.

As with the custodial department manager, the manager of the children's clothing department is also a salaried employee, so the wages do not change each month—the wages are a fixed cost for the department. Since the clothing accessories revenue declined, the cost of accessories also declined. The accessories expenses were $576 lower than expected. While this appears to be good news for the department, recall that clothing accessories revenue dropped by $800. Therefore, the department profit margin decreased by a net amount of $224 versus expectations ($800 revenue decline and a corresponding expense decrease of $576).

All other actual expenses were over budget, as indicated by the positive numbers. Remember, these are expenses, and in this analysis, they indicate unfavorable financial performance. It probably comes as no surprise that all of the expense overages are a result of the increased sales. Because of the increased sales, more associates were needed to cover each shift, and they worked

more hours to cover the longer store hours, which caused wages to go over budget. The substantial increase in clothing revenue also caused the cost of clothing sold to increase proportionately. Similarly, the increased sales drove an increase in equipment/fixture repairs of $735 (or 253.4%) over budget due to repairs to cash registers and clothing racks. Because the store was open longer hours during the holiday season, the utilities expenses also exceeded budget by $275, or 44.4%.

Overall, the Apparel World department store management was pleased with the December financial performance of the children's clothing department. The department exceeded budgeted sales, which resulted in an increase in department profitability. The review also highlighted an area for improvement in the department—increasing accessory sales—which is easily corrected through additional training.

Notice that the review of the children's clothing department profit center report discussed differences measured in both dollars and percentages. When analyzing financial information, looking only at dollar values can be misleading. Displaying information as percentages—percentage of an entire amount or percentage change—standardizes the information and facilitates an easier and more accurate comparison, especially when dealing with segments (or companies) with vastly different sizes.

Let's look at another scenario using Apparel World. The example so far has explored the financial performance review processes for a cost center and a profit center. Now assume that store management wants to compare two different profit centers—children's clothing and women's clothing. Figure 11.3.3 shows the December financial information for the children's clothing department, and Figure 11.3.4 shows the financial information for the women's clothing department.

APPAREL WORLD DEPARTMENT STORE
Children's Clothing Department Profit Center
For the Month of December 2018

Revenues	**Actual**	**Budgeted**	**Difference ($)**	**Difference (%)**
Clothing revenue	$175,000	$145,000	$30,000	20.7%
Clothing accessories revenue	1,400	2,200	(800)	–36.4%
Total revenue	$176,400	$147,200	$29,200	19.8%
Expenses				
Associates wages	$ 22,500	$ 21,750	$ 750	3.4%
Department manager wages	7,200	7,200	0	0.0%
Cost of clothing sold	111,125	87,000	24,125	27.7%
Cost of accessories sold	1,008	1,584	(576)	–36.4%
Equipment/fixture repairs	1,025	290	735	253.4%
Utilities	895	620	275	44.4%
Total expenses	$143,753	$118,444	$25,309	21.4%
Department profit (loss)	$ 32,647	$ 28,756	$ 3,891	13.5%

Figure 11.3.3: Profit Center Report for the Children's Clothing Department, without Percentages. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

APPAREL WORLD DEPARTMENT STORE Women's Clothing Department Profit Center For the Month of December 2018			
Revenues	**Actual**	**Budgeted**	**Difference ($)**
Clothing revenue	$400,000	$308,000	$92,000
Clothing accessories revenue	17,280	14,300	2,980
Total revenue	$417,280	$322,300	$94,980
Expenses			
Associates wages	$ 42,000	$ 38,500	$ 3,500
Department manager wages	12,400	12,400	0
Cost of clothing sold	288,000	201,124	86,876
Cost of accessories sold	12,442	10,296	2,146
Equipment/fixture repairs	275	400	(125)
Utilities	1,050	1,000	50
Total expenses	$356,167	$263,720	$92,447
Department profit (loss)	$ 61,113	$ 58,580	$ 2,533

Figure 11.3.4: Profit Center Report for the Women's Clothing Department, without Percentages. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Comparing the dollar differences in the two departments, notice that the children's clothing department is a smaller department, as measured by total revenue, than the women's clothing department.

Now, let's compare the differences in the two departments by looking at the percentages. The children's clothing department financial information is shown in Figure 11.3.5, and the women's clothing department financial information is shown in Figure 11.3.6.

APPAREL WORLD DEPARTMENT STORE Children's Clothing Department Profit Center For the Month of December 2018				
Revenues	**Actual**	**Budgeted**	**Difference ($)**	**Difference (%)**
Clothing revenue	$175,000	$145,000	$30,000	20.7%
Clothing accessories revenue	1,400	2,200	(800)	–36.4%
Total revenue	$176,400	$147,200	$29,200	19.8%
Expenses				
Associates wages	$ 22,500	$ 21,750	$ 750	3.4%
Department manager wages	7,200	7,200	0	0.0%
Cost of clothing sold	111,125	87,000	24,125	27.7%
Cost of accessories sold	1,008	1,584	(576)	–36.4%
Equipment/fixture repairs	1,025	290	735	253.4%
Utilities	895	620	275	44.4%
Total expenses	$143,753	$118,444	$25,309	21.4%
Department profit/(loss)	$ 32,647	$ 28,756	$ 3,891	13.5%

Figure 11.3.5: Profit Center Report for the Children's Clothing Department. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

APPAREL WORLD DEPARTMENT STORE Women's Clothing Department Profit Center For the Month of December 2018				
Revenues	**Actual**	**Budgeted**	**Difference ($)**	**Difference (%)**
Clothing revenue	$400,000	$308,000	$92,000	29.9%
Clothing accessories revenue	$17,280	$14,300	$2,980	20.8%
Total revenue	$417,280	$322,300	$94,980	29.5%
Expenses				
Associates wages	$42,000	$38,500	$3,500	9.1%
Department manager wages	$12,400	$12,400	$0	0.0%
Cost of clothing sold	$288,000	$201,124	$86,876	43.2%
Cost of accessories sold	$12,442	$10,296	$2,146	20.8%
Equipment/fixture repairs	$275	$400	($125)	−31.3%
Utilities	$1,050	$1,000	$50	5.0%
Total expenses	$356,167	$263,720	$92,447	35.1%
Department profit (loss)	$61,113	$58,580	$2,533	4.3%

Figure 11.3.6: Profit Center Report for the Women's Clothing Department. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Does the comparison change when the dollar differences are shown as percentages? Which department was more effective at strengthening the store's financial position? Which department was more efficient with the December revenue? What other factors might the Apparel World management consider?

Adding the percentages to the financial analysis allows managers to more directly make comparisons, to separate departments in this case. Simply reviewing the dollar differences can be misleading because of size differences between the departments being compared. The Women's Department added more value ($61,113) to the store's financial position, while the Children's Department was more efficient, converting 13.5% (or $0.135) of every dollar of revenue to profit.

Investment Centers

It is important for managers to continually invest in the business. Managers must choose investments that improve the value of the business by improving the customer experience, increasing customer loyalty, and, ultimately, increasing the value of the organization. A limitation of the centers explored so far—cost center, discretionary cost center, revenue center, and profit center—is that these structures do not account for the investments made by the various responsibility center managers. The final responsibility center—investment centers—takes into account and evaluates the investments made by the responsibility center managers. The goal of the investment center structure is to ensure that segment managers choose investments that add value and help the organization achieve its strategic goals.

An **investment center** is an organizational segment (such as the northern region of **Best Buy**) in which a manager is accountable for profits (revenues minus expenses) *and* the invested capital used by the segment.

CONCEPTS IN PRACTICE

Research and Development at Hershey's

As you know by now, financial statements tell users what has occurred in the past—the statements provide feedback value. Responsibility accounting is no exception—it is a system that measures the financial performance of what has already occurred and provides management with a measure of past events.

Have you ever considered how companies measure the outcome of activities that have not yet occurred? As you've learned, many companies invest in research and development activities to determine how to improve existing products and to create entirely new products or processes.

The **Hershey Chocolate Company** is one company that invests heavily in research and development. **Hershey's** has created an Advanced Technology & Foresight Lab, which looks for innovative ways to bring chocolate to the market.

Here are some of the innovative things that **Hershey's** has developed:

- Sourcemap—an interactive, web-based tool to show consumers where the ingredients in their favorite **Hershey's** snack, such as Hershey's Milk Chocolate with Almonds Bar comes from. There is also a video and short story for each point on the interactive map for more information.
- SmartLabel—a scannable label on each **Hershey's** product that gives the user up-to-date ingredient, allergen, and other information.
- 3D Chocolate Printing—using a 3D printer, **Hershey's** has developed an innovative way to create customized chocolate candies.[5]

Measuring the financial success of innovations such as these is nearly impossible in the short-run. However, in the long-run, investments in product development help companies like **Hershey's** increase sales, reduce costs, gain market share, and remain competitive in the marketplace.

There are numerous methods used to evaluate the financial performance of investment centers. When discussing profit centers, we used the segment's profit/loss stated in dollars. Another method to evaluate segment financial performance involves using the profit margin percentage.

The profit margin percentage is calculated by taking the net profit (or loss) divided by the net sales. This is a useful calculation to measure the organization's (or segment's) efficiency at converting revenue into profit (net income). While the dollar value of a segment's profit/loss is important, the advantage of using a percentage is that percentages allow for more direct comparisons of different-sized segments.

Let's return to the Apparel World example and look at the profit margin percentage for the children's and women's clothing departments. Figure 11.3.7 shows the December financial information for the children's clothing department, including the profit margin percentage.

APPAREL WORLD DEPARTMENT STORE
Children's Clothing Department Profit Center
For the Month of December 2018

Revenues	**Actual**	**Budgeted**
Clothing revenue	$175,000	$145,000
Clothing accessories revenue	1,400	2,200
Total revenue	$176,400	$147,200
Expenses		
Associates wages	$ 22,500	$ 21,750
Department manager wages	7,200	7,200
Cost of clothing sold	111,125	87,000
Cost of accessories sold	1,008	1,584
Equipment/fixture repairs	1,025	290
Utilities	895	620
Total expenses	$143,753	$118,444
Department profit (loss)	$ 32,647	$ 28,756
Profit margin %	18.5%	19.5%

Figure 11.3.7: Profit Center Report for the Children's Clothing Department, Including Profit Margin Percentage. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The actual profit margin percentage achieved by the children's clothing department was 18.5%, calculated by taking the department profit of $32,647 divided by the total revenue of $176,400 ($32,647 / $176,400). The actual profit margin percentage was slightly lower than the expected percentage of 19.5% ($28,756 / $147,200). To determine why the profit margin percentage slipped slightly compared to expectations, management could compare the actual revenue and expenses with the budgeted revenue and expenses using a vertical analysis. Doing so would highlight the fact that the cost of clothing sold as a percentage of clothing revenue increased significantly compared to what was expected. Management would want to explore this further, looking

at factors influencing both clothing revenue (sales prices and quantity) and the cost of the clothing (which may have increased).

Figure 11.3.8 shows the December financial information for the women's clothing department, including the profit margin percentage.

APPAREL WORLD DEPARTMENT STORE
Women's Clothing Department Profit Center
For the Month of December 2018

Revenues	**Actual**	**Budgeted**
Clothing revenue	$400,000	$308,000
Clothing accessories revenue	17,280	14,300
Total revenue	$417,280	$322,300
Expenses		
Associates wages	$ 42,000	$ 38,500
Department manager wages	12,400	12,400
Cost of clothing sold	288,000	201,124
Cost of accessories sold	12,442	10,296
Equipment/fixture repairs	275	400
Utilities	1,050	1,000
Total expenses	$356,167	$263,720
Department profit (loss)	$ 61,113	$ 58,580
Profit margin %	14.6%	18.2%

Figure 11.3.8: Profit Center Report for the Women's Clothing Department, Including Profit Margin Percentage. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

The actual profit margin percentage of the women's clothing department was 14.6%, calculated by taking the department profit of $61,113 divided by the total revenue of $417,280 ($61,113 / $417,280). The actual profit margin percentage was significantly lower than the expected percentage of 18.2% ($58,580 / $322,300). As with the children's clothing department, a vertical analysis indicates the significant decrease from budgeted profit margin percentage was a result of the cost of clothing sold. This would lead management to investigate possible causes that would have influenced the clothing revenue (sales prices and quantity), the cost of the clothing, or both.

Another method used to evaluate investment centers is called return on investment. **Return on investment** (ROI) is the department or segment's profit (or loss) divided by the investment base (Net Income / Base). It is a measure of how effective the segment was at generating profit with a given level of investment. Another way to think about ROI is its use as a measure of leverage. That is, the return on investment calculation measures how much profit the segment can realize per dollar invested.

Several points are in order regarding the definition of return on investment. In practice, the numerator (segment profit or loss) may have different names, depending upon the terms used by the organization. Some organizations may call this value *net income* (or loss) or *operating income* (or loss). These terms relate to the financial performance of the segment, and each organization decides how best to identify and quantify financial performance.

Another significant point in the definition of return on investment relates to the denominator (investment base). There is no uniform definition of "investment base" within the accounting/finance profession. Some organizations define investment base as operating assets, while others define the investment base as average operating assets. Other organizations use the book value of assets, and still others use the historical or even replacement cost of assets. There are valid arguments for all of these definitions for investment base. It is important not to be confused by these variations but instead to know the definition in a particular context and to use it consistently. For our purposes, the denominator in the return on investment formula will be "investment base," and the value will be provided.

Finally, accountants carefully consider where to place certain costs (either on the balance sheet as assets or on the income statement as expenses). While ROI typically deals with long-lived assets such as buildings and equipment that are charged to the balance sheet, the ROI approach also applies to certain "investments" that are expensed. For instance, advertising costs are expensed. If a segment is considering an advertising campaign, management would assess the effectiveness of the advertising campaign in a similar manner as the traditional ROI analysis using large, capitalized investments. That is, management would want to assess the additional revenue (or profit) derived from the advertising campaign (which would be the numerator in the ROI calculation) compared to the investment or cost of the advertising campaign (which would be the denominator in the ROI

calculation). To illustrate, let's say management was able to identify that an advertising campaign costing $2,500 brought in an additional $500 of profit. This would be a 20% return on investment ($500 / $2,500).

A return on investment analysis of an investment center begins with the same information as an analysis of a profit center. To explore return on investment, let's return to the December Apparel World profit center information analyzing the children's and women's clothing departments. Assume that a smaller store in another location had the following profit for December:

- Children's clothing department: $3,891
- Women's clothing department: $2,533

Now assume that each department had an investment base of the following amounts:

- Children's clothing department: $15,000
- Women's clothing department: $65,000

To calculate the return on investment (ROI) for each department, divide the segment profit by the segment investment base. The ROI for each department is:

- Children's clothing department: 25.9% ($3,891 / $15,000)
- Women's clothing department: 3.9% ($2,533 / $65,000)

The children's clothing department contributed the most to the financial position of this Apparel World location ($3,891 vs. $2,533). In addition, the children's clothing department was able to better leverage every dollar invested into profit. Stated differently, for every dollar invested, the children's clothing department was able to realize $0.259 of profit while the women's clothing department realized only $0.039 of profit for every dollar invested.

It is also significant that the children's clothing department requires a smaller dollar value of investment. This conserves store resources (financial capital) and helps store management prioritize and efficiently allocate future resources. By investing in the children's clothing department, store management is able to invest a smaller dollar amount while achieving a higher rate of return (profitability) on that investment.

One of the criticisms of the ROI approach is that each segment evaluates potential investments *only* in relation to the individual segment's ROI. This may cause the individual segment manager to select only projects or activities that improve the individual segment's ROI and decline projects that improve the financial position of the overall company. Most often, segment managers are primarily evaluated based on the performance of the segment they manage with only a small portion, if any, of their evaluation based on overall corporate performance. This means that the bonuses of a segment manager are largely dependent on how the segment performs, or in other words, based on the decisions made by that segment manager. A manager may choose to forgo a project or activity because it will lower the segment's ROI even though the project would benefit the entire company.

The final investment center evaluation method, residual income (RI), structures the investment selection process to incentivize segment managers to select projects that benefit the entire company, rather than only the specific segment.

YOUR TURN

Analyzing Historical Success

Companies want to be sure the investments they make are generating an acceptable return. Additionally, individual investors want to ensure they are receiving the highest financial return for the money they are investing.

This article published in the New York Times on best investments listed **Microsoft** as having one of the best investments since 1926 (based on a study by Hendrik Bessembinder). Based on stock market returns to investors, **Microsoft** ranked third, behind **ExxonMobil** and **Apple**. According to the article, "since 1986, it has had an annualized return of 25 percent."

Other companies in the ranking included familiar company names such as **General Electric** (ranked #4), **Walmart** (ranked #10), **McDonald's** (#31), and **Coca-Cola** (#15).

> But does historical success ensure future success? **General Electric** is listed in the article as the 4th highest-ranking company for creating wealth for investors. Conduct internet research to find out the condition of **General Electric** today. What do you think the future holds for **General Electric**?
>
> As the worldwide economy changes, **General Electric** seems to be struggling to evolve, and this issue potentially leaves them with an uncertain future.

Residual income (RI) establishes a minimum level that *all* investments must attain in order to be accepted by management. This minimum acceptable level is defined as a dollar value and is applicable to all departments or segments of the business. Residual income is calculated by taking the segment income less the product of the investment value and cost of capital percentage. The formula is:

$$\text{Residual Income} = \text{Income} - (\text{Investment} \times \text{Cost of Capital Percentage})$$

As with the return on investment calculation, income can be defined as segment operating income (or loss) or segment profit (or loss). Some organizations may use different terms. In RI scenarios, the investment refers to a *specific* project the segment is considering. Investment, in RI calculations, should not be confused with the *total* investment base, which was used in the ROI calculation. Finally, the cost of capital refers to the rate at which the company raises (or earns) capital. Essentially, the cost of capital can be considered the same as the interest rate at which the company can borrow funds through a bank loan. By establishing a standard cost of capital rate used by all segments of the company, the company is establishing a minimum investment level that all investment opportunities must achieve. For example, assume a company can borrow funds from a local bank at an interest rate of 10%. The company, then, does not want a segment accepting an investment opportunity that earns anything less than 10%. Therefore, the company will establish a threshold—the cost of capital percentage—that will be used to screen potential investments. At the same time, under the residual income structure, managers of the individual segments (also called responsibility centers) will be incentivized to undertake investments that benefit not only the segment but also the entire company. Recall that the ROI of the children's clothing department was 25.9% ($3,891 profit / $15,000 investment). Under an ROI analysis, the manager of the children's clothing department would not accept an investment that earns less than 25.9% because the rate of return would be negatively impacted, even though the company may benefit. Under a residual income structure, managers would accept all investments with a positive value because the investment would exceeded the investment threshold established by the company.

Let's look at an example. Recall that the children's clothing department of Apparel World had an investment base of $15,000. Assuming the cost of capital (understood as the rate of a bank loan) to Apparel World is 10%. This is the rate that Apparel World will also set as the rate it expects all responsibility centers to earn. Therefore, in the example, the expected amount of residual value—the profit goal, in a sense—for the children's clothing department is $1,500 ($15,000 investment base × 10% cost of capital). Management is pleased with the December performance of the children's clothing department because it earned a profit of $3,891, well in excess of the $1,500 goal.

Now let's examine how the manager of the children's clothing department would evaluate a potential investment opportunity. Assume in December the manager had an opportunity to invest to upgrade the store by adding a supervised children's play area for children to use while parents shopped. The manager believes this enhancement might increase sales because parents could take their time shopping, while knowing their children are safe and having fun. The upgrade would make the customer shopping experience more enjoyable for everyone.

The children's play area requires an investment of $50,000 and the expected increase in income as a result of the children's play area is $5,001. Because the Apparel World store has a cost of capital requirement of 10%, the manager would invest in the children's play area because the residual income on this investment would be positive. To be precise, the residual income is $1. Using the residual income formula, the residual income is $5,001 – ($50,000 × 10%) = $1.

While this is an exaggerated and oversimplified example, it is intended to highlight the fact that, as long as resources (funds) are available to invest, a responsibility manager will (or should) accept projects that have a positive residual value. In this example, the children's clothing department would be in a better financial position by undertaking this project than if they rejected this project. The department earned $3,891 of profit in December but would have earned, based on the estimates, $3,892 if the department added the children's play area.

The benefit of a residual income approach is that all investments in all segments of the organization are evaluated using the same

approach. Instead of having each segment select only investments that benefit only the segment, the residual income approach guides managers to select investments that benefit the entire organization.

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11.4: Describe the Effects of Various Decisions on Performance Evaluation of Responsibility Centers

Organizations incur various types of costs using decentralization and responsibility accounting, and they need to determine how the costs relate to particular segments of the organization within the responsibility accounting framework. One way to categorize costs is based on the level of autonomy the organization (or responsibility center manager) has over the costs. **Controllable costs** are costs that a company or manager can influence. Examples of controllable costs include the wages paid to employees of the company, the cost of training provided to employees, and the cost of maintaining buildings and equipment. As it relates to controllable costs, managers have a fair amount of discretion. While managers may choose to reduce controllable costs like the examples listed, the long-term implications of reducing certain controllable costs must be considered. For example, suppose a manager chooses to reduce the costs of maintaining buildings and equipment. While the manager would achieve the short-term goal of reducing expenses, it is important to also consider the long-term implications of those decisions. Often, deferring routine maintenance costs leads to a greater expense in the long-term because once the building or equipment ultimately needs repairs, the repairs will likely be more extensive, expensive, and time-consuming compared to investments in routine maintenance.

THINK IT THROUGH

The Frequency of Maintenance

If you own your own vehicle, you may have been advised (maybe all too often) to have your vehicle maintained through routine oil changes, inspections, and other safety-related checks. With advancements in technology in both car manufacturing and motor oil technology, the recommended mileage intervals between oil changes has increased significantly. If you ask some of your family members how often to change the oil in your vehicle, you might get a wide range of answers—including both time-based and mileage-based recommendations. It is not uncommon to hear that oil should be changed every three months or 3,000 miles. An article from the Edmunds.com website devoted to automobiles suggests automobile manufacturers are extending the recommended intervals between oil changes to up to 15,000 miles.

Do you know what the recommendation is for changing the oil in the vehicle you drive? Why do you think the recommendations have increased from the traditional 3,000 miles to longer intervals? How might a business apply these concepts to the concept of maintaining and upgrading equipment? If you were the accountant for a business, what factors would you recommend management consider when making the decisions on how frequently to maintain equipment and how big of a priority should equipment maintenance be?

The goal of responsibility center accounting is to evaluate managers only on the decisions over which they have control. While many of the costs that managers will encounter are controllable, other costs are uncontrollable and originate from within the organization. **Uncontrollable costs** are those costs that the organization or manager has little or no ability to influence (in the short-term, at least) and therefore should not be incorporated into the analysis of either the manager or the segment's performance. Examples of uncontrollable costs include the cost of electricity the company uses, the cost per gallon of fuel for a company's delivery trucks, and the amount of real estate taxes charged by the municipalities in which the company operates. While there are some long-term ways that companies can influence these costs, the examples listed are generally considered uncontrollable.

One category of uncontrollable costs is **allocated costs**. These are costs that are often allocated (or charged) to the segments within the organization based on some allocation formula or process, such as the costs of receiving support from corporate headquarters. These costs cannot be controlled by the responsibility center manager and thus should not be considered when that manager is being evaluated.

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11.5: Allocation of Service Department Costs

Allocating Costs to Profit Centers

Many companies in all sectors of the economy, and not-for-profit and governmental organizations as well, allocate service department costs to "production" or user departments, and ultimately to the products and services that they provide. For example, hospitals use sophisticated methods for allocating costs of service departments such as Housekeeping, Patient Admissions, and Medical Records to patient wards and outpatient services, and then to individual patients. Historically, these allocations were important to hospitals because Medicare reimbursement was based on actual costs. To the extent that the hospital allocated service department costs to Medicare patients, Medicare covered these costs.

Companies that allocate service department costs do so for one or more of the following reasons:

1. To provide more accurate product cost information. Allocating service department costs to production departments, and then to products, recognizes that these services constitute an input in the production process.
2. To improve decisions about resource utilization. By imposing on division managers the cost of the service department resources that they use, division managers are encouraged to use these resources only to the extent that their benefit exceeds their cost.
3. To ration limited resources. When production departments have some discretion over their utilization of a service department resource, charging production departments for the resource usually results in less demand for it than if the resource were "free" to the production departments.

The motivation for the first reason, to provide more accurate product cost information, can be to improve decision-making within the organization, to improve the quality of external financial reporting, or to comply with contractual agreements in regulatory settings where cost-based pricing is used. As discussed above, Medicare was historically a cost-based reimbursement scheme. As another example, defense contractors that provide the U.S. military "big ticket" items such as airplanes and ships often operate under cost-plus contracts, under which they are reimbursed for their production costs plus a guaranteed profit. In such settings, the calculation of cost includes a reasonable allocation of overhead, including overhead from service departments.

The distinction between the second and third reasons is important in the context of fixed versus variable costs. In connection with the second reason, to improve decisions about resource utilization, from the company's perspective, a division manager making a short-term decision about whether to utilize service department resources should incorporate into that decision the service department's marginal costs, which are usually the variable costs. The manager should ignore the service department's fixed costs if these costs will not be affected by the manager's decision. This reasoning suggests that only the service department's variable costs should be charged out.

However, in connection with the third reason, to ration a scarce resource, if the service department controls a fixed asset, and if demand for the asset exceeds capacity, charging users a fee for the asset allows the service department to balance demand with supply. The fee need not relate to the cost of obtaining the asset; rather, it is a mechanism for managing demand. Examples would be charging departments a "rental fee" for their use of vehicles from the motor pool, or for their use of a corporate conference facility.

Service department costs can be allocated based on actual rates or budgeted rates. Actual rates ensure that all service department costs are allocated. Budgeted rates provide service department managers incentives to control costs, and also provide user departments more accurate information about service department billing rates for planning purposes. In either case, service department costs should be allocated using an allocation base that reflects a cause-and-effect relationship, whenever possible. Here are some examples:

- Allocate building maintenance costs based on square footage;
- Allocate costs of the company airplane based on miles flown;
- Allocate costs of the data processing department based on CPU time.

In some cases, companies benefit from allocating fixed costs using a different allocation base than variable costs. For example, fixed costs might be allocated based on an estimate of long-term usage by the production departments.

Historically, there have been three alternative methods for allocating service department costs. These methods differ in the extent to which they recognize that service departments provide services to other service departments as well as to production departments. All three methods ultimately allocate all service department costs to production departments; no costs remain in the service departments under any of the three methods.

The three methods for allocating service department costs are the direct method, the step-down method, and the reciprocal method. We will focus on the step-down method in this course. If you are interested in learning more about the other two methods, go to http://denniscaplan.fatcow.com/Chapter12.htm

The Step-Down Method

The **step-down method** is also called the **sequential method**. This method allocates the costs of some service departments to other service departments, but once a service department's costs have been allocated, no subsequent costs are allocated back to it.

The choice of which department to start with is important. The sequence in which the service departments are allocated usually affects the ultimate allocation of costs to the production departments, in that some production departments gain and some lose when the sequence is changed. Hence, production department managers usually have preferences over the sequence. The most defensible sequence is to start with the service department that provides the highest percentage of its total services to other service departments, or the service department that provides services to the most number of service departments, or the service department with the highest costs, or some similar criterion.

Example: Human Resources (H.R.), Data Processing (D.P.), and Risk Management (R.M.) provide services to the Machining and Assembly production departments, and in some cases, the service departments also provide services to each other:

Total Cost	**Service Dept**	**% of services provided by the service department listed at left to:**				
		H.R.	**D.P.**	**R.M.**	**Machining**	**Assembly**
$ 80,000	H.R.	--	20%	10%	40%	30%
120,000	D.P.	8%	--	7%	30%	55%
40,000	R.M.	--	--	--	50%	50%
$240,000						

The amounts in the far left column are the costs incurred by each service department. Any services that a department provides to itself are ignored, so the intersection of the row and column for each service department shows zero. The rows sum to 100%, so that all services provided by each service department are charged out.

The company decides to allocate the costs of Human Resources first, because it provides services to two other service departments, and provides a greater percentage of its services to other service departments. However, a case could be made to allocate Data Processing first, because it has greater total costs than either of the other two service departments. In any case, the company decides to allocate Data Processing second.

In the table below, the row for each service department allocates the total costs in that department (the original costs incurred

by the department plus any costs allocated to it from the previous allocation of other service departments) to the production departments as well as to any service departments that have not yet been allocated.

	H.R.	D.P.	R.M.	Machining	Assembly
Costs prior to allocation	$ 80,000	$120,000	$40,000	--	--
Allocation of H.R.	($ 80,000)	16,000	8,000	$32,000	$24,000
Allocation of D.P.		(136,000)	10,348	44,348	81,304
Allocation of R.M.			(58,348)	29,174	29,174
	0	0	0	$105,522	$134,478

After the first service department has been allocated, in order to derive the percentages to apply to the production departments and any remaining service departments, it is necessary to "normalize" these percentages so that they sum to 100%. For example, after H.R. has been allocated, no costs from D.P. can be allocated back to H.R. The percentages for the remaining service and production departments sum to 92% (7% + 30% + 55%), not 100%. Therefore, these percentages are normalized as follows:

- Risk Management: 7% ÷ 92% = 7.61%
- Machining: 30% ÷ 92% = 32.61%
- Assembly: 55% ÷ 92% = 59.78%
- Total: 100.00%

For example, in the table above, 59.78% of $136,000 (= $81,304) is allocated to assembly, not 55%.

The characteristic feature of the step-down method is that once the costs of a service department have been allocated, no costs are allocated back to that service department. As can be seen by adding $105,522 and $134,478, all $240,000 incurred by the service departments are ultimately allocated to the two production departments. The intermediate allocations from service department to service department improve the accuracy of those final allocations.

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12: MAKING DECISIONS

Learning Objectives

- Define relevant costs and benefits
- Prepare analyses related to special decisions

12.1: Why It Matters
12.2: Identify Relevant Information for Decision-Making
12.3: Evaluate and Determine Whether to Accept or Reject a Special Order
12.4: Evaluate and Determine Whether to Make or Buy a Component
12.5: Evaluate and Determine Whether to Keep or Discontinue a Segment or Product
12.6: Evaluate and Determine Whether to Sell or Process Further
12.7: Evaluate and Determine How to Make Decisions When Resources Are Constrained

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12.1: Why It Matters



Figure 12.1.1: Value Add. Used coffee grounds can add value to a business. (credit left: modification of “Old coffee grounds to sprinkle on your garden” by Tristan Ferne/Flickr; credit right: modification of “Reusing coffee grounds” by Montgomery Cty Division of Solid Waste Services’s photostream/Flickr)

One day, at your part-time job in a local coffee shop, you realize that the employees throw many pounds of used coffee grounds in the trash each day. From an environmental perspective, you are concerned because of the volume of trash being transferred to the landfill. From a business perspective, you wonder if discarding the used grounds is the only option. Could those coffee grounds be used in a profitable manner? After a bit of research, you discover that, if prepared in certain ways, used coffee grounds are good as fertilizer, can kill insects on some plants, can be used as a body scrub, among other options. A recent radio talk show discussed the possibility that coffee grounds could be used as an alternative fuel source, and you learned that coffee grounds are actually being used to help fuel buses in London.

You consider the options for the used coffee grounds and come up with three possibilities for your coffee shop: (1) throw away the used grounds; (2) sell the used grounds to a company that will process them into fertilizer, bio-fuel, or some other product; or (3) process and package the used grounds for resale in the coffee shop as fertilizer and bug repellant. What information would you need for your analysis? Which decision would you choose and why? Are the revenue and cost components the only components of the decision that you should consider? These and similar issues are the types of questions that the accounting analysis process can help management address when evaluating short-term decisions.

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12.2: Identify Relevant Information for Decision-Making

Almost everything we do in life results from choosing between alternatives, and the choices we make result in different consequences. For example, when choosing whether or not to eat breakfast before going to class, you face two alternatives and two sets of consequences. Eating breakfast means you must get up a little earlier, have food available, and be willing to prepare the food. Not eating means sleeping in longer, not having to plan food, and being hungry during class. Just as our lives are fraught with decisions large and small, the same is true for businesses. Almost every aspect of being in business involves choosing between alternatives, and each alternative typically has one or more consequences. Understanding how businesses make decisions paves the way not only to better decision-making processes but potentially to better outcomes.

Decisions made by businesses can have short-term effects or long-term impacts, or in some situations, both. Short-term decisions often address a temporary circumstance or an immediate need while long-term decisions align more with permanent problem solving and meeting strategic goals. Because these two types of decisions require different types of analyses, we will consider short-term decision-making here and long-term decision-making in Capital Budgeting Decision. Accounting distinguishes between short-term and long-term decisions not only because of the difference in the general nature of these decisions but also because the types of analyses differ significantly between short-term and long-term decision categories. As the time horizon over which the decision will have an impact expands, more costs become relevant to the decision-making process. In addition, when a time element is considered, there will be additional factors such as interest (paid or received) that will have a greater influence on decisions. Table 12.2.1 provides examples of short-term and long-term business decisions.

Examples of Short-Term and Long-Term Business Decisions

Short-Term Business Decisions	Long-Term Bus
• Accepting a special production order • Determining the best product mix from current products • Outsourcing a part or service • Further processing or refining a current product	• Buying new • Choosing w • Expanding • Diversifying

Table 12.2.1 Short-term and long-term business decisions should be analyzed using different frameworks.

CONTINUING APPLICATION

Short-Term Decision-Making

Considering the business challenges facing **Gearhead Outfitters**, what short-term decisions might the company encounter? Remember that the retailer sells men's, women's, and children's outdoor clothing, footwear, and accessories. **Gearhead** must carry a certain level and variety of inventory to meet the demands of its customers. The company will have to maintain appropriate accounting records to make proper business decisions to promote sustainability and growth.

How might **Gearhead** be able to compete with larger chains and remain profitable? Will every sale result in the anticipated profit to the company? Consider what specialized short-term decision-making processes the company may use to meet its goals. Should more of an item than normal be purchased for resale to receive a larger discount from the supplier? What information about cost, volume, and profit is needed to make a sound business decision in this case? Some items may be sold at a loss (or lesser profit) to attract customers to the store. What type of information and accounting system is needed to help in this situation? The company requires relevant, consistent, and reliable data to determine the proper course of action.

Short-term decision-making is vital in any business. Consider this concept in relation to Centralized vs. Decentralized Management and how a company's approach may affect the decision-making process. Discuss possible short-term issues and decisions, management focuses, and whether or not the centralized versus decentralized style will aid in company flexibility and success. Also, think in terms of how the decision-making process will be evaluated.

Relevant Information for Short-Term Decision-Making

Business decision-making can be outlined as a process that is applied by management with each decision that is made. The process of decision-making in a managerial business environment can be summed up in these steps.

1. Identify the objective or goal. For a business, typically the goal is to maximize revenues or minimize costs.
2. Identify alternative courses of action that can achieve the goal or address an obstacle that is hindering goal achievement.
3. Perform a comprehensive analysis of potential solutions. This includes identifying revenues, costs, benefits, and other financial and qualitative variables.
4. Decide, based upon the analysis, the best course of action.
5. Review, analyze, and evaluate the results of the decision.

The first step of the decision-making process is to identify the goal. In the decisions discussed in this course, the quantitative goal will either be to maximize revenues or to minimize costs. The second step is to identify the alternative courses of action to achieve the goal. (In the real world, steps one and two may require more thought and research that you will learn about in advanced cost accounting and management courses.). This chapter focuses on steps three and four, which involve **short-term decision analysis**: determining the appropriate information necessary for making a decision that will impact the company in the short term, usually 12 months or fewer, and using that information in a proper analysis in order to reach an informed decision among alternatives. Step five, which involves reviewing and evaluating the decision, is briefly addressed with each type of decision analyzed.

Though these same general steps could be used in long-term decision analyses, the nature of long-term decisions is different. Short-term decisions are typically operational in nature: making versus buying a component of a product, using scarce resources, selling a product as-is, or processing it further into a different product. It is relatively easy to change a short-term decision with minimal impact on the company. Long-term decisions are strategic in nature and typically involve large sums of money. The effects of a long-term decision can have significant financial impact on a company for years. Examples of long-term decisions include replacing manufacturing equipment, building a new factory, or deciding to eliminate a product line. While you've learned how managerial accounting classifies, tracks, monitors, and controls costs, managerial accountants also closely analyze revenues, which are less controllable than costs, but are important in these decisions. As stated in the first step of the decision-making process, maximizing revenues is usually one of the goals of an organization. Therefore, making some short-term decisions requires analysis of both costs and revenues.

In carrying out step three of the managerial decision-making process, a differential analysis compares the relevant costs and revenues of potential solutions. What does this involve? First, it is important to understand that there are many types of short-term decisions that a business may face, but these decisions always involve choosing between alternatives. Examples of these types of decisions include determining whether to accept a special order; making a product or component versus buying the product or component; performing additional processing on a product; keeping versus eliminating a product or segment; or determining whether to take on a new project. In each of these situations, the business should compare the relevant costs and the relevant revenues of one alternative to the relevant costs and relevant revenues of the other alternative(s). Therefore, an important step in the differential analysis of potential solutions is to identify the relevant costs and relevant revenues of the decision.

What does it mean for something to be relevant? In the context of decision-making, something is relevant if it will influence the decision being made. For example, suppose you have two options for a summer job—either flagging traffic for a road crew or working for a landscaping company doing lawn care. For either job, you will be required to have industrial grade sound protectors (plugs or headphones) for your ears. This cost would not be relevant because it is the same under either alternative, so it will not influence your decision between the two jobs; it would be considered an **irrelevant cost**. You also believe your transportation costs will be the same for either job; thus this would also be an irrelevant cost.

However, if you are required to have steel-toed boots for the road work job but can wear any type of work boot for the landscaping job, you would need to consider the difference between the costs, or the **differential cost**, of these two types of boots. This difference in cost between the two pairs of boots would be designated as a **relevant cost** because it influences your decision.

The two jobs also may have differences in revenues, called a **differential revenue**. Because the differential revenue influences the decision, it is also a **relevant revenue**. If both jobs pay the same hourly wage, it would have an **irrelevant revenue**, but if the road crew job offers overtime for any time worked over 40 hours, then this overtime wage has the potential to be a relevant revenue if overtime is a likely occurrence. Looking only at these differences—of both costs and revenues—between the alternatives is known as **differential analysis**.

In conducting these types of analyses between alternatives, the initial focus will be on each **quantitative factor** of the analysis—in other words, the component that can be measured numerically. Examples of quantitative factors in business include sales growth, number of defective parts produced, or number of labor hours worked. However, in decision-making, it is important also to consider each **qualitative factor**, which is one that cannot be measured numerically. For example, using the same summer job scenario, qualitative factors may include the environment in which you would be working (road dust and tar odors versus pollen and mower exhaust fumes), the amount of time exposed to the sun, the people with whom you will be working (working with friends versus making new friends), and weather-related issues (both jobs are outdoors, but could one job send you home for the day due to weather?). Examples of qualitative factors in business include employee morale, customer satisfaction, and company or brand image. In making short-term decisions, a business will want to analyze both qualitative and quantitative factors.

In short-term decision-making, revenues are often easier to evaluate than costs. In addition, each alternative typically only has one possible one revenue outcome even though there are many costs to consider for each alternative. How do we know if a cost will have an impact on the decision? The starting point is to understand the various labels that are attached to costs in these decision-making environments.

Avoidable versus Unavoidable Costs

Management must determine if a cost is avoidable or unavoidable because, in the short run, only avoidable costs are relevant for decision-making purposes. An **avoidable cost** is one that can be eliminated (in whole or in part) by choosing one alternative over another. For example, assume that a bike shop offers their customers custom paint jobs for bikes that the customers already own. If they eliminate the service, the cost of the bike paint could be eliminated. Also, assume that they had been employing a part-time painter to do the work. The painter's compensation would also be an avoidable cost.

An **unavoidable cost** is one that does not change or go away in the short-run by choosing one alternative over another. For example, a company might sign a long-term lease on equipment or a production facility. These types of leases typically don't allow for a cancelation, so if this one does not, then their required payments are unavoidable costs for the duration of the lease.

Variable costs are avoidable costs, since variable costs do not exist if the product is no longer made, or if the portion of the business (such as a segment or division) that generated the variable costs ceases to operate. Fixed costs, on the other hand, may be unavoidable, partially unavoidable, or avoidable only in certain circumstances. Remember that fixed costs tend to remain constant for a period of time and within a relevant range of production and are not easily eliminated in the short-run. Therefore, most fixed costs also are unavoidable. If a fixed cost is specific only to one of the alternatives, then that fixed cost also may be avoidable. Avoidable costs are future costs that are relevant to decision-making. Past costs are never an avoidable cost.

Recall that we are using a short-term viewpoint to determine whether or not costs are avoidable. In the long run, virtually all costs are avoidable. For example, assume that a company has a long-term, ten-year lease on a production facility that cannot be canceled. For the first ten years, it would be non-cancelable and thus unavoidable. But after ten years it would become avoidable.

YOUR TURN

AlexCo's Wagons

AlexCo produces collapsible wagons that are popular with beachgoers, shoppers, gardeners, parents, and tailgaters. Annual sales have been 100,000 wagons per year. The retail selling price of each wagon is $67.00. To date, AlexCo has produced each of the components used in making the wagons but has been approached by DAL, Inc. with an offer to provide the axle and wheel assembly for $18.75 per assembly. AlexCo's costs to produce the axle and wheel assembly are $9.00 in direct materials, $6.50 in direct labor, $3.57 in variable overhead, and $2.50 in fixed overhead. Twenty-five percent of the fixed overhead is avoidable if the assembly is produced by DAL. Should AlexCo continue to make the axle and wheel assembly or should it buy the assembly from DAL, Inc.?

Answer available at the end of this section.

Sunk Costs

A **sunk cost** is one that cannot be avoided because it has already occurred. A sunk cost will not change regardless of the alternative that management chooses; therefore, sunk costs have no bearing on future events and are not relevant in decision-making. The basic premise sounds simple enough, but sunk costs are difficult to ignore due to human nature and are sometimes

incorrectly included in the decision-making process. For example, suppose you have an old car, a hand-me-down from your grandmother, and last year you spent $1,600 on repairs and new tires and were just told by your mechanic that the car needs $1,200 in repairs to operate safely. Your goal is to have a safe and reliable car. Your alternatives are to get the repairs completed or trade in the car for a newer used car.

From a quantitative perspective, you have gathered the following information to help with your decision. The trade-in value of your old car will be the minimum given by the dealer, or $200. The newer used car will require you to make monthly payments of $150 for two years. In analyzing your two alternatives, what costs do you consider? Remember, the $1,600 you have already spent (note the past tense) is a sunk cost; it is a consequence of a past decision. In this example, the relevant costs for each alternative are the following: $1,200 in current repair costs to keep your current car or $3,400 (from the 24 payments of $150 minus $200 for the trade in) to buy a newer used car. Obviously, you also would consider qualitative factors, such as the sentimental value of your grandmother's car or the excitement of having a newer car.

Sunk costs are most problematic for business decisions when they pertain to existing equipment. The book value of an asset (historical cost – accumulated depreciation) is a sunk cost regardless of whether a business keeps the asset or disposes of it in some manner. The cost of the asset occurred in the past and therefore is sunk and irrelevant to the decision at hand. Managers may be reluctant to ignore sunk costs when making decisions, especially if the prior decision to purchase the asset was an unwise one. Often, when management takes a path of action that is not achieving the desired results, managers may continue the same path in the hope that the effect of prior decisions will improve the results. The use of the word *prior* is a key indicator that information is nonrelevant to a current decision. Holding on to old decisions or old commitments is common because letting them go forces management to admit they made a bad decision.

Future Costs That Do Not Differ

Any future cost that does not differ between the alternatives is not a relevant cost for the decision. For example, if a company is considering baking either bagels or doughnuts and both baked goods require $0.30 worth of flour, then the cost of flour would not be a relevant cost in determining which of the two had the highest production cost. As relevant information for short-term decision-making, the cost of sound protectors for your summer job would not be relevant to your decision because that cost exists in both scenarios. Another irrelevant cost would be your transportation cost, since that cost is also the same regardless of the job you choose. In another example, if a company is planning to produce either red widgets or blue wingdings and will need to hire 10 additional employees to produce either of the goods, the cost of those 10 employees is irrelevant because it does not differ between the alternatives.

ETHICAL CONSIDERATIONS

Johnson & Johnson's 1982 Recall and Replacement of All Tylenol in the World

In 1982, **Johnson & Johnson** was faced with a large-scale business and ethical dilemma. During the course of several days beginning on September 29, 1982, seven deaths occurred in the Chicago area that were attributed to consuming capsules of Extra-Strength Tylenol. The painkiller was, at the time, **Johnson & Johnson**'s best-selling product. The company had to decide if the short-term cost of replacing the Tylenol was worth the future cost to their reputation and their customer's health and safety. At tremendous expense, **Johnson & Johnson** "placed consumers first by recalling 31 million bottles of Tylenol capsules from store shelves and offering replacement product in the safer tablet form free of charge."

As it was later discovered, someone was lacing Tylenol capsules with cyanide and returning the pills in the original packages to store shelves. However, **Johnson & Johnson**'s decision to incur short-term costs by recalling all of their pills ultimately paid off, as in the long run, the company's stock value increased and Tylenol sales recovered. One could look at the decision as an opportunity cost: **Johnson & Johnson** had to choose between two alternatives. The company could have chosen a short-term solution with reduced short-term losses, but by making an ethical business decision, the long-term rewards were greater than the short-term savings.

Opportunity Costs

When choosing between two alternatives, usually only one of the two choices can be selected. When this is the case, you may be faced with **opportunity costs**, which are the costs associated with not choosing the other alternative. For example, if you are trying to choose between going to work immediately after completing your undergraduate degree or continuing to graduate

school, you will have an opportunity cost. If you choose to go to work immediately, your opportunity cost is forgoing a graduate degree and any potential job limitations or advancements that result from that decision. If you choose instead to go directly into graduate school, your opportunity cost is the income that you could have been earning by going to work immediately upon graduation.

YOUR TURN

Costs and Revenue at Carolina Clusters

Carolina Clusters, Inc., a candy manufacturer in a resort town, just bought a new taffy pulling machine for $27,000 and is planning to increase the production of salt-water taffy. Due to the increased production, Carolina is deciding between hiring two part-time college students or one full-time employee. Each college student would work half days totaling 20 hours per week, and would earn $12 per hour. The full-time employee would work full days 40 hours per week and would earn $12 per hour plus the equivalent of $2 per hour in benefits. Each employee is given two t-shirts to wear as their uniform. The t-shirts cost Carolina $8 each. In addition, Carolina provides disposable hair coverings and gloves for the employees. Each employee uses, on average, six sets of gloves per eight-hour shift or four sets per four-hour shift. One hair covering per shift per person is typical. The cost of the hair covering is $0.05 per covering and the cost of a pair of gloves is $0.02 per pair. Identify any relevant costs, relevant revenues, sunk costs, and opportunity costs that Carolina Clusters needs to consider in making the decision whether to hire two part-time employees or one full-time employee.

Answer available at the end of this section.

Answers

YOUR TURN

	Relevant Costs	
	Make Internally	Buy from DAL, Inc.
Direct materials	$ 9.00	
Direct labor	6.50	
Variable overhead	3.57	
Avoidable fixed costs	0.63	
Total unit relevant cost	19.70	$ 18.75
Units required	100,000	100,000
Total relevant costs	$1,970,000	$1,875,000

Ignoring qualitative factors, it would be more cost-effective for AlexCo to buy the axle and wheel assembly from DAL, Inc. However, AlexCo should be certain of any qualitative issues and not solely base their decision on the quantitative analysis.

YOUR TURN

Relevant costs:

$2 per hour for benefits $16 for two t-shirts: Hiring one full-time person will result in a $16 expenditure for t-shirts. Hiring two college students would result in $32 in t-shirt expenditures, thus the relevant t-shirts costs is the $16 difference. $0.05 for a hair covering: Hiring one full-time person will result in $0.05 per day in hair covering costs but hiring two college students would result in $0.10 per day in hair covering costs thus the relevant hair covering cost is the $0.05 difference. $0.04 for a pair of gloves: Hiring one full-time person will result in $0.12 (6 × $0.02) per day in glove costs, but hiring two college students would result in $0.16 (8 × $0.02) per day in glove costs. Thus, the relevant glove cost is the $0.04 difference.

Relevant revenues: None

Sunk costs: $27,000 for the taffy machine

Opportunity costs: None

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12.3: Evaluate and Determine Whether to Accept or Reject a Special Order

Both manufacturing and service companies often receive requests to fill special orders. These **special orders** are typically for goods or services at a reduced price and are usually a one-time order that, in the short-run, does not affect normal sales. When deciding whether to accept a special order, management must consider several factors:

- The capacity required to fulfill the special order
- Whether the price offered by the buyer will cover the cost of producing the products
- The role of fixed costs in the analysis
- Qualitative factors
- Whether the order will violate the Robinson-Patman Act and other fair pricing legislation

Fundamentals of the Decision to Accept or Reject a Special Order

The starting point for making this decision is to assess the company's normal production capacity. The **normal capacity** is the production level a company can achieve without adding additional production resources, such as additional equipment or labor. For example, if the company can produce 10,000 towels a month based on its current production capacity, and it is currently contracted to produce 9,000 a month, it could not take on a special one-time order for 3,000 towels without adding additional equipment or workers. Most companies do not work at maximum capacity; rather, they function at normal capacity, which is a concept related to a company's relevant range. The **relevant range** is the quantitative range of units that can be produced based on the company's current productive assets. These assets can include equipment capacity or its labor capacity. Labor capacity is typically easier to increase on a short-term basis than equipment capacity. The following example assumes that labor capacity is available, so only equipment capacity is considered in the example.

Assume that based on a company's present equipment, it can produce 20,000 units a month. Its relevant range of production would be zero to 20,000 units a month. As long as the units of production fall within this range, it does not need additional equipment. However, if it wanted to increase production from 20,000 units to 24,000 units, it would need to buy or lease additional equipment. If production is fewer than 20,000 units, the company would have unused capacity that could be used to produce additional units for its current customers or for new clients.

If the company does not have the capacity to produce a special order, it will have to reduce production of another good or service in order to fulfill the special order or provide another means of producing the goods, such as hiring temporary workers, running an additional shift, or securing additional equipment. As you will learn, not having the capacity to fill the special order will create a different analysis than it would if there is sufficient capacity.

Next, management must determine if the price offered by the buyer will result in enough revenue to cover the differential costs of producing the items. For example, if price does not meet the variable costs of production, then accepting the special order would be an unprofitable decision.

Additionally, fixed costs may be relevant if the company is already operating at capacity, as there may be additional fixed costs, such as the need to run an extra shift, hire an additional supervisor, or buy or lease additional equipment. If the company is not operating at capacity—in other words, the company has *unused* capacity—then the fixed costs are irrelevant to the decision if the special order can be met with this unused capacity.

Special orders create several qualitative issues. A logical issue is the concern for how existing customers will feel if they discover a lower price was offered to the special-order customer. A special order that might be profitable could be rejected if the company determined that accepting the special order could damage relations with current customers. If the goods in the special order are modified so that they are cheaper to manufacture, current customers may prefer the modified, cheaper version of the product. Would this hurt the profitability of the company? Would it affect the reputation?

In addition to these considerations, sometimes companies will take on a special order that will not cover costs based on qualitative assessments. For example, the business requesting the special order might be a potential client with whom the manufacturer has been trying to establish a business relationship and the producer is willing to take a one-time loss. However,

our coverage of special orders concentrates on decisions based on quantitative factors.

Companies considering special orders must also be aware of the anti–price discrimination rules established in the Robinson-Patman Act. The Robinson-Patman Act is a federal law that was passed in 1936. Its primary intent is to prevent some forms of price discrimination in sales transactions between smaller and larger businesses.

LINK TO LEARNING

The Robinson-Patman Act prevents large retailers from purchasing goods in bulk at a greater discount than smaller retailers are able to obtain them. It helps keep competition fair between large and small businesses and is sometimes called the "Anti-Chain Store Act." Read the LegalDictionary.net full definition and example of the Robinson-Patman Act to learn more.

Sample Data

Franco, Inc., produces dental office examination chairs. Franco has the capacity to produce 5,000 chairs per year and currently is producing 4,000. Each chair retails for $2,800, and the costs to produce a single chair consist of direct materials of $750, direct labor of $600, and variable overhead of $300. Fixed overhead costs of $1,350,000 are met by selling the first 3,000 chairs. Franco has received a special order from Ghanem, Inc., to buy 800 chairs for $1,800. Should Franco accept the special order?

Calculations Using Sample Data

Franco is not operating at capacity and the special order does not take them over capacity. Additionally, all the fixed costs have already been met. Therefore, when evaluating the special order, Franco must determine if the special offer price will meet and exceed the costs to produce the chairs. Figure 12.3.1 details the analysis.

	Current Cost to Produce	Special Order Price Offer	Difference in Favor of Accepting Special Order
Direct materials	$ 750		
Direct labor	600		
Variable overhead	300		
Variable costs to produce	1,650		
Special offer price		$1,800	$150 per chair

Figure 12.3.1: Special Order: Supplier Has Excess Capacity. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Since Franco has already met his fixed costs with current production and since he has the capacity to produce the additional 800 units, Franco only needs to consider his variable costs for this order. Franco's variable cost to produce one chair is $1,650. Ghanem is offering to buy the chairs for $1,800 apiece. By accepting the special order, Franco would meet his variable costs and make $150 per chair. Considering only quantitative factors, Franco should accept the special offer.

How would Franco's decision change if the factory was already producing at capacity at the time of the special offer? In other words, assume the corporation is already producing the most it can produce without working more hours or adding more equipment. Accepting the order would likely mean that Franco would incur additional fixed costs. Assume that, to fill the order from Ghanem, Franco would have to run an extra shift, and this would require him to hire a temporary production manager at a cost of $90,000. Assume no other fixed costs would be incurred. Also, assume Franco will incur additional costs related to maintenance and utilities for this extra shift and estimates those costs will be $70,000. As shown in Figure 12.3.2, in this scenario, Franco would have to charge Ghanem at least $1,850 in order to meet his cost.

	Current Production	Special Order Current Offer
Selling price	$2,800	$1,800
Variable cost to produce	1,650	1,650
Additional costs to recover*		200
Contribution margin	$1,150	$ (50)

*$90,000 supervisor salary + $70,000 additional costs = $160,000 in costs to recover ÷ 800 chairs in special order = $200 per chair additional costs due to capacity issue.

Figure 12.3.1: Special Order: Supplier Does Not Have Excess Capacity. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Final Analysis of the Decision

The analysis of Franco's options did not consider any qualitative factors, such as the impact on morale if the company is already at capacity and opts to implement overtime or hire temporary workers to fill the special order. The analysis also does not consider the effect on regular customers if management elects to meet the special order by not fulfilling some of the regular orders. Another consideration is the impact on existing customers if the price offered for the special order is lower than the regular price. These effects may create a bad dynamic between the company and its customers, or they may cause customers to seek products from competitors. As in the example, Franco would need to consider the impact of displacing other customers and the risk of losing business from regular customers, such as dental supply companies, if he is unable to meet their orders. The next step is to do an overall cost/benefit analysis in which Franco would consider not only the quantitative but the qualitative factors before making his final decision on whether or not to accept the special order.

THINK IT THROUGH

Athletic Jersey Special Orders

Jake's Jerseys has been asked to produce athletic jerseys for a local school district. The special order is for 1,000 jerseys of varying sizes, and the price offered by the school district is $10 less per jersey than the normal $50 market price. The school district interested in the jerseys is one of the largest in the area. What quantitative and qualitative factors should Jake consider in making the decision to accept or reject the special order?

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12.4: Evaluate and Determine Whether to Make or Buy a Component

One of the most common outsourcing scenarios is one in which a company must decide whether it is going to make a component that it needs in manufacturing a product or buy that component already made. For example, all of the components of the iPhone are made by companies other than **Apple**. **Ford** buys truck and automobile seats, as well as many other components and individual parts, from various suppliers and then assembles them at **Ford** factories. With each component, **Ford** must decide if it is more cost effective to make that component internally or to buy that component from an external supplier.

This type of analysis is also relevant to the service industry; for example, **ADP** provides payroll and data processing services to over 650,000 companies worldwide. Or a law firm may decide to hire certain research activities to be completed by outside experts rather than hire the necessary staff to keep that function in-house. These are all examples of outsourcing. **Outsourcing** is the act of using another company to provide goods or services that your company requires.

Many companies outsource some of their work, but why? Consider this scenario: Today, while driving home from class, one of your car's engine warning lights goes on. You will most likely take your car to an auto repair specialist to have it analyzed and repaired, whereas your grandfather might have popped the hood, grabbed his toolbox, and attempted to diagnose and fix the problem himself. Why? It is often a matter of expertise and sometimes simply a matter of cost benefit. In your grandfather's time, car engines were more mechanical and less electronic, which made learning to repair cars a simpler process that required less expertise and only basic tools. Today, your car has many electronic components and often requires sophisticated monitors to assess the problem and may involve the replacement of computer chips or electronic sensors. Thus, you opt to outsource the repair of your car to someone who has the knowledge and facilities to provide the repair more cost-effectively than you could if you did it yourself. Your grandfather likely could have made the repair to his car several decades ago as cheaply as the mechanic with only a sacrifice of his time. To your grandfather, the cost of his time was worth the benefit of completing the repair himself.

Companies outsource for the same reasons. Many companies have found that it is more cost-effective to outsource certain activities, such as payroll, data storage, and web design and hosting. It is more efficient to pay an outside expert than to hire the appropriate staff to keep a particular task inside the company.

Fundamentals of the Decision to Make or to Buy

As with other decisions, the make-versus-buy decision involves both quantitative and qualitative analysis. The quantitative component requires cost analysis to determine which alternative is more cost-effective. This cost analysis can be performed by looking at the cost to buy the component versus the cost to produce the component, which allows us to make a decision based on an analysis of unavoidable costs. For example, the costs to produce will include direct materials, direct labor, variable overhead, and fixed overhead. If the business chooses to buy the component instead, the avoidable costs will go away but unavoidable costs will remain and would need to be considered as part of the cost to buy the component.

Sample Data

Thermal Mugs, Inc., manufactures various types of leak-proof personal drink carriers. Thermal's T6 container, its most insulated carrier, maintains the temperature of the liquid inside for 6 hours. Thermal has designed a new lid for the T6 carrier that allows for easier drinking and pouring. The cost to produce the new lid is $2.19:

Direct materials	$0.87
Direct labor	0.45
Fixed overhead	0.51
Variable overhead	0.36
Total unit cost	$2.19

Plato Plastics has approached Thermal and offered to produce the 120,000 lids Thermal will require for current production levels of the T6 carrier, at a unit price of $1.75 each. Is this a good deal? Should Thermal buy the lids from Plato rather than produce them themselves? Initially, the $1.75 presented by Plato seems like a much better price than the $2.19 that it would cost Thermal to produce the lids. However, more information about the relevant costs is necessary to determine whether the offer by Plato is the better offer. Remember that all the variable costs of producing the lid will only exist if the lid is produced by Thermal, thus the variable costs (direct materials, direct labor, and variable overhead) are all relevant costs that will differ between the alternatives.

What about the fixed costs? Assume all the fixed costs are not tied directly to the production of the lid and therefore will still exist even if the lid is purchased externally from Plato. This means the fixed costs of $0.51 per unit are unavoidable and therefore are not relevant.

Calculations Using Sample Data

Calculations show that when the relevant costs are compared between the two alternatives, it is more cost-effective for Thermal to produce the 120,000 units of the T6 lid internally than to purchase it from Plato.

	Relevant Costs	
	Make Internally	**Buy from Plato**
Direct materials	$ 0.87	
Direct labor	0.45	
Variable overhead	0.36	
Total unit relevant cost	1.68	$ 1.75
Units required	120,000	120,000
Total relevant costs	$201,600	$210,000

By producing the T6 lid internally, Thermal can save $8,400 ($210,000 – $201,600). How would the analysis change if a portion of the fixed costs were avoidable? Suppose that, of the $0.51 in fixed costs per unit of the T6 lid, $0.12 of those fixed costs are associated with interest costs and insurance expenses and thus would be avoidable if the T6 lid is purchased externally rather than produced internally. How does that change the analysis?

	Relevant Costs	
	Make Internally	Buy from Plato
Direct materials	$ 0.87	
Direct labor	0.45	
Variable overhead	0.36	
Avoidable fixed costs	0.12	
Total unit relevant cost	1.80	$ 1.75
Units required	120,000	120,000
Total relevant costs	$216,000	$210,000

In this scenario, it is more cost-effective for Thermal to buy the T6 lid from Plato, as Thermal would save $6,000 ($216,000 – $210,000).

Final Analysis of the Decision

The difference in these two presentations of the data emphasizes the importance of defining which costs are relevant, as improper cost identification can lead to bad decisions.

These analyses only considered the quantitative factors in a make-versus-buy decision, but there are qualitative factors to consider as well, including:

- Will the T6 lid made by Plato meet the quality requirements of Thermal?
- Will Plato continue to produce the T6 lid at the $1.75 price, or is this a teaser rate to obtain the business, with the plan for the rate to go up in the future?
- Can Plato continue to produce the quantity of the lids desired? If more or fewer are needed from Plato, is the adjusted production level obtainable, and does it affect the cost?
- Does using Plato to produce the lids displace Thermal workers or hamper morale?
- Does using Plato to produce the lids affect the reputation of Thermal?

In addition, if the decision is to buy the lid, Thermal is dependent on Plato for quality, timely delivery, and cost control. If Plato fails to deliver the lids on time, this can negatively affect Thermal's production and sales. If the lids are of poor quality, returns, replacements, and the damage to Thermal's reputation can be significant. Without long-term agreements on price increases, Plato can increase the price they charge Thermal, thus making the entire drink container more expensive and less profitable. However, buying the lid likely means that Thermal has excess production capacity that can now be applied to making other products. If Thermal chooses to make the lid, this consumes some of the productive capacity and may affect the relationship Thermal has with the outside supplier if that supplier is already working with Thermal on other products.

Make versus buy, one of many outsourcing decisions, should involve assessing all relevant costs in conjunction with the qualitative issues that affect the decision or arise because of the choice. Although it may appear that these types of outsourcing decisions are difficult to resolve, companies throughout the world make these decisions daily as part of the company's strategic plan, and therefore, each company must weigh the advantages and disadvantages of outsourcing production of goods and services. Some examples are shown in Table 12.4.1.

Advantages and Disadvantages of Outsourcing

Advantages of Outsourcing	Disadvantages of Outsourcing
• Utilizes external expertise, removes the need for in-house expertise • Frees up capacity for other uses • Frees up capital for other uses • Allows management to focus on competitive strengths • Transfers some production and technological risks to supplier	• Takes away control over quality and timing of production • May limit ability to upsize or downsize production • May have hidden costs and/or a lack of stability of price • May diminish innovation • Often makes it difficult to bring the production back in-house once it has been removed

Table 12.4.1

In an outsourcing decision, the relevant costs and qualitative issues should be analyzed thoroughly. If there are no qualitative issues that affect the decision and the leasing or purchasing price is less than the relevant (avoidable) costs of producing the good or service in-house, the company should outsource the product or service. The following example demonstrates this issue for a service entity.

Lake Law has ten lawyers on staff who handle workers' compensation and workplace discrimination lawsuits. Lake has an excellent success rate and frequently wins large settlements for their clients. Because of the size of their settlements, many clients are interested in establishing trusts to manage the investing and distribution of the funds. Lake Law does not have a trust or estate lawyer on staff and is debating between hiring one or using an attorney at a nearby law firm that specializes in wills, trusts, and estates to handle the trusts of Lake's clients. Hiring a new attorney would require $120,000 in salary for the attorney, an additional 20% in benefits, a legal assistant for the new attorney for 20 hours per week at a cost of $20 per hour, and conversion of a storage room into an office. Lake spent $100,000 on redecorating the offices last year and has sufficient furniture for a new office. The attorney at the nearby firm would charge a retainer of $50,000 plus $200 per hour worked on each trust. The retainer is in addition to the $200 per hour charge for work on trusts. The average trust takes 10 hours to complete and Lake estimates approximately 50 trusts per year. In addition, an external attorney would charge $500 for each trust to cover office expenses and filing fees. Which option should Lake choose?

To determine the solution, first, find the relevant costs for hiring internally and for using an external attorney.

	Hire Internally	Use External Attorney
Salary	$120,000	
Benefits (20%)	24,000	
Legal assistant (20 hrs x $20 x 52 weeks)	20,800	
Retainer		$ 50,000
Cost per trust × number of trusts ($200 × 10 × 50)		$100,000
Additional fees		25,000
Total relevant costs	$164,800	$175,000

Based on the quantitative analysis, Lake should hire an estate attorney to have on staff. For the year, the firm would save $10,200 ($164,800 for internal versus $175,000 with the external attorney) by going with the internal hire. Other potential advantages would be that an in-house attorney could complete more than the estimated 50 trusts without incurring additional costs, and by keeping the work in-house, it helps to build the relationship between the firm and the clients. A disadvantage would be if there is not sufficient work to keep the in-house attorney busy, the company would still have to pay the $120,000 salary plus the additional

costs of $44,800 for benefits and the legal assistant's salary, even if the attorney is working at less than full capacity.

LINK TO LEARNING

The iPhone is the ultimate example of outsourcing. Though created in the United States, it is produced all around the globe, with thousands of parts supplied by over 200 suppliers—none of which is **Apple**. Read this article from *The New York Times* on where parts for the iPhone are made to learn how an iPhone gets from the design phase in the United States to production of components around the world, to assembly in China, and then back to the United States for sale in a retail store.

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12.5: Evaluate and Determine Whether to Keep or Discontinue a Segment or Product

Companies tend to divide their organization along product lines, geographic locations, or other management needs for decision-making and reporting. A **segment** is a portion of the business that management believes has sufficient similarities in product lines, geographic locations, or customers to warrant reporting that portion of the company as a distinct part of the entire company. For example, **General Electric, Inc.**, has eight segments and the **Walt Disney Company** has four segments. Table 12.5.1 shows these segments.

Examples of Company Segments

General Electric Segments	Disney Segment
• Additive • Aviation • Capital • Digital • Healthcare • Lighting • Power • Renewable Energy • Transportation	• Media Netw • Parks, Exper • Studio Enter • Direct to Co

Table 12.5.1 Examples of Company Segments

As part of the normal operations of a business, managers make decisions such as whether to keep producing a product, whether to continue operating in certain areas, or whether to close entire segments of their operations. These are historically some of the most difficult decisions that managers make. Examples of these types of decisions include **Macy's** decision to close 100 stores in 2016 due to increased competition from online retailers such as **Amazon.com** and **Delta Airline's** decision to eliminate 16 routes to save costs. What information does management use in making these types of decisions?

As with other decisions, management must consider both the quantitative and qualitative aspects. In choosing between alternatives—that is, in choosing between keeping and eliminating the product, segment, or service—the relevant revenues and costs should be analyzed. Remember that relevant revenues and costs are those that differ between alternatives. Often, the keep-versus-eliminate decision arises because the product or segment appears to be generating less of a profit than in prior periods or is unprofitable. In these situations, the product or segment may produce a positive contribution margin but may appear to have a lower or negative profit because of the allocation of common fixed costs.

Fundamentals of the Decision to Keep or Discontinue a Segment or Product

Two basic approaches can be used to analyze data in this type of decision. One approach is to compare contribution margins and fixed costs. In this method, the contribution margins with and without the segment (or division or product line) are determined. The two contribution margins are compared and the alternative with the greatest contribution margin would be the chosen alternative because it provides the biggest contribution toward meeting fixed costs.

The second approach involves calculating the total net income for retaining the segment and comparing it to the total net income for dropping the segment. The company would then proceed with the alternative that has the highest net income. In order to perform these net income calculations, the company would need more information than they would need in order to follow the contribution margin approach, which does not consider the costs and revenues that are the same between the alternatives.

THINK IT THROUGH

Allocating Common Fixed Costs

Acme, Co., has three retail divisions: Small, Medium, and Large. Sales, variable costs, and fixed costs for each of the divisions are:

	Sales	Variable Costs	Fixed Costs
Small	$ 5,000,000	$ 2,875,000	$2,450,000
Medium	10,000,000	7,235,000	5,125,000
Large	25,000,000	18,960,000	8,230,000

Included in the fixed costs are $5,400,000 in allocated common costs, which are split evenly among the three divisions. Is an even split the best way to allocate those costs? Why or why not? What other ways might Acme consider using to allocate the common fixed costs?

Sample Data

Suppose SnowBucks, Inc., has three product lines: snow boots, snow sporting equipment, and a clothing line for winter sports. It has been brought to senior management's attention that the snow boot product line is unprofitable. Figure 12.5.1 shows the data presented to senior management:

	Snow Boots	Snow Sporting Equipment	Clothing Line	Total
Sales	$1,150,000	$1,540,000	$1,354,000	$4,044,000
Cost of goods sold				
Variable manufacturing expenses	423,000	507,000	378,000	1,308,000
Fixed manufacturing expenses	392,000	413,000	353,000	1,158,000
Gross margin	335,000	620,000	623,000	1,578,000
Selling and administrative expenses				
Variable selling and administrative expenses	195,000	130,000	147,000	472,000
Fixed selling and administrative expenses	216,000	216,000	216,000	648,000
Operating income	$ (76,000)	$ 274,000	$ 260,000	$ 458,000

Figure 12.5.1: Operating Income Report for SnowBucks, by Segment. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

Figure 12.5.1

Upon initial review, it appears that the snow boot product line is unprofitable. Should this product line be eliminated? To adequately analyze this situation, a proper analysis of the relevant revenues and costs must be made. The functional income statement in Figure 12.5.1 does not separate relevant from non-relevant costs.

In conducting the analysis, the accounting team discovers that each product line is allocated certain costs over which the product line managers have no control. These **allocated costs** are typically associated with areas of the company that do not generate revenue but are necessary for the running of the organization, such as salaries for executives, human resources, and accounting at headquarters.

The cost of these parts of the organization must somehow be shared with the revenue-generating portions of the business. Companies often allocate these costs to other parts of the organization based on some formula, such as dividing the total costs by the number of divisions or segments, as percentage of total revenue, or as percentage of total square footage.

SnowBucks currently allocates these costs equally to the three product lines, and all the fixed selling and administrative expenses are considered allocated costs. In addition, the fixed manufacturing expenses represent factory rent, depreciation, and insurance, and all these costs will continue to exist regardless of whether the snow boot division continues. However, included in the fixed manufacturing expenses is the $75,000 salary of a sales supervisor for each division. This is an avoidable fixed cost as this cost would no longer exist if any division ceased operating.

Calculations Using Sample Data

Based on the new information, a new analysis using a product line margin indicates the following:

	Snow Boots	Snow Sporting Equipment	Clothing Line	Total
Sales	$1,150,000	$1,540,000	$1,354,000	$4,044,000
Variable expenses				
Variable manufacturing expenses	423,000	507,000	378,000	1,308,000
Variable selling and administrative expenses	195,000	130,000	147,000	472,000
Contribution margin	532,000	903,000	829,000	2,264,000
Direct fixed manufacturing expenses	75,000	75,000	75,000	225,000
Product margin	457,000	828,000	754,000	2,039,000
Allocated fixed expenses				
Fixed selling and administrative expenses				648,000
Fixed manufacturing expenses				933,000
Operating income				$ 458,000

Final Analysis of the Decision

This new analysis shows that when the relevant costs and revenues are considered, it is apparent the snow boot product line is contributing toward meeting the fixed costs of the organization and therefore to overall corporate profitability. The reason the snow boot product line was showing an operating loss was due to the allocation of common costs. Consideration should be given to the way allocated costs are assigned to the various products to determine if the allocation is logical or if another allocation method, such as one based on each product line's percentage of the total corporate sales, would provide a better matching of costs and services provided by corporate headquarters. Management should also consider qualitative factors, such as the impact of removing one product line on the overall sales of the other products. If customers commonly buy snow boots and skis together, then discontinuing the snow boot line could impact the sales of snow skis.

YOUR TURN

Disney's Segments

View Walt Disney Company's 2018 full year earnings report on their website. Scroll to the section on Segment Results and answer these questions:

A. How many segments does **Disney** have?
B. Which segment had the highest revenue in 2018?
C. Which segment had the highest operating income in 2018?
D. Which segment has shown the most revenue growth between 2017 and 2018?
E. How many segments showed growth in operating income between 2017 and 2018 and how many segments showed a decline in operating income between 2017 and 2018?
F. Which segment has shown the least operating income growth between 2017 and 2018?

Answer available at the end of this section.

Answers

YOUR TURN

A. Four: Media Networks, Parks & Resorts, Studio Entertainment, and Consumer Products & Interactive Media
B. Media Networks
C. Media Networks
D. Studio Entertainment
E. Two segments (Parks & Resorts and Studio Entertainment) showed operating income growth, while two segments (Media Networks and Consumer Products & Interactive Media) showed a decline in operating income between 2017 and 2018.
F. Consumer Products & Interactive Media

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12.6: Evaluate and Determine Whether to Sell or Process Further

One major decision a company has to make is to determine the point at which to sell their product—in other words, when it is no longer cost-effective to continue processing the product before sale. For example, in refining oil, the refined oil can be sold at various stages of the refining process. The point at which some products are removed from production and sold while others receive additional processing is known as the **split-off point**. As you have learned, the relevant revenues and costs must be evaluated in order to make the best decision for the company.

In making the decision, a company must consider the **joint costs**, or those costs that have been shared by products up to the split-off point. In some manufacturing processes, several end products are produced from a single raw material input. For example, once milk has been processed it can be sold as milk or it can be processed further into cheese, yogurt, cream, or ice cream. The costs of processing the milk to the stage at which it can be sold or processed further are the joint costs. These costs are allocated among all the products that are sold at the split off point as well as those products that are processed further. Ice cream has the basic costs of the milk plus the costs of processing it further into ice cream.

As another example, suppose a company that makes leather jackets realizes it has a reasonable amount of unused leather from the cutting of the patterns for the jackets. Typically, this scrap leather is sold, but the company is beginning to consider using the scrap to make leather belts. How would the company allocate the costs incurred from processing and preparing the leather before cutting it if they decide to make both the jackets and the belts? Would it be financially beneficial to process the scrap leather further into belts?

Fundamentals of the Decision to Sell or Process Further

When facing the choice of selling or processing further, the company must determine the revenues that would be received if the product is sold at the split-off point versus the net revenues that would be received if the product is processed further. This requires knowing the additional costs of further processing. In general, if the differential revenue from further processing is greater than the differential costs, then it will be profitable to process a joint product after the split-off point. Any costs incurred prior to the split-off point are irrelevant to the decision to process further as those are sunk costs; only future costs are relevant costs.

Even though joint product costs are common costs, they are routinely allocated to the joint products. A potential reason for this treatment is the GAAP (generally accepted accounting principles) requirement that all production costs must be inventoried.

Be aware that some complexities can arise when allocating joint product costs. The first issue is that joint production costs can be allocated based on varying production and sales characteristics or assumptions. For example, a physical measurement method, a relative sales value method at the point of split-off, and a net realizable value method based on additional processing after the split-off point can all be used to allocate joint production costs.

A second complexity is that eliminating the production of one or more joint products will not always enable the company to reduce joint production costs. Because of the mechanics of the common cost allocation process, such an action will only work if reductions are made in all of the joint products collectively. If only some of the joint products are eliminated, the remaining joint product or products would absorb all of the joint product costs.

An example of this last issue might help clarify the point. Assume that you have a lumber production company that cuts trees, prepares board lumber for housing and furniture, and also prepares sawdust and wood scraps that is used in the production of particleboard. Assume that in a given year the company experienced $1,100,000 in joint costs. Using one of the three previously mentioned cost allocation methods, the company allocated $1,000,000 in joint costs to the production of board lumber and $100,000 to the production of wood scraps and sawdust.

Assume that in the next year it also experienced $1,100,000 in joint costs. However, in that year, the company lost its buyer of wood scraps and sawdust, so it had to give both of them away, without generating any revenue. In this case, the company would still realize $1,100,000 in joint costs. However, the entire amount would be allocated to the production of the board lumber. The only way to reduce the joint costs is to realize joint costs of less than $1,000,000.

YOUR TURN

Luxury Leathers

Luxury Leathers, Inc., produces various leather accessories, such as belts and wallets. In the process of cutting out the leather pieces for each product, 400,000 pounds of scrap leather is produced. Luxury has been selling this leather scrap to Sammy's Scrap Procurement for $2.25 per pound. Luxury has an employee suggestion box and one of the suggestions was to use most of the scrap to make leather watch bands. The management of Luxury is interested in this idea as the machines necessary to produce the watch bands are the same as the ones used in making belts and would merely need reprogramming for the cutting and stitching processes on the watch bands. The process to attach the buckle would be the same for the watch bands as it was for the belts, thus this would require no additional worker training. Luxury would have additional costs for new packaging and for the supply and insertion of the pins that connect the band to the watch. The total variable cost to produce the watch band would be $2.85. Fixed costs would increase by $85,000 per year for the lease of the packaging equipment, and Luxury estimates it could produce and sell 100,000 watch bands per year. Finished watch bands could be sold for $15.00 each. Should Luxury continue to sell the scrap leather or should Luxury process the scrap into watch bands to sell?

Answer available at the end of this section.

Sample Data

Ainsley's Apples grows organic apples and sells them to national grocery chains, local grocers, and markets. Ainsley purchased a machine for $450,000 that sorts the apples by size. The largest apples are sold as loose apples to the various stores, the medium-sized apples are bagged and sold to the grocers in their bagged state, and the smallest apples are sold to deep discounters or to a local manufacturing plant that processes the apples into applesauce. Ainsley is considering keeping the small apples and processing them into apple juice that would be sold under Ainsley's own label to local grocers. The small apples currently sell to the deep discounters and local manufacturers for $1.10 per dozen. The variable cost to prepare the small apples for sale, including transporting the apples, is $0.30 per dozen. Ainsley can sell each gallon of organic apple juice for $3.50 per gallon. It takes two dozen small apples to make one gallon of apple juice. The cost to produce the organic apple juice will be $0.60 variable cost per gallon plus $200,000 fixed costs for the one-year lease of the equipment needed to make and bottle the juice. Ainsley normally harvests and sells 2,400,000 small apples per year. Should Ainsley continue to sell the small apples to local grocers and the applesauce manufacturer or should Ainsley process the apples further into organic apple juice?

Calculations of Sample Data

In order to decide whether or not to process the small apples or to process them further into applesauce, Ainsley conducts an analysis of the relevant revenues and costs for the two alternatives: sell at split-off or process further into applesauce.

	Sell at Split-Off	Process Further
Selling price per dozen	$ 1.10	
Selling price per gallon		$ 3.50
Variable costs to sell	0.30	0.60
Contribution margin	0.80	2.90
Units sold	200,000*	100,000**
Total contribution margin	160,000	290,000
Additional fixed costs	0	200,000
Effect on operating income	$160,000	$ 90,000

*2,400,000 ÷ 12 = 200,000 dozen
**200,000 dozen ÷ 2 dozen per gallon = 100,000 gallons

Ainsley should continue to sell the apples at split-off rather than process them further, as selling them generates a $160,000 increase in operating income compared to only $90,000 if she processes the apples further.

Final Analysis of the Decision

When making the decision to sell or process further, the company also must consider that processing a product further may create a new successful market or it may undercut sales of already existing products. For example, a furniture manufacturer that sells unfinished furniture may lose sales of the unfinished pieces if it decides to stain some pieces and sell them as finished products.

THINK IT THROUGH

Disposing of Coffee Grounds

Return to Why It Matters in this chapter. With the knowledge you have gained thus far, answer these questions:

1. From your perspective, what are the alternatives for the used coffee grounds?
2. For the alternatives listed in question 1, what information do you need to evaluate between the alternatives?
3. What type of analysis would you do to choose between alternatives?
4. What qualitative factors might influence your decision regarding which alternative to select?
5. Do you think the quantitative and qualitative components both will lead you to the same decision? Why or why not?

Answers

YOUR TURN

	Sell at Split-Off	Process Further
Selling price per lb of scrap	$ 2.25	
Selling price per watch band		$ 15.00
Variable costs to sell	0	2.85
Contribution margin	2.25	12.15
Units sold	400,000*	100,000**
Total contribution margin	900,000	1,215,000
Additional fixed costs	0	85,000
Effect on operating income	$900,000	$1,130,000

*lbs of scrap
**watch bands

Luxury should process the leather scrap further into watch bands. Not only does the act of processing the scrap further result in an increase in operating income, it offers Luxury another product line that may draw customers to its other products.

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12.7: Evaluate and Determine How to Make Decisions When Resources Are Constrained

Companies use various resources to be productive. These resources, which include time, labor, space, and machines, are limited, thus constraining the ability of a company to have unlimited productive capacity. For example, a retail store is constrained by the amount of floor space available to display its goods, while a law office may be constrained by the number of hours the paralegal team can feasibly work. These constraints require companies to make decisions on the best ways to allocate their resources in a way that maximizes the benefit to the firm. This situation is especially true when a company is operating at capacity or makes multiple products or provides multiple services.

The question as to which products and how many should be made is a common constraint problem. For example, consider a business that runs at capacity, making four products by running two eight-hour shifts per day, seven days a week for 50 weeks per year. This business is limited to 5,600 working hours per year (8 hr. shifts × 2 shifts × 7 days per week × 50 weeks) unless a third shift is added. Adding a third shift may be prohibitive for any number of reasons, including local ordinances that prevent operating twenty-four hours a day, Environmental Protection Agency constraints, or the down-time of the machines that is required several hours a day for maintenance and calibration. What is the best way for this company to use these work hours? Which products should it produce first and how many of each should it produce?

These types of situations constrain or limit management's ability to use their facilities and workforce. Having limited availability of a resource, such as time, labor, or machine hours means that item becomes a scarce resource. A **constraint** is a scarce resource that limits the output or productive capacity of the organization.

Ordinarily, there are very few actual constraints in any process. Sometimes, there is only one. However, the existence of a constraint can have a major effect on the productivity of an organization. This fact applies to all types of entities, such as production facilities or service providers. One way to view this issue is to consider the old cliché that *a chain is only as strong as its weakest link*. In the example, when trying to measure or estimate an organization's maximum efficiency, its results will often be reduced by the overall negative effects of the constraints. When the constraint slows production, it is called a **bottleneck**. Managers are often faced with the problem of deciding how to best use a scarce resource to prevent bottlenecks. Under the constraint of limited resources, how do managers make decisions when they are working within these conditions?

Fundamentals of How to Make Decisions When Resources are Constrained

As with other short-term decisions, a company must consider the relevant costs and revenues when making decisions when resources are constrained. Whether the organization facing a constraint is a merchandising, manufacturing, or service organization, the initial step in allocating scarce or constrained resources is to determine the **unit contribution margin**, which is the selling price per unit minus the variable cost per unit, for each product or service. The company should produce or provide the products or services that generate the highest contribution margin first, followed by those with the second-highest, and so forth. The total contribution margin will be maximized by promoting those products or accepting those orders with the highest contribution margin in relation to the scarce resource. In other words, products or services should be ranked based on their **unit contribution margin per production restraint**, which is the unit contribution margin divided by the production restraint.

If constraints are not managed, a bottleneck usually results, meaning that production slows and a back-up occurs at stages prior to the bottleneck. For example, in producing boxes of cereal, if the cereal is produced at a rate of 1,000 ounces per minute but the bagging machines can only bag 800 ounces per minute, this will create a bottleneck. Similarly, if on a Saturday morning before a home football game, the local grocery store has ten checkout lines but only opens four of them, long lines will result from the constraint of too few checkout lanes available. Management must decide how many scarce resources (employees, in this example) to pull from stocking the shelves to running cash registers. It may be difficult to see how bottlenecks affect profitability, and they appear to be more of a timing or throughput issue. But bottlenecks can affect profitability in a number of ways. Bottlenecks at the grocery store can result in customers leaving to store shop elsewhere or can negatively affect the reputation of the store, which can impact future sales. In the cereal example, bottlenecks in the packaging area can slow the delivery of boxes of cereal to distributors and individual stores. Poor or inconsistent delivery may drive customers to purchase from other cereal manufacturers, which would have a definite impact on profitability.

A common problem relating to constraints occurs in multi-product production environments. Management will need to evaluate

the constraints to determine the best mix of products that will minimize the effects of the constraints. In addition to making sure that the best product mix is chosen, managers should seek ways to increase the effective capacity of the constraint. Conceptually, there are two ways a company can do this: increase the rate of output at the bottleneck, or increase the time available at the bottleneck. Increasing the capacity of the constraint or bottleneck is also called *relaxing the constraint* or *elevating the constraint*. Some specific examples of ways to relax the constraint include:

- Keep the production facilities open longer hours. This may allow the work-flow through the bottleneck area to be slowed and thus prevent the bottleneck from occurring. However, this may require paying workers overtime pay.
- If working extra hours is not a viable option, then moving additional workers to the bottleneck area may be beneficial as long as the areas from which they were moved are adequately covered and additional problem areas do not result.
- Instead of using current workers, additional staff may be hired to smooth the workflow through the bottleneck area.
- Outsource some or all of the work in the area of the bottleneck. It may be cheaper and more cost-effective to buy parts of components than to slow production due to the bottleneck.
- Redesign the production process to prevent the bottleneck by adding more resources to eliminate the bottleneck, reorganizing the process to distribute the bottleneck-causing activities to different parts of the production process, or managing processing times at other stages prior to the bottleneck to help prevent the bottleneck form occurring.
- Insuring a minimal number of defects and rework, since they typically slow the production process and thus add to the bottleneck.

Preventing and minimizing bottlenecks can have significant benefits to the bottom line of the company. The reduction of bottlenecks allows the company to move more products through the production phase and thus be ready to sell.

ETHICAL CONSIDERATIONS

When to Include a Lifesaving Option: The Case of the Ford Pinto

The case of the fiery **Ford** Pinto demonstrates that more than cost and revenue should be considered when making an ethical business decision. In the early 1970s, the **Ford Motor Company** set out to build a Pinto for less than $2,000. Cars were much less expensive then, and Ford had to determine whether or not to include a component part that cost around $10. Given the high cost, Ford decided not to include the component, a rubber bladder for the gas tank. However, in rear-end collisions at over 21 miles per hour, the rubber bladder component functions to prevent the gas tank from flooding the interior of the car with gasoline and gas fumes. Because of the decision not to include the component, a number of Pintos involved in collisions exploded into flames, injuring and sometimes killing the occupants.

Although **Ford** was aware of the defect, the company's cost/benefit analysis indicated it was less expensive to build Pintos without the rubber bladder, even when including expected reimbursement costs for anyone injured or killed. However, the decision to allow a defective product to be built in order to reduce overall costs caused a significant hit to **Ford**'s reputation. Ultimately, the litigation costs for knowingly constructing a defective car were higher than the original cost of including the rubber bladder component. While **Ford**'s decision seemed profitable in the short-term, their financial analysis could have been improved if it also took into account long-term impacts.

Sample Data

Wood World, Inc., produces wooden desks, chairs, and bookcases. These items are produced using the same machines, and there is a maximum of 80,000 machine-hours available during the year. The information about the production time and costs for these three items is:

	Desks	Chair	Bookcase
Hours to produce	1	0.50	0.25
Selling price	$350	$200	$175
Direct materials	$ 40	$ 30	$ 35
Direct labor	$ 70	$ 65	$ 50
Variable overhead	$ 55	$ 50	$ 45
Fixed overhead	$ 28	$ 32	$ 24

Wood World is limited in producing its products by the number of possible machine-hours. Orders have been received for 60,000 desks, 48,000 chairs, and 40,000 bookcases, which will require 94,000 machine-hours to produce. Since there are not enough machine-hours available to fill all of the orders, which orders should Wood World fill first?

Calculations Using Sample Data

To address this question, Wood World must find the contribution margin per machine-hour since machine-hours are the constraining factor for production.

	Desks	Chair	Bookcase
Selling price	$ 350	$ 200	$ 175
Direct materials	$ 40	$ 30	$ 35
Direct labor	$ 70	$ 65	$ 50
Variable overhead	$ 55	$ 50	$ 42
Contribution margin	$ 185	$ 55	$ 48
Hours to produce	1	0.50	0.25
Contribution margin per machine-hour	$ 185	$ 110	$ 192

Final Analysis of the Decisions

Wood World should fulfill the orders for bookcases first, desks second, and chairs last. The bookcases provide the highest contribution margin per machine-hour, followed by desks and then chairs. Maximizing the contribution margin per constraint, in this case per machine-hour, is the best way for Wood World to manage the constraint. How many of each item will be produced?

Available machine hours	80,000
Hours to fill bookcase orders (40,000 × 0.25)	10,000
Remaining hours	70,000
Hours to fill desk orders (60,000 × 1)	60,000
Remaining hours	10,000
Hours needed to produce chairs	÷ 0.50
Chair orders that would be filled	20,000

Therefore, based on contribution margin and the constraint of machine-hours, Wood World should fill all 40,000 of the bookcase orders first, then fill the 60,000 desk orders and, and fill 20,000 of the chair orders last.

Are there any qualitative issues that Wood World should consider? One concern may be that customers who typically buy a desk and chair together may not be able to do so if the chair production is affected by a bottleneck. Another qualitative issue in keeping with the furniture example is that a company might find producing dining room tables to be significantly more profitable than matching chairs or matching cupboards. However, they will still be required to produce the less profitable chairs and cupboards, because many consumers will want to buy all three items as a set.

The benefits of effectively managing constraints can be enormous. Managers need to understand the positive impact effective management of constrained resources can have on the company's bottom line. The contribution margin per unit of the scarce resource can be used to assess the value of relaxing the constraint. When there is unsatisfied demand for a single product because of a constraint, the value of additional time on the constraint is simply the contribution margin per unit of the scarce resource for that product. When there are two or more products with unsatisfied demand, the value of additional time on the bottleneck would be the largest contribution margin per unit of the scarce resource for any product whose demand is unsatisfied. In many situations, when dealing with conflicting time constraints an evaluation of multiple bottlenecks might identify a viable solution. While many bottleneck issues and their solutions could be somewhat complex, others might be addressed more simply. For example, in some cases, the problem might be solved by the addition of an additional work shift.

CONCEPTS IN PRACTICE

Distributing Caseloads at a Law Firm

As a new business school graduate, you landed your first job in the human resources department of a large national law firm in New York City. Your position is providing you with many opportunities to learn about the company and the various tasks for which the human resources department is responsible. Your most recent assignment is to determine the best way to distribute caseloads to the junior level attorneys based on their areas of expertise and to assign paralegal hours to assist the junior level attorneys. What are the constraints with which you are dealing? What information do you need to properly complete this assignment? What type of analysis would be required to effectively allocate caseload hours?

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13: CAPITAL BUDGETING

Learning Objectives

- Explain the nature of capital expenditure decisions
- Apply and evaluate various methods using in making capital expenditure decisions

13.1: Why It Matters

13.2: Describe Capital Investment Decisions and How They Are Applied

13.3: Evaluate the Payback and Accounting Rate of Return in Capital Investment Decisions

13.4: Explain the Time Value of Money and Calculate Present and Future Values of Lump Sums and Annuities

13.5: Use Discounted Cash Flow Models to Make Capital Investment Decisions

13.6: Compare and Contrast Non-Time Value-Based Methods and Time Value-Based Methods in Capital Investment Decisions

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13.1: Why It Matters

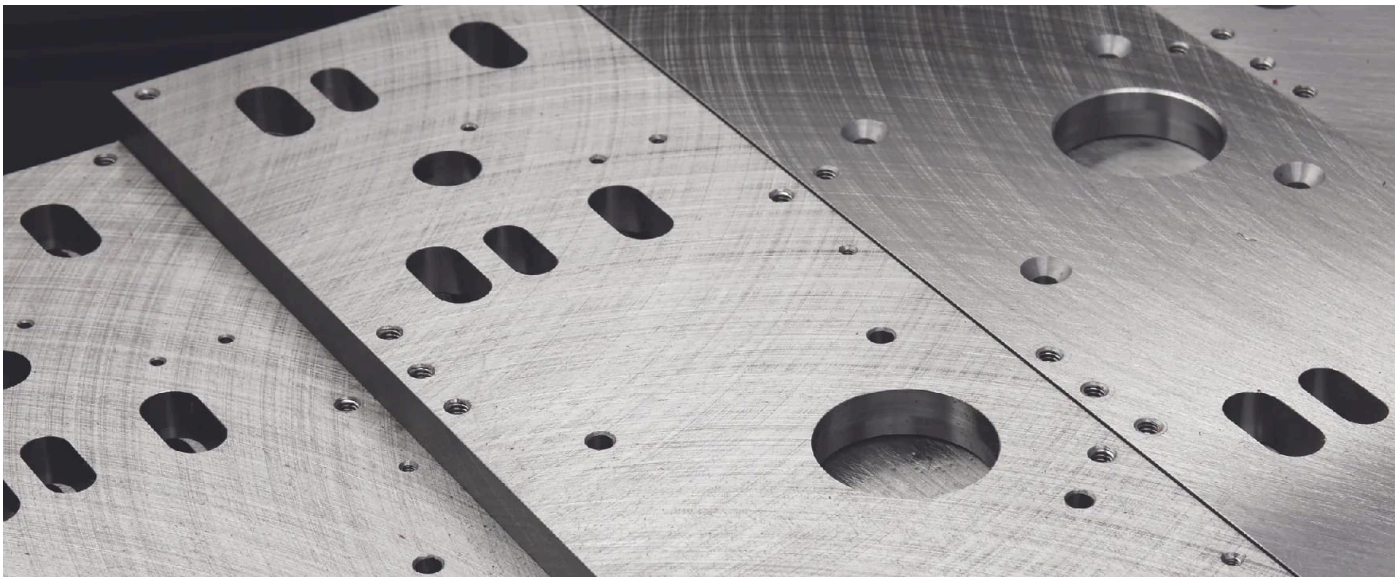


Figure 13.1.1: Milling Manufacturing. Long-term project investment requires careful capital budgeting analysis. (credit: modification of “Parts for CNC Machine” by Andy Malmin/Flickr, CC BY 2.0)

Jerry Price owns Milling Manufacturing, a production facility geared toward entrepreneurial product development. Initially, Jerry purchased several milling machines, but after seven years, the machines have become obsolete due to technological advances. Jerry must purchase new machines to continue business growth, and there are several options available. How does he choose the best machines for his business? What factors must he consider before purchase?

Jerry must consider several important factors—both financial and non-financial—as he makes this decision. First, he needs to consider the commitment of his initial capital investment. He also needs to compare differences between options such as warranties, the production capacities of different machines, and maintenance and repair costs. Another factor is the useful life of the new equipment—in other words, both its physical and the technological life. He will also consider how long it will take to recoup the cost of the investment, the impact on cash flow, and how the passage of time affects the value of the asset to the organization—it’s monetary value that considered depreciation to determine what the asset is actually worth to the organization in terms of dollars (i.e., “what could we sell it for?”). Jerry will consider the value of the dollar invested today in purchasing the machine as opposed to the value of the dollar in the future that might be better spent on another project. This last factor is significant because the new equipment will probably provide part of his down payment on future replacement equipment. There are also nonfinancial factors to consider, such as changes to customer satisfaction and employee morale.

Jerry knows this equipment choice goes well beyond color or price preferences. The decision has a long-lasting influence on company direction and opportunity, and he needs to utilize capital budgeting analysis to help him make this decision.

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13.2: Describe Capital Investment Decisions and How They Are Applied

Assume that you own a small printing store that provides custom printing applications for general business use. Your printers are used daily, which is good for business but results in heavy wear on each printer. After some time, and after a few too many repairs, you consider whether it is best to continue to use the printers you have or to invest some of your money in a new set of printers. A capital investment decision like this one is not an easy one to make, but it is a common occurrence faced by companies every day. Companies will use a step-by-step process to determine their capital needs, assess their ability to invest in a capital project, and decide which capital expenditures are the best use of their resources.

Fundamentals of Capital Investment Decisions

Capital investment (sometimes also referred to as capital budgeting) is a company's contribution of funds toward the acquisition of long-lived (long-term or capital) assets for further growth. Long-term assets can include investments such as the purchase of new equipment, the replacement of old machinery, the expansion of operations into new facilities, or even the expansion into new products or markets. These capital expenditures are different from operating expenses. An **operating expense** is a regularly-occurring expense used to maintain the current operations of the company, but a capital expenditure is one used to grow the business and produce a future economic benefit.

Capital investment decisions occur on a frequent basis, and it is important for a company to determine its project needs to establish a path for business development. This decision is not as obvious or as simple as it may seem. There is a lot at stake with a large outlay of capital, and the long-term financial impact may be unknown due to the capital outlay decreasing or increasing over time. To help reduce the risk involved in capital investment, a process is required to thoughtfully select the best opportunity for the company.

The process for capital decision-making involves several steps:

1. Determine capital needs for both new and existing projects.
2. Identify and establish resource limitations.
3. Establish baseline criteria for alternatives.
4. Evaluate alternatives using screening and preference decisions.
5. Make the decision.

The company must first determine its needs by deciding what capital improvements require immediate attention. For example, the company may determine that certain machinery requires replacement before any new buildings are acquired for expansion. Or, the company may determine that the new machinery and building expansion both require immediate attention. This latter situation would require a company to consider how to choose which investment to pursue first, or whether to pursue both capital investments concurrently.

CONCEPTS IN PRACTICE

Brexit

The decision to invest money in capital expenditures may not only be impacted by internal company objectives, but also by external factors. In 2016, Great Britain voted to leave the European Union (EU) (termed "Brexit"), which separates their trade interests and single-market economy from other participating European nations. This has led to uncertainty for United Kingdom (UK) businesses.

Because of this instability, capital spending slowed or remained stagnant immediately following the Brexit vote and has not yet recovered growth momentum. The largest decrease in capital spending has occurred in the expansions of businesses into new markets. The UK is expected to separate from the EU in 2019.

The second step, exploring resource limitations, evaluates the company's ability to invest in capital expenditures given the

availability of funds and time. Sometimes a company may have enough resources to cover capital investments in many projects. Many times, however, they only have enough resources to invest in a limited number of opportunities. If this is the situation, the company must evaluate both the time and money needed to acquire each asset. Time allocation considerations can include employee commitments and project set-up requirements. Fund limitations may result from a lack of capital fundraising, tied-up capital in non-liquid assets, or extensive up-front acquisition costs that extend beyond investment means (Table 13.2.1). Once the ability to invest has been established, the company needs to establish baseline criteria for alternatives.

Resource Limitations

Time Considerations	Money Considerat
• Employee commitments • Project set-up • Time-frame necessary to secure financing	• Lack of liquidi • Tied up in nor • Up-front acqu

Table 13.2.1 When resources are limited, capital budgeting procedures are needed.

Alternatives are the options available for investment. For example, if a company needs to purchase new printing equipment, all possible printing equipment options are considered alternatives. Since there are so many alternative possibilities, a company will need to establish baseline criteria for the investment. Baseline criteria are measurement methods that can help differentiate among alternatives. Common measurement methods include the payback method, accounting rate of return, net present value, or internal rate of return. These methods have varying degrees of complexity and will be discussed in greater detail in Evaluate the Payback and Accounting Rate of Return in Capital Investment Decisions and Explain the Time Value of Money and Calculate Present and Future Values of Lump Sums and Annuities.

To evaluate alternatives, businesses will use the measurement methods to compare outcomes. The outcomes will not only be compared against other alternatives, but also against a predetermined rate of return on the investment (or minimum expectation) established for each project consideration. The rate of return concept is discussed in more detail in Balanced Scorecard and Other Performance Measures. A company may use experience or industry standards to predetermine factors used to evaluate alternatives. Alternatives will first be evaluated against the predetermined criteria for that investment opportunity, in a screening decision. The **screening decision** allows companies to remove alternatives that would be less desirable to pursue given their inability to meet basic standards. For example, if there were three different printing equipment options and a minimum return had been established, any printers that did not meet that minimum return requirement would be removed from consideration.

If one or more of the alternatives meets or exceeds the minimum expectations, a preference decision is considered. A **preference decision** compares potential projects that meet screening decision criteria and will rank the alternatives in order of importance, feasibility, or desirability to differentiate among alternatives. Once the company determines the rank order, it is able to make a decision on the best avenue to pursue (Figure 13.2.1). When making the final decision, all financial and non-financial factors are deliberated.

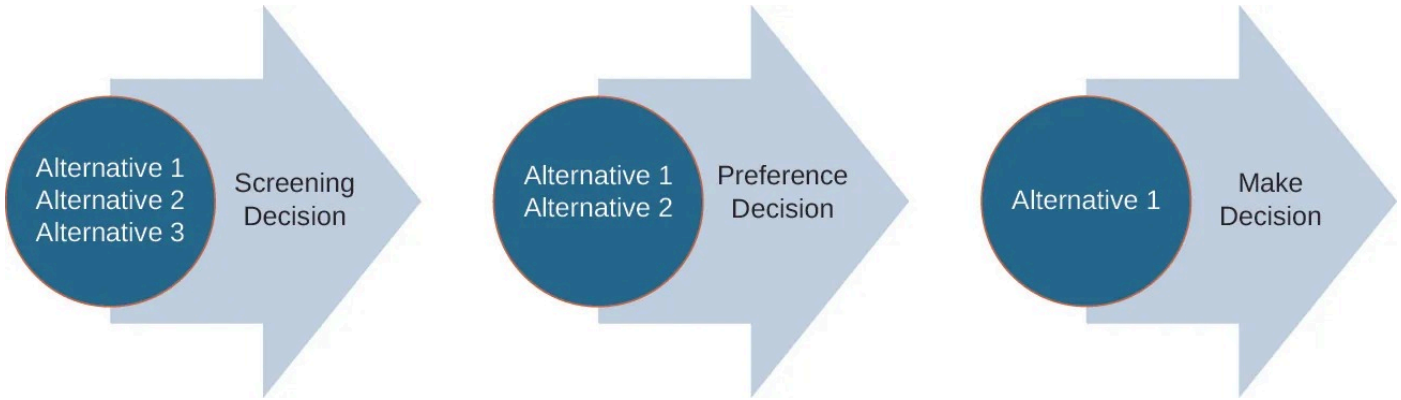


Figure 13.2.1: Select Between Alternatives. Screening and preference decisions can narrow alternatives in making a selection. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

ETHICAL CONSIDERATIONS

Volkswagen Diesel Emissions Scandal

Sometimes a company makes capital decisions due to outside pressures or unforeseen circumstances. The *New York Times* reported in 2015 that the car company **Volkswagen** was "scarred by an emissions-cheating scandal," and "would need to cut its budget next year for new technology and research—a reversal after years of increased spending aimed at becoming the world's biggest carmaker." This was a huge setback for **Volkswagen**, not only because the company had budgeted and planned to become the largest car company in the world, but also because the scandal damaged its reputation and set it back financially.

Volkswagen "set aside about 9 billion euros ($9.6 billion) to cover costs related to making the cars compliant with pollution regulations;" however, the sums were "unlikely to cover the costs of potential legal judgments or other fines." All of the costs related to the company's unethical actions needed to be included in the capital budget, as company resources were limited. **Volkswagen** used capital budgeting procedures to allocate funds for buying back the improperly manufactured cars and paying any legal claims or penalties. Other companies might take other approaches, but an unethical action that results in lawsuits and fines often requires an adjustment to the capital decision-making process.

Let's broadly consider what the five-step process for capital decision-making looks like for Melanie's Sewing Studio. Melanie owns a sewing studio that produces fabric patterns for wholesale.

1. **Determine capital needs for both new and existing projects.** Upon review of her future needs, Melanie determines that her five-year-old commercial sewing machine could be replaced. The old machine is still working, but production has slowed in recent months with an increase in repair needs and replacement parts. Melanie expects a new sewing machine to make her production process more efficient, which could also increase her current business volume. She decides to explore the possibility of purchasing a new sewing machine.
2. **Identify and establish resource limitations.** Melanie must consider if she has enough time and money to invest in a new sewing machine. The Sewing Studio has been in business for three years and has shown steady financial growth year over year. Melanie expects to make enough profit to afford a capital investment of $50,000. If she does purchase a new sewing machine, she will have to train her staff on how to use the machine and will have to cease production while the new machine is installed. She anticipates a loss of $20,000 for training and production time. The estimation of the $20,000 loss is based on the downtime in production for both labor and product output.
3. **Establish baseline criteria for alternatives.** Melanie is considering two different sewing machines for purchase. Before she evaluates which option is a better investment, she must establish minimum requirements for the investment. She determines that the new machine must return her initial investment back to her in three years at a rate of 20%, and the initial investment cost cannot exceed her future earnings. This established a baseline for what she considers reasonable for this type of investment, and she will not consider any investment alternative that does not meet these minimum criteria.
4. **Evaluate alternatives using screening and preference decisions.** Now that she has established minimum requirements for the new machine, she can evaluate each of these machines to see if they meet or exceed her criteria. The first sewing machine costs $45,000. She is expected to recoup her initial investment in two-and-a-half years. The return rate is 25%, and her future earnings would exceed the initial cost of the machine.
   The second machine will cost $55,000. She expects to recoup her initial investment in three years. The return rate is $18%, and her future earnings would be less than the initial cost of the machine.
5. **Make the decision.** Melanie will now decide which sewing machine to invest in. The first machine meets or exceeds her established minimum requirements in cost, payback, return rate, and future earnings compared to the initial investment. For the second machine, the $55,000 cost exceeds the cash available for investment. In addition, the second machine does not meet the return rate of 20% and the anticipated future earnings does not compare well to the value of the initial investment. Based on this information, Melanie would choose to purchase the first sewing machine.
   These steps make it seem as if narrowing down the alternatives and making a selection is a simple process. However, a company needs to use analysis techniques, including the payback method and the accounting rate of return method, as well as other, more sophisticated and complex techniques, to help them make screening and preference decisions. These techniques can assist management in making a final investment decision that is best for the company. We begin learning about these various screening and preference decisions in Evaluate the Payback and Accounting Rate of Return in Capital.

LINK TO LEARNING

More and more companies are using capital expenditure software in budgeting analysis management. One company using this software is Solarcentury, a United Kingdom-based solar company. Read this case study on Solarcentury's advantages to capital budgeting resulting from this software investment to learn more.

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13.3: Evaluate the Payback and Accounting Rate of Return in Capital Investment Decisions

Many companies are presented with investment opportunities continuously and must sift through both viable and nonviable options to identify the best possible expenditure for business growth. The process to select the best option requires careful budgeting and analysis. In conducting their analysis, a company may use various evaluation methods with differing inputs and analysis features. These methods are often broken into two broad categories: (1) those that consider the time value of money, or the fact that a dollar today differs from a dollar in the future due to inflation and the ability to invest today's money for future growth, and (2) those analysis methods that do not consider the time value of money. We will examine the non-time value methods first.

Non-Time Value Methods

Non-time value methods do not compare the value of a dollar today to the value of a dollar in the future and are often used as screening tools. Two non-time value evaluative methods are the payback method and the accounting rate of return.

Fundamentals of the Payback Method

The **payback method (PM)** computes the length of time it takes a company to recover their initial investment. In other words, it calculates how long it will take until either the amount earned or the costs saved are equal to or greater than the costs of the project. This can be useful when a company is focused solely on retrieving their funds from a project investment as quickly as possible.

Businesses do not want their money tied up in capital assets that have limited liquidity. The longer money is unavailable, the less ability the company has to use these funds for other growth purposes. This extended length of time is also a concern because it produces a riskier opportunity. Therefore, a company would like to get their money returned to them as quickly as possible. One way to focus on this is to consider the payback period when making a capital budget decision. The payback method is limited in that it only considers the time frame to recoup an investment based on expected annual cash flows, and it doesn't consider the effects of the time value of money.

The payback period is calculated when there are even or uneven annual cash flows. **Cash flow** is money coming into or out of the company as a result of a business activity. A **cash inflow** can be money received or cost savings from a capital investment. A **cash outflow** can be money paid or increased cost expenditures from capital investment. Cash flow will estimate the ability of the company to pay long-term debt, its liquidity, and its ability to grow. Cash flows appear on the statement of cash flows. Cash flows are different than net income. Net income will represent all company activities affecting revenues and expenses regardless of the occurrence of a cash transaction and will appear on the income statement.

A company will estimate the future cash inflows and outflows to be generated by the capital investment. It's important to remember that the cash inflows can be caused by an increase in cash receipts or by a reduction in cash expenditures. For example, if a new piece of equipment would reduce the production costs for a company from $120,000 a year to $80,000 a year, we would consider this is a $40,000 cash inflow. While the company does not actually receive the $40,000 in cash, it does save $40,000 in operating costs giving it a positive cash inflow of $40,000.

Cash flow can also be generated through increased production volume. For example, a company purchases a new building costing $100,000 that will allow them to house more space for production. This new space allows them to produce more product to sell, which increases cash sales by $300,000. The $300,000 is a new cash inflow.

The difference between cash inflows and cash outflows is the net cash inflow or outflow, depending on which cash flow is larger.

$$\text{Net annual cash flows} = \text{Cash Inflows} - \text{Cash Outflows}$$

Annual net cash flows are then related to the initial investment to determine a payback period in years. When the expected net annual cash flow is an even amount each period, payback can be computed as follows:

$$\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Net Annual Cash Flow}}$$

The result is the number of years it will take to recover the cash made in the original investment. For example, a printing company is considering a printer with an initial investment cost of $150,000. They expect an annual net cash flow of $20,000. The payback period is

Payback Period = $150,000 / $20,000 = 7.5 years

The initial investment cost of $150,000 is divided by the annual cash flow of $20,000 to compute an expected payback period of 7.5 years. Depending on the company's payback period requirements for this type of investment, they may pass this option through the screening process to be considered in a preference decision. For example, the company might require a payback period of 5 years. Since 7.5 years is greater than 5 years, the company would probably not consider moving this alternative to a preference decision. If the company required a payback period of 9 years, the company would consider moving this alternative to a preference decision, since the number of years is less than the requirement.

When net annual cash flows are uneven over the years, as opposed to even as in the previous example, the company requires a more detailed calculation to determine payback. Uneven cash flows occur when different amounts are returned each year. In the previous printing company example, the initial investment cost was $150,000 and even cash flows were $20,000 per year. However, in most examples, organizations experience uneven cash flows in a multiple-year ownership period. For example, an uneven cash flow distribution might be a return of $10,000 in year one, $20,000 in years two and three, $15,000 in years four and five, and $20,000 in year six and beyond.

Year	Yearly Cash Flow	Outflow or Inflow	Remaining to Recoup	Number of Years	Cumulative Number of Years for Repayment
0	$150,000	Outflow	$150,000		
1	10,000	Inflow	140,000	1	1
2	20,000	Inflow	120,000	1	2
3	20,000	Inflow	100,000	1	3
4	15,000	Inflow	85,000	1	4
5	15,000	Inflow	70,000	1	5
6	20,000	Inflow	50,000	1	6
7	20,000	Inflow	30,000	1	7
8	20,000	Inflow	10,000	1	8
9	20,000	Inflow	$\left(\frac{10,000}{20,000}\right)$	0.5	8.5

In this case, then, the payback period is 8.5 years.

In a second example of the payback period for uneven cash flows, consider a company that will need to determine the net cash flow for each period and figure out the point at which cash flows equal or exceed the initial investment. This could arise in the middle of a year, prompting a calculation to determine the partial year payback.

$$\text{Partial Year Payback} = \frac{\text{Initial Investment Outstanding}}{\text{Net cash flow for current period}}$$

The company would add the partial year payback to the prior years' payback to get the payback period for uneven cash flows. For example, a company may make an initial investment of $40,000 and receive net cash flows of $10,000 in years one and two, $5,000 in year three and four, and $7,500 for years five and beyond.

Year	Cash Flow	Outflow or Inflow	Remaining to Recoup	Number of years
0	($40,000)	Outflow	$40,000	
1	$10,000	Inflow	30,000	1
2	10,000	Inflow	20,000	1
3	5,000	Inflow	15,000	1
4	5,000	Inflow	10,000	1
5	7,500	Inflow	2,500	1
6	7,500	Inflow	(5,000)	0.33
				5.33

Figure 13.3.1 Cash Flow. (attribution: Copyright Rice University, OpenStax, under CC BY-NC-SA 4.0 license)

We know that somewhere between years 5 and 6, the company recovers the money. In years one and two they recovered a total of $20,000 (10,000 + 10,000), in years three and four they recovered and additional $10,000 (5,000 + 5,000), and in year five they recovered $7,500, for a total through year five of $37,500. This left an outstanding balance after year five of $2,500 (40,000 – 37,500) to fully recover the costs of the investment. In year six, they had a cash flow of $7,500. This is more than they needed to recoup their initial investment. To get a more specific calculation, we need to compute the partial year's payback.

Partial Year Payback = $2,500 / $7,500 = 0.33 years (rounded)

Therefore, the total payback period is 5.33 years (5 years + 0.33 years).

Demonstration of the Payback Method

For illustration, consider Baby Goods Manufacturing (BGM), a large manufacturing company specializing in the production of various baby products sold to retailers. BGM is considering investment in a new metal press machine. The payback period is calculated as follows:

Payback Period = $50,000 / $15,000 = 3.33 years

We divide the initial investment of $50,000 by the annual inflow of $15,000 to arrive at a payback period of 3.33 years. Assume that BGM will not allow a payback period of more than 7 years for this type of investment. Since this computed payback period meets their initial screening requirement, they can pass this investment opportunity on to a preference decision level. If BGM had an expected or maximum allowable payback period of 2 years, the same investment would not have passed their screening requirement and would be dropped from consideration.

To illustrate the concept of uneven cash flows, let's assume BGM shows the following expected net cash flows instead. Recall that that the initial investment in the metal press machine is $50,000.

Year	Net Cash Flow	Outstanding Initial Investment	Calculations
0	($50,000)	($50,000)	Initial Investment
1	$10,000	$(40,000)	50,000 – 10,000
2	5,000	(35,000)	40,000 – 5,000
3	7,000	(28,000)	35,000 – 7,000
4	3,000	(25,000)	28,000 – 3,000
5	10,000	(15,000)	25,000 – 10,000
6	10,000	(5,000)	15,000 – 5,000
7	10,000	5,000	10,000 – 5,000

Between years 6 and 7, the initial investment outstanding balance is recovered. To determine the more specific payback period, we calculate the partial year payback.

$$\text{Payback Period} = \$5{,}000 / \$10{,}000 = 0.5 \text{ years}$$

The total payback period is 6.5 years (6 years + 0.5 years).

THINK IT THROUGH

Capital Investment

You are the accountant at a large firm looking to make a capital investment in a future project. Your company is considering two project investments. Project A's payback period is 3 years, and Project B's payback period is 5.5 years.

Your company requires a payback period of no more than 5 years on such projects. Which project should they further consider? Why? Is there an argument that can be made to advance either project or neither project? Why? What other factors might be necessary to make that decision?

Fundamentals of the Accounting Rate of Return Method

The **accounting rate of return (ARR)** computes the return on investment considering changes to net income. It shows how much extra income the company could expect if it undertakes the proposed project. Unlike the payback method, ARR compares income to the initial investment rather than cash flows. This method is useful because it reviews revenues, cost savings, and expenses associated with the investment and, in some cases, can provide a more complete picture of the impact, rather than focusing solely on the cash flows produced. However, ARR is limited in that it does not consider the value of money over time, similar to the payback method.

The accounting rate of return is computed as follows:

$$\text{Accounting Rate of Return} = \frac{\text{Incremental Revenues} - \text{Incremental Expenses}}{\text{Initial Investment}}$$

Incremental revenues represent the increase to revenue if the investment is made, as opposed to if the investment is rejected. The increase to revenues includes any cost savings that occur because of the project. Incremental expenses show the change to expenses if the project is accepted as opposed to maintaining the current conditions. Incremental expenses also include depreciation of the acquired asset. The difference between incremental revenues and incremental expenses is called

the incremental net income. The initial investment is the original amount invested in the project; however, any salvage (residual) value for the capital asset needs to be subtracted from the initial investment before obtaining ARR.

The concept of salvage value was addressed in Long-Term Assets. Basically, it is the anticipated future fair market value (FMV) of an asset when it is to be sold or used as a trade-in for a replacement asset. For example, assume that you bought a commercial printer for $40,000 five years ago with an anticipated salvage value of $8,000, and you are now considering replacing it. Assume that as of the date of replacement after the five-year holding period, the old printer has an FMV of $8,000. If the new printer has a purchase price of $45,000 and the seller is going to take the old printer as a trade-in, then you would owe $37,000 for the new printer. If the printer had been sold for $8,000, instead being used as a trade-in, the $8,000 could have been used as a down payment, and the company would still owe $37,000. This amount is the price of $45,000 minus the FMV value of $8,000.

$$\text{Accounting Rate of Return (ARR)} = \frac{\text{Incremental Net Income}}{\text{Initial Investment} - \text{Salvage Value}}$$

There is one more point to make with this example. The fair market value is not the same as the book value. The book value is the original cost less the accumulated depreciation that has been taken. For example, if you buy a long-term asset for $60,000 and the accumulated depreciation that you have taken is $42,000, then the asset's book value would be $18,000. The fair market value could be more, less, or the same as the book value.

For example, a piano manufacturer is considering investment in a new tuning machine. The initial investment will cost $300,000. Incremental revenues, including cost savings, are $200,000, and incremental expenses, including depreciation, are $125,000. ARR is computed as:

$$\text{ARR} = (\$200{,}000 - \$125{,}000) / \$300{,}000 = 0.25 \text{ or } 25\%$$

This outcome means the company can expect an increase of 25% to net income, or an extra 25 cents on each dollar, if they make the investment. The company will have a minimum expected return that this project will need to meet or exceed before further consideration is given. ARR, like payback method, should not be used as the sole determining factor to invest in a capital asset. Also, note that the ARR calculation does not consider uneven annual income growth, or other depreciation methods besides straight-line depreciation.

Demonstration of the Accounting Rate of Return Method

Returning to the BGM example, the company is still considering the metal press machine because it passed the payback period method of less than 7 years. BGM has a set rate of return of 25% expected for the metal press machine investment. The company expects incremental revenues of $22,000 and incremental expenses of $12,000. Remember that the initial investment cost is $50,000. BGM computes ARR as follows:

$$\text{ARR} = (\$20{,}000 - \$5{,}000) / \$50{,}000 = 0.3 \text{ or } 30\%$$

The ARR in this situation is 30%, exceeding the required hurdle rate of 25%. A **hurdle rate** is the minimum required rate of return on an investment to consider an alternative for further evaluation. In this case, BGM would move this investment option to a preference decision level. If we were to add a salvage value of $5,000 into the situation, the computation would change as follows:

$$\text{ARR} = (\$20{,}000 - \$5{,}000) / (\$50{,}000 - \$5{,}000) = 0.33 \text{ or } 33\% \text{ (rounded)}$$

The ARR still exceeds the hurdle rate of 25%, so BGM would still forward the investment opportunity for further consideration. Let's say BGM changes their required return rate to 35%. In both cases, the project ARR would be less than the required rate, so BGM would not further consider either investment.

YOUR TURN

Analyzing Hurdle Rate

Turner Printing is looking to invest in a printer, which costs $60,000. Turner expects a 15% rate of return on this printer investment. The company expects incremental revenues of $30,000 and incremental expenses of $15,000. There is no salvage value for the printer. What is the accounting rate of return (ARR) for this printer? Did it meet the hurdle rate of 15%?

Solution

ARR is 25% calculated as ($30,000 – $15,000) / $60,000. 25% exceeds the hurdle rate of 15%, so the company would consider moving this alternative to a preference decision.

Both the payback period and the accounting rate of return are useful analytical tools in certain situations, particularly when used in conjunction with other evaluative techniques. In certain situations, the non-time value methods can provide relevant and useful information. However, when considering projects with long lives and significant costs to initiate, there are more advanced models that can be used. These models are typically based on time value of money principles, the basics of which are explained here.

YOUR TURN

Analyzing Investments

Your company is considering making an investment in equipment that will cost $240,000. The equipment is expected to generate annual cash flows of $60,000, provide incremental cash revenues of $200,000, and provide incremental cash expenses of $140,000 annually. Depreciation expense is included in the $140,000 incremental expense.

Calculate the payback period and the accounting rate of return.

Solution

Payback Period = $240,000 / 60,000 = 4 years

ARR = ($200,000 – $140,000) / 240,000 = 25%

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13.4: Explain the Time Value of Money and Calculate Present and Future Values of Lump Sums and Annuities

Your mother gives you $100 cash for a birthday present, and says, “Spend it wisely.” You want to purchase the latest cellular telephone on the market but wonder if this is really the best use of your money. You have a choice: You can spend the money now or spend it in the future. What should you do? Is there a benefit to spending it now as opposed to saving for later use? Does time have an impact on the value of your money in the future? Businesses are confronted with these questions and more when deciding how to allocate investment money. A major factor that affects their investment decisions is the concept of the time value of money.

Time Value of Money Fundamentals

The concept of the **time value of money** asserts that the value of a dollar today is worth more than the value of a dollar in the future. This is typically because a dollar today can be used now to earn more money in the future. There is also, typically, the possibility of future inflation, which decreases the value of a dollar over time and could lead to a reduction in economic buying power.

At this point, potential effects of inflation can probably best be demonstrated by a couple of examples. The first example is the Ford Mustang. The first Ford Mustang sold in 1964 for $2,368. Today’s cheapest Mustang starts at a list price of $25,680. While a significant portion of this increase is due to additional features on newer models, much of the increase is due to the inflation that occurred between 1964 and 2019.

Similar inflation characteristics can be demonstrated with housing prices. After World War II, a typical small home often sold for between $16,000 and $30,000. Many of these same homes today are selling for hundreds of thousands of dollars. Much of the increase is due to the location of the property, but a significant part is also attributed to inflation. The annual inflation rate for the Mustang between 1964 and 2019 was approximately 4.5%. If we assume that the home sold for $16,500 in 1948 and the price of the home in 2019 was about $500,000, that’s an annual appreciation rate of almost 5%.

Today’s dollar is also more valuable because there is less risk than if the dollar was in a long-term investment, which may or may not yield the expected results. On the other hand, delaying payment from an investment may be beneficial if there is an opportunity to earn interest. The longer payment is delayed, the more available earning potential there is. This can be enticing to businesses and may persuade them to take on the risk of deferment.

Businesses consider the time value of money before making an investment decision. They need to know what the future value is of their investment compared to today’s present value and what potential earnings they could see because of delayed payment. These considerations include present and future values.

Before you learn about present and future values, it is important to examine two types of cash flows: lump sums and annuities.

Lump Sums and Annuities

A **lump sum** is a one-time payment or repayment of funds at a particular point in time. A lump sum can be either a present value or future value. For a lump sum, the present value is the value of a given amount today. For example, if you deposited $5,000 into a savings account today at a given rate of interest, say 6%, with the goal of taking it out in exactly three years, the $5,000 today would be a present value-lump sum. Assume for simplicity’s sake that the account pays 6% at the end of each year, and it also compounds interest on the interest earned in any earlier years.

In our current example, interest is calculated once a year. However, interest can also be calculated in numerous ways. Some of the most common interest calculations are daily, monthly, quarterly, or annually. One concept important to understand in interest calculations is that of compounding. **Compounding** is the process of earning interest on previous interest earned, along with the interest earned on the original investment.

Returning to our example, if $5,000 is deposited into a savings account for three years earning 6% interest compounded annually, the amount the $5,000 investment would be worth at the end of three years is $5,955.08 ($5,000 × 1.06 – $5,300 × 1.06

– $5,618 × 1.06 – $5,955.08). The $5,955.08 is the future value of $5,000 invested for three years at 6%. More formally, **future value** is the amount to which either a single investment or a series of investments will grow over a specified time at a given interest rate or rates. The initial $5,000 investment is the present value. Again, more formally, **present value** is the current value of a single future investment or a series of investments for a specified time at a given interest rate or rates. Another way to phrase this is to say the $5,000 is the present value of $5,955.08 when the initial amount was invested at 6% for three years. The interest earned over the three-year period would be $955.08, and the remaining $5,000 would be the original deposit of $5,000.

As shown in the example the future value of a lump sum is the value of the given investment at some point in the future. It is also possible to have a series of payments that constitute a series of lump sums. Assume that a business receives the following four cash flows. They constitute a series of lump sums because they are *not all* the same amount.

December 31, 2019	$12,000
December 31, 2020	12,000
December 31, 2021	11,500
December 31, 2022	12,000

The company would be receiving a stream of four cash flows that are all lump sums. In some situations, the cash flows that occur each time period are the same amount; in other words, the cash flows are even each period. These types of even cash flows occurring at even intervals, such as once a year, are known as an **annuity**. The following figure shows an annuity that consists of four payments of $12,000 made at the end of each of four years.

December 31, 2019	$12,000
December 31, 2020	12,000
December 31, 2021	12,000
December 31, 2022	12,000

The nature of cash flows—single sum cash flows, even series of cash flows, or uneven series of cash flows—have different effects on compounding.

Compounding

Compounding can be applied in many types of financial transactions, such as funding a retirement account or college savings account. Assume that an individual invests $10,000 in a four-year certificate of deposit account that pays 10% interest at the end of each year (in this case 12/31). Any interest earned during the year will be retained until the end of the four-year period and will also earn 10% interest annually.

Year	Interest Earned	Investment Balance
0		$10,000
1	($10,000 × 10%) $1,000	11,000
2	(11,000 × 10%) 1,100	12,100
3	(12,100 × 10%) 1,210	13,310
4	(13,310 × 10%) 1,331	14,641
Total Interest Earned	4,641	

Through the effects of compounding—earning interest on interest—the investor earned $4,641 in interest from the four-year investment. If the investor had removed the interest earned instead of reinvesting it in the account, the investor would have earned $1,000 a year for four years, or $4,000 interest ($10,000 × 10% = $1,000 per year × 4 years = $4,000 total interest). Compounding is a concept that is used to determine future value (more detailed calculations of future value will be covered later in this section). But what about present value? Does compounding play a role in determining present value? The term applied to finding present value is called discounting.

Discounting

Discounting is the procedure used to calculate the present value of an individual payment or a series of payments that will be received in the future based on an assumed interest rate or return on investment. Let's look at a simple example to explain the concept of discounting.

Assume that you want to accumulate sufficient funds to buy a new car and that you will need $5,000 in three years. Also, assume that your invested funds will earn 8% a year for the three years, and you reinvest any interest earned during the three-year period. If you wanted to take out adequate funds from your savings account to fund the three-year investment, you would need to invest $3,969.16 today and invest it in the account earning 8% for three years. After three years, the $3,969.16 would earn $1,030.84 and grow to exactly the $5,000 that you will need. This is an example of discounting. Discounting is the method by which we take a future value and determine its current, or present, value. An understanding of future value applications and calculations will aid in the understanding of present value uses and calculations.

Future Value

There are benefits to investing money now in hopes of a larger return in the future. These future earnings are possible because of interest payments received as an incentive for tying up money long-term. Knowing what these future earnings will be can help a business decide if the current investment is worth the long-term potential. Recall, the **future value (FV)** as the value of an investment after a certain period of time. Future value considers the initial amount invested, the time period of earnings, and the earnings interest rate in the calculation. For example, a bank would consider the future value of a loan based on whether a long-time client meets a certain interest rate return when determining whether to approve the loan.

To determine future value, the bank would need some means to determine the future value of the loan. The bank could use formulas, future value tables, a financial calculator, or a spreadsheet application. The same is true for present value calculations. Due to the variety of calculators and spreadsheet applications, we will present the determination of both present and future values using tables. In many college courses today, these tables are used primarily because they are relatively simple to understand while demonstrating the material. For those who prefer formulas, the different formulas used to create each table are printed at the top of the corresponding table. In many finance classes, you will learn how to utilize the formulas. Regarding the use of a financial calculator, while all are similar, the user manual or a quick internet search will provide specific directions for each financial calculator. As for a spreadsheet application such as Microsoft Excel, there are some common formulas, shown in Table 13.4.1.

Excel Formulas

Time Value Component	Excel Formula Shorthand
Present Value Single Sum	=PV
Future Value Single Sum	+FV
Present Value Annuity	=PV
Future Value Annuity	=FV
Net Present Value	=NPV
Internal Rate of Return	=IRR
Rate = annual interest rate	
N = number of periods	
Payment = annual payment amount, entered as a negative number, use 0 when calculating both present value of a single sum and f	
FV = future value	
PV = current or present value	
Type = 0 for regular annuity, 1 for annuity due	
CF = cash flow for a period, thus CF1 – cash flow period 1, CF2 – cash flow period 2, etc.	
Invest = initial investment entered as a negative number	

Table 13.4.1

Since we will be using the tables in the examples in the body of the chapter, it is important to know there are four possible table, each used under specific conditions (Table 13.4.2).

Time Value of Money Tables

Situation	Table Heading
Future Value – Lump Sum	Future Value of $1
Future Value – Annuity (even payment stream)	Future Value of an A
Present Value – Lump Sum	Present Value of $1
Present Value – Annuity (even payment stream)	Present Value of an

Table 13.4.2

In the prior situation, the bank would use either the Future Value of $1 table or Future Value of an Ordinary Annuity table. To use the correct table, the bank needs to determine whether the customer will pay them back at the end of the loan term or periodically throughout the term of the loan. The Future Value of $1 table is used if the customer will pay back at the end of the period; if the payments will be made periodically throughout the term of the loan, they will use the Future Value of an Annuity table. Choosing the correct table to use is critical for accurate determination of the future value. The application in other business matters is the same: a business needs to also consider if they are making an investment with a repayment in one lump sum or in an annuity structure before choosing a table and making the calculation. In the tables, the columns show interest rates (i) and the rows show periods (n). The interest columns represent the anticipated interest rate payout for that investment. Interest rates can be based on experience, industry standards, federal fiscal policy expectations, and risk investment. Periods represent the number of years until payment is received. The intersection of the expected payout years and the interest rate is a number called a future value factor. The future value factor is multiplied by the initial investment cost to produce the future value of the expected cash flows (or investment return).

Future Value of $1

A lump-sum payment is the present value of an investment when the return will occur at the end of the period in one installment.

To determine this return, the Future Value of $1 table is used.

For example, you are saving for a vacation you plan to take in 6 years and want to know how much your initial savings will yield in the future. You decide to place $4,500 in an investment account now that yields an anticipated annual return of 8%. Looking at the FV table, n = 6 years, and i = 8%, which return a future value factor of 1.587. Multiplying this factor by the initial investment amount of $4,500 produces $7,141.50. This means your initial savings of $4,500 will be worth approximately $7,141.50 in 6 years.

Future Value of $1 Table
Factor = $(1 + i)^n$

Period (n) \ Rate (i)	1%	2%	3%	5%	8%
1	1.010	1.020	1.030	1.050	1.080
2	1.020	1.040	1.061	1.103	1.166
3	1.030	1.061	1.093	1.158	1.260
4	1.041	1.082	1.126	1.216	1.360
5	1.051	1.104	1.159	1.276	1.469
6	1.062	1.126	1.194	1.340	**1.587**

Future Value of an Ordinary Annuity

An **ordinary annuity** is one in which the payments are made at the end of each period in equal installments. A future value ordinary annuity looks at the value of the current investment in the future, if periodic payments were made throughout the life of the series.

For example, you are saving for retirement and expect to contribute $10,000 per year for the next 15 years to a 401(k) retirement plan. The plan anticipates a periodic interest yield of 12%. How much would your investment be worth in the future meeting these criteria? In this case, you would use the Future Value of an Ordinary Annuity table. The relevant factor where n = 15 and i = 12% is 37.280. Multiplying the factor by the amount of the cash flow yields a future value of these installment savings of (37.280 × $10,000) $372,800. Therefore, you could expect your investment to be worth $372,800 at the end of 15 years, given the parameters.

Future Value of an Ordinary Annuity Table
Factor = $\frac{[(1 + i)^n - 1]}{i}$

Period (n) \ Rate (i)	1%	2%	3%	5%	8%	10%	12%
1	1.000	1.000	1.000	1.000	1.000	1.000	1. 000
2	2.010	2.020	2.030	2.050	2.080	2.100	2.120
3	3.030	3.060	3.091	3.153	3.246	3.310	3.374
4	4.060	4.122	4.184	4.310	4.506	4.641	4.779
5	5.101	5.204	5.309	5.526	5.867	6.105	6.353
6	6.152	6.308	6.468	6.802	7.336	7.716	8.115
7	7.214	7.434	7.662	8.142	8.923	9.487	10.089
8	8.286	8.583	8.892	9.549	10.637	11.436	12.300
9	9.369	9.755	10.159	11.027	12.488	13.579	14.776
10	10.462	10.950	11.464	12.578	14.487	15.937	17.549
11	11.567	12.169	12.808	14.207	16.645	18.531	20.655
12	12.683	13.412	14.192	15.917	18.977	21.384	24.133
13	13.809	14.680	15.618	17.713	21.495	24.523	28.029
14	14.947	15.974	17.086	19.599	24.215	27.975	32.393
15	16.097	17.293	18.599	21.579	27.152	31.772	**37.280**

Let's now examine how present value differs from future value in use and computation.

YOUR TURN

Determining Future Value

Determine the future value for each of the following situations. Round answers to the nearest cent where required.

A. You are saving for a car and you put away $5,000 in a savings account. You want to know how much your initial savings will be worth in 7 years if you have an anticipated annual interest rate of 5%.
B. You are saving for retirement and make contributions of $11,500 per year for the next 14 years to your 403(b) retirement plan. The interest rate yield is 8%.

Answer available at the end of this section.

Present Value

It is impossible to compare the value or potential purchasing power of the future dollar to today's dollar; they exist in different times and have different values. **Present value (PV)** considers the future value of an investment expressed in today's value. This allows a company to see if the investment's initial cost is more or less than the future return. For example, a bank might consider the present value of giving a customer a loan before extending funds to ensure that the risk and the interest earned are worth the initial outlay of cash.

Similar to the Future Value tables, the columns show interest rates (i) and the rows show periods (n) in the Present Value tables. Periods represent how often interest is compounded (paid); that is, periods could represent days, weeks, months, quarters, years, or any interest time period. For our examples and assessments, the period (n) will almost always be in years. The intersection of the expected payout years (n) and the interest rate (i) is a number called a present value factor. The present value factor is multiplied by the initial investment cost to produce the present value of the expected cash flows (or investment return).

$$\text{Present Value} = \text{Present Value Factor} \times \text{Initial Investment Cost}$$

The two tables provided for present value are the Present Value of $1 and the Present Value of an Ordinary Annuity. As with the future value tables, choosing the correct table to use is critical for accurate determination of the present value.

Present Value of $1

When referring to present value, the lump sum return occurs at the end of a period. A business must determine if this delayed repayment, with interest, is worth the same as, more than, or less than the initial investment cost. If the deferred payment is more than the initial investment, the company would consider an investment.

To calculate present value of a lump sum, we should use the Present Value of $1 table. For example, you are interested in saving money for college and want to calculate how much you would need put in the bank today to return a sum of $40,000 in 10 years. The bank returns an interest rate of 3% per year during these 10 years. Looking at the PV table, n = 10 years and i = 3% returns a present value factor of 0.744. Multiplying this factor by the return amount of $40,000 produces $29,760. This means you would need to put in the bank now approximately $29,760 to have $40,000 in 10 years.

Present Value of $1 Table Factor = $\frac{1}{(1+i)^n}$					
Period (n)	Rate (i)				
		1%	2%	**3%**	5%
	1	0.990	0.980	0.971	0.952
	2	0.980	0.961	0.943	0.907
	3	0.971	0.942	0.915	0.864
	4	0.961	0.924	0.888	0.823
	5	0.952	0.906	0.863	0.784
	6	0.942	0.888	0.837	0.746
	7	0.933	0.871	0.813	0.711
	8	0.924	0.853	0.789	0.677
	9	0.914	0.837	0.766	0.645
	10	0.905	0.820	0.744	0.614
	11	0.896	0.804	0.722	0.585

As mentioned, to determine the present value or future value of cash flows, a financial calculator, a program such as Excel, knowledge of the appropriate formulas, or a set of tables must be used. Though we illustrate examples in the text using tables, we recognize the value of these other calculation instruments and have included chapter assessments that use multiple approaches to determining present and future value. Knowledge of different approaches to determining present and future value is useful as there are situations, such as having fractional interest rates, 8.45% for example, in which a financial calculator or a program such as Excel would be needed to accurately determine present or future value.

Annuity Table

As discussed previously, annuities are a series of equal payments made over time, and ordinary annuities pay the equal installment at the end of each payment period within the series. This can help a business understand how their periodic returns translate into today's value.

For example, assume that Sam needs to borrow money for college and anticipates that she will be able to repay the loan in $1,200 annual payments for each of 5 years. If the lender charges 5% per year for similar loans, how much cash would the bank be willing to lend Sam today? In this case, she would use the Present Value of an Ordinary Annuity table, where $n = 5$ and $i = 5\%$. This yields a present value factor of 4.329. The current value of the cash flow each period is calculated as 4.329 × $1,200 = $5,194.80. Therefore, Sam could borrow $5,194.80 now given the repayment parameters.

Present Value of an Ordinary Annuity Table Factor = $\frac{[1 - 1/(1+i)^n]}{i}$					
Period (n)	Rate (i)				
		1%	2%	3%	5%
	1	0.990	0.980	0.971	0.952
	2	1.970	1.942	1.913	1.859
	3	2.941	2.884	2.829	2.723
	4	3.902	3.808	3.717	3.546
	5	4.853	4.713	4.580	**4.329**

Our focus has been on examples of *ordinary* annuities (annuities due and other more complicated annuity examples are addressed in advanced accounting courses). With **annuities due**, the cash flow occurs at the start of the period. For example, if you wanted to deposit a lump sum of money into an account and make monthly rent payments starting today, the first payment would be made the same day that you made the deposit into the funding account. Because of this timing difference in the withdrawals from the annuity due, the process of calculating annuity due is somewhat different from the methods that you've covered for ordinary annuities.

YOUR TURN

Determining Present Value

Determine the present value for each of the following situations. Use the present value tables when needed, and round answers to the nearest cent where required.

a. You are saving for college and you want to return a sum of $100,000 in 12 years. The bank returns an interest rate of 5% after these 12 years.
b. You need to borrow money for college and can afford a yearly payment to the lending institution of $1,000 per year for the next 8 years. The interest rate charged by the lending institution is 3% per year.

Answer available at the end of this section.

LINK TO LEARNING

For a lucky few, winning the lottery can be a dream come true and the option to take a one-time payout or receive payments over several years does not seem to matter at the time. This lottery payout calculator shows how the time value of money may affect your take-home winnings.

Answers

YOUR TURN

A. Use FV of $1 table. Future value factor where $n = 7$ and $i = 5$ is 1.407. 1.407 × 5,000 = $7,035.
B. Use FV of an ordinary annuity table. Future value factor where $n = 14$ and $i = 8$ is 24.215. 24.215 × 11,500 = $278,472.50.

YOUR TURN

A. Use PV of $1 table. Present value factor where $n = 12$ and $i = 5$ is 0.557. 0.557 × $100,000 = $55,700.
B. Use PV of an ordinary annuity table. Present value factor where $n = 8$ and $i = 3$ is 7.020. 7.020 × $1,000 = $7,020.

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13.5: Use Discounted Cash Flow Models to Make Capital Investment Decisions

Your company, Rudolph Incorporated, has begun analyzing two potential future project alternatives that have passed the basic screening using the non–time value methods of determining the payback period and the accounting rate of return. Both proposed projects seem reasonable, but your company typically selects only one option to pursue. Which one should you choose? How will you decide? A discounted cash flow model can assist with this process. In this section, we will discuss two commonly used time value of money–based options: the net present value method (NPV) and the internal rate of return (IRR). Both of these methods are based on the discounted cash flow process.

Fundamentals of the Discounted Cash Flow Model

The **discount cash flow model** assigns a value to a business opportunity using time-value measurement tools. The model considers future cash flows of the project, discounts them back to present time, and compares the outcome to an expected rate of return. If the outcome exceeds the expected rate of return and initial investment cost, the company would consider the investment. If the outcome does not exceed the expected rate of return or the initial investment, the company may not consider investment. When considering the discounted cash flow process, the time value of money plays a major role.

Time Value-Based Methods

As previously discussed, time value of money methods assume that the value of money today is worth more now than in the future. The payback period and accounting rate of return methods do not consider this concept when performing calculations and analyzing results. That is why they are typically only used as basic screening tools. To decide the best option between alternatives, a company performs preference measurement using tools, such as net present value and internal rate of return that do consider the time value of money concept. **Net present value (NPV)** discounts future cash flows to their present value at the expected rate of return and compares that to the initial investment. NPV does not determine the actual rate of return earned by a project. The **internal rate of return (IRR)** shows the profitability or growth potential of an investment at the point where NPV equals zero, so it determines the actual rate of return a project earns. As the name implies, net present value is stated in dollars, whereas the internal rate of return is stated as an interest rate. Both NPV and IRR require the company to determine a rate of return to be used as the target return rate, such as the minimum required rate of return or the weighted average cost of capital.

A positive NPV implies that the present value of the cash inflows from the project are greater than the present value of the cash outflows, which represent the expenses and costs associated with the project. In an NPV calculation, a positive NPV is typically considered a potentially good investment or project. However, other extenuating circumstances should be considered. For example, the company might not wish to borrow the necessary funding to make the investment because the company might be anticipating a downturn in the national economy.

An IRR analysis compares the calculated IRR with either a predetermined rate of return or the cost of borrowing the money to invest in the project in order to determine whether a potential investment or project is favorable. For example, assume that the investment or equipment purchase is expected to generate an IRR of 15% and the company's expected rate of return is 12%. In this case, similar to the NPV calculation, we assume that the proposed investment would be undertaken. However, remember that other factors must be considered, as they are with NPV.

When considering cash inflows—whether using NPV or IRR—the accountant should examine both profits generated or expenses reduced. Investments that are made may generate additional revenue or could reduce production costs. Both cases assume that the new product or other type of investment generates a positive cash inflow that will be compared to the cost outflows to determine whether there is an overall positive or negative net present value.

Additionally, a company would determine whether the projects being considered are mutually exclusive or not. If the projects or investment options are mutually exclusive, the company can evaluate and identify more than one alternative as a viable project or investment, but they can only invest in one option. For example, if a company needs one new delivery truck, it might solicit proposals from five different truck dealers and conduct NPV and IRR evaluations. Even if all proposals pass the financial requirements of the NPV and IRR methods, only one proposal will be accepted.

Another consideration occurs when a company has the ability to evaluate and accept multiple proposals. For example, an automobile manufacturer is considering expanding its number of dealerships in the United States over the next ten-year period and has allocated $30,000,000 to buy the land. They could purchase any number of properties. They conduct NPV and IRR analyses of fifteen properties and determine that four meet their required standards and market feasibility needs and then purchase those four properties. The opportunities were not mutually exclusive: the number of properties purchased was driven by research and expansion projections, not by their need for only one option.

CONTINUING APPLICATION

Capital Budgeting Decisions

Gearhead Outfitters has expanded to many locations throughout its twenty-plus years in business. How did company management decide to expand? One of the financial tools a business can use is capital budgeting, which addresses many different issues involving the use of current cash flow for future return. As you've learned, capital outlay decisions can be evaluated through payback period, net present value, and methods involving rates of return.

With this in mind, think about the capital budgeting issues **Gearhead**'s management might have faced. For example, in deciding to expand, should the company buy a building or lease one? What method should be used to evaluate this? Purchasing a building might require more initial outlay, but the company will retain an asset. How will such a decision affect the bottom line? With respect to equipment, **Gearhead** could maintain a fleet of vehicles. Should the vehicles be purchased or leased? What will need to be considered in the process?

In developing and maintaining its strategy for sustainability, a business must not only consider day-to-day operations, but also address long-term decisions. Common capital budgeting items like equipment purchases to increase efficiency or reduce costs, decisions about replacement versus repair, and expansion all involve significant cash outlay. How will these items be evaluated? How long will recouping the initial investment take? How much revenue will be generated (or costs saved) through capital outlay? Does the company require a minimum rate of return before it moves forward with investment? If so, how is that return determined? Considering **Gearhead**'s decision to expand, what are some specific capital budgeting decisions important for the company to consider in their long-term strategy?

Basic Characteristics of the Net Present Value Model

Net present value helps companies choose between alternatives at a particular point in time by determining which produces the higher NPV. To determine the NPV, the initial investment is subtracted from the present value of cash inflows and outflows associated with a project at a required rate of return. If the outcome is positive, the company should consider investment. If the outcome is negative, the company would forgo investment.

We previously discussed the calculation for present value using the present value tables, where n is the number of years and i is the expected interest rate. Once the present value factor is determined, it is multiplied by the expected net cash flows to produce the present value of future cash flows. The initial investment is subtracted from this present value calculation to determine the net present value.

Net present value = Sum of Present Value of net cash flows – Initial Investment

Recall that the Present Value of $1 table is used for a lump sum payout, whereas the Present Value of an Ordinary Annuity table is used for a series of equal payments occurring at the end of each period. Taking this distinction one step further, NPV requires use of different tables depending on whether the future cash flows are equal or unequal in each time period. If the cash flows each period are equal, the company uses the Present Value of an Ordinary Annuity table, where the present value factor is multiplied by the cash flow amount for one period to get the present value. If the cash flows each period are unequal, the company uses the Present Value of $1 table, where the total present value is the sum of each of the unequal cash flows multiplied by the appropriate present value factor for each time period. This concept is discussed in the following example.

Assume that your company, Rudolph Incorporated, is determining the NPV for a new X-ray machine. The X-ray machine has an initial investment of $200,000 and an expected cash flow of $40,000 each period for the next 10 years. The expected $40,000 cash flows from the new X-ray machine can be attributed to either additional revenue generated or cost savings realized by more

efficient operations of the new machine. Since these annual cash flows of $40,000 are the same amount in each period over the ten-years this will be a stream of annuity amounts received. The required rate of return on such an investment is 8%. The present value factor (i = 8, n = 10) is 6.710 using the Present Value of an Ordinary Annuity table. Multiplying the present value factor (6.710) by the equal cash flow ($40,000) gives a present value of $268,400. NPV is found by taking the present value of $268,400 and subtracting the initial investment of $200,000 to arrive at $68,400. This is a positive NPV, so the company would consider investment.

Present Value of an Ordinary Annuity Table

Period (n) \ Rate (i)	1%	2%	3%	5%	8%
1	0.990	0.980	0.971	0.952	0.926
2	1.970	1.942	1.913	1.859	1.783
3	2.941	2.884	2.829	2.723	2.577
4	3.902	3.808	3.717	3.546	3.312
5	4.853	4.713	4.580	4.329	3.993
6	5.795	5.601	5.417	5.076	4.623
7	6.728	6.472	6.230	5.786	5.206
8	7.652	7.325	7.020	6.463	5.747
9	8.566	8.162	7.786	7.108	6.247
10	9.471	8.983	8.530	7.722	**6.710**

If there are two investments that have a positive NPV, and the investments are mutually exclusive, meaning only one can be chosen, the more profitable of the two investments is typically the appropriate one for a company to choose. We can also use the profitability index to compare them. The profitability index measures the amount of profit returned for each dollar invested in a project. This is particularly useful when projects being evaluated are of a different size, as the profitability index scales the projects to make them comparable. The profitability index is found by taking the present value of the net cash flows and dividing by the initial investment cost.

$$\text{Profitability index} = \frac{\text{Present value of cash flows}}{\text{Initial investment cost}}$$

For example, Rudolph Incorporated is considering the X-ray machine that had present value cash flows of $268,400 (not considering salvage value) and an initial investment cost of $200,000. Another X-ray equipment option, option B, produces present value cash flows of $290,000 and an initial investment cost of $240,000. The profitability index is computed as follows.

Option A:$268,400$200,000=1.342Option B:$290,000$240,000=1.208Option A:$268,400$200,000=1.342Option B:$290,000$240,000=1.208

Based on this outcome, the company would invest in Option A, the project with a higher profitability index of 1.342.

If there were unequal cash flows each period, the Present Value of $1 table would be used with a more complex calculation. Each year's present value factor is determined and multiplied by that year's cash flow. Then all cash flows are added together to get one overall present value figure. This overall present value figure is used when finding the difference between present value and the initial investment cost.

For example, let's say the X-ray machine information is the same, except now cash flows are as follows:

Year	Cash Flow Amount
1	$20,000
2	25,000
3	20,000
4	40,000
5	40,000
6	60,000
7	30,000
8	35,000
9	25,000
10	45,000

To find the overall present value, the following calculations take place using the present value of $1 table.

Year	Cash Flow Amount	Present Value Factor (i = 8, n = specific year)	Present Value
1	$ 20,000	(i = 8, n = 1) = 0.926	0.926 × $20,000 = $18,520
2	25,000	(i = 8, n = 2) = 0.857	0.857 × 25,000 = 21,425
3	20,000	(i = 8, n = 3) = 0.794	0.794 × 20,000 = 15,880
4	40,000	(i = 8, n = 4) = 0.735	0.735 × 40,000 = 29,400
5	40,000	(i = 8, n = 5) = 0.681	0.681 × 40,000 = 27,240
6	60,000	(i = 8, n = 6) = 0.630	0.630 × 60,000 = 37,800
7	30,000	(i = 8, n = 7) = 0.583	0.583 × 30,000 = 17,490
8	35,000	(i = 8, n = 8) = 0.540	0.540 × 35,000 = 18,900
9	25,000	(i = 8, n = 9) = 0.500	0.500 × 25,000 = 12,500
10	45,000	(i = 8, n = 10) = 0.463	0.463 × 45,000 = 20,835
Total	**$340,000**		**$219,990**

The Present Value of $1 table is used because, each year, a new "lump sum" cash flow is received, so the cash flow in each period is different. The cash flows are treated as one-time lump sum payouts during that year. The present value for each period looks at each year's present value factor at an interest rate of 8%. All the PVs are added together for a total present value of $219,990. The initial investment of $200,000 is subtracted from the $219,990 to arrive at a positive NPV of $19,990. In this case, the company would consider investment since the outcome is positive. (More complex considerations, such as depreciation, the effects of income taxes, and inflation, which could affect the overall NPV, are covered in advanced accounting courses.)

YOUR TURN

Analyzing a Postage Meter Investment

Yellow Industries is considering investment in a new postage meter system. The postage meter system would have an initial investment cost of $135,000. Annual net cash flows are $40,000 for the next 5 years, and the expected interest rate return is 10%. Calculate net present value and decide whether or not Yellow Industries should invest in the new postage meter system.

Answer available at the end of this section.

Calculation and Discussion of the Results of the Net Present Value Model

To demonstrate NPV, assume that a company, Rayford Machining, is considering buying a drill press that will have an initial investment cost of $50,000 and annual cash flows of $10,000 for the next 7 years. Assume that Rayford expects a 5% rate of return on such an investment. We need to determine the NPV when cash flows are equal. The present value factor (i = 5, n = 7) is 5.786 using the Present Value of an Ordinary Annuity table. We multiply 5.786 by the equal cash flow of $10,000 to get a present value of $57,860. NPV is found by taking the present value of $57,860 and subtracting the initial investment of $50,000 to arrive at $7,860. This is a positive NPV, so the company would consider the investment.

Present Value of an Ordinary Annuity Table

Period (n)	Rate (i)			
	1%	2%	3%	5%
1	0.990	0.980	0.971	0.952
2	1.970	1.942	1.913	1.859
3	2.941	2.884	2.829	2.723
4	3.902	3.808	3.717	3.546
5	4.853	4.713	4.580	4.329
6	5.795	5.601	5.417	5.076
7	6.728	6.472	6.230	**5.786**

Let's say Rayford Machining has another option, Option B, for a drill press purchase with an initial investment cost of $56,000 that produces present value cash flows of $60,500. The profitability index is computed as follows.

Option A:$57,860$50,000=1.157Option B:$60,500$56,000=1.080Option A:$57,860$50,000=1.157Option B:$60,500$56,000=1.080

Based on this outcome, the company would invest in Option A, the project with a higher profitability potential of 1.157.

Now let's assume cash flows are unequal. Unequal cash flow information for Rayford Machining is summarized here.

Year	Net Cash Flow
1	$10,000
2	5,000
3	7,000
4	3,000
5	10,000
6	10,000
7	10,000

To find the overall present value, the following calculations take place using the Present Value of $1 table.

Year	Cash Flow Amount	Present Value Factor (i = 5, n = specific year)	Present Value
1	$10,000	(i = 5, n = 1) = 0.952	0.952 × $10,000 = $9,520
2	5,000	(i = 5, n = 2) = 0.907	0.907 × 5,000 = 4,535
3	7,000	(i = 5, n = 3) = 0.864	0.864 × 7,000 = 6,048
4	3,000	(i = 5, n = 4) = 0.823	0.823 × 3,000 = 2,469
5	10,000	(i = 5, n = 5) = 0.784	0.784 × 10,000 = 7,840
6	10,000	(i = 5, n = 6) = 0.746	0.746 × 10,000 = 7,460
7	10,000	(i = 5, n = 7) = 0.711	0.711 × 10,000 = 7,110
Total	**$55,000**		**$44,982**

The present value for each period looks at each year's present value factor at an interest rate of 5%. All individual year present values are added together for a total present value of $44,982. The initial investment of $50,000 is subtracted from the $44,982 to arrive at a negative NPV of $5,018. In this case, Rayford Machining would not invest, since the outcome is negative. The negative NPV value does not mean the investment would be unprofitable; rather, it means the investment does not return the desired 5% the company is looking for in the investments that it makes.

Basic Characteristics of the Internal Rate of Return Model

The internal rate of return model allows for the comparison of profitability or growth potential among alternatives. All external factors, such as inflation, are removed from calculation, and the project with the highest return rate percentage is considered for investment.

IRR is the discounted rate (interest rate) point at which NPV equals zero. In other words, the IRR is the point at which the present value cash inflows equal the initial investment cost. To consider investment, IRR needs to meet or exceed the required rate of return for the investment type. If IRR does not meet the required rate of return, the company will forgo investment.

To find IRR using the present value tables, we need to know the cash flow number of return periods (n) and the intersecting present value factor. To calculate present value factor, we use the following formula.

$$\text{Present Value Factor} = \frac{\text{Initial Investment Cost}}{\text{Annual Net Cash Flows}}$$

We find the present value factor in the present value table in the row with the corresponding number of periods (n). We find the matching interest rate (i) at this present value factor. The corresponding interest rate at the number of periods (n) is the IRR. When cash flows are equal, use the Present Value of an Ordinary Annuity table to find IRR.

For example, a car manufacturer needs to replace welding equipment. The initial investment cost is $312,000 and each annual net cash flow is $49,944 for the next 9 years. We need to find the internal rate of return for this welding equipment. The expected rate of return for such a purchase is 6%. In this case, n = 9 and the present value factor is computed as follows.

Present Value Factor=$312,000$49,944=6.247(rounded)Present Value Factor=$312,000$49,944=6.247(rounded)

Looking at the Present Value of an Ordinary Annuity table, where n = 9 and the present value factor is 6.247, we discover that the corresponding return rate is 8%. This exceeds the expected return rate, so the company would typically invest in the project.

Present Value of an Ordinary Annuity Table							
Period (*n*)	Rate (*i*)						
		1%	2%	3%	5%	8%	10%
	1	0.990	0.980	0.971	0.952	0.926	0.909
	2	1.970	1.942	1.913	1.859	1.783	1.736
	3	2.941	2.884	2.829	2.723	2.577	2.487
	4	3.902	3.808	3.717	3.546	3.312	3.170
	5	4.853	4.713	4.580	4.329	3.993	3.791
	6	5.795	5.601	5.417	5.076	4.623	4.355
	7	6.728	6.472	6.230	5.786	5.206	4.868
	8	7.652	7.325	7.020	6.463	5.747	5.335
	9	8.566	8.162	7.786	7.108	**6.247**	5.759

If there is more than one viable option, the company will select the alternative with the highest IRR that exceeds the expected rate of return.

Our tables are limited in scope, and therefore, a present value factor may fall in between two interest rates. When this is the case, you may choose to identify an IRR range instead of a single interest rate figure. A spreadsheet program or financial calculator can produce a more accurate result and can also be used when cash flows are unequal.

Calculation and Discussion of the Results of the Internal Rate of Return Model

Assume that Rayford Machining wants to know the internal rate of return for the new drill press. The drill press has an initial investment cost of $50,000 and an annual cash flow of $10,000 for each of the next seven years. The company expects a 7% rate of return on this type of investment. We calculate the present value factor as:

Present Value Factor=$50,000$10,000=5.000Present Value Factor=$50,000$10,000=5.000

Scanning the Present Value of an Ordinary Annuity table reveals that the interest rate where the present value factor is 5 and the number of periods is 7 is between 8 and 10%. Since the required rate of return was 7%, Rayford would consider investment in this metal press machine.

Present Value of an Ordinary Annuity Table							
Period (*n*)	Rate (*i*)						
		1%	2%	3%	5%	8%	10%
	1	0.990	0.980	0.971	0.952	0.926	0.909
	2	1.970	1.942	1.913	1.859	1.783	1.736
	3	2.941	2.884	2.829	2.723	2.577	2.487
	4	3.902	3.808	3.717	3.546	3.312	3.170
	5	4.853	4.713	4.580	4.329	3.993	3.791
	6	5.795	5.601	5.417	5.076	4.623	4.355
	7	6.728	6.472	6.230	5.786	**5.206**	**4.868**
	8	7.652	7.325	7.020	6.463	5.747	5.335
	9	8.566	8.162	7.786	7.108	6.247	5.759

Consider another example using Rayford, where they have two drill press purchase options. Option A has an IRR between 8% and 10%. The other option, Option B, has an initial investment cost of $60,500 and equal annual net cash flows of $13,256 for the next seven years. We calculate the present value factor as:

Present Value Factor=$60,500$13,256=4.564(rounded)Present Value Factor=$60,500$13,256=4.564(rounded)

Scanning the Present Value of an Ordinary Annuity table reveals that, when the present value factor is 4.564 and the number of periods is 7, the interest rate is 12%. This not only exceeds the 7% required rate, it also exceeds Option A's return of 8% to 10%. Therefore, if resources were limited, Rayford would select Option B over Option A.

Present Value of an Ordinary Annuity Table

Period (*n*)	Rate (*i*)						
	1%	2%	3%	5%	8%	10%	12%
1	0.990	0.980	0.971	0.952	0.926	0.909	0.893
2	1.970	1.942	1.913	1.859	1.783	1.736	1.690
3	2.941	2.884	2.829	2.723	2.577	2.487	2.402
4	3.902	3.808	3.717	3.546	3.312	3.170	3.037
5	4.853	4.713	4.580	4.329	3.993	3.791	3.605
6	5.795	5.601	5.417	5.076	4.623	4.355	4.111
7	6.728	6.472	6.230	5.786	5.206	4.868	**4.564**

Final Summary of the Discounted Cash Flow Models

The internal rate of return (IRR) and the net present value (NPV) methods are types of discounted cash flow analysis that require taking estimated future payments from a project and discounting them into present values. The difference between the two methods is that the NPV calculation determines the project's estimated return in dollars and the IRR provides the percentage rate of return from a project needed to break even.

When the NPV is determined to be $0, the present value of the cash inflows and the present value of the cash outflows are equal. For example, assume that the present value of the cash inflows is $10,000 and the present value of the cash outflows is also $10,000. In this example, the NPV would be $0. At a net present value of zero, the IRR would be exactly equal to the interest rate that was used to perform the NPV calculation. For example, in the previous example, where both the cash inflows and the cash outflows have present values of $10,000 and the NPV is $0, assume that they were discounted at an 8% interest rate. If you were to then calculate the internal rate of return, the IRR would be 8%, the same interest rate that gave us an NPV of $0.

Overall, it is important to understand that a company must consider the time value of money when making capital investment decisions. Knowing the present value of a future cash flow enables a company to better select between alternatives. The net present value compares the initial investment cost to the present value of future cash flows and requires a positive outcome before investment. The internal rate of return also considers the present value of future cash flows but considers profitability stated in terms of percentage of return on the investment or project. These models allow two or more options to be compared to eliminate bias with raw financial figures.

THINK IT THROUGH

Choosing Investments

Companies are presented with viable alternatives that sometimes produce nearly identical results and profitability goals. If they have the ability to invest in both alternatives, they may do so. But what about when resources are constrained? How do they choose which investment is best for their company?

Consider this: you have two projects that met the payback period and accounting rate of return screenings identically. Project 1 produced an NPV of $45,000 and had an IRR between 5% and 8%. Project 2 produced a NPV of $35,000 and had an IRR of 10%. This leaves you with a difficult choice, since each alternative has a measurement that exceeds the other and the other variables are the same. Which project would you invest in and why?

Answers

YOUR TURN

Use the Present Value of an Ordinary Annuity table. Present value factor at n = 5 and i = 10% is 3.791. Present value = 3.791 × $40,000 = $151,640. NPV = $151,640 – $135,000 = $16,640. In this case, Yellow Industries should invest since the NPV is positive.

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13.6: Compare and Contrast Non-Time Value-Based Methods and Time Value-Based Methods in Capital Investment Decisions

When an investment opportunity is presented to a company, there are many financial and non-financial factors to consider. Using capital budgeting methods to narrow down the choices by removing unviable alternatives is an important process for any successful business. The four methods for capital budgeting analysis—payback period, accounting rate of return, net present value, and internal rate of return—all have their strengths and weaknesses, which are discussed as follows.

Summary of the Strengths and Weaknesses of the Non-Time Value-Based Capital Budgeting Methods

Non-time value-based capital budgeting methods are best used in an initial screening process when there are many alternatives to choose from. Two such methods are payback method and accounting rate of return. Their strengths and weaknesses are discussed in Table 13.6.1 and Table 13.6.2.

The payback method determines the length of time needed to recoup an investment.

Payback Method

Strengths	Weaknesses
• Simple calculation • Screens out many unviable alternatives quickly • Removes high-risk investments from consideration	• Does not cor • Profitability • Cash flows b

Table 13.6.1

Accounting rate of return measures incremental increases to net income. This method has several strengths and weaknesses that are similar to payback period but include a deeper evaluation of income.

Accounting Rate of Return

Strengths	Weaknesses
• Simple calculation • Screens out many unviable options quickly • Considers the impact on income rather than cash flows only (profitability)	• Does not con • Return rates • External facto • Return rates

Table 13.6.2

Because of the limited information each of the non-time value-based methods give, they are typically used in conjunction with time value-based capital budgeting methods.

Summary of the Strengths and Weaknesses of the Time Value-Based Capital Budgeting Methods

Time value-based capital budgeting methods are best used after an initial screening process, when a company is choosing between few alternatives. They help determine the best of the alternatives that a company should pursue. Two such methods are net present value and internal rate of return. Their strengths and weaknesses are presented in Table 13.6.3 and Table 13.6.4.

Net present value converts future cash flow dollars into current values to determine if the initial investment is less than the future returns.

Net Present Value

Strengths	Weaknesses
• Considers the time value of money • Acknowledges higher risk investments • Comparable future earnings with today's value • Allows for a selection of investment	• Requires a more difficult calculation than non-time value methods • Required return rate is an estimate, thus any changes to this condition and the impact that has on earnings are unknown • Difficult to compare alternatives that have varying investment amounts

Table 13.6.3

Internal rate of return looks at future cash flows as compared to an initial investment to find the rate of return on investment. The goal is to have an interest rate higher than the predetermined rate of return to consider investment.

Internal Rate of Return

Strengths	Weaknesses
• Considers the time value of money • Easy to compare different-sized investments, removes dollar bias • A predetermined rate of return is not required • Allows for a selection of investment	• Does not acknowledge higher risk investments because the focus is on return rates • More difficult calculation than non-time value methods, and outcome may be uncertain if not using a financial calculator or spreadsheet program • If the time for return on investment is important, IRR will not place more importance on shorter-term investments

Table 13.6.4

After a time-value based capital budgeting method is analyzed, a company can be move toward a decision on an investment opportunity. This is of particular importance when resources are limited.

Before discussing the mechanics of choosing the NPV versus the IRR method for decision-making, we first need to discuss one cardinal rule of using the NPV or IRR methods to evaluate time-sensitive investments or asset purchases: If a project or investment has a positive NPV, then it will, by definition, have an IRR that is above the interest rate used to calculate the NPV.

For example, assume that a company is considering buying a piece of equipment. They determine that it will cost $30,000 and will save them $10,000 a year in expenses for five years. They have decided that the interest rate that they will choose to calculate the NPV and to evaluate the purchase IRR is 8%, predicated on current loan rates available. Based on this sample data, the NPV will be positive $9,927 ($39,927 PV for inflows and $30,000 PV for the outflows), and the IRR will be 19.86%. Since the calculations require at least an 8% return, the company would accept the project using either method. We will not spend

additional time on the calculations at this point, since our purpose is to create numbers to analyze. If you want to duplicate the calculations, you can use a software program such as Excel or a financial calculator.

CONCEPTS IN PRACTICE

Solar Energy as Capital Investment

A recent capital investment decision that many company leaders need to make is whether or not to invest in solar energy. Solar energy is replacing fossil fuels as a power source, and it provides a low-cost energy, reducing overhead costs. The expensive up-front installation costs can deter some businesses from making the initial investment.

Businesses must now choose between an expensive initial capital outlay and the long-term benefits of solar power. A capital investment such as this would require an initial screening and preference process to determine if the cost savings and future benefits are worth more today than the current capital expenditure. If it makes financial sense, they may look to invest in this increasingly popular energy source.

Now, we return to our comparison of the NPV and IRR methods. There are typically two situations that we want to consider. The first involves looking at projects that are not mutually exclusive, meaning we can consider more than one possibility. If a company is considering non-mutually exclusive opportunities, they will generally consider all options that have a positive NPV or an IRR that is above the target rate of interest as favorable options for an investment or asset purchase. In this situation, the NPV and IRR methods will provide the same accept-or-reject decision. If the company accepts a project or investment under the NPV calculation, then they will accept it under the IRR method. If they reject it under the NPV calculation, then they will also reject under the IRR method.

The second situation involves mutually exclusive opportunities. For example, if a company has one computer system and is considering replacing it, they might look at seven options that have favorable NPVs and IRRs, even though they only need one computer system. In this case, they would choose only one of the seven possible options.

In the case of mutually exclusive options, it is possible that the NPV method will select Option A while the IRR method might choose Option D. The primary reason for this difference is that the NPV method uses dollars and the IRR uses an interest rate. The two methods may select different options if the company has investments with major differences in costs in terms of dollars. While both will identify an investment or purchase that exceeds the required standards of a positive NPV or an interest rate above the target interest rate, they might lead the company to choose different positive options. When this occurs, the company needs to consider other conditions, such as qualitative factors, to make their decision. Future cost accounting or finance courses will cover this content in more detail.

Final Comparison of the Four Capital Budgeting Options

A company will be presented with many alternatives for investment. It is up to management to analyze each investment's possibilities using capital budgeting methods. The company will want to first screen each possibility with the payback method and accounting rate of return. The payback method will show the company how long it will take to recoup their investment, while accounting rate of return gives them the profitability of the alternatives. This screening will typically get rid of non-viable options and allow the company to further consider a select few alternatives. A more detailed analysis is found in time-value methods, such as net present value and internal rate of return. Net present value converts future cash flows into today's valuation for comparability purposes to see if an initial outlay of cash is worth future earnings. The internal rate of return determines the minimum expected return on a project given the present value of cash flow expectations and the initial investment. Analyzing these opportunities, with consideration given to time value of money, allows a company to make an informed decision on how to make large capital expenditures.

ETHICAL CONSIDERATIONS

Barclays and the LIBOR Scandal

As discussed in the Volkswagen Diesel Emissions Scandal, when a company makes an unethical decision, it must adjust its budget for fines and lawsuits. In 2012, **Barclays**, a British financial services company, was caught illegally manipulating LIBOR interest rates. LIBOR sets the interest rate for many types of loans. As CNN reported, "LIBOR, which stands for London Interbank Offered Rate, is the rate at which banks lend to each other, and is used globally to price financial products, such as mortgages, worth hundreds of trillions of dollars."

While **Volkswagen** decided to cover the costs related to fines and lawsuits by reducing its capital budget for technology and research, **Barclays** took a different approach. The company chose to "cut or claw back about 450 million pounds ($680 million) of pay from its staff" and from past pay packages "another 140 million pounds ($212 million)." Instead of reducing other areas of its capital budget, **Barclays** decided to cover its fines and lawsuits by cutting employee compensation.

The LIBOR scandal involved a number of international banks and rocked the international banking community. An independent review of **Barclays** reported that "if Barclays is to achieve a material improvement in its reputation, it will need to continue to make changes to its top levels of pay so as to reflect talent and contribution more realistically, and in ways that mean something to the general public." Previously, as described by the company website, "Barclays has been a leader in innovation; funding the world's first industrial steam railway, naming the UK's first female branch manager and introducing the world's first ATM machine." The positive reputation **Barclays** built over 300 years was tarnished by just one scandal, and demonstrates the difficulty of calculating just how much unethical behavior will cost a company's reputation.

LINK TO LEARNING

A popular television show, *Shark Tank*, explores the decision-making process investors use when considering ownership in a new business. Entrepreneurs will pitch their business concept and current position to the "sharks," who will evaluate the business using capital budgeting methods, such as payback period and net present value, to decide whether or not to invest in the entrepreneur's company. Learn more about *Shark Tank*'s concept and success stories on the web.

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Manufacturing costs
2.3: Cost Terminology

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GLOSSARY

S

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