Course Material

On

Cost and Management Accounting I

(AcFn2091)

Credit Hours – 3 (5 EtCTS)

Compiled by: Hailemichael Tesfay

Department of Accounting and Finance

College of Business and Economics

Mekelle University

Course Plan		
Course code	AcFn2091	
Course Title	**Cost and Management Accounting –I**	
ETCTS Credits	5	
Contact Hours (per week)	3	
Course Objectives	After successfully completing this course, the students should be able to: • Describe and make use of the basic principles and practices of cost accounting. • Differentiate cost accounting , management accounting and financial accounting • Apply appropriate costing system to determine the cost of various cost objects. • Apply for spoilage, reworked units, and scrap in job and process costing system. • Determine cost of the product or service using job order costing , process costing and Activity Based Costing • Distinguish variable and absorption costing as used in product costing. • Properly account for by products and joint product costs.	
Course Description	Modern businesses needs frequent information about business activities to plan accurately for the future, control business results, and make a proper appraisal of the performance of persons working in an organization. The fulfillment of their goals requires details about the costs incurred and benefits (revenues) obtained which are provided by what is known as "Cost Accounting". In Comparison, financial accounting does not provide management with detailed cost and revenue, information relevant to its needs. The course deals with detailed concepts about cost accounting practices, the theory and techniques of cost accounting. Cost behavior, cost identification and analysis, system for establishing costs, absorption and variable costing, cost allocation, managerial use of cost data, modern costing system (Activity Based Costing) nature and objective of management accounting.	
WEEKS	**Course Contents**	**Reading**
2WEEK **{1ST&2ND**	**1. Introduction** 1.1 Purpose of an accounting system 1.2 The role of an accountant 1.3 Accounting and the management process 1.4 Financial Accounting, cost accounting and Management accounting. 1.5 Cost benefit philosophy and behavioral considerations in management Accounting systems 1.6 Management Accounting in service organizations 1.7 Ethical considerations in Management Accounting	

1 WEEK **{3RD }**	**2. Introduction to cost terms and cost classifications** 2.1 Cost in general 2.2Cost object and cost driver 2.3Cost accumulation, assignment and trailing/Allocation. 2.4Classification of costs	
4WEEKS **{4TH ,5TH ,6TH&7TH }**	**3 Job, process and operation costing** 3.1 Concepts: costing system, cost pool, cost allocation bases 3.2Job order costing system features 3.3Accounting procedures for job order costing system. 3.4Process costing system features 3.5Job order costing system- - illustration 3.6Process costing system 3.6.1. Illustration (WA & FIFO methods) 3.6.2. Spread sheet application of process costing 3.7 Problems of overhead application 3.8Operations costing	
3WEEKS **{8TH,9TH&10TH }**	**4 Spoilage, reworked units and scrap** 4.1 Spoilage, rework and scrap in general 4.2Process costing and spoilage 4.3Job order costing and spoilage 4.4Reworked units 4.5Accounting for scrap	
2WEEKS **{11TH&12TH }**	**5 Income Effect of Alternative product Costing Methods** 5.1 Variable and Absorption Costing 5.2Role of various denominator levels in absorption costing 5.3Adjusting inventories for external reporting	
2WEEKS **{13TH&14TH }**	**6 Cost Allocation** 6.1.Cost Allocation –in General 6.2. General Purpose of Cost Allocation 6.3. Allocation for economic decisions and motivations 6.4. Cost allocation Methods 6.5. The contribution approach to cost allocation	
2WEEKS **{15TH&16TH }**	**7 Cost Allocation-Joint products and by products** 7.1. Concepts – Joint. Byproducts Joint costs 7.2. Allocation of Joint costs 7.3. Accounting for byproducts	
	8 Practical application of cost accounting in Ethiopian manufacturing firms (to be done by students in the form of term paper)	

<table>
<tr><td>Teaching & Learning Methods/strategy</td><td>The teaching and learning methodology include lecturing, discussions, problem solving, and analysis. Take-home assignment will be given at the end of each chapter for submission within a week. Solution to the assignments will be given once assignments are collected. Cases with local relevance will also be given for each chapter for group of students to present in a class room. Practical application of cost accounting in Ethiopian manufacturing firms (to be done by students in the form of term paper). The full and active participation of students is highly encouraged.</td></tr>
<tr><td>Assessment/Evaluation</td><td>The evaluation scheme will be as follows:
<table>
<tr><td>Test 1</td><td>Test 2</td><td>Test 3</td><td>Quiz1</td><td>Assignment 1</td><td>Final</td><td>Total</td></tr>
<tr><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>50%</td><td>100%</td></tr>
</table></td></tr>
<tr><td>Work load in hours</td><td>
<table>
<tr><td colspan="7">Hours Required</td><td rowspan="2">Total Hrs</td></tr>
<tr><td>Lectures</td><td>Lab</td><td>Assessments</td><td>Tutorials</td><td>Self-Studies</td><td>Assignment</td><td>Advising</td></tr>
<tr><td>48</td><td>-</td><td>10</td><td>12</td><td>55</td><td>-</td><td>-</td><td>135</td></tr>
</table></td></tr>
<tr><td>Roles of the Instructor</td><td>He/she will come to the class regularly on time and deliver the lecture in a well-organized manner. Besides, at the end of each class he/she gives reading assignment for the next class. He/she will make sure that proper assessments is given. He/she is also responsible to give feedback for each assessment.</td></tr>
<tr><td>Roles of the students</td><td>The success of this course depends on the students' individual and collective contribution to the class discussions. Students are expected to participate voluntarily, or will be called upon, to contribute to set exercises and problems. Students are also expected to read the assigned readings and prepare the cases before each class so that they could contribute effectively to class discussions. Students must attempt assignments by their own. Proficiency in this course comes from individual knowledge and understanding. Copying the works of others is considered as serious offence and leads to disciplinary actions.</td></tr>
<tr><td>Text and reference books</td><td><u>Text Book:</u>
• Horngren, Datar & Rajan. Cost Accounting: A Managerial Emphasis, 14th Ed. 2012
<u>Reference Books</u>
• Garison. Noreen and Brewer, Managerial Accounting, 13th Ed. 2010
• Gray and Ricketts; "Cost and Managerial Accounting"
• Heltger and Matulich; "Managerial Accounting"
• Moore - Jaedicke- Anderson; "Managerial Accounting"</td></tr>
</table>

Chapter 1: Introduction

Nature of Business and Accounting

A **business** is an organization in which basic resources (inputs), such as materials and labor, are assembled and processed to provide goods or services (outputs) to customers. Businesses come in all sizes, from a local coffee house to big multi-billion multi-national corporations. The objective of most businesses is to earn a profit. **Profit** is the difference between the amounts received from customers for goods or services and the amounts paid for the inputs used to provide the goods or services. In this course material, the focus is on businesses operating to earn a profit. However many of the same concepts and principles also apply to not-for-profit organizations such as hospitals, churches, and government agencies.

The Role of Accounting in Business

What is the role of accounting in business? The simplest answer is that accounting provides information for managers to use in operating the business. In addition, accounting provides information to other users in assessing the economic performance and condition of the business. Thus, **accounting** can be defined as an information system that provides reports to users about the economic activities and condition of a business. You may think of accounting as the "language of business." This is because accounting is the means by which businesses' financial information is communicated to users.

The process by which accounting provides information to users is as follows:

1. Identify users.
2. Assess users' information needs.
3. Design the accounting information system to meet users' needs.
4. Record economic data about business activities and events.
5. Prepare accounting reports for users.

As illustrated in Exhibit 1, users of accounting information can be divided into two groups: internal users and external users.

Internal users of accounting information include managers and employees. These users are directly involved in managing and operating the business. The area of accounting that provides internal users with information is called **managerial accounting** or **management accounting**. The objective of managerial accounting is to provide relevant and timely

information for managers' and employees' decision-making needs. Often times, such information is sensitive and is not distributed outside the business. Examples of sensitive information might include information about customers, prices, and plans to expand the business. Managerial accountants employed by a business are employed in **private accounting**.

External users of accounting information include customers, creditors, and the government. These users are not directly involved in managing and operating the business. The area of accounting that provides external users with information is called **financial accounting**. The objective of financial accounting is to provide relevant and timely information for the decision-making needs of users outside of the business. For example, financial reports on the operations and condition of the business are useful for banks and other creditors in deciding whether to lend money to the business. **General-purpose financial statements** are one type of financial accounting report that is distributed to external users. The term *general-purpose* refers to the wide range of decision-making needs that these reports are designed to serve.

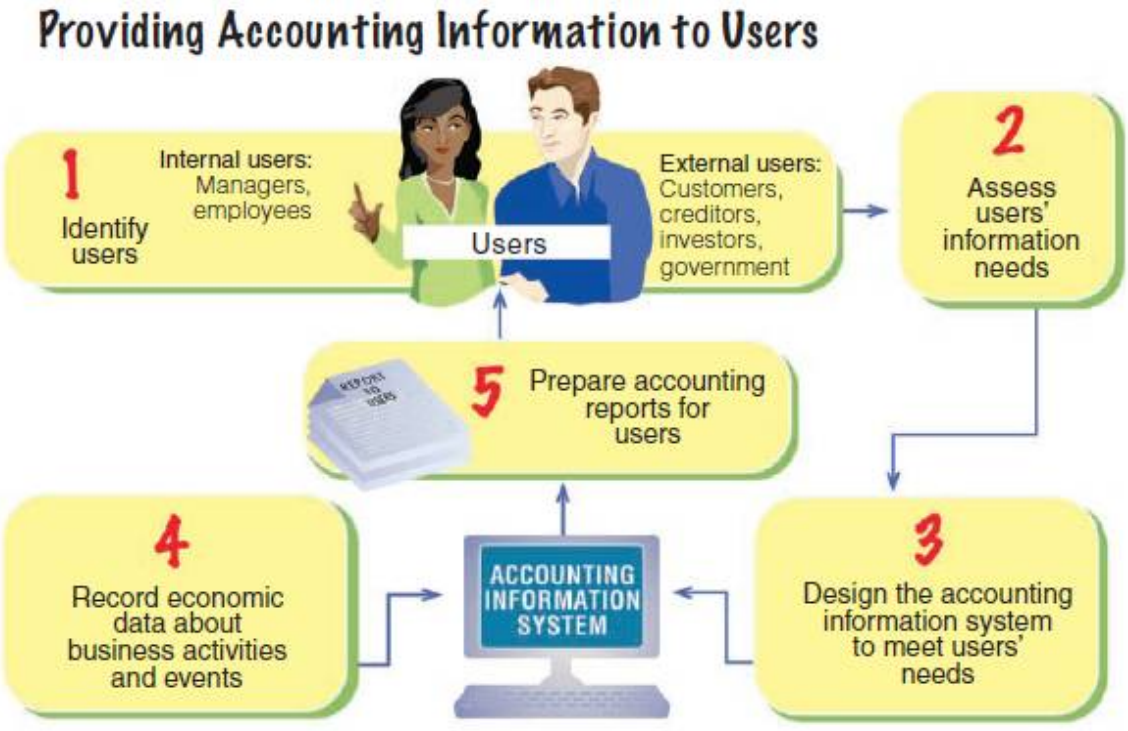


Exhibit 1: Users of Accounting Information

Role of Ethics in Accounting and Business

The objective of accounting is to provide relevant, timely information for user decision making. Accountants must behave in an ethical manner so that the information they provide will be trustworthy and, thus, useful for decision making. Managers and employees must also behave in an ethical manner in managing and operating a business. Otherwise, no one will be willing to invest in or loan money to the business.

Ethics are moral principles that guide the conduct of individuals. Unfortunately, business managers and accountants sometimes behave in an unethical manner. Our world has witnessed a number of managers of big companies (mainly in the developed world) being engaged in accounting or business fraud. These ethical violations led to fines, firings, and lawsuits. In some cases, managers were criminally prosecuted, convicted, and sent to prison. Though there might be a number of reasons, here are two commonly cited reasons.

Failure of Individual Character. An ethical manager, and accountant is honest and fair. However, managers and accountants often face pressures from supervisors to meet company and investor expectations. In many of the instances, managers and accountants justified small ethical violations to avoid such pressures. However, these small violations became big violations as the company's financial problems became worse.

Culture of Greed and Ethical Indifference. By their behavior and attitude, senior managers set the company culture. In most of the companies that showed ethical violation, the senior managers created a culture of greed and indifference to the truth.

Financial Accounting, Management Accounting, and Cost Accounting

As you may know from your Principles of Accounting course, accounting systems take economic events and transactions, such as sales and materials purchases, and process the data into information helpful to managers, sales representatives, production supervisors, and others. Processing any economic transaction means collecting, categorizing, summarizing, and analyzing. For example, costs are collected by category, such as materials, labor, and shipping. These costs are then summarized to determine total costs by month, quarter, or year. The results are analyzed to evaluate, say, how costs have changed relative to revenues from one period to the next.

Accounting systems provide the information found in the income statement, the balance sheet, the statement of cash flow, and in performance reports, such as the cost of serving customers or running an advertising campaign. Managers use accounting information to administer the activities, businesses, or functional areas they oversee and to coordinate those activities, businesses, or functions within the framework of the organization. Understanding this information is essential for managers to do their jobs.

Individual managers often require the information in an accounting system to be presented or reported differently. Consider, for example, sales order information. A sales manager may be interested in the total dollar amount of sales to determine the commissions to be paid. A distribution manager may be interested in the sales order quantities by geographic region and by customer-requested delivery dates to ensure timely deliveries.
A manufacturing manager may be interested in the quantities of various products and their desired delivery dates, so that he or she can develop an effective production schedule. To simultaneously serve the needs of all three managers, companies create a database—sometimes called a data warehouse or infobarn—consisting of small, detailed bits of information that can be used for multiple purposes. For instance, the sales order database will contain detailed information about product, quantity ordered, selling price, and delivery details (place and date) for each sales order. The database stores information in a way that allows different managers to access the information they need.

Many companies are building their own Enterprise Resource Planning (ERP) systems, single databases that collect data and feed it into applications that support the company's business activities, such as purchasing, production, distribution, and sales.

Financial accounting and management accounting have different goals. As you may have seen it already, **financial accounting** focuses on reporting to external parties such as investors, government agencies, banks, and suppliers. It measures and records business transactions and provides financial statements that are based on either International Financial Reporting Standards (IFRS) or Generally Accepted Accounting Principles (GAAP). The most important way that financial accounting information affects managers' decisions and actions is through compensation, which is often, in part, based on numbers in financial statements.

Management accounting measures, analyzes, and reports financial and nonfinancial information that helps managers make decisions to fulfill the goals of an organization.
Managers use management accounting information to develop, communicate, and implement strategy. They also use management accounting information to coordinate product design, production, and marketing decisions and to evaluate performance.

Management accounting information and reports do not have to follow set principles or rules. The key questions are always (1) how will this information help managers do their jobs better, and (2) do the benefits of producing this information exceed the costs?
Exhibit 2 summarizes the major differences between management accounting and financial accounting. Note, however, that reports such as balance sheets, income statements, and statements of cash flows are common to both management accounting and financial accounting.

Cost accounting provides information for management accounting and financial accounting. **Cost accounting** measures, analyzes, and reports financial and nonfinancial information relating to the costs of acquiring or using resources in an organization. For example, calculating the cost of a product is a cost accounting function that answers financial accounting's inventory-valuation needs and management accounting's decision-making needs (such as deciding how to price products and choosing which products to promote). Modern cost accounting takes the perspective that collecting cost information is a function of the management decisions being made. Thus, the distinction between management accounting and cost accounting is not so clear-cut, and we often use these terms interchangeably in the book.
We frequently hear business people use the term *cost management*. Unfortunately, that term has no uniform definition. We use **cost management** to describe the approaches and activities of managers to use resources to increase value to customers and to achieve organizational goals. Cost management decisions include decisions such as whether to enter new markets, implement new organizational processes, and change product designs.
Information from accounting systems helps managers to manage costs, but the information and the accounting systems themselves are not cost management.

Cost management has a broad focus and is not only about reduction in costs. Cost management includes decisions to incur additional costs, for example to improve customer satisfaction and quality and to develop new products, with the goal of enhancing revenues and profits.

Why is Management/managerial accounting important?

As explained earlier, **Managerial accounting** is concerned with providing information to managers for use within the organization. It recognizes that the fundamental difference between financial and managerial accounting is that financial accounting serves the needs of those *outside* the organization, whereas managerial accounting serves the needs of managers employed *inside* the organization. Because of this fundamental difference in users, financial accounting emphasizes the financial consequences of past activities, objectivity and verifiability, precision, and companywide performance, whereas managerial accounting emphasizes decisions affecting the future, relevance, timeliness, and *segment* performance. A **segment** is a part or activity of an organization about which managers would like cost, revenue, or profit data. Examples of business segments include product lines, customer groups (segmented by age, ethnicity, gender, volume of purchases, etc.), geographic territories, divisions, plants, and departments. Finally, financial accounting is mandatory for external reports and it needs to comply with rules, such as international financial reporting standards (IFRS) or generally accepted accounting principles (GAAP), whereas managerial accounting is not mandatory and it does not need to comply with externally imposed rules.

Generally managerial accounting helps managers perform three vital activities— *planning, controlling,* and *decision making.* **Planning** involves establishing goals and specifying how to achieve them. **Controlling** involves gathering feedback to ensure that the plan is being properly executed or modified as circumstances change. **Decision making** involves selecting a course of action from competing alternatives. Now let's take a closer look at these three pillars of managerial accounting.

Planning

Assume that you work for Mesobo Cement Factory (MCF) and that you are in charge of the company's campus recruiting for all undergraduate business majors. In this example, your planning process would begin by establishing a goal such as: our goal is to recruit the "best and brightest" college graduates. The next stage of the planning process would require specifying how to achieve this goal by answering numerous questions such as:

- How many students do we need to hire in total and from each major?
- What schools do we plan to include in our recruiting efforts?
- Which of our employees will be involved in each school's recruiting activities?
- When will we conduct our interviews?
- How will we compare students to one another to decide who will be extended job offers?
- What salary will we offer our new hires? Will the salaries differ by major?
- How much money can we spend on our recruiting efforts?

As you can see, there are many questions that need to be answered as part of the planning process. Plans are often accompanied by a *budget.* A **budget** is a detailed plan for the future that is usually expressed in formal quantitative terms. As the head of recruiting at MCF, your budget would include two key components. First, you would have to work with other senior managers inside the company to establish a budgeted amount of total salaries that can be offered to all new hires. Second, you would have to create a budget that quantifies how much you intend to spend on your campus recruiting activities.

Controlling

Once you established and started implementing MCF's recruiting plan, you would transition to the control process. This process would involve gathering, evaluating, and responding to feedback to ensure that this year's recruiting process meets expectations.

It would also include evaluating the feedback in search of ways to run a more effective recruiting campaign next year. The control process would involve answering questions such as:

- Did we succeed in hiring the planned number of students within each major and at each school?

- Did we lose too many exceptional candidates to competitors?
- Did each of our employees involved in the recruiting process perform satisfactorily?
- Is our method of comparing students to one another working?
- Did the on-campus and office interviews run smoothly?
- Did we stay within our budget in terms of total salary commitments to new hires?
- Did we stay within our budget regarding spending on recruiting activities?

As you can see, there are many questions that need to be answered as part of the control process. When answering these questions your goal would be to go beyond simple yes or no answers in search of the underlying reasons why performance exceeded or failed to meet expectations. Part of the control process includes preparing *performance reports.* A **performance report** compares budgeted data to actual data in an effort to identify and learn from excellent performance and to identify and eliminate sources of unsatisfactory performance. Performance reports can also be used as one of many inputs to help evaluate and reward employees.

Although this example focused on MCF's campus recruiting efforts, we could have described how planning enables TransEthiopia S.Co. to efficiently transport goods from Djibouti port to different parts of the country; or see how the control process in Mesebo Cement Factory helps meet the quality standards. In short, all managers (and that probably includes you someday) perform planning and controlling activities.

Decision Making

Perhaps the most basic managerial skill is the ability to make intelligent, data-driven decisions. Broadly speaking, many of those decisions revolve around the following three questions: *What* should we be selling? *Who* should we be serving? *How* should we execute?

For example, Mesebo Cement Factory must decide which one of its five products should be produced most. Whether a new product should be introduced? In which markets (areas) to sell its products? Whether it has to open sales outlet or branch in a certain area or else close an existing one? Commercial Bank of Ethiopia must decide whether to open a new branch in a certain locality? Ethiopian Airlines must do similar decisions every year in determining new

flight destinations. It must also decide what ticket prices to establish for each of its hundreds of flights per day.

All companies have to decide among competing improvement opportunities. For example, a company may have to decide whether to implement a new software system, to upgrade a piece of equipment, or to provide extra training to its employees. This portion of the chapter has explained that the three pillars of managerial accounting are planning, controlling, and decision making. And the discussions in this course should help you prepare in becoming an effective manager in the future by explaining how to make intelligent data-driven decisions, how to create financial plans for the future, and how to continually make progress toward achieving goals by obtaining, evaluating, and responding to feedback.

Major differences between Managerial and Financial Accounting

	Financial Accounting	**Managerial Accounting**
Purpose of information	Communicate organization's financial position and performance to: Owners, creditors, tax authorities, regulators (reports to those outside the organization)	Help managers make decisions to fulfill an organization's goals (Reports to managers inside the organization for: planning, controlling, and decision making)
Focus of emphasis	Emphasizes financial consequences of past activities (past oriented)	Emphasizes decision affecting the future (future oriented)
Reliability vs relevance	Emphasizes objectivity and verifiability	Emphasizes relevance
Precision vs timeliness	Emphasizes precision	Emphasizes timeliness
Type of report (Scope)	Emphasizes companywide reports	Emphasizes segment reports (reports on products, departments, territories, and strategies)
Rules of measurement and reporting	Must follow IFRS/GAAP	Need not follow IFRS/GAAP
Mandatory?	Mandatory for external reports	Not mandatory
Time span	Annual and quarterly financial reports	Varies from hourly information to 15 to 20 years

Discussion Questions

1. How is management accounting different from financial accounting?
2. How do management accountants support strategic decisions?
3. What are the ethical responsibilities of management accountants?
4. “Management accounting deals only with costs.” Do you agree? Explain.
5. Distinguish planning decisions from control decisions.

Chapter 2: Basic Cost Concepts

Learning Objectives

- To understand the meaning of different costing terms
- To understand different costing methods
- To have a basic idea of different costing techniques
- To understand the meaning of cost sheet

In order to determine and take a dispassionate view about what lies beneath the surface of accounting figures, a financial analyst has to make use of different management accounting techniques. Cost techniques have a precedence over the other techniques since accounting treatment of cost is often both complex and financially significant. For example, if a firm proposes to increase its output by 10%, is it reasonable to expect total cost to increase by less than 10%, exactly 10% or more than 10%? Such questions are concerned with the cost behavior, i.e. the way costs change with the levels of activity. The answers to these questions are very much pertinent for a management accountant or a financial analyst since they are basic for a firm's projections and profits which ultimately become the basis of all financial decisions. It is, therefore, necessary for a financial analyst to have a reasonably good working knowledge about the basic cost concepts and patterns of cost behavior. All these come within the ambit of cost accounting.

Meaning of Cost Accounting

Previously, cost accounting was merely considered to be a technique for the ascertainment of costs of products or services on the basis of historical data. In course of time, due to competitive nature of the market, it was realized that ascertaining of cost is not so important as controlling costs. Hence, cost accounting started to be considered more as a technique for cost control as compared to cost ascertainment. Due to the technological developments in all fields, cost reduction has also come within the ambit of cost accounting. Cost accounting is, thus, concerned with recording, classifying and summarizing costs for determination of costs of products or services, planning, controlling and reducing such costs and furnishing of information to management for decision making.

According to Charles T. Horngren, cost accounting is a quantitative method that accumulates, classifies, summarizes and interprets information for the following three major purposes:

- Operational planning and control
- Special decisions
- Product decisions

According to the Chartered Institute of Management Accountants, London, cost accounting is the process of accounting for costs from the point at which its expenditure is incurred or committed to the establishment of the ultimate relationship with cost units. In its widest sense, it embraces the preparation of statistical data, the application of cost control methods and the ascertainment of the profitability of the activities carried out or planned.

Cost accounting, thus, provides various information to management for all sorts of decisions. It serves multiple purposes on account of which it is generally indistinguishable from management accounting or so-called internal accounting. Wilmot has summarized the nature of cost accounting as "the analyzing, recording, standardizing, forecasting, comparing, reporting and recommending" and the role of a cost accountant as "a historian, news agent and prophet." As a historian, he should be meticulously accurate and sedulously impartial. As a news agent, he should be up to date, selective and pithy. As a prophet, he should combine knowledge and experience with foresight and courage.

Objectives of Cost Accounting

The main objectives of cost accounting can be summarized as follows:

1. **Determining Selling Price**

   Business enterprises run on a profit-making basis. It is, thus, necessary that revenue should be greater than expenditure incurred in producing goods and services from which the revenue is to be derived. Cost accounting provides various information regarding the cost to make and sell such products or services. Of course, many other factors such as the condition of market, the area of distribution, the quantity which can be supplied etc. are also given due consideration by management before deciding upon the price but the cost plays a dominating role.

2. **Determining and Controlling Efficiency**

Cost accounting involves a study of various operations used in manufacturing a product or providing a service. The study facilitates measuring the efficiency of an organization as a whole or department-wise as well as devising means of increasing efficiency.

Cost accounting also uses a number of methods, e.g., budgetary control, standard costing etc. for controlling costs. Each item viz. materials, labor and expenses is budgeted at the commencement of a period and actual expenses incurred are compared with budget. This greatly increases the operating efficiency of an enterprise.

3. **Facilitating Preparation of Financial and Other Statements**

The third objective of cost accounting is to produce statements whenever is required by management. The financial statements are prepared under financial accounting generally once a year or half-year and are spaced too far with respect to time to meet the needs of management. In order to operate a business at a high level of efficiency, it is essential for management to have a frequent review of production, sales and operating results. Cost accounting provides daily, weekly or monthly volumes of units produced and accumulated costs with appropriate analysis. A developed cost accounting system provides immediate information regarding stock of raw materials, work-in-progress and finished goods. This helps in speedy preparation of financial statements.

4. **Providing Basis for Operating Policy**

Cost accounting helps management to formulate operating policies. These policies may relate to any of the following matters:

- Determination of a cost-volume-profit relationship
- Shutting down or operating at a loss
- Making for or buying from outside suppliers
- Continuing with the existing plant and machinery or replacing them by improved and economic ones

Concept of Cost

Cost accounting is concerned with cost and therefore is necessary to understand the meaning of term cost in a proper perspective.

In general, cost means the amount of expenditure (actual or notional) incurred on, or attributable to a given thing.

However, the term cost cannot be exactly defined. Its interpretation depends upon the following factors:

- The nature of business or industry
- The context in which it is used

In a business where selling and distribution expenses are quite nominal the cost of an article may be calculated without considering the selling and distribution overheads. At the same time, in a business where the nature of a product requires heavy selling and distribution expenses, the calculation of cost without taking into account the selling and distribution expenses may prove very costly to a business. The cost may be factory cost, office cost, cost of sales and even an item of expense. For example, prime cost includes expenditure on direct materials, direct labor and direct expenses. Money spent on materials is termed as cost of materials just like money spent on labor is called cost of labor and so on. Thus, the use of term cost without understanding the circumstances can be misleading.

Different costs are found for different purposes. The work-in-progress is valued at factory cost while stock of finished goods is valued at office cost. Numerous other examples can be given to show that the term "cost" does not mean the same thing under all circumstances and for all purposes. Many items of cost of production are handled in an optional manner which may give different costs for the same product or job without going against the accepted principles of cost accounting. Depreciation is one of such items. Its amount varies in accordance with the method of depreciation being used. However, endeavor should be, as far as possible, to obtain an accurate cost of a product or service.

Elements of Cost

Broadly speaking costs could, among other things, be classified as manufacturing and non-manufacturing costs.

Manufacturing Costs

Most manufacturing companies separate manufacturing costs into three broad categories: direct materials, direct labor, and manufacturing overhead. A discussion of each of these categories follows.

Direct Materials

- The materials that go into the final product are called **raw materials**

This term is somewhat misleading because it seems to imply unprocessed natural resources like wood pulp or iron ore. Actually, raw materials refer to any materials that are used in the final product; and the finished product of one company can become the raw materials of another company. For example, the plastics produced by Du Pont (chemical company) are a raw material used by Hewlett-Packard in the manufacturing of its personal computers.

Raw materials may include both *direct* and *indirect materials*. **Direct materials** are those materials that become an integral part of the finished product and whose costs can be conveniently traced to the finished product. This would include, for example, the seats that Airbus purchases from subcontractors to install in its commercial aircraft and the tiny electric motor Panasonic uses in its DVD players.

Sometimes it isn't worth the effort to trace the costs of relatively insignificant materials to end products. Such minor items would include the solder used to make electrical connections in a Sony TV or the glue used to assemble 3F Company's arm-chair. Materials such as solder and glue are called **indirect materials** and are included as part of manufacturing overhead, which is discussed later in this section.

Direct Labor

Direct labor consists of labor costs that can be easily (i.e., physically and conveniently) traced to individual units of product. Direct labor is sometimes called *touch labor* because direct labor workers typically touch the product while it is being made. Examples of direct labor include assembly-line workers at Toyota car manufacturing company, carpenters at a local furniture factory, and electricians who install equipment on automobile in Mesfin Industrial Engineering (MIE) in its automobile assembly plant.

Labor costs that cannot be physically traced to particular products, or that can be traced only at great cost and inconvenience, are termed **indirect labor.** Just like indirect materials, indirect labor is treated as part of manufacturing overhead. Indirect labor includes the labor costs of janitors, supervisors, materials handlers, and night security guards. Although the efforts of these workers are essential, it would be either impractical or impossible to accurately trace their costs to specific units of product. Hence, such labor costs are treated as indirect labor.

Manufacturing Overhead

Manufacturing overhead, the third element of manufacturing cost, includes all manufacturing costs except direct materials and direct labor. Manufacturing overhead includes items such as indirect materials; indirect labor; maintenance and repairs on production equipment; and heat and light, property taxes, depreciation, and insurance on manufacturing facilities. A company also incurs costs for heat and light, property taxes, insurance, depreciation, and so forth, associated with its selling and administrative functions, but these costs are not included as part of manufacturing overhead. Only those costs associated with *operating the factory* are included in manufacturing overhead.

Various names are used for manufacturing overhead, such as *indirect manufacturing cost, factory overhead,* and *factory burden.* All of these terms are synonyms for *manufacturing overhead.*

Nonmanufacturing Costs

Nonmanufacturing costs are often divided into two categories: (1) *selling costs* and (2) *administrative costs.*

Selling costs include all costs that are incurred to secure customer orders and get the finished product to the customer. These costs are sometimes called *order-getting* and *order-filling costs.* Examples of selling costs include advertising, shipping, sales travel, sales commissions, sales salaries, and costs of finished goods warehouses.

Administrative costs include all costs associated with the *general management* of an organization rather than with manufacturing or selling. Examples of administrative costs include executive compensation, general accounting, secretarial, public relations, and similar costs involved in the overall, general administration of the organization *as a whole.*

Nonmanufacturing costs are also often called selling, general, and administrative (SG&A) costs or just selling and administrative costs.

In addition to classifying costs as manufacturing or nonmanufacturing costs, there are other ways to look at costs. For instance, they can also be classified as either *product costs* or *period costs.* To understand the difference between product costs and period costs, we must first discuss the matching principle from financial accounting.

Generally, costs are recognized as expenses on the income statement in the period that benefits from the cost. For example, if a company pays for liability insurance in advance for two years, the entire amount is not considered an expense of the year in which the payment is made. Instead, one-half of the cost would be recognized as an expense each year. The reason is that both years—not just the first year—benefit from the insurance payment. The unexpensed portion of the insurance payment is carried on the balance sheet as an asset called prepaid insurance.

The *matching principle* is based on the *accrual* concept that *costs incurred to generate a particular revenue should be recognized as expenses in the same period that the revenue is recognized.* This means that if a cost is incurred to acquire or make something that will eventually be sold, then the cost should be recognized as an expense only when the sale takes place—that is, when the benefit occurs. Such costs are called *product costs.*

Product Costs

For financial accounting purposes, **product costs** include all costs involved in acquiring or making a product. In the case of manufactured goods, these costs consist of direct materials, direct labor, and manufacturing overhead. Product costs "attach" to units of product as the goods are purchased or manufactured, and they remain attached as the goods go into inventory awaiting sale. Product costs are initially assigned to an inventory account on the balance sheet. When the goods are sold, the costs are released from inventory as expenses (typically called cost of goods sold) and matched against sales revenue. Because product costs are initially assigned to inventories, they are also known as **inventoriable costs.**

We want to emphasize that product costs are not necessarily treated as expenses in the period in which they are incurred. Rather, as explained above, they are treated as expenses in the period in which the related products *are sold.*

Period Costs

Period costs are all the costs that are not product costs. *All selling and administrative expenses are treated as period costs.* For example, sales commissions, advertising, executive

salaries, public relations, and the rental costs of administrative offices are all period costs. Period costs are not included as part of the cost of either purchased or manufactured goods; instead, period costs are expensed on the income statement in the period in which they are incurred using the usual rules of accrual accounting. Keep in mind that the period in which a cost is incurred is not necessarily the period in which cash changes hands. For example, as discussed earlier, the costs of liability insurance are spread across the periods that benefit from the insurance—regardless of the period in which the insurance premium is paid.

Prime Cost and Conversion Cost

Two more cost categories are often used in discussions of manufacturing costs— *prime cost* and *conversion cost.* **Prime cost** is the sum of direct materials cost and direct labor cost. **Conversion cost** is the sum of direct labor cost and manufacturing overhead cost. The term *conversion cost* is used to describe direct labor and manufacturing overhead because these costs are incurred to convert materials into the finished product.

Cost Sheet

Cost sheet is a document that provides for the assembly of an estimated detailed cost in respect of cost centers and cost units. It analyzes and classifies in a tabular form the expenses on different items for a particular period. Additional columns may also be provided to show the cost of a particular unit pertaining to each item of expenditure and the total per unit cost.

Cost sheet may be prepared on the basis of actual data (historical cost sheet) or on the basis of estimated data (estimated cost sheet), depending on the technique employed and the purpose to be achieved.

The techniques of preparing a cost sheet can be understood with the help of the following examples.

Example 1

Following information has been obtained from the records of ABC Corporation for the period from June 1 to June 30, 2019.

Cost of raw materials on June 1, 2019	30,000
Purchase of raw materials during the month	450,000
Wages paid	230,000
Factory overheads	92,000
Cost of work in progress on June 1, 2019	12,000
Cost of raw materials on June 30, 2019	15,000
Cost of stock of finished goods on June 1, 2019	60,000
Cost of stock of finished goods on June 30, 2019	55,000
Selling and distribution overheads	20,000
Sales	900,000
Administration overheads	30,000

Prepare a statement of cost.

Solution

Statement of cost of production of goods manufactured for the period ending on June 30, 2019.

Opening stock of raw materials Add: Purchase of raw materials	30,000 450,000	
Cost of raw materials available for use Less: cost of raw materials at end	480,000 (15,000)	
Cost of raw materials consumed Wages paid		465,000 230,000
Prime Cost Factory overheads		695,000 92,000
Total manufacturing costs		787,000
Cost of work in progress, June 1, 2019 Total manufacturing costs for June		12,000 787,000
Total manufacturing to date		799,000

Continued...

Total manufacturing to date Less: Cost of work in progress, June 30, 2019		799,000 0
Cost of goods manufactured during June, 2019 Plus: Cost of stock of finished goods, June 1, 2019		799,000 60,000
Cost of finished goods available for sale in June Less: Cost of stock of finished goods, June 30, 2019		859,000 55,000
Cost of production of the goods sold		804,000

Total Sales for June Less: Cost of production of goods sold Administrative overhead Selling and Distributions overhead	804,000 30,000 20,000	900,000 (854,000)
Net income (profit)		46,000

Example 2

From the following information, prepare a cost sheet showing the total cost per ton for the period ended on December 31, 2019.

Raw materials	33,000	Rent and taxes (office)	500
Productive wages	35,000	Water supply	1,200
Direct expenses	3,000	Factory insurance	1,100
Unproductive wages	10,500	Office insurance	500
Factory rent and taxes	2,200	Legal expenses	400
Factory lighting	1,500	Rent of warehouse	300
Factory heating	4,400	Depreciation--	
Motive power Haulage	3,000	Plant and machinery	2,000
Director's fees (works)	1,000	Office building	1,000
Directors fees (office)	2,000	Delivery vans	200
Factory cleaning	500	Bad debt	100
Sundry office expenses	200	Advertising	300
Expenses	800	Sales department salaries	1,500

Factory stationery	750	Up keeping of delivery vans	700
Office stationery	900	Bank charges	50
Loose tools written off	600	Commission on sales	1,500

The total output for the period has been 10000 tons.

Classification of Cost

Cost may also be classified into different categories depending upon the purpose of classification. Some of the important categories in which the costs are classified are as follows:

1. Fixed, Variable and Semi-Variable Costs

The cost which varies in total, directly in proportion with every increase or decrease in the volume of activity, output or production is known as variable cost. Variable cost, however, remains constant per unit. Some of its examples are as follows:

- Wages of laborers
- Cost of direct material
- Power

The cost which does not vary (in total) but remains constant within a given period of time and a range of activity in spite of the fluctuations in production is known as fixed cost. Some of its examples are as follows:

- Rent or rates
- Insurance charges
- Management salary

The cost which does not vary proportionately but simultaneously does not remain stationary at all times is known as semi-variable cost. It can also be named as semi-fixed cost. Some of its examples are as follows:

- Depreciation
- Repairs

Fixed costs are sometimes referred to as "period costs" and variable costs as "direct costs" in system of direct costing. Fixed costs can be further classified into:

- Committed fixed costs
- Discretionary fixed costs

Committed fixed costs consist largely of those fixed costs that arise from the possession of plant, equipment and a basic organization structure. For example, once a building is erected and a plant is installed, nothing much can be done to reduce the costs such as depreciation, property taxes, insurance and salaries of the key personnel etc. without impairing an organization's competence to meet the long-term goals.

Discretionary fixed costs are those which are set at fixed amount for specific time periods by the management in budgeting process. These costs directly reflect the top management policies and have no particular relationship with volume of output. These costs can, therefore, be reduced or entirely eliminated as demanded by the circumstances. Examples of such costs are research and development costs, training costs, advertising and sales promotion costs, donations, management consulting fees etc. These costs are also termed as managed or programmed costs.

In some circumstances, variable costs are classified into the following:

- Discretionary cost
- Engineered cost

The term discretionary costs is generally linked with the class of fixed cost. However, in the circumstances where management has predetermined that the organization would spend a certain percentage of its sales for the items like research, donations, sales promotion etc., discretionary costs will be of a variable character.

Engineered variable costs are those variable costs which are directly related to the production or sales level. These costs exist in those circumstances where specific relationship exists between input and output. For example, in an automobile industry there may be exact specifications as one radiator, two fan belts, one battery etc. would be required for one car. In a case where more than one car is to be produced, various inputs will have to be increased in the direct proportion of the output.

Thus, an increase in discretionary variable costs is due to the authorization of management whereas an increase in engineered variable costs is due to the volume of output or sales.

2. Product Costs and Period Costs

The costs which are a part of the cost of a product rather than an expense of the period in which they are incurred are called as "product costs." They are included in inventory values. In financial statements, such costs are treated as assets until the goods they are assigned to are

sold. They become an expense at that time. These costs may be fixed as well as variable, e.g., cost of raw materials and direct wages, depreciation on plant and equipment etc.

The costs which are not associated with production are called period costs. They are treated as an expense of the period in which they are incurred. They may also be fixed as well as variable. Such costs include general administration costs, salaries salesmen and commission, depreciation on office facilities etc. They are charged against the revenue of the relevant period. Differences between opinions exist regarding whether certain costs should be considered as product or period costs. Some accountants feel that fixed manufacturing costs are more closely related to the passage of time than to the manufacturing of a product. Thus, according to them variable manufacturing costs are product costs whereas fixed manufacturing and other costs are period costs. However, their view does not seem to have been yet widely accepted.

3. Direct and Indirect Costs

The expenses incurred on material and labor which are economically and easily traceable for a product, service or job are considered as direct costs. In the process of manufacturing of production of articles, materials are purchased, laborers are employed and the wages are paid to them. Certain other expenses are also incurred directly. All of these take an active and direct part in the manufacture of a particular commodity and hence are called direct costs.

The expenses incurred on those items which are not directly chargeable to production are known as indirect costs. For example, salaries of timekeepers, storekeepers and foremen. Also certain expenses incurred for running the administration are the indirect costs. All of these cannot be conveniently allocated to production and hence are called indirect costs.

4. Decision-Making Costs and Accounting Costs

Decision-making costs are special purpose costs that are applicable only in the situation in which they are compiled. They have no universal application. They need not tie into routine-financial accounts. They do not and should not conform the accounting rules. Accounting costs are compiled primarily from financial statements. They have to be altered before they can be used for decision-making. Moreover, they are historical costs and show what has happened under an existing set of circumstances. Decision-making costs are future costs. They represent what is expected to happen under an assumed set of conditions. For example, accounting costs

may show the cost of a product when the operations are manual whereas decision-making cost might be calculated to show the costs when the operations are mechanized.

5. Relevant and Irrelevant Costs

Relevant costs are those which change by managerial decision. Irrelevant costs are those which do not get affected by the decision. For example, if a manufacturer is planning to close down an unprofitable retail sales shop, this will affect the wages payable to the workers of a shop. This is relevant in this connection since they will disappear on closing down of a shop. But prepaid rent of a shop or unrecovered costs of any equipment which will have to be scrapped are irrelevant costs which should be ignored.

6. Shutdown and Sunk Costs

A manufacturer or an organization may have to suspend its operations for a period on account of some temporary difficulties, e.g., shortage of raw material, non-availability of requisite labor etc. During this period, though no work is done yet certain fixed costs, such as rent and insurance of buildings, depreciation, maintenance etc., for the entire plant will have to be incurred. Such costs of the idle plant are known as shutdown costs.

Sunk costs are historical or past costs. These are the costs which have been created by a decision that was made in the past and cannot be changed by any decision that will be made in the future. Investments in plant and machinery, buildings etc. are prime examples of such costs. Since sunk costs cannot be altered by decisions made at the later stage, they are irrelevant for decision-making.

An individual may regret for purchasing or constructing an asset but this action could not be avoided by taking any subsequent action. Of course, an asset can be sold and the cost of the asset will be matched against the proceeds from sale of the asset for the purpose of determining gain or loss. The person may decide to continue to own the asset. In this case, the cost of asset will be matched against the revenue realized over its effective life. However, he/she cannot avoid the cost which has already been incurred by him/her for the acquisition of the asset. It is, as a matter of fact, sunk cost for all present and future decisions.

Example

Jolly Ltd. purchased a machine for $30,000. The machine has an operating life of five years without any scrap value. Soon after making the purchase, management feels that the machine should not have been purchased since it is not yielding the operating advantage originally contemplated. It is expected to result in savings in operating costs of $18,000 over a period of five years. The machine can be sold immediately for $22,000.

To take the decision whether the machine should be sold or be used, the relevant amounts to be compared are $18,000 in cost savings over five years and $22,000 that can be realized in case it is immediately disposed. $30,000 invested in the asset is not relevant since it is same in both the cases. The amount is the sunk cost. Jolly Ltd., therefore, sold the machinery for $22,000 since it would result in an extra profit of $4,000 as compared to keeping and using it.

7. Controllable and Uncontrollable Costs

Controllable costs are those costs which can be influenced by the ratio or a specified member of the undertaking. The costs that cannot be influenced like this are termed as uncontrollable costs.

A factory is usually divided into a number of responsibility centers, each of which is in charge of a specific level of management. The officer in charge of a particular department can control costs only of those matter which come directly under his control, not of other matter. For example, the expenditure incurred by tool room is controlled by the foreman in charge of that section but the share of the tool room expenditure which is apportioned to a machine shop cannot be controlled by the foreman of that shop. Thus, the difference between controllable and uncontrollable costs is only in relation to a particular individual or level of management. The expenditure which is controllable by an individual may be uncontrollable by another individual.

8. Avoidable or Escapable Costs and Unavoidable or Inescapable Costs

Avoidable costs are those which will be eliminated if a segment of a business (e.g., a product or department) with which they are directly related is discontinued. Unavoidable costs are those which will not be eliminated with the segment. Such costs are merely reallocated if the segment is discontinued. For example, in case a product is discontinued, the salary of a factory

manager or factory rent cannot be eliminated. It will simply mean that certain other products will have to absorb a large amount of such overheads. However, the salary of people attached to a product or the bad debts traceable to a product would be eliminated. Certain costs are partly avoidable and partly unavoidable. For example, closing of one department of a store might result in decrease in delivery expenses but not in their altogether elimination.

It is to be noted that only avoidable costs are relevant for deciding whether to continue or eliminate a segment of a business.

9. Imputed or Hypothetical Costs

These are the costs which do not involve cash outlay. They are not included in cost accounts but are important for taking into consideration while making management decisions. For example, interest on capital is ignored in cost accounts though it is considered in financial accounts. In case two projects require unequal outlays of cash, the management should take into consideration the capital to judge the relative profitability of the projects.

10. Differentials, Incremental or Decrement Cost

The difference in total cost between two alternatives is termed as differential cost. In case the choice of an alternative results in an increase in total cost, such increased costs are known as incremental costs. While assessing the profitability of a proposed change, the incremental costs are matched with incremental revenue. This is explained with the following example:

Example

A company is manufacturing 1,000 units of a product. The present costs and sales data are as follows:

Selling price per unit	$ 10
Variable cost per unit	$ 5
Fixed costs	$ 4,000

The management is considering the following two alternatives:

i. To accept an export order for another 200 units at $8 per unit. The expenditure of the export order will increase the fixed costs by $500.

ii. To reduce the production from present 1,000 units to 600 units and buy another 400 units from the market at $6 per unit. This will result in reducing the present fixed costs from $4,000 to $3,000.

Which alternative the management should accept?

Solution

Statement showing profitability under different alternatives is as follows:

Particulars	Present situation		Proposed situations			
	$.	$.				
Sales.		10,000	6,000	11,600	5,400	10,000
Less:						
Variable purchase costs	5,000		4,500	10,500	3,000	8,400
Fixed costs	4,000	9,000				
Profit		1,000		1,100		1,600

Observations

i. In the present situation, the company is making a profit of $1,000.

ii. In the proposed situation (i), the company will make a profit of $1,100. The incremental costs will be $1,500 (i.e. $10,500 - $9,000) and the incremental revenue (sales) will be $1,600. Hence, there is a net gain of $100 under the proposed situation as compared to the existing situation.

iii. In the proposed situation (ii), the detrimental costs are $600 (i.e. $9,000 to $8,400) as there is no decrease in sales revenue as compared to the present situation. Hence, there is a net gain of $600 as compared to the present situation.

Thus, under proposal (ii), the company makes the maximum profit and therefore it should adopt alternative (ii).

The technique of differential costing which is based on differential cost is useful in planning and decision-making and helps in selecting the best alternative.

In case the choice results in decrease in total costs, these decreased costs will be known as decrimental costs.

11. Out-of-Pocket Costs

Out-of-pocket cost means the present or future cash expenditure regarding a certain decision that will vary depending upon the nature of the decision made. For example, a company has

its own trucks for transporting raw materials and finished products from one place to another. It seeks to replace these trucks by keeping public carriers. In making this decision, of course, the depreciation of the trucks is not to be considered but the management should take into account the present expenditure on fuel, salary to drivers and maintenance. Such costs are termed as out-of-pocket costs.

12. Opportunity Cost

Opportunity cost refers to an advantage in measurable terms that have foregone on account of not using the facilities in the manner originally planned. For example, if a building is proposed to be utilized for housing a new project plant, the likely revenue which the building could fetch, if rented out, is the opportunity cost which should be taken into account while evaluating the profitability of the project. Suppose, a manufacturer is confronted with the problem of selecting anyone of the following alternatives:

a. Selling a semi-finished product at $2 per unit
b. Introducing it into a further process to make it more refined and valuable

Alternative (b) will prove to be remunerative only when after paying the cost of further processing, the amount realized by the sale of the product is more than $2 per unit. Also, the revenue of $2 per unit is foregone in case alternative (b) is adopted. The term "opportunity cost" refers to this alternative revenue foregone.

13. Traceable, Untraceable or Common Costs

The costs that can be easily identified with a department, process or product are termed as traceable costs. For example, the cost of direct material, direct labor etc. The costs that cannot be identified so are termed as untraceable or common costs. In other words, common costs are the costs incurred collectively for a number of cost centers and are to be suitably apportioned for determining the cost of individual cost centers. For example, overheads incurred for a factory as a whole, combined purchase cost for purchasing several materials in one consignment etc.

Joint cost is a kind of common cost. When two or more products are produced out of one material or process, the cost of such material or process is called joint cost. For example, when cottonseeds and cotton fibers are produced from the same material, the cost incurred till the split-off or separation point will be joint costs.

14. Production, Administration and Selling and Distribution Costs

A business organization performs a number of functions, e.g., production, illustration, selling and distribution, research and development. Costs are to be curtained for each of these functions. The Chartered Institute of Management accountants, London, has defined each of the above costs as follows:

i. **Production Cost**

The cost of sequence of operations which begins with supplying materials, labor and services and ends with the primary packing of the product. Thus, it includes the cost of direct material, direct labor, direct expenses and factory overheads.

ii. **Administration Cost**

The cost of formulating the policy, directing the organization and controlling the operations of an undertaking which is not related directly to a production, selling, distribution, research or development activity or function.

iii. **Selling Cost**

It is the cost of selling to create and stimulate demand (sometimes termed as marketing) and of securing orders.

iv. **Distribution Cost**

It is the cost of sequence of operations beginning with making the packed product available for dispatch and ending with making the reconditioned returned empty package, if any, available for reuse.

v. **Research Cost**

It is the cost of searching for new or improved products, new application of materials, or new or improved methods.

vi. **Development Cost**

The cost of process which begins with the implementation of the decision to produce a new or improved product or employ a new or improved method and ends with the commencement of formal production of that product or by the method.

vii. **Pre-Production Cost**

The part of development cost incurred in making a trial production as preliminary to formal production is called pre-production cost.

15. Conversion Cost

The cost of transforming direct materials into finished products excluding direct material cost is known as conversion cost. It is usually taken as an aggregate of total cost of direct labor, direct expenses and factory overheads.

Cost Unit and Cost Center

The technique of costing involves the following:

- Collection and classification of expenditure according to cost elements
- Allocation and apportionment of the expenditure to the cost centers or cost units or both

Cost Unit

While preparing cost accounts, it becomes necessary to select a unit with which expenditure may be identified. The quantity upon which cost can be conveniently allocated is known as a unit of cost or cost unit. The Chartered Institute of Management Accountants, London defines a unit of cost as a unit of quantity of product, service or time in relation to which costs may be ascertained or expressed.

Unit selected should be unambiguous, simple and commonly used. Following are the examples of units of cost:

(i) Brick works	per 1000 bricks made
(ii) Collieries	per ton of coal raised
(iii) Textile mills	per yard or per lb. of cloth manufactured or yarn spun
(iv) Electrical companies	per unit of electricity generated
(v) Transport companies	per passenger km.
(vi) Steel mills	per ton of steel made

Cost Center

According to the Chartered Institute of Management Accountants, London, cost center means "a location, person or item of equipment (or group of these) for which costs may be ascertained and used for the purpose of cost control." Thus, cost center refers to one of the convenient units into which the whole factory or an organization has been appropriately divided for costing purposes. Each such unit consists of a department, a sub-department or an item or equipment or machinery and a person or a group of persons. Sometimes, closely

associated departments are combined together and considered as one unit for costing purposes. For example, in a laundry, activities such as collecting, sorting, marking and washing of clothes are performed. Each activity may be considered as a separate cost center and all costs relating to a particular cost center may be found out separately.

Cost centers may be classified as follows:

- Productive, unproductive and mixed cost centers
- Personal and impersonal cost centers
- Operation and process cost centers

Productive cost centers are those which are actually engaged in making products. Service or unproductive cost centers do not make the products but act as the essential aids for the productive centers. The examples of such service centers are as follows:

- Administration department
- Repairs and maintenance department
- Stores and drawing office department

Mixed costs centers are those which are engaged sometimes on productive and other times on service works. For example, a tool shop serves as a productive cost center when it manufactures dies and jigs to be charged to specific jobs or orders but serves as servicing cost center when it does repairs for the factory.

Impersonal cost center is one which consists of a department, a plant or an item of equipment whereas a personal cost center consists of a person or a group of persons. In case a cost center consists of those machines or persons which carry out the same operation, it is termed as operation cost center. If a cost center consists of a continuous sequence of operations, it is called process cost center.

In case of an operation cost center, cost is analyzed and related to a series of operations in sequence such as in chemical industries, oil refineries and other process industries. The objective of such an analysis is to ascertain the cost of each operation irrespective of its location inside the factory.

Cost Estimation and Cost Ascertainment

Cost estimation is the process of pre-determining the cost of a certain product job or order. Such pre-determination may be required for several purposes. Some of the purposes are as follows:

- Budgeting

- Measurement of performance efficiency
- Preparation of financial statements (valuation of stocks etc.)
- Make or buy decisions
- Fixation of the sale prices of products

Cost ascertainment is the process of determining costs on the basis of actual data. Hence, the computation of historical cost is cost ascertainment while the computation of future costs is cost estimation.

Both cost estimation and cost ascertainment are interrelated and are of immense use to the management. In case a concern has a sound costing system, the ascertained costs will greatly help the management in the process of estimation of rational accurate costs which are necessary for a variety of purposes stated above. Moreover, the ascertained cost may be compared with the pre-determined costs on a continuing basis and proper and timely steps be taken for controlling costs and maximizing profits.

Cost Allocation and Cost Apportionment

Cost allocation and cost apportionment are the two procedures which describe the identification and allotment of costs to cost centers or cost units. Cost allocation refers to the allotment of all the items of cost to cost centers or cost units whereas cost apportionment refers to the allotment of proportions of items of cost to cost centers or cost units Thus, the former involves the process of charging direct expenditure to cost centers or cost units whereas the latter involves the process of charging indirect expenditure to cost centers or cost units.

For example, the cost of labor engaged in a service department can be charged wholly and directly but the canteen expenses of the factory cannot be charged directly and wholly. Its proportionate share will have to be found out. Charging of costs in the former case will be termed as “allocation of costs” whereas in the latter, it will be termed as “apportionment of costs.”

Cost Reduction and Cost Control

Cost reduction and cost control are two different concepts. Cost control is achieving the cost target as its objective whereas cost reduction is directed to explore the possibilities of improving the targets. Thus, cost control ends when targets are achieved whereas cost reduction has no visible end. It is a continuous process. The difference between the two can be summarized as follows:

i. Cost control aims at maintaining the costs in accordance with established standards whereas cost reduction is concerned with reducing costs. It changes all standards and endeavors to improve them continuously.

ii. Cost control seeks to attain the lowest possible cost under existing conditions whereas cost reduction does not recognize any condition as permanent since a change will result in lowering the cost.

iii. In case of cost control, emphasis is on past and present. In case of cost reduction, emphasis is on the present and future.

iv. Cost control is a preventive function whereas cost reduction is a correlative function. It operates even when an efficient cost control system exists.

Installation of Costing System

The installation of a costing system requires careful consideration of the following two interrelated aspects:

- Overcoming the practical difficulties while introducing a system
- Main considerations that should govern the installation of such a system

Practical Difficulties

The important difficulties in the installation of a costing system and the suggestions to overcome them are as follows:

a. Lack of Support from Top Management

Often, the costing system is introduced at the behest of the managing director or some other director without taking into confidence other members of the top management team. This results in opposition from various managers as they consider it interference as well as an uncalled check of their activities. They, therefore, resist the additional work involved in the cost accounting system.

This difficulty can be overcome by taking the top management into confidence before installing the system. A sense of cost consciousness has to be instilled in their minds.

b. Resistance from the Staff

The existing financial accounting staff may offer resistance to the system because of a feeling of their being declared redundant under the new system.

This fear can be overcome by explaining the staff that the costing system would not replace but strengthen the existing system. It will open new areas for development which will prove beneficial to them.

c. Non-Cooperation at Other Levels

The foreman and other supervisory staff may resent the additional paper work and may not cooperate in providing the basic data which is essential for the success of the system.

This needs re-orientation and education of employees. They have to be told of the advantages that will accrue to them and to the organization as a whole on account of efficient working of the system.

d. Shortage of Trained Staff

Costing is a specialized job in itself. In the beginning, a qualified staff may not be available. However, this difficulty can be overcome by giving the existing staff requisite training and recruiting additional staff if required.

e. Heavy Costs

The costing system will involve heavy costs unless it has been suitably designed to meet specific requirements. Unnecessary sophistication and formalities should be avoided. The costing office should serve as a useful service department.

Main Considerations

In view of the above difficulties and suggestions, following should be the main considerations while introducing a costing system in a manufacturing organization:

1. Product

The nature of a product determines to a great extent the type of costing system to be adopted. A product requiring high value of material content requires an elaborate system of materials control. Similarly, a product requiring high value of labor content requires an efficient time keeping and wage systems. The same is true in case of overheads.

2. Organization

The existing organization structure should be distributed as little as possible. It becomes, therefore, necessary to ascertain the size and type of organization before introducing the costing system. The scope of authority of each executive, the sources from which a cost accountant has to derive information and reports to be submitted at various managerial levels should be carefully gone through.

3. Objective

The objectives and information which management wants to achieve and acquire should also be taken care of. For example, if a concern wants to expand its operations, the system of costing should be designed in a way so as to give maximum attention to production aspect. On the other hand, if a concern were not in a position to sell its products, the selling aspect would require greater attention.

4. Technical Details

The system should be introduced after a detailed study of the technical aspects of the business. Efforts should be made to secure the sympathetic assistance and support of the principal members of the supervisory staff and workmen.

5. Informative and Simple

The system should be informative and simple. In this connection, the following points may be noted:

(i) It should be capable of furnishing the fullest information required regularly and systematically, so that continuous study or check-up of the progress of business is possible.

(ii) Standard printed forms can be used so as to make the information detailed, clear and intelligible. Over-elaboration which will only complicate matter should be avoided.

(iii) Full information about departmental outputs, processes and operations should be clearly presented and every item of expenditure should be properly classified.

(iv) Data, complete and reliable in all respects should be provided in a lucid form so that the measurement of the variations between actual and standard costs is possible.

6. Method of Maintenance of Cost Records

A choice has to be made between integral and non-integral accounting systems. In case of integral accounting system, no separate sets of books are maintained for costing transactions but they are interlocked with financial transactions into one set of books.

In case of non-integral system, separate books are maintained for cost and financial transactions. At the end of the accounting period, the results shown by two sets of books are reconciled. In case of a big business, it will be appropriate to maintain a separate set of books for cost transactions.

7. Elasticity

The costing system should be elastic and capable of adapting to the changing requirements of a business.

It may, therefore, be concluded from the above discussion that costing system introduced in any business will not be a success in case of the following circumstances:

1. If it is unduly complicated and expensive
2. If a cost accountant does not get the cooperation of his/her staff
3. If cost statements cannot be reconciled with financial statements
4. If the results actually achieved are not compared with the expected ones

Methods of Costing

Costing can be defined as the technique and process of ascertaining costs. The principles in every method of costing are same but the methods of analyzing and presenting the costs differ with the nature of business. The methods of job costing are as follows:

1. Job Costing

The system of job costing is used where production is not highly repetitive and in addition consists of distinct jobs so that the material and labor costs can be identified by order number. This method of costing is very common in commercial foundries and drop forging shops and in plants making specialized industrial equipments. In all these cases, an account is opened for each job and all appropriate expenditure is charged thereto.

2. Contract Costing

Contract costing does not in principle differ from job costing. A contract is a big job whereas a job is a small contract. The term is usually applied where large-scale contracts are carried out. In case of ship-builders, printers, building contractors etc., this system of costing is used. Job or contract is also termed as terminal costing.

3. Cost Plus Costing

In contracts where in addition to cost, an agreed sum or percentage to cover overheads and fit is paid to a contractor, the system is termed as cost plus costing. The term cost here includes materials, labor and expenses incurred directly in the process of production. The system is used generally in cases where government happens to be the party to give contract.

4. Batch Costing

This method is employed where orders or jobs are arranged in different batches after taking into account the convenience of producing articles. The unit of cost is a batch or a group of identical products instead of a single job order or contract. This method is particularly suitable for general engineering factories which produce components in convenient economic batches and pharmaceutical industries.

5. Process Costing

If a product passes through different stages, each distinct and well defined, it is desired to know the cost of production at each stage. In order to ascertain the same, process costing is employed under which a separate account is opened for each process.

This system of costing is suitable for the extractive industries, e.g., chemical manufacture, paints, foods, explosives, soap making etc.

6. Operation Costing

Operation costing is a further refinement of process costing. The system is employed in the industries of the following types:

a. The industry in which mass or repetitive production is carried out
b. The industry in which articles or components have to be stocked in semi-finished stage to facilitate the execution of special orders, or for the convenience of issue for later operations

The procedure of costing is broadly the same as process costing except that in this case, cost unit is an operation instead of a process. For example, the manufacturing of handles for bicycles involves a number of operations such as those of cutting steel sheets into proper strips molding, machining and finally polishing. The cost to complete these operations may be found out separately.

7. Unit Costing (Output Costing or Single Costing)

In this method, cost per unit of output or production is ascertained and the amount of each element constituting such cost is determined. In case where the products can be expressed in identical quantitative units and where manufacture is continuous, this type of costing is applied. Cost statements or cost sheets are prepared in which various items of expense are classified and the total expenditure is divided by the total quantity produced in order to arrive

at per unit cost of production. The method is suitable in industries like brick making, collieries, flour mills, paper mills, cement manufacturing etc.

8. Operating Costing

This system is employed where expenses are incurred for provision of services such as those tendered by bus companies, electricity companies, or railway companies. The total expenses regarding operation are divided by the appropriate units (e.g., in case of bus company, total number of passenger/kms.) and cost per unit of service is calculated.

9. Departmental Costing

The ascertainment of the cost of output of each department separately is the objective of departmental costing. In case where a factory is divided into a number of departments, this method is adopted.

10. Multiple Costing (Composite Costing)

Under this system, the costs of different sections of production are combined after finding out the cost of each and every part manufactured. The system of ascertaining cost in this way is applicable where a product comprises many assailable parts, e.g., motor cars, engines or machine tools, typewriters, radios, cycles etc.

As various components differ from each other in a variety of ways such as price, materials used and manufacturing processes, a separate method of costing is employed in respect of each component. The type of costing where more than one method of costing is employed is called multiple costing.

It is to be noted that basically there are only two methods of costing viz. job costing and process costing. Job costing is employed in cases where expenses are traceable to specific jobs or orders, e.g., house building, ship building etc. In case where it is impossible to trace the prime cost of the items for a particular order because of the reason that their identity gets lost while manufacturing operations, process costing is used. For example, in a refinery where several tons of oil is being produced at the same time, the prime cost of a specific order of 10 tons cannot be traced. The cost can be found out only by finding out the cost per ton of total oil produced and then multiplying it by ten.

It may, therefore, be concluded that the methods of batch contract and cost plus costing are only the variants of job costing whereas the methods of unit, operation and operating costing are the variants of process costing.

Techniques of Costing

Besides the above methods of costing, following are the types of costing techniques which are used by management only for controlling costs and making some important managerial decisions. As a matter of fact, they are not independent methods of cost finding such as job or process costing but are basically costing techniques which can be used as an advantage with any of the methods discussed above.

1. Marginal Costing

Marginal costing is a technique of costing in which allocation of expenditure to production is restricted to those expenses which arise as a result of production, e.g., materials, labor, direct expenses and variable overheads. Fixed overheads are excluded in cases where production varies because it may give misleading results. The technique is useful in manufacturing industries with varying levels of output.

2. Direct Costing

The practice of charging all direct costs to operations, processes or products and leaving all indirect costs to be written off against profits in the period in which they arise is termed as direct costing. The technique differs from marginal costing because some fixed costs can be considered as direct costs in appropriate circumstances.

3. Absorption or Full Costing

The practice of charging all costs both variable and fixed to operations, products or processes is termed as absorption costing.

4. Uniform Costing

A technique where standardized principles and methods of cost accounting are employed by a number of different companies and firms is termed as uniform costing. Standardization may extend to the methods of costing, accounting classification including codes, methods of defining costs and charging depreciation, methods of allocating or apportioning overheads to cost centers or cost units. The system, thus, facilitates inter- firm comparisons, establishment of realistic pricing policies, etc.

Systems of Costing

It has already been stated that there are two main methods used to determine costs. These are:

- Job cost method • Process cost method

It is possible to ascertain the costs under each of the above methods by two different ways:

- Historical costing
- Standard costing

Historical Costing

Historical costing can be of the following two types in nature:

- Post costing
- Continuous costing

Post Costing

Post costing means ascertainment of cost after the production is completed. This is done by analyzing the financial accounts at the end of a period in such a way so as to disclose the cost of the units which have been produced.

For instance, if the cost of product A is to be calculated on this basis, one will have to wait till the materials are actually purchased and used, labor actually paid and overhead expenditure actually incurred. This system is used only for ascertaining the costs but not useful for exercising any control over costs, as one comes to know of things after they had taken place. It can serve as guidance for future production only when conditions in future continue to be the same.

Continuous Costing

In case of this method, cost is ascertained as soon as a job is completed or even when a job is in progress. This is done usually before a job is over or product is made. In the process, actual expenditure on materials and wages and share of overheads are also estimated. Hence, the figure of cost ascertained in this case is not exact. But it has an advantage of providing cost information to the management promptly, thereby enabling it to take necessary corrective action on time. However, it neither provides any standard for judging current efficiency nor does it disclose what the cost of a job ought to have been.

Standard Costing

Standard costing is a system under which the cost of a product is determined in advance on certain pre-determined standards. With reference to the example given in post costing, the cost of product A can be calculated in advance if one is in a position to estimate in advance the material labor and overheads that should be incurred over the product. All this requires an efficient system of cost accounting. However, this system will not be useful if a vigorous

system of controlling costs and standard costs are not in force. Standard costing is becoming more and more popular nowadays.

Summary

1. Cost accounting is a quantitative method that accumulates, classifies, summarizes and interprets information for operational planning and control, special decisions and product decisions.
2. Cost may be classified into different categories depending upon the purpose of classification viz. fixed cost, variable cost and semi variable cost.
3. Costing can be defined as the technique and process of ascertaining costs.

Chapter 3: Job, Process and Operation Costing

Understanding how products and services are costed is vital to managers because the way in which these costs are determined can have a substantial impact on reported profits, as well as on key management decisions.

A managerial costing system should provide cost data to help managers plan, control, and make decisions. Nevertheless, external financial reporting and tax reporting requirements often heavily influence how costs are accumulated and summarized on managerial reports. This is true of product costing. In this chapter we use *absorption costing* to determine product costs. In absorption costing, all manufacturing costs, both fixed and variable, are assigned to units of product—units are said to *fully absorb manufacturing costs.* In later chapters we look at alternatives to absorption costing such as variable costing and activity-based costing.

Most countries require some form of absorption costing for both external financial reports and for tax reports. In addition, the vast majority of companies throughout the world also use absorption costing in their management reports. Because absorption costing is the most common approach to product costing throughout the world, this is discussed first and then discuss the alternatives in subsequent chapters.

We need to introduce and explain two more terms before discussing costing systems:

1. **Cost pool.** A **cost pool** is a grouping of individual indirect cost items. Cost pools can range from broad, such as all manufacturing-plant costs, to narrow, such as the costs of operating metal-cutting machines. Cost pools are often organized in conjunction with cost-allocation bases.

2. **Cost-allocation base.** How should a company allocate costs to operate metal-cutting machines among different products? One way to allocate costs is based on the number of machine-hours used to produce different products.

The **cost-allocation base** (number of machine-hours) is a systematic way to link an indirect cost or group of indirect costs (operating costs of all metal-cutting machines) to cost objects (different products). For example, if indirect costs of operating metal-cutting machines is$500,000 based on running these machines for 10,000 hours, the cost allocation rate is $500,000 ÷ 10,000 hours = $50 per machine-hour, where machine-hours is the cost allocation base. If a product uses 800 machine-hours, it will be allocated $40,000, $50 per machine-hour

* 800 machine-hours. The ideal cost-allocation base is the cost driver of the indirect costs, because there is a cause-and-effect relationship between the cost allocation base and the indirect costs. A cost-allocation base can be either financial (such as direct labor costs) or nonfinancial (such as the number of machine-hours). When the cost object is a job, product, or customer, the cost-allocation base is also called a **cost-application base**.

Management accountants use two basic types of costing systems to assign costs to products or services: Job-Costing and Process-Costing Systems

1. Job-costing system. In this system, the cost object is a unit or multiple units of a distinct product or service called a **job**. Each job generally uses different amounts of resources. The product or service is often a single unit, such as a specialized machine made at Hitachi, a construction project managed by Bechtel Corporation, a repair job done at an Audio Service Center, or an advertising campaign produced by Saatchi & Saatchi. Each special machine made by Hitachi is unique and distinct. An advertising campaign for one client at Saatchi and Saatchi is unique and distinct from advertising campaigns for other clients. Job costing is also used by companies such as Ethan Allen to cost multiple identical units of distinct furniture products. Because the products and services are distinct, job-costing systems accumulate costs separately for each product or service.

2. Process-costing system. In this system, the cost object is masses of identical or similar units of a product or service. For example, Citibank provides the same service to all its customers when processing customer deposits. Intel provides the same product (say, a Pentium 4 chip) to each of its customers. All Minute Maid consumers receive the same frozen orange juice product. In each period, process-costing systems divide the total costs of producing an identical or similar product or service by the total number of units produced to obtain a per-unit cost. This per-unit cost is the average unit cost that applies to each of the identical or similar units produced in that period.

Job order costing

In its job-costing system, a manufacturing company, for example Robinson Co., accumulates costs incurred on a job in different parts of the value chain, such as manufacturing, marketing, and customer service. We focus here on Robinson's manufacturing function (which also includes product installation).

To make a machine, Robinson purchases some components from outside suppliers and makes others itself. Each of Robinson's jobs also has a service element: installing a machine at a customer's site, integrating it with the customer's other machines and processes, and ensuring the machine meets customer expectations. One form of a job-costing system that Robinson can use is actual costing. **Actual costing** is a costing system that traces direct costs to a cost object by using the actual direct cost rates times the actual quantities of the direct-cost inputs. It allocates indirect costs based on the actual indirect-cost rates times the actual quantities of the cost-allocation bases. The *actual indirect-cost rate* is calculated by dividing actual total indirect costs by the actual total quantity of the cost-allocation base.

As its name suggests, actual costing systems calculate the actual costs of jobs. Yet, actual costing systems are not commonly found in practice because actual costs cannot be computed in a *timely* manner. The problem is not with computing direct-cost rates for direct materials and direct manufacturing labor. For example, Robinson records the actual prices paid for materials. As it uses these materials, the prices paid serve as actual direct-cost rates for charging material costs to jobs. As we discuss next, calculating actual indirect-cost rates on a timely basis each week or each month is, however, a problem. Robinson can only calculate actual indirect-cost rates at the end of the fiscal year and Robinson's managers are unwilling to wait that long to learn the costs of various jobs.

The numerator reason (indirect-cost pool). The shorter the period is, the greater the influence of seasonal patterns on the amount of costs.

Levels of total indirect costs are also affected by non-seasonal erratic costs. Examples of non-seasonal erratic costs include costs incurred in a particular month that benefit operations during future months, such as costs of repairs and maintenance of equipment, and costs of vacation and holiday pay. If monthly indirect-cost rates were calculated, jobs done in a month with high, non-seasonal erratic costs would be charged with these costs. Pooling all indirect

costs together over the course of a full year and calculating a single annual indirect-cost rate helps smooth some of the erratic bumps in costs associated with shorter periods.

The denominator reason (quantity of the cost-allocation base). Another reason for longer periods is to avoid spreading monthly fixed indirect costs over fluctuating levels of monthly output and fluctuating quantities of the cost-allocation base.

Normal Costing

The difficulty of calculating actual indirect-cost rates on a weekly or monthly basis means managers cannot calculate the actual costs of jobs as they are completed.

However, managers, including those at Robinson, want a close approximation of the costs of various jobs regularly during the year, not just at the end of the fiscal year.

Managers want to know manufacturing costs (and other costs, such as marketing costs)for ongoing uses, including pricing jobs, monitoring and managing costs, evaluating the success of the job, learning about what worked and what didn't, bidding on new jobs, and preparing interim financial statements. Because of the need for immediate access to job costs, few companies wait to allocate overhead costs until year-end when the actual manufacturing overhead is finally known. Instead, a *predetermined* or *budgeted* indirect-cost rate is calculated for each cost pool at the beginning of a fiscal year, and overhead costs are allocated to jobs as work progresses. For the numerator and denominator reasons already described, the **budgeted indirect-cost rate** for each cost pool is computed as follows:

$$\text{Budgeted indirect cost rate} = \frac{\text{Budgeted annual indirect costs}}{\text{Budgeted annual quantity of the cost-allocation base}}$$

Using budgeted indirect-cost rates gives rise to normal costing.

Normal costing is a costing system that (1) traces direct costs to a cost object by using the actual direct-cost rates times the actual quantities of the direct-cost inputs and

(2) Allocates indirect costs based on the *budgeted* indirect-cost rates times the actual quantities of the cost-allocation bases.

We illustrate normal costing for the Robinson Company example using the following seven steps to assign costs to an individual job. This approach is commonly used by companies in the manufacturing, merchandising, and service sectors.

Step 1: Identify the Job That Is the Chosen Cost Object

The cost object in the Robinson Company example is Job WPP 298, manufacturing a paper-making machine for Western Pulp and Paper (WPP) in 2011. Robinson's managers and management accountants gather information to cost jobs through source documents.

Step 2: Identify the Direct Costs of the Job. Robinson identifies two direct-manufacturing cost categories: direct materials and direct manufacturing labor. The source document for direct material is a **materials-requisition record** and the source document for direct labor is **labor time sheet.**

Step 3: Select the Cost-Allocation Bases to Use for Allocating Indirect Costs to the Job.

Companies often use multiple cost-allocation bases to allocate indirect costs because different indirect costs have different cost drivers. For example, some indirect costs such as depreciation and repairs of machines are more closely related to machine-hours. Other indirect costs such as supervision and production support are more closely related to direct manufacturing labor-hours. Robinson, however, chooses direct manufacturing labor-hours as the sole allocation base for linking all indirect manufacturing costs to jobs. That's because, in its labor-intensive environment, Robinson believes that the number of direct manufacturing labor-hours drives the manufacturing overhead resources (such as salaries paid to supervisors, engineers, production support staff, and quality management staff) required by individual jobs. In 2011, Robinson budgets 28,000 direct manufacturing labor-hours.

Step 4: Identify the Indirect Costs Associated with Each Cost-Allocation Base.

Because Robinson believes that a single cost-allocation base—direct manufacturing labor-hours— can be used to allocate indirect manufacturing costs to jobs, Robinson creates a single cost pool called manufacturing overhead costs. This pool represents all indirect costs of the Manufacturing Department that are difficult to trace directly to individual jobs. In 2011, patent budgeted manufacturing overhead costs total $1,120,000.

Step 5: Compute the Rate per Unit of Each Cost-Allocation Base Used to Allocate Indirect Costs to the Job.

For each cost pool, the budgeted indirect-cost rate is calculated by dividing budgeted total indirect costs in the pool (determined in Step 4) by the budgeted total quantity of the cost-

allocation base (determined in Step 3). Robinson calculates the allocation rate for its single manufacturing overhead cost pool as follows:

Budgeted manufacturing overhead rate = Budgeted manufacturing overhead costs / Budgeted total quantity of cost-allocation base

= $1,120,000 / 28,000 direct manufacturing labor-hours

= $40 per direct manufacturing labor-hour

Step 6: Compute the Indirect Costs Allocated to the Job.

The indirect costs of a job are calculated by multiplying the *actual* quantity of each different allocation base (one allocation base for each cost pool) associated with the job by the *budgeted* indirect cost rate of each allocation base (computed in Step 5). Recall that Robinson's managers selected direct manufacturing labor-hours as the only cost-allocation base. Robinson uses 88 direct manufacturing labor-hours on the WPP 298 job. Manufacturing overhead costs allocated to WPP 298 equal $3,520 ($40 per direct manufacturing labor-hour * 88 hours).

Step 7: Compute the Total Cost of the Job by Adding All Direct and Indirect Costs Assigned to the Job.

Direct manufacturing costs		
Direct materials	$4,606	
Direct manufacturing labor	1,579	$ 6,185
Manufacturing overhead costs		
($40 per direct manufacturing labor-hour * 88 hours)		3,520
Total manufacturing costs of job WPP 298		$9,705

Recall that Robinson bid a price of $15,000 for the job. At that revenue, the normal costing system shows a gross margin of $5,295 ($15,000 – $9,705) and a gross-margin percentage of 35.3% ($5,295 ÷ $15,000 = 0.353).

Explanations of Transactions

We next look at a summary of Robinson Company's transactions for February 2011 and the corresponding journal entries for those transactions.

1. Purchases of materials (direct and indirect) on credit, $89,000

Material control 89,000

Account payable control 89,000

2. Usage of direct materials, $81,000, and indirect materials, $4,000

Work-in-Process Control 81,000

Manufacturing Overhead Control 4,000

Materials Control 85,000

3. Manufacturing payroll for February: direct labor, $39,000, and indirect labor, $15,000, paid in cash

Work-in-Process Control 39,000

Manufacturing Overhead Control 15,000

Cash Control 54,000

4. Other manufacturing overhead costs incurred during February, $75,000, consisting of supervision and engineering salaries, $44,000 (paid in cash); plant utilities, repairs, and insurance, $13,000 (paid in cash); and plant depreciation, $18,000

Manufacturing Overhead Control 75,000

Cash Control 57,000

Accumulated Depreciation Control 18,000

5. Allocation of manufacturing overhead to jobs, $80,000

Work-in-Process Control 80,000

Manufacturing Overhead Allocated 80,000

6. Completion and transfer of individual jobs to finished goods, $188,800

Finished Goods Control 188,800

Work-in-Process Control 188,800

7. Cost of goods sold, $180,000

Cost of Goods Sold 180,000

Finished Goods Control 180,000

8. Marketing costs for February, $45,000, and customer service costs for February, $15,000, paid in cash

Marketing Expenses 45,000

Customer Service Expenses 15,000

Cash Control 60,000

9. Sales revenues, all on credit, $270,000

Accounts Receivable Control	270,000	
Revenues		270,000

Under allocated and over allocated Indirect Costs

Underallocated indirect costs occur when the allocated amount of indirect costs in an accounting period is less than the actual (incurred) amount. **Overallocated indirect costs** occur when the allocated amount of indirect costs in an accounting period is greater than the actual (incurred) amount.

Underallocated (overallocated) indirect costs = Actual indirect costs incurred - Indirect costs allocated. Underallocated (overallocated) indirect costs are also called **underapplied (overapplied) indirect costs** and **underabsorbed (overabsorbed) indirect costs**.

Consider the manufacturing overhead cost pool at Robinson Company. There are two indirect-cost accounts in the general ledger that have to do with manufacturing overhead:

1. Manufacturing Overhead Control, the record of the actual costs in all the individual overhead categories (such as indirect materials, indirect manufacturing labor, supervision, engineering, utilities, and plant depreciation)

2. Manufacturing Overhead Allocated, the record of the manufacturing overhead allocated to individual jobs on the basis of the budgeted rate multiplied by actual direct manufacturing labor-hours

At the end of the year, the overhead accounts show the following amounts.

Manufacturing Overhead Control	**Manufacturing Overhead Allocated**
Bal. Dec. 31, 2011 $1,215,000	Bal. Dec. 31, 2011 $1,080,000

The $1,080,000 credit balance in Manufacturing Overhead Allocated results from multiplying the 27,000 actual direct manufacturing labor-hours worked on all jobs in 2011 by the budgeted rate of $40 per direct manufacturing labor-hour. The $135,000 ($1,215,000 – $1,080,000) difference (a net debit) is an under allocated amount because actual manufacturing overhead costs are greater than the allocated amount. This difference arises from two reasons related to the computation of the $40 budgeted hourly rate:

There are three main approaches to accounting for the $135,000 Underallocated manufacturing overhead caused by Robinson underestimating manufacturing overhead costs

and overestimating the quantity of the cost-allocation base: (1) adjusted allocation-rate approach, (2) proration approach, and (3) write-off to cost of goods sold approach.

1) Adjusted Allocation-Rate Approach

The **adjusted allocation-rate approach** restates all overhead entries in the general ledger and subsidiary ledgers using actual cost rates rather than budgeted cost rates. First, the actual manufacturing overhead rate is computed at the end of the fiscal year. Then, the manufacturing overhead costs allocated to every job during the year are recomputed using the actual manufacturing overhead rate (rather than the budgeted manufacturing overhead rate). Finally, end-of-year closing entries are made. The result is that at year-end, every job-cost record and finished goods record—as well as the ending Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold accounts—represent actual manufacturing overhead costs incurred.

The adjusted allocation-rate approach yields the benefits of both the timeliness and convenience of normal costing during the year and the allocation of actual manufacturing overhead costs at year-end.

2) Proration Approach

Proration spreads under allocated overhead or over allocated overhead among ending work-in-process inventory, finished goods inventory, and cost of goods sold. Materials inventory is not included in this proration, because no manufacturing overhead costs have been allocated to it. In our Robinson example, end-of-year proration is made to the ending balances in Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold. Assume the following actual results for Robinson Company in 2011:

	Account Balance (Before Proration	Allocated Manufacturing Overhead Included in Each Account Balance(Before Proration)	Allocated Manufacturing Overhead Included in Each Account Balance as a Percent of Total	Proration of $135,000 of Underallocated Manufacturing Overhead	Account Balance (After Proration)
Account	**(1)**	**(2)**	(3)=(2)/ $1,080,000	(4)=(3)x$135,000	(5) = (1) + (4)
Work-in-process control	$ 50,000	16,200	1.5%	2,025	52,025
Finished goods control	75,000	31,320	2.9%	3,915	78,915
CGS	2,375,000	1,032,480	95.6%	129,060	2,504,060
Total	$2,500,000	$1,080,000	100.0%	$135,000	$2,635,000

Robinson prorates under-allocated or over-allocated amounts on the basis of the total amount of manufacturing overhead allocated in 2011 (before proration) in the ending balances of Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold. The $135,000 under-allocated overhead is prorated over the three affected accounts in proportion to the total amount of manufacturing overhead allocated (before proration) in column 2 of the following table, resulting in the ending balances (after proration) in column5 at actual costs. Prorating on the basis of the manufacturing overhead allocated (before proration) results in allocating manufacturing overhead based on actual manufacturing overhead costs. Recall that the actual manufacturing overhead ($1,215,000) in 2011 exceeds the manufacturing overhead allocated ($1,080,000) in 2011 by 12.5%. The proration amounts in column 4 can also be derived by multiplying the balances in column 2 by0.125. For example, the $3,915 proration to Finished Goods is 0.125 _ $31,320.Adding these amounts effectively means allocating manufacturing overhead at112.5% of what had been allocated before. The journal entry to record this proration is as follows:

Work-in-Process Control	2,025	
Finished Goods Control	3,915	
Cost of Goods Sold	129,060	
Manufacturing Overhead Allocated	1,080,000	
Manufacturing Overhead Control		1,215,000

If manufacturing overhead had been overallocated, the Work-in-Process Control, Finished Goods Control and Cost of Goods Sold accounts would be decreased (credited) instead of increased (debited).

3) Write-Off to Cost of Goods Sold Approach

Under this approach, the total under- or overallocated manufacturing overhead is included in this year's Cost of Goods Sold. For Robinson, the journal entry would be as follows:

Cost of Goods Sold	135,000	
Manufacturing Overhead Allocated	1,080,000	
Manufacturing Overhead Control		1,215,000

How managers should dispose of under- or overallocated manufacturing overhead costs at the end of the fiscal year?

Robinson's two Manufacturing Overhead accounts are closed with the difference between them included in the cost of goods sold. The Cost of Goods Sold account after the write-off equals $2,510,000, the balance before the write-off of $2,375,000 *plus the under-allocated* manufacturing overhead amount of $135,000.

Process Costing

Before we examine process costing in more detail, let's briefly compare job costing and process costing. Job-costing and process-costing systems are best viewed as ends of a continuum:

Job-costing system – For Distinct, identifiable units of a product or service (for example, custom-made machines and houses).
Process-costing system – For Masses of identical or similar units of a product or service (for example, food or chemical processing).

In a *process-costing system*, the unit cost of a product or service is obtained by assigning total costs to many identical or similar units of output. In other words, unit costs are calculated by dividing total costs incurred by the number of units of output from the production process. In a manufacturing process-costing setting, each unit receives the same or similar amounts of direct material costs, direct manufacturing labor costs, and indirect manufacturing costs (manufacturing overhead).

The main difference between process costing and job costing is the *extent of averaging* used to compute unit costs of products or services. In a job-costing system, individual jobs use different quantities of production resources, so it would be incorrect to cost each job at the same average production cost. In contrast, when identical or similar units of products or services are mass-produced, not processed as individual jobs, process costing is used to calculate an average production cost for all units produced. Some processes such as clothes manufacturing have aspects of both process costing (cost per unit of each operation, such as cutting or sewing, is identical) and job costing (different materials are used in different batches of clothing, say, wool versus cotton). The final section in this chapter describes "hybrid" costing systems that combine elements of both job and process costing.

Illustration Process Costing

Consider the following illustration of process costing: Suppose that Pacific Electronics manufactures a variety of cell phone models. These models are assembled in the assembly department. Upon completion, units are transferred to the testing department. We focus on the assembly department process for one model, SG-40. All units of SG-40 are identical and

must meet a set of demanding performance specifications. The process-costing system for SG-40 in the assembly department has a single direct-cost category—direct materials— and a single indirect-cost category—conversion costs. Conversion costs are all manufacturing costs other than direct material costs, including manufacturing labor, energy, plant depreciation, and so on. Direct materials are added at the beginning of the assembly process. Conversion costs are added evenly during assembly.

Process-costing systems separate costs into cost categories according to *when costs are introduced into the process*. Often, as in our Pacific Electronics example, only two cost classifications—direct materials and conversion costs—are necessary to assign costs to products. Why only two? Because *all* direct materials are added to the process at one time and all conversion costs generally are added to the process evenly through time. If, however, two different direct materials were added to the process at different times, two different direct-materials categories would be needed to assign these costs to products. Similarly, if manufacturing labor costs were added to the process at a different time from when the other conversion costs were added, an additional cost category—direct manufacturing labor costs—would be needed to separately assign these costs to products.

We will use the production of the SG-40 component in the assembly department to illustrate process costing in three cases, starting with the simplest case and introducing additional complexities in subsequent cases:

_ **Case 1—**Process costing with zero beginning and zero ending work-in-process inventory of SG-40. (That is, all units are started and fully completed within the accounting period.) *This case presents the most basic concepts of process costing and illustrates the feature of averaging of costs.*

_ **Case 2—**Process costing with zero beginning work-in-process inventory and some ending work-in-process inventory of SG-40. (That is, some units of SG-40 started during the accounting period are incomplete at the end of the period.) *This case introduces the five steps of process costing and the concept of equivalent units.*

_ **Case 3—**Process costing with both some beginning and some ending work-in-process inventory of SG-40. *This case adds more complexity and illustrates the effect of weighted-average and first-in, first-out (FIFO) cost flow assumptions on cost of units completed and cost of work-in-process inventory.*

Case 1: Process Costing with No Beginning or Ending Work-in-Process Inventory

On January 1, 2012, there was no beginning inventory of SG-40 units in the assembly department. During the month of January, Pacific Electronics started, completely assembled, and transferred out to the testing department 400 units.

Data for the assembly department for January 2012 are as follows:

Physical Units for January 2012

Work in process, beginning inventory (January 1)	0 units
Started during January	400 units
Completed and transferred out during January	400 units
Work in process, ending inventory (January 31)	0 units

Physical units refer to the number of output units, whether complete or incomplete. In January 2012, all 400 physical units started were completed.

Total Costs for January 2012

Direct material costs added during January	$32,000
Conversion costs added during January	24,000
Total assembly department costs added during January	$56,000

Pacific Electronics records direct material costs and conversion costs in the assembly department as these costs are incurred. By averaging, assembly cost of SG-40 is $56,000 ÷ 400 units = $140 per unit, itemized as follows:

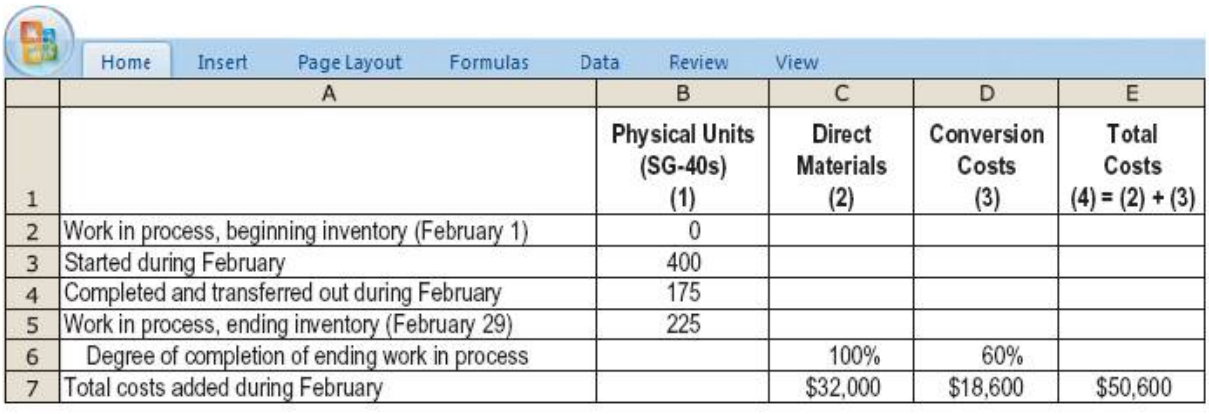
Direct material cost per unit ($32,000 ÷ 400 units)	$ 80
Conversion cost per unit ($24,000 ÷ 400 units)	60
Assembly department cost per unit	$140

Case 1 shows that in a process-costing system, average unit costs are calculated by dividing total costs in a given accounting period by total units produced in that period. Because each unit is identical, we assume all units receive the same amount of direct material costs and conversion costs. Case 1 applies whenever a company produces a homogeneous product or service but has no incomplete units when each accounting period ends, which is a common situation in service-sector organizations. For example, a bank can adopt this process-costing approach to compute the unit cost of processing 100,000 customer deposits, each similar to the other, made in a month.

Case 2: Process Costing with Zero Beginning & Some Ending Work-in-Process Inventory

In February 2012, Pacific Electronics places another 400 units of SG-40 into production. Because all units placed into production in January were completely assembled, there is no beginning inventory of partially completed units in the assembly department on February 1. Some customers order late, so not all units started in February are completed by the end of the month. Only 175 units are completed and transferred to the testing department.

Data for the assembly department for February 2012 are as follows:



	A	B	C	D	E
1		**Physical Units (SG-40s) (1)**	**Direct Materials (2)**	**Conversion Costs (3)**	**Total Costs (4) = (2) + (3)**
2	Work in process, beginning inventory (February 1)	0			
3	Started during February	400			
4	Completed and transferred out during February	175			
5	Work in process, ending inventory (February 29)	225			
6	Degree of completion of ending work in process		100%	60%	
7	Total costs added during February		$32,000	$18,600	$50,600

The 225 partially assembled units as of February 29, 2012, are fully processed with respect to direct materials, because all direct materials in the assembly department are added at the beginning of the assembly process. Conversion costs, however, are added evenly during assembly. Based on the work completed relative to the total work required to complete the SG-40 units still in process at the end of February, an assembly department supervisor

estimates that the partially assembled units are, on average, 60% complete with respect to conversion costs.

The accuracy of the completion estimate of conversion costs depends on the care, skill, and experience of the estimator and the nature of the conversion process. Estimating the degree of completion is usually easier for direct material costs than for conversion costs, because the quantity of direct materials needed for a completed unit and the quantity of direct materials in a partially completed unit can be measured more accurately. In contrast, the conversion sequence usually consists of a number of operations, each for a specified period of time, at various steps in the production process. The degree of completion for conversion costs depends on the proportion of the total conversion costs needed to complete one unit (or a batch of production) that has already been incurred on the units still in process. It is a challenge for management accountants to make this estimate accurately.

Because of these uncertainties, department supervisors and line managers—individuals most familiar with the process—often make conversion cost estimates. Still, in some industries, such as semiconductor manufacturing, no exact estimate is possible; in other settings, such as the textile industry, vast quantities in process make the task of estimation too costly. In these cases, it is necessary to assume that all work in process in a department is complete to some preset degree with respect to conversion costs (for example, one-third, one-half, or two-thirds complete).

The point to understand here is that a partially assembled unit is not the same as a fully assembled unit. Faced with some fully assembled units and some partially assembled units, we require a common metric that will enable us to compare the work done in each category and, more important, obtain a total measure of work done. The concept we will use in this regard is that of *equivalent units*. We will explain this notion in greater detail next as part of the set of five steps required to calculate (1) the cost of fully assembled units in February 2012 and (2) the cost of partially assembled units still in process at the end of that month, for Pacific Electronics. The five steps of process costing are as follows:

Step 1: Summarize the flow of physical units of output.

Step 2: Compute output in terms of equivalent units.

Step 3: Summarize total costs to account for.

Step 4: Compute cost per equivalent unit.

Step 5: Assign total costs to units completed and to units in ending work in process.

Physical Units and Equivalent Units (Steps 1 and 2)

Step 1 tracks physical units of output. Recall that physical units are the number of output units, whether complete or incomplete. Where did physical units come from? Where did they go? The physical-units column of Exhibit 17-1 tracks where the physical units came from (400 units started) and where they went (175 units completed and transferred out, and 225 units in ending inventory). Remember, when there is no opening inventory, units started must equal the sum of units transferred out and ending inventory.

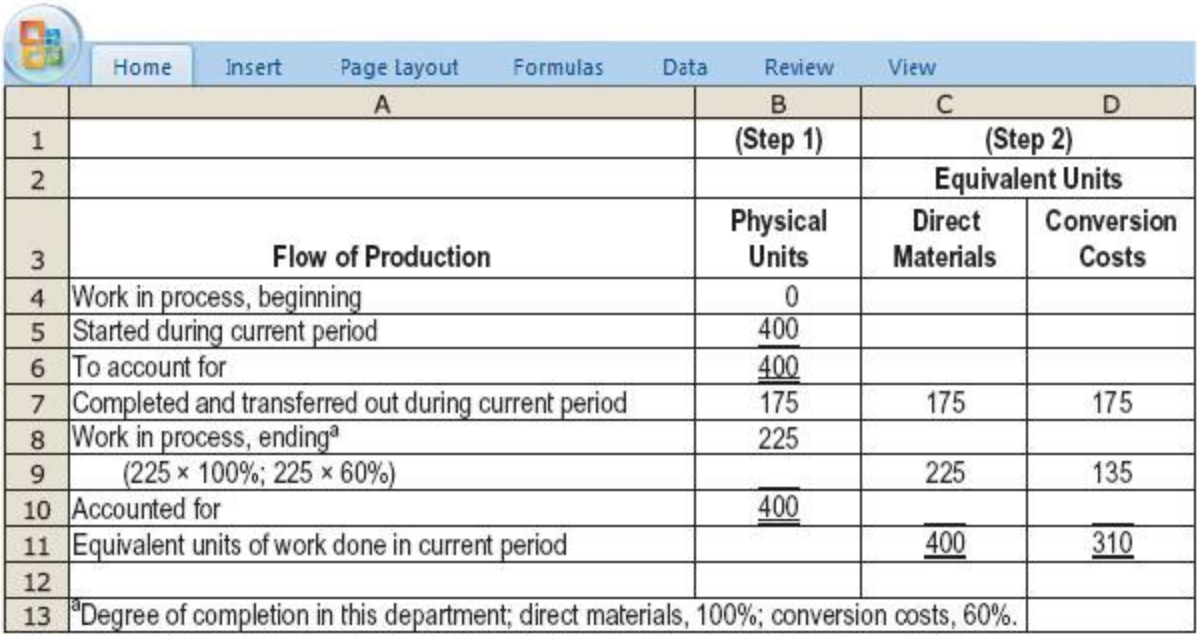
Because not all 400 physical units are fully completed, output in **Step 2** is computed in *equivalent units*, not in *physical units*. To see what we mean by equivalent units, let's say that during a month, 50 physical units were started but not completed by the end of the month. These 50 units in ending inventory are estimated to be 70% complete with respect to conversion costs. Let's examine those units from the perspective of the conversion costs already incurred to get the units to be 70% complete. Suppose we put all the conversion costs represented in the 70% into making fully completed units. How many units could have been 100% complete by the end of the month? The answer is 35 units. Why? Because 70% of conversion costs incurred on 50 incomplete units could have been incurred to make 35 (0.70 x 50) complete units by the end of the month. That is, if all the conversion-cost input in the 50 units in inventory had been used to make completed output units, the company would have produced 35 completed units (also called *equivalent units*) of output.

Equivalent units is a derived amount of output units that (1) takes the quantity of each input (factor of production) in units completed and in incomplete units of work in process and (2) converts the quantity of input into the amount of completed output units that could be produced with that quantity of input. Note that equivalent units are calculated separately for each input (such as direct materials and conversion costs). Moreover, every completed unit, by definition, is composed of one equivalent unit of each input required to make it. This chapter focuses on equivalent-unit calculations in manufacturing settings.

Equivalent-unit concepts are also found in nonmanufacturing settings. For example, universities convert their part-time student enrollments into "full-time student equivalents."

When calculating equivalent units in Step 2, focus on quantities. Disregard dollar amounts until after equivalent units are computed. In the Pacific Electronics example, all 400 physical units—the 175 fully assembled units and the 225 partially assembled units— are 100% complete with respect to direct materials because all direct materials are added in the assembly department at the start of the process. Therefore, the schedule shows output as 400 *equivalent units* for direct materials: 175 equivalent units for the 175 physical units assembled and transferred out, and 225 equivalent units for the 225 physical units in ending work-in-process inventory.

The 175 fully assembled units are also completely processed with respect to conversion costs. The partially assembled units in ending work in process are 60% complete (on average). Therefore, conversion costs in the 225 partially assembled units are *equivalent* to conversion costs in 135 (60% of 225) fully assembled units. Hence, it shows output as 310 *equivalent units* with respect to conversion costs: 175 equivalent units for the 175 physical units assembled and transferred out and 135 equivalent units for the 225 physical units in ending work-in-process inventory.



Home Insert Page Layout Formulas Data Review View

	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	**Flow of Production**	**Physical Units**	**Direct Materials**	**Conversion Costs**
4	Work in process, beginning	0		
5	Started during current period	400		
6	To account for	400		
7	Completed and transferred out during current period	175	175	175
8	Work in process, ending[a]	225		
9	(225 × 100%; 225 × 60%)		225	135
10	Accounted for	400		
11	Equivalent units of work done in current period		400	310
12				
13	[a]Degree of completion in this department; direct materials, 100%; conversion costs, 60%.			

Calculation of Product Costs (Steps 3, 4, and 5)

The next schedule shows Steps 3, 4, and 5. Together, they are called the *production cost worksheet*.

Step 3 summarizes total costs to account for. Because the beginning balance of work-in-process inventory is zero on February 1, total costs to account for (that is, the total charges or debits to the Work in Process—Assembly account) consist only of costs added during February: direct materials of $32,000 and conversion costs of $18,600, for a total of $50,600.

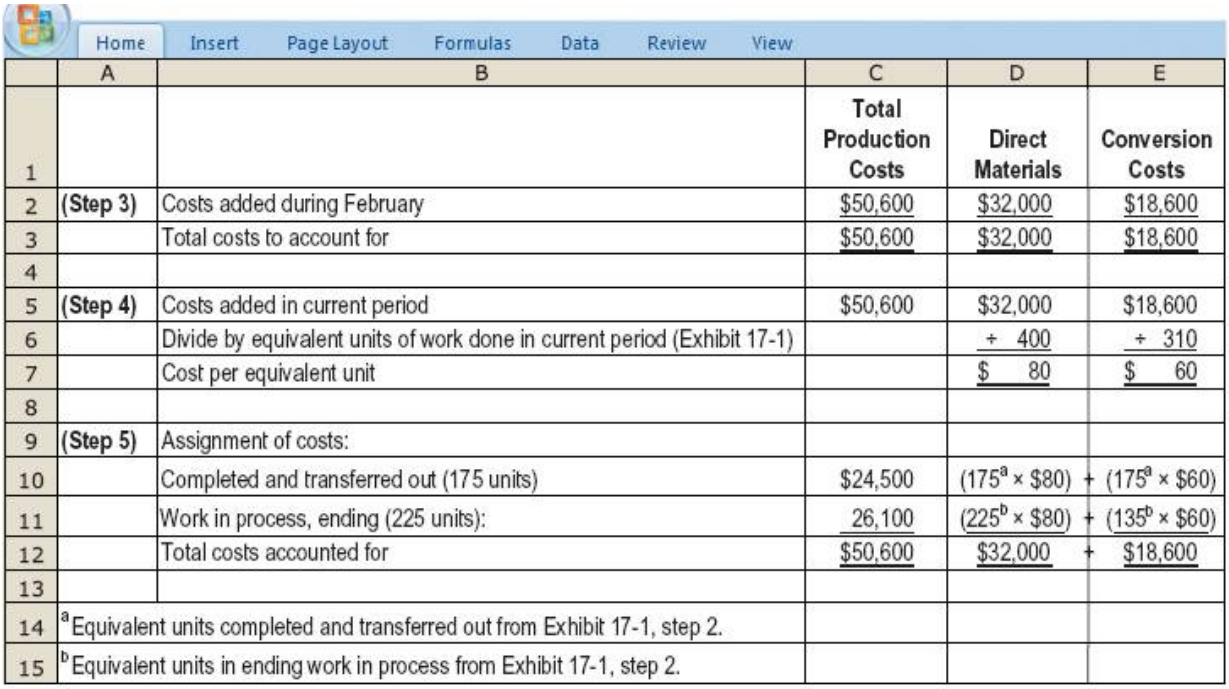
Step 4 calculates cost per equivalent unit separately for direct materials and for conversion costs by dividing direct material costs and conversion costs added during February by the related quantity of equivalent units of work done in February.

To see the importance of using equivalent units in unit-cost calculations, compare conversion costs for January and February 2012. Total conversion costs of $18,600 for the 400 units worked on during February are lower than the conversion costs of $24,000 for the 400 units worked on in January. However, in this example, the conversion costs to fully assemble a unit are $60 in both January and February. Total conversion costs are lower in February because fewer equivalent units of conversion-costs work were completed in February (310) than in January (400). Using physical units instead of equivalent units in the per-unit calculation would have led to the erroneous conclusion that conversion costs per unit declined from $60 in January to $46.50 ($18,600 ÷ 400 units) in February. This incorrect costing might have prompted Pacific Electronics to presume that greater efficiencies in processing had been achieved and to lower the price of SG-40, for example, when in fact costs had not declined.

Step 5 in the schedule (worksheet) assigns these costs to units completed and transferred out and to units still in process at the end of February 2012. The idea is to attach dollar amounts to the equivalent output units for direct materials and conversion costs of (a) units completed and (b) ending work in process, Step 2. *Equivalent output units for each input are multiplied by cost per equivalent unit, as calculated in Step 4*. For example, costs assigned to the 225 physical units in ending work-in-process inventory are as follows:

Direct material costs of 225 equivalent units (Step 2) x $80 cost per equivalent unit of direct materials calculated in Step 4	$18,000
Conversion costs of 135 equivalent units (Step 2) x $60 cost per equivalent unit of conversion costs calculated in Step 4	8,100
Total cost of ending work-in-process inventory	$26,100

Note that total costs to account for in Step 3 ($50,600) equal total costs accounted for in Step 5.



	A	B	C	D	E
1			**Total Production Costs**	**Direct Materials**	**Conversion Costs**
2	**(Step 3)**	Costs added during February	$50,600	$32,000	$18,600
3		Total costs to account for	$50,600	$32,000	$18,600
4					
5	**(Step 4)**	Costs added in current period	$50,600	$32,000	$18,600
6		Divide by equivalent units of work done in current period (Exhibit 17-1)		÷ 400	÷ 310
7		Cost per equivalent unit		$ 80	$ 60
8					
9	**(Step 5)**	Assignment of costs:			
10		Completed and transferred out (175 units)	$24,500	(175^a × $80)	+ (175^a × $60)
11		Work in process, ending (225 units):	26,100	(225^b × $80)	+ (135^b × $60)
12		Total costs accounted for	$50,600	$32,000	+ $18,600
13					
14	[a] Equivalent units completed and transferred out from Exhibit 17-1, step 2.				
15	[b] Equivalent units in ending work in process from Exhibit 17-1, step 2.				

Journal Entries

Journal entries in process-costing systems are similar to the entries made in job-costing systems with respect to direct materials and conversion costs. The main difference is that, in process costing, there is one Work in Process account for each process. In our example, there are accounts for Work in Process—Assembly and Work in Process—Testing. Pacific Electronics purchases direct materials as needed. These materials are delivered directly to the assembly department. Using amounts from the above schedule, summary journal entries for February are as follows:

1. Work in Process—Assembly 32,000

Accounts Payable Control 32,000

To record direct materials purchased and used in production during February.

2. Work in Process—Assembly 18,600

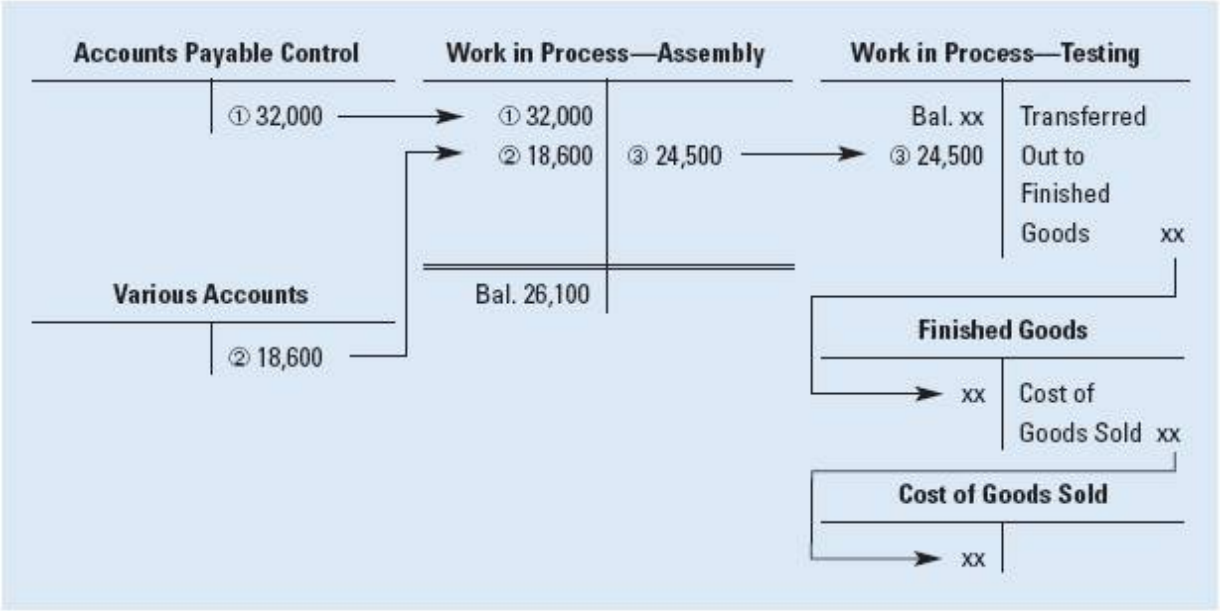
Various accounts such as Wages Payable Control and Accumulated Depreciation 18,600

To record conversion costs for February; examples include energy, manufacturing supplies, all manufacturing labor, and plant depreciation.

3. Work in Process—Testing 24,500

Work in Process—Assembly 24,500

To record cost of goods completed and transferred from assembly to testing during February.



Case 3: Process Costing with Some Beginning & Some Ending WIP Inventory

At the beginning of March 2012, Pacific Electronics had 225 partially assembled SG-40 units in the assembly department. It started production of another 275 units in March.

Data for the assembly department for March are as follows:

Home Insert Page Layout Formulas Data Review View

	A	B	C	D	E
1		Physical Units (SG-40s) (1)	Direct Materials (2)	Conversion Costs (3)	Total Costs (4) = (2) + (3)
2	Work in process, beginning inventory (March 1)	225	$18,000[a]	$8,100[a]	$26,100
3	Degree of completion of beginning work in process		100%	60%	
4	Started during March	275			
5	Completed and transferred out during March	400			
6	Work in process, ending inventory (March 31)	100			
7	Degree of completion of ending work in process		100%	50%	
8	Total costs added during March		$19,800	$16,380	$36,180
9					
10					
11	[a]Work in process, beginning inventory (equals work in process, ending inventory for February)				
12	Direct materials: 225 physical units × 100% completed × $80 per unit = $18,000				
13	Conversion costs: 225 physical units × 60% completed × $60 per unit = $8,100				

Pacific Electronics now has incomplete units in both beginning work-in-process inventory and ending work-in-process inventory for March 2012. We can still use the five steps described earlier to calculate (1) cost of units completed and transferred out and (2) cost of ending work in process. To assign costs to each of these categories, however, we first need to choose an inventory-valuation method. We next describe the five-step approach for two important methods—the *weighted-average method* and the *first-in, first-out method*. These different valuation methods produce different amounts for cost of units completed and for ending work in process when the unit cost of inputs changes from one period to the next.

Weighted-Average Method

The **weighted-average process-costing method** calculates cost per equivalent unit of all *work done to date* (regardless of the accounting period in which it was done) and assigns this cost to equivalent units completed and transferred out of the process and to equivalent units in ending work-in-process inventory. The weighted-average cost is the total of all costs entering the Work in Process account (whether the costs are from beginning work in process or from work started during the current period) divided by total equivalent units of work done to date. We now describe the weighted-average method using the five-step procedure introduced on earlier.

Step 1: Summarize the Flow of Physical Units of Output. The physical-units column of the next schedule shows where the units came from—225 units from beginning inventory and

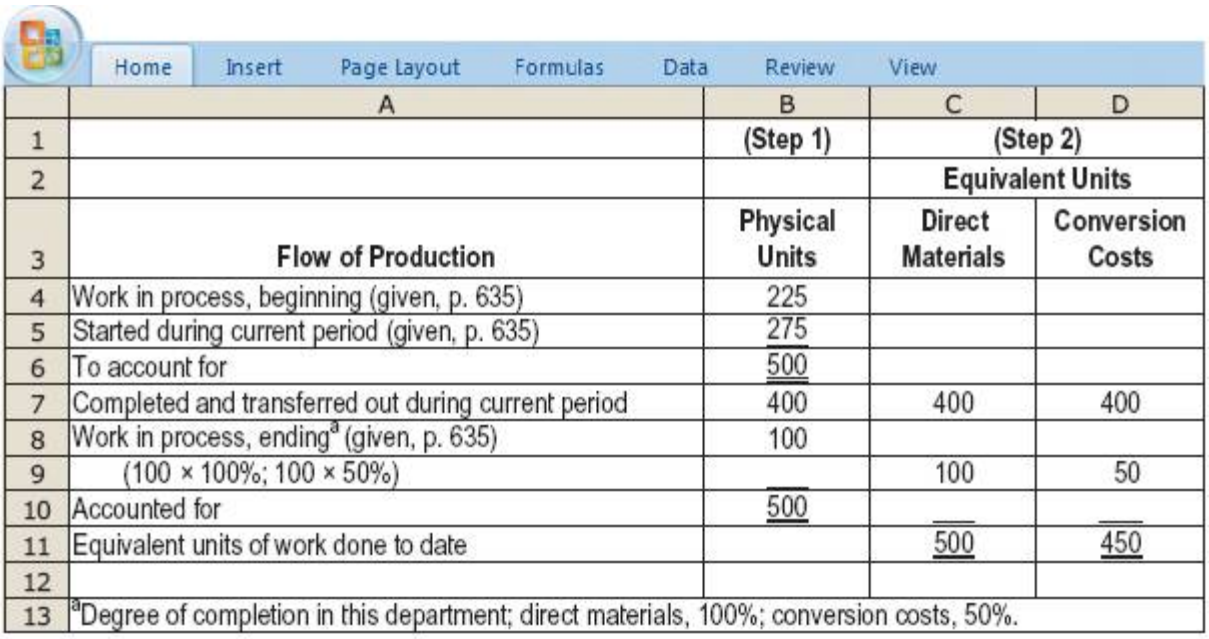
275 units started during the current period—and where they went—400 units completed and transferred out and 100 units in ending inventory.

Step 2: Compute Output in Terms of Equivalent Units. The weighted-average cost of inventory is calculated by merging together the costs of beginning inventory and the manufacturing costs of a period and dividing by the total number of units in beginning inventory and units produced during the accounting period. We apply the same concept here except that calculating the units—in this case equivalent units—is done differently. We use the relationship shown in the following equation:

Equivalent units in beginning work in process	+	Equivalent units of work done in current period	=	Equivalent units completed and transferred out in current period	+	Equivalent units in ending work in process

Although we are interested in calculating the left-hand side of the preceding equation, it is easier to calculate this sum using the equation's right-hand side: (1) equivalent units completed and transferred out in the current period plus (2) equivalent units in ending work in process. *Note that the stage of completion of the current-period beginning work in process is not used in this computation.*

The equivalent-units columns in the next schedule show equivalent units of work done to date: 500 equivalent units of direct materials and 450 equivalent units of conversion costs. All completed and transferred-out units are 100% complete as to both direct materials and conversion costs. Partially completed units in ending work in process are 100% complete as to direct materials because direct materials are introduced at the beginning of the process, and 50% complete as to conversion costs, based on estimates made by the assembly department manager.



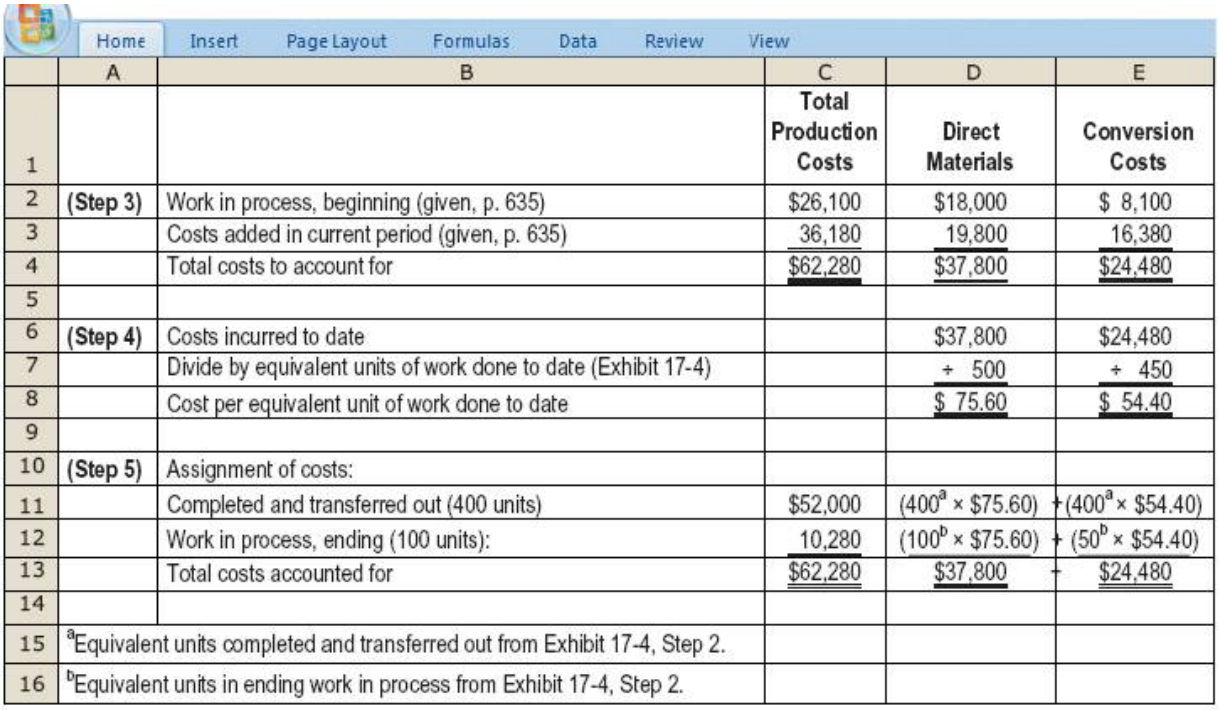
	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	Flow of Production	Physical Units	Direct Materials	Conversion Costs
4	Work in process, beginning (given, p. 635)	225		
5	Started during current period (given, p. 635)	275		
6	To account for	500		
7	Completed and transferred out during current period	400	400	400
8	Work in process, ending[a] (given, p. 635)	100		
9	(100 × 100%; 100 × 50%)		100	50
10	Accounted for	500		
11	Equivalent units of work done to date		500	450
12				
13	[a]Degree of completion in this department; direct materials, 100%; conversion costs, 50%.			

Step 3: Summarize Total Costs to Account For. Next schedule presents Step 3. Total costs to account for in March 2012 are described in the example data on page 637: beginning work in process, $26,100 (direct materials, $18,000, plus conversion costs, $8,100), plus costs added during March, $36,180 (direct materials, $19,800, plus conversion costs, $16,380). The total of these costs is $62,280.

Step 4: Compute Cost per Equivalent Unit. In the same schedule, Step 4 shows the computation of weighted-average cost per equivalent unit for direct materials and conversion costs. Weighted-average cost per equivalent unit is obtained by dividing the sum of costs for beginning work in process plus costs for work done in the current period by total equivalent units of work done to date. When calculating weighted-average conversion cost per equivalent unit in the next schedule, for example, we divide total conversion costs, $24,480 (beginning work in process, $8,100, plus work done in current period, $16,380), by total equivalent units of work done to date, 450 (equivalent units of conversion costs in beginning work in process and in work done in current period), to obtain weighted-average cost per equivalent unit of $54.40.

Step 5: Assign Total Costs to Units Completed and to Units in Ending Work in Process.

Step 5 in the next schedule takes the equivalent units completed and transferred out and equivalent units in ending work in process calculated in the previous schedule, Step 2, and assigns dollar amounts to them using the weighted-average cost per equivalent unit for direct materials and conversion costs calculated in Step 4. For example, total costs of the 100 physical units in ending work in process are as follows:



	A	B	C	D	E
1			Total Production Costs	Direct Materials	Conversion Costs
2	(Step 3)	Work in process, beginning (given, p. 635)	$26,100	$18,000	$ 8,100
3		Costs added in current period (given, p. 635)	36,180	19,800	16,380
4		Total costs to account for	$62,280	$37,800	$24,480
5					
6	(Step 4)	Costs incurred to date		$37,800	$24,480
7		Divide by equivalent units of work done to date (Exhibit 17-4)		÷ 500	÷ 450
8		Cost per equivalent unit of work done to date		$ 75.60	$ 54.40
9					
10	(Step 5)	Assignment of costs:			
11		Completed and transferred out (400 units)	$52,000	(400^a × $75.60)	+ (400^a × $54.40)
12		Work in process, ending (100 units):	10,280	(100^b × $75.60)	+ (50^b × $54.40)
13		Total costs accounted for	$62,280	$37,800	+ $24,480
14					
15	[a]Equivalent units completed and transferred out from Exhibit 17-4, Step 2.				
16	[b]Equivalent units in ending work in process from Exhibit 17-4, Step 2.				

Direct materials:

100 equivalent units * weighted-average cost per equivalent unit of $75.60 $ 7,560

Conversion costs:

50 equivalent units * weighted-average cost per equivalent unit of $54.40 2,720

Total costs of ending work in process $10,280

The summary journal entries under the weighted average method for March 2012 at Pacific Electronics are as follows:

1. Work in Process—Assembly 19,800

Accounts Payable Control 19,800

To record direct materials purchased and used in production during March.

2. Work in Process—Assembly 16,380

Various accounts such as Wages Payable Control and Accumulated Depreciation 16,380

To record conversion costs for March; examples include energy, manufacturing supplies, all manufacturing labor, and plant depreciation.

3. Work in Process—Testing 52,000

Work in Process—Assembly 52,000

To record cost of goods completed and transferred from assembly to testing during March.

The T-account Work in Process—Assembly, under the weighted-average method, is as follows:

Work in Process—Assembly

Beginning inventory, March 1	26,100	③ Completed and transferred out to Work in Process—Testing	52,000
① Direct materials	19,800		
② Conversion costs	16,380		
Ending inventory, March 31	10,280		

First-In, First-Out Method

The **first-in, first-out (FIFO) process-costing method** (1) assigns the cost of the previous accounting period's equivalent units in beginning work-in-process inventory to the first units completed and transferred out of the process, and (2) assigns the cost of equivalent units worked on during the *current* period first to complete beginning inventory, next to start and complete new units, and finally to units in ending work-in-process inventory. The FIFO method assumes that the earliest equivalent units in work in process are completed first.

A distinctive feature of the FIFO process-costing method is that work done on beginning inventory before the current period is kept separate from work done in the current period.

Costs incurred and units produced in the current period are used to calculate cost per equivalent unit of work done in the current period. In contrast, equivalent-unit and cost per-

equivalent-unit calculations under the weighted-average method *merge* units and costs in beginning inventory with units and costs of work done in the current period.

We now describe the FIFO method using the five-step procedure.

Step 1: Summarize the Flow of Physical Units of Output. Next schedule, Step 1, traces the flow of physical units of production. The following observations help explain the calculation of physical units under the FIFO method for Pacific Electronics.

_ The first physical units assumed to be completed and transferred out during the period are 225 units from beginning work-in-process inventory.

_ The March data on page 635 indicate that 400 physical units were completed during March. The FIFO method assumes that of these 400 units, 175 units (400 units 225 units from beginning work-in-process inventory) must have been started and completed during March.

_ Ending work-in-process inventory consists of 100 physical units—the 275 physical units started minus the 175 units that were started and completed.

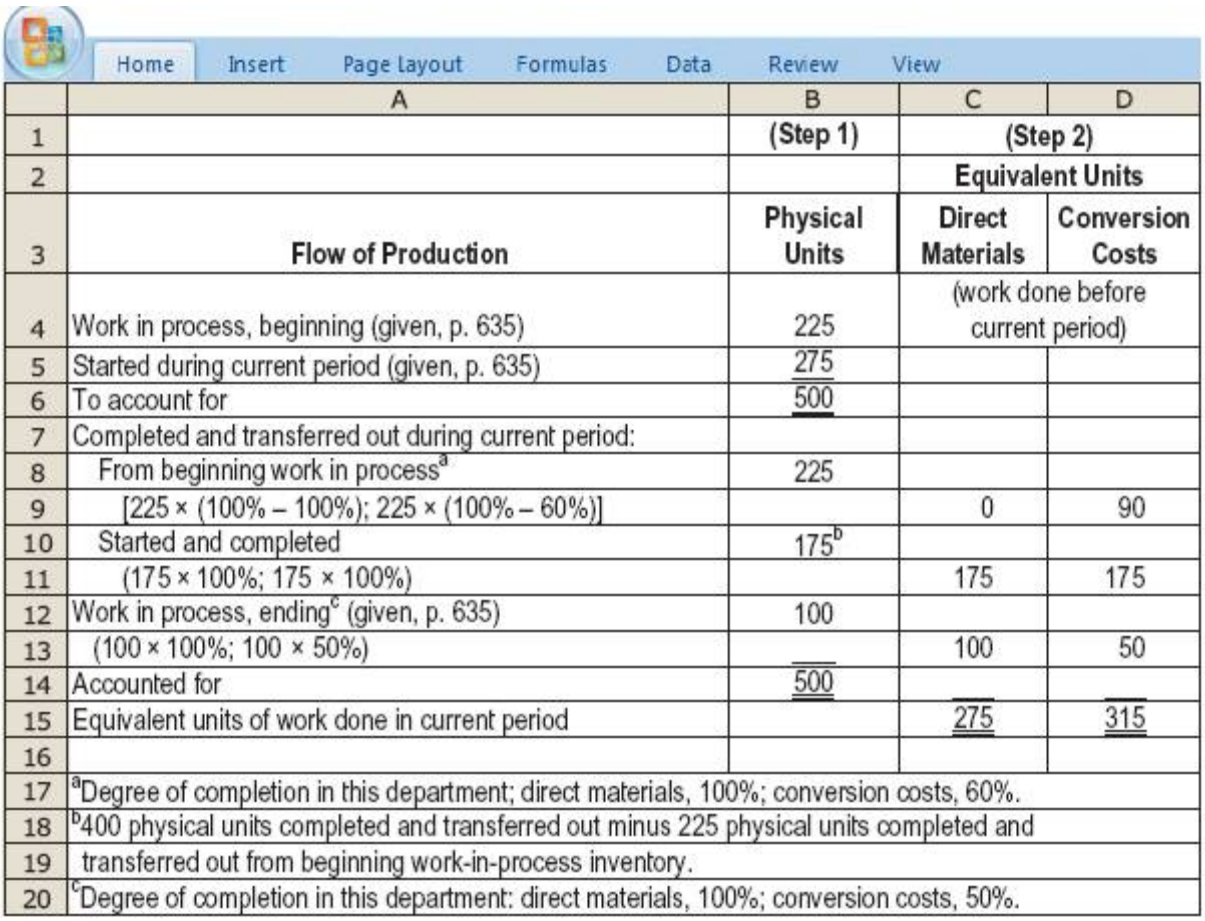
_ The physical units "to account for" equal the physical units "accounted for" (500 units).

Step 2: Compute Output in Terms of Equivalent Units. Next schedule also presents the computations for Step 2 under the FIFO method. *The equivalent-unit calculations for each cost category focus on equivalent units of work done in the current period (March) only.*

Under the FIFO method, equivalent units of work done in March on the beginning work-in-process inventory equal 225 physical units times *the percentage of work remaining to be done in March to complete these units*: 0% for direct materials, because beginning work in process is 100% complete with respect to direct materials, and 40% for conversion costs, because beginning work in process is 60% complete with respect to conversion costs. The results are 0 (0% x 225) equivalent units of work for direct materials and 90 (40% x 225) equivalent units of work for conversion costs.

The equivalent units of work done on the 175 physical units started and completed equals 175 units times 100% for both direct materials and conversion costs, because all work on these units is done in the current period.

The equivalent units of work done on the 100 units of ending work in process equal 100 physical units times 100% for direct materials (because all direct materials for these units are added in the current period) and 50% for conversion costs (because 50% of the conversion-costs work on these units is done in the current period).



Home Insert Page Layout Formulas Data Review View

	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	**Flow of Production**	**Physical Units**	**Direct Materials**	**Conversion Costs**
4	Work in process, beginning (given, p. 635)	225	(work done before current period)	
5	Started during current period (given, p. 635)	275		
6	To account for	500		
7	Completed and transferred out during current period:			
8	From beginning work in process[a]	225		
9	[225 × (100% – 100%); 225 × (100% – 60%)]		0	90
10	Started and completed	175[b]		
11	(175 × 100%; 175 × 100%)		175	175
12	Work in process, ending[c] (given, p. 635)	100		
13	(100 × 100%; 100 × 50%)		100	50
14	Accounted for	500		
15	Equivalent units of work done in current period		275	315
16				
17	[a]Degree of completion in this department; direct materials, 100%; conversion costs, 60%.			
18	[b]400 physical units completed and transferred out minus 225 physical units completed and			
19	transferred out from beginning work-in-process inventory.			
20	[c]Degree of completion in this department: direct materials, 100%; conversion costs, 50%.			

Step 3: Summarize Total Costs to Account For. Next schedule presents Step 3 and summarizes total costs to account for in March 2012 (beginning work in process and costs added in the current period) of $62,280, as described in the example data.

Step 4: Compute Cost per Equivalent Unit. Next schedule shows the Step 4 computation of cost per equivalent unit for *work done in the current period only* for direct materials and conversion costs. For example, conversion cost per equivalent unit of $52 is obtained by dividing current-period conversion costs of $16,380 by current-period conversion costs equivalent units of 315.

Step 5: Assign Total Costs to Units Completed and to Units in Ending Work in Process.

Next schedule shows the assignment of costs under the FIFO method. Costs of work done in the current period are assigned (1) first to the additional work done to complete the beginning work in process, then (2) to work done on units started and completed during the current period, and finally (3) to ending work in process. *Step 5 takes each quantity of equivalent units calculated in Exhibit 17-6, Step 2, and assigns dollar amounts to them (using the cost-per-equivalent-unit calculations in Step 4).* The goal is to use the cost of work done in the current period to determine total costs of all units completed from beginning inventory and from work started and completed in the current period, and costs of ending work in process.

Of the 400 completed units, 225 units are from beginning inventory and 175 units are started and completed during March. The FIFO method starts by assigning the costs of beginning work-in-process inventory of $26,100 to the first units completed and transferred out. As we saw in Step 2, an additional 90 equivalent units of conversion costs are needed to complete these units in the current period. Current-period conversion cost per equivalent unit is $52, so $4,680 (90 equivalent units x $52 per equivalent unit) of additional costs are incurred to complete beginning inventory. Total production costs for units in beginning inventory are $26,100 + $4,680 = $30,780. The 175 units started and completed in the current period consist of 175 equivalent units of direct materials and 175 equivalent units of conversion costs. These units are costed at the cost per equivalent unit in the current period (direct materials, $72, and conversion costs, $52) for a total production cost of $21,700 [175 x ($72 + $52)].

Under FIFO, ending work-in-process inventory comes from units that were started but not fully completed during the current period. Total costs of the 100 partially assembled physical units in ending work in process are as follows:

Direct materials:	
100 equivalent units * $72 cost per equivalent unit in March	$7,200
Conversion costs:	
50 equivalent units * $52 cost per equivalent unit in March	2,600
Total cost of work in process on March 31	$9,800

	A	B	C	D	E
1			Total Production Costs	Direct Material	Conversion Costs
2	(Step 3)	Work in process, beginning (given, p. 635)	$26,100	$18,000	$ 8,100
3		Costs added in current period (given, p. 635)	36,180	19,800	16,380
4		Total costs to account for	$62,280	$37,800	$24,480
5					
6	(Step 4)	Costs added in current period		$19,800	$16,380
7		Divide by equivalent units of work done in current period (Exhibit 17-6)		÷ 275	÷ 315
8		Cost per equivalent unit of work done in current period		$ 72	$ 52
9					
10	(Step 5)	Assignment of costs:			
11		Completed and transferred out (400 units):			
12		Work in process, beginning (225 units)	$26,100	$18,000 +	$8,100
13		Costs added to beginning work in process in current period	4,680	(0^a × $72) +	(90^a × $52)
14		Total from beginning inventory	30,780		
15		Started and completed (175 units)	21,700	(175^b × $72) +	(175^b × $52)
16		Total costs of units completed and transferred out	52,480		
17		Work in process, ending (100 units):	9,800	(100^c × $72) +	(50^c × $52)
18		Total costs accounted for	$62,280	$37,800 +	$24,480
19					
20	[a]Equivalent units used to complete beginning work in process from Exhibit 17-6, Step 2.				
21	[b]Equivalent units started and completed from Exhibit 17-6, Step 2.				
22	[c]Equivalent units in ending work in process from Exhibit 17-6, Step 2.				

Notice how under the FIFO method, the layers of beginning work in process and costs added in the current period are kept separate. The arrows indicate where the costs in each layer go—that is, to units completed and transferred out or to ending work in process. Be sure to include costs of beginning work in process ($26,100) when calculating costs of units completed from beginning inventory.

Costs to Account for		Costs Accounted for Calculated on a FIFO Basis	
		Completed and transferred out	
Beginning work in process	$26,100	Beginning work in process	$26,100
Costs added in current period	36,180	Used to complete beginning work in process	4,680
		Started and completed	21,700
		Completed and transferred out	52,480
		Ending work in process	9,800
Total costs to account for	$62,280	Total costs accounted for	$62,280

Keep in mind that FIFO is applied within each department to compile the cost of units *transferred out*. As a practical matter, however, units *transferred in* during a given period usually are carried at a single average unit cost. For example, the assembly department uses FIFO in the preceding example to distinguish between monthly batches of production.

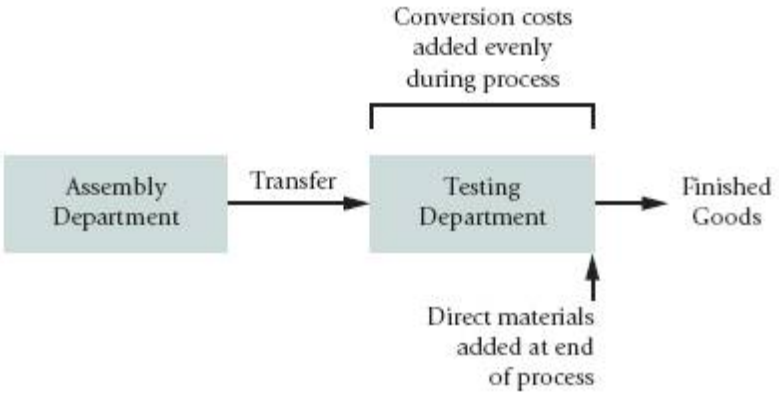
The resulting average cost of units transferred out of the assembly department is $52,480 ÷ 400 units = $131.20 per SG-40 unit. The succeeding department, testing, however, costs these units (which consist of costs incurred in both February and March) at one average unit cost ($131.20 in this illustration). If this averaging were not done, the attempt to track costs on a pure FIFO basis throughout a series of processes would be cumbersome. As a result, the FIFO method should really be called a *modified* or *department* FIFO method.

Transferred-In Costs in Process Costing

Many process-costing systems have two or more departments or processes in the production cycle. As units move from department to department, the related costs are also transferred by monthly journal entries. **Transferred-in costs** (also called **previous-department costs**) are costs incurred in previous departments that are carried forward as the product's cost when it moves to a subsequent process in the production cycle.

We now extend our Pacific Electronics example to the testing department. As the assembly process is completed, the assembly department of Pacific Electronics immediately transfers SG-40 units to the testing department. Conversion costs are added evenly during the testing department's process. At the ***end of the process*** in testing, units receive additional direct materials, including crating and other packing materials to prepare units for shipment. As units are completed in testing, they are immediately transferred to Finished Goods. Computation of testing department costs consists of transferred-in costs, as well as direct materials and conversion costs that are added in testing.

The following diagram represents these facts:



Home Insert Page Layout Formulas Data Review View

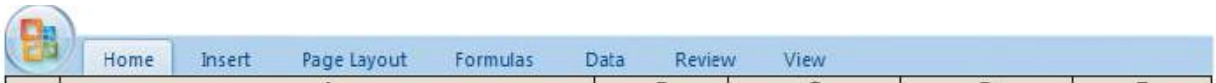
	A	B	C	D	E
1		Physical Units (SG-40s)	Transferred-In Costs	Direct Materials	Conversion Costs
2	Work in process, beginning inventory (March 1)	240	$33,600	$ 0	$18,000
3	Degree of completion of beginning work in process		100%	0%	62.5%
4	Transferred in during March	400			
5	Completed and transferred out during March	440			
6	Work in process, ending inventory (March 31)	200			
7	Degree of completion of ending work in process		100%	0%	80%
8	Total costs added during March				
9	Direct materials and conversion costs			$13,200	$48,600
10	Transferred in (Weighted-average from Exhibit 17-5)[a]		$52,000		
11	Transferred in (FIFO from Exhibit 17-7)[a]		$52,480		
12					
13	[a]The transferred-in costs during March are different under the weighted-average method (Exhibit 17-5) and the FIFO method (Exhibit 17-7). In our example, beginning work-in-process inventory, $51,600 ($33,600 + $0 + $18,000) is the same under both the weighted-average and FIFO inventory methods because we assume costs per equivalent unit to be the same in both January and February. If costs per equivalent unit had been different in the two months, work-in-process inventory at the end of February (beginning of March) would be costed differently under the weighted-average and FIFO methods. The basic approach to process costing with transferred-in costs, however, would still be the same as what we describe in this section.				

Transferred-in costs are treated as if they are a separate type of direct material added at the beginning of the process. That is, transferred-in costs are always 100% complete as of the beginning of the process in the new department. When successive departments are involved, transferred units from one department become all or a part of the direct materials of the next department; however, they are called transferred-in costs, not direct material costs.

Transferred-In Costs and the Weighted-Average Method

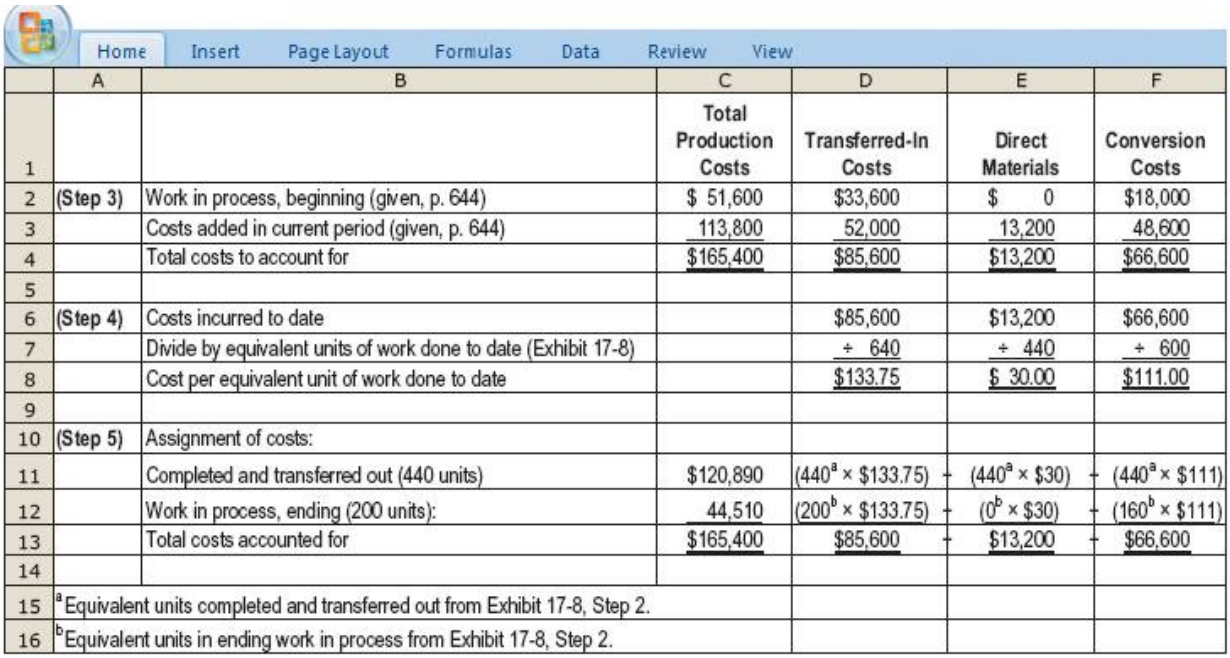
To examine the weighted-average process-costing method with transferred-in costs, we use the five-step procedure described earlier to assign costs of the testing department to units completed and transferred out and to units in ending work in process.

The next schedule shows Steps 1 and 2. The computations are similar to the calculations of equivalent units under the weighted-average method for the assembly department in earlier example. The one difference here is that we have transferred-in costs as an additional input. All units, whether completed and transferred out during the period or in ending work in process, are always fully complete with respect to transferred-in costs. The reason is that the transferred-in costs refer to costs incurred in the assembly department, and any units received in the testing department must have first been completed in the assembly department. However, direct material costs have a zero degree of completion in both beginning and ending work-in-process inventories because, in testing, direct materials are introduced at the *end* of the process.



	A	B	C	D	E
1		(Step 1)	(Step 2)		
2			Equivalent Units		
3	Flow of Production	Physical Units	Transferred-In Costs	Direct Materials	Conversion Costs
4	Work in process, beginning (given, p. 644)	240			
5	Transferred in during current period (given, p. 644)	400			
6	To account for	640			
7	Completed and transferred out during current period	440	440	440	440
8	Work in process, ending[a] (given, p. 644)	200			
9	(200 × 100%; 200 × 0%; 200 × 80%)		200	0	160
10	Accounted for	640			
11	Equivalent units of work done to date		640	440	600
12					
13	[a]Degree of completion in this department; transferred-in costs, 100%; direct materials, 0%; conversion costs, 80%.				

The next schedule describes Steps 3, 4, and 5 for the weighted-average method. Beginning work in process and work done in the current period are combined for purposes of computing cost per equivalent unit for transferred-in costs, direct material costs, and conversion costs.



	A	B	C	D	E	F
1			Total Production Costs	Transferred-In Costs	Direct Materials	Conversion Costs
2	(Step 3)	Work in process, beginning (given, p. 644)	$ 51,600	$33,600	$ 0	$18,000
3		Costs added in current period (given, p. 644)	113,800	52,000	13,200	48,600
4		Total costs to account for	$165,400	$85,600	$13,200	$66,600
5						
6	(Step 4)	Costs incurred to date		$85,600	$13,200	$66,600
7		Divide by equivalent units of work done to date (Exhibit 17-8)		÷ 640	÷ 440	÷ 600
8		Cost per equivalent unit of work done to date		$133.75	$ 30.00	$111.00
9						
10	(Step 5)	Assignment of costs:				
11		Completed and transferred out (440 units)	$120,890	(440^a × $133.75) +	(440^a × $30) +	(440^a × $111)
12		Work in process, ending (200 units):	44,510	(200^b × $133.75) +	(0^b × $30) +	(160^b × $111)
13		Total costs accounted for	$165,400	$85,600 +	$13,200 +	$66,600
14						
15	[a] Equivalent units completed and transferred out from Exhibit 17-8, Step 2.					
16	[b] Equivalent units in ending work in process from Exhibit 17-8, Step 2.					

The journal entry for the transfer from testing to Finished Goods is as follows:

Finished Goods Control 120,890

Work in Process—Testing 120,890

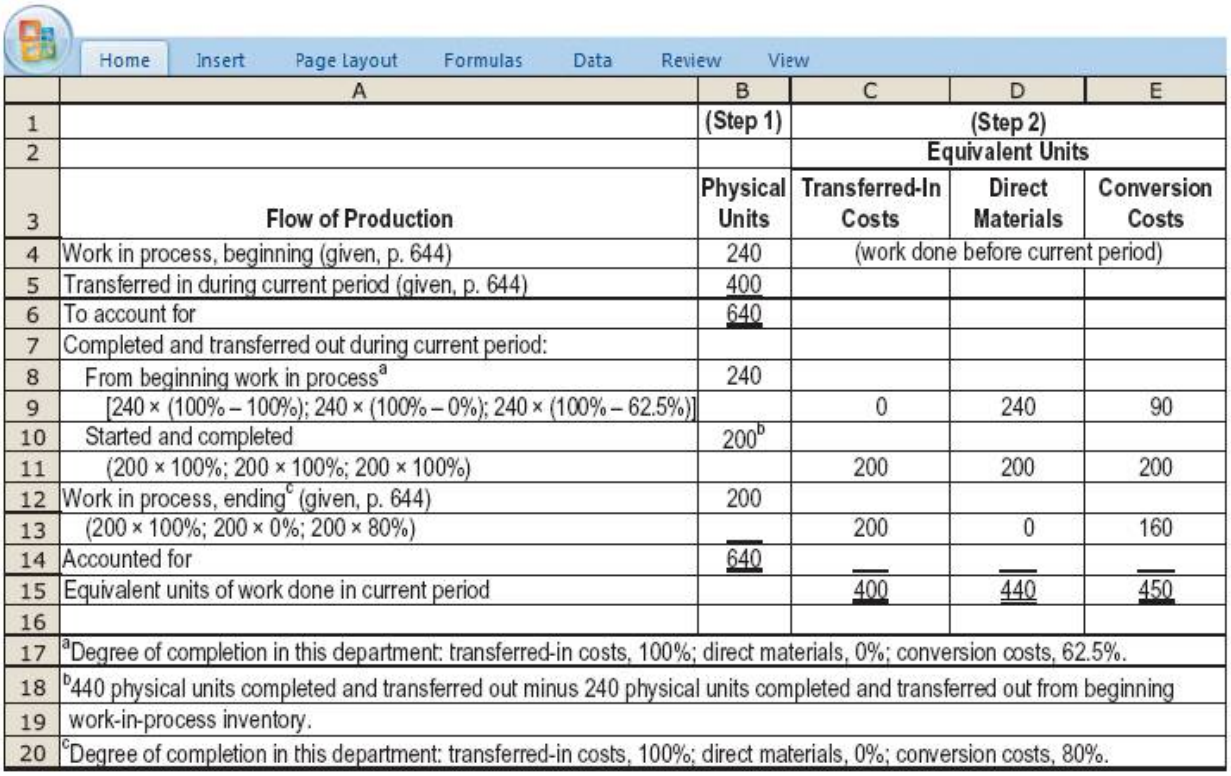
To record cost of goods completed and transferred from testing to Finished Goods.

Transferred-In Costs and the FIFO Method

To examine the FIFO process-costing method with transferred-in costs, we again use the five-step procedure. Next schedule shows Steps 1 and 2. Other than considering transferred- in costs, computations of equivalent units are the same as under the FIFO method for the assembly department shown in earlier.

The other schedule describes Steps 3, 4, and 5. In Step 3, total costs to account for of $165,880 under the FIFO method differs from the corresponding amount under the weighted-average method of $165,400. The reason is the difference in cost of completed units transferred in from the assembly department under the two methods—$52,480 under FIFO and $52,000 under weighted average. Cost per equivalent unit for the current period in Step 4 is calculated on the basis of costs transferred in and work done in the current period only. Step 5 then accounts for the total costs of $165,880 by assigning them to the units transferred out and those in ending work in process. Again, other than considering transferred-in costs, the calculations mirror those under the FIFO method for the assembly department shown earlier.

Remember that in a series of interdepartmental transfers, each department is regarded as separate and distinct for accounting purposes.



	A	B	C	D	E
1		(Step 1)	(Step 2)		
2			Equivalent Units		
3	**Flow of Production**	**Physical Units**	**Transferred-In Costs**	**Direct Materials**	**Conversion Costs**
4	Work in process, beginning (given, p. 644)	240	(work done before current period)		
5	Transferred in during current period (given, p. 644)	400			
6	To account for	640			
7	Completed and transferred out during current period:				
8	From beginning work in process[a]	240			
9	[240 × (100% – 100%); 240 × (100% – 0%); 240 × (100% – 62.5%)]		0	240	90
10	Started and completed	200[b]			
11	(200 × 100%; 200 × 100%; 200 × 100%)		200	200	200
12	Work in process, ending[c] (given, p. 644)	200			
13	(200 × 100%; 200 × 0%; 200 × 80%)		200	0	160
14	Accounted for	640			
15	Equivalent units of work done in current period		400	440	450
16					
17	[a]Degree of completion in this department: transferred-in costs, 100%; direct materials, 0%; conversion costs, 62.5%.				
18	[b]440 physical units completed and transferred out minus 240 physical units completed and transferred out from beginning				
19	work-in-process inventory.				
20	[c]Degree of completion in this department: transferred-in costs, 100%; direct materials, 0%; conversion costs, 80%.				

Home Insert Page Layout Formulas Data Review View

	A	B	C	D	E	F
1			Total Production Costs	Transferred-In Cost	Direct Material	Conversion Costs
2	(Step 3)	Work in process, beginning (given, p. 644)	$ 51,600	$33,600	$ 0	$18,000
3		Costs added in current period (given, p. 644)	114,280	52,480	13,200	48,600
4		Total costs to account for	$165,880	$86,080	$13,200	$66,600
5						
6	(Step 4)	Costs added in current period		$52,480	$13,200	$48,600
7		Divide by equivalent units of work done in current period (Exhibit 17-10)		÷ 400	÷ 440	÷ 450
8		Cost per equivalent unit of work done in current period		$131.20	$ 30	$ 108
9						
10	(Step 5)	Assignment of costs:				
11		Completed and transferred out (440 units)				
12		Work in process, beginning (240 units)	$ 51,600	$33,600	+ $0	+ $18,000
13		Costs added to beginning work in process in current period	16,920	(0^a × $131.20)	+ (240^a × $30)	+ (90^a × $108)
14		Total from beginning inventory	68,520			
15		Started and completed (200 units)	53,840	(200^b × $131.20)	+ (200^b × $30)	+ (200^b × $108)
16		Total costs of units completed and transferred out	122,360			
17		Work in process, ending (200 units):	43,520	(200^c × $131.20)	+ (0^c × $30)	+ (160^c × $108)
18		Total costs accounted for	$165,880	$86,080	+ $13,200	+ $66,600
19						
20	[a]Equivalent units used to complete beginning work in process from Exhibit 17-10, Step 2.					
21	[b]Equivalent units started and completed from Exhibit 17-10, Step 2.					
22	[c]Equivalent units in ending work in process from Exhibit 17-10, Step 2.					

The journal entry for the transfer from testing to Finished Goods is as follows:

Finished Goods Control 122,360

Work in Process—Testing 122,360

To record cost of goods completed and transferred from testing to Finished Goods.

Points to Remember About Transferred-In Costs

Some points to remember when accounting for transferred-in costs are as follows:

1. Be sure to include transferred-in costs from previous departments in your calculations.

2. In calculating costs to be transferred on a FIFO basis, do not overlook costs assigned in the previous period to units that were in process at the beginning of the current period but are now included in the units transferred. For example, do not overlook the $51,600.

3. Unit costs may fluctuate between periods. Therefore, transferred units may contain batches accumulated at different unit costs. For example, the 400 units transferred in at $52,480 using the FIFO method consist of units that have different unit costs of direct materials and conversion costs when these units were worked on in the assembly department. Remember,

however, that when these units are transferred to the testing department, they are costed at *one average unit cost* of $131.20 ($52,480 ÷ 400 units).

4. Units may be measured in different denominations in different departments. Consider each department separately. For example, unit costs could be based on kilograms in the first department and liters in the second department. Accordingly, as units are received in the second department, their measurements must be converted to liters.

Hybrid Costing Systems

Product-costing systems do not always fall neatly into either job-costing or process-costing categories. Consider Ford Motor Company. Automobiles may be manufactured in a continuous flow (suited to process costing), but individual units may be customized with a special combination of engine size, transmission, music system, and so on (which requires job costing). A **hybrid-costing system** blends characteristics from both job-costing and process costing systems. Product-costing systems often must be designed to fit the particular characteristics of different production systems. Many production systems are a hybrid: They have some features of custom-order manufacturing and other features of mass-production manufacturing. Manufacturers of a relatively wide variety of closely related standardized products (for example, televisions, dishwashers, and washing machines) tend to use hybrid-costing systems. The Concepts in Action feature describes a hybrid-costing system at Adidas. The next section explains *operation costing*, a common type of hybrid costing system.

Overview of Operation-Costing Systems

An **operation** is a standardized method or technique that is performed repetitively, often on different materials, resulting in different finished goods. Multiple operations are usually conducted within a department. For instance, a suit maker may have a cutting operation and a hemming operation within a single department. The term *operation*, however, is often used loosely. It may be a synonym for a department or process. For example, some companies may call their finishing department a finishing process or a finishing operation.

An **operation-costing system** is a hybrid-costing system applied to batches of similar, but not identical, products. Each batch of products is often a variation of a single design, and it

proceeds through a sequence of operations. Within each operation, all product units are treated exactly alike, using identical amounts of the operation's resources. A key point in the operation system is that each batch does not necessarily move through the same operations as other batches. Batches are also called production runs.

In a company that makes suits, management may select a single basic design for every suit to be made, but depending on specifications, each batch of suits varies somewhat from other batches. Batches may vary with respect to the material used or the type of stitching. Semiconductors, textiles, and shoes are also manufactured in batches and may have similar variations from batch to batch.

An operation-costing system uses work orders that specify the needed direct materials and step-by-step operations. Product costs are compiled for each work order.

Direct materials that are unique to different work orders are specifically identified with the appropriate work order, as in job costing. However, each unit is assumed to use an identical amount of conversion costs for a given operation, as in process costing.

A single average conversion cost per unit is calculated for each operation, by dividing total conversion costs for that operation by the number of units that pass through it. This average cost is then assigned to each unit passing through the operation.

Units that do not pass through an operation are not allocated any costs of that operation. Our examples assume only two cost categories—direct materials and conversion costs—but operation costing can have more than two cost categories. Costs in each category are identified with specific work orders using job-costing or process costing methods as appropriate.

Managers find operation costing useful in cost management because operation costing focuses on control of physical processes, or operations, of a given production system. For example, in clothing manufacturing, managers are concerned with fabric waste, how many fabric layers that can be cut at one time, and so on. Operation costing measures, in financial terms, how well managers have controlled physical processes.

Exercises on Job and process costing (Source: Horngren, 14 Ed.)

1. Actual costing, normal costing, accounting for manufacturing overhead.

Destin Products uses a job-costing system with two direct-cost categories (direct materials and direct manufacturing labor) and one manufacturing overhead cost pool. Destin allocates manufacturing overhead costs using direct manufacturing labor costs. Destin provides the following information:

	Budget for 2011	Actual Results for 2011
Direct material costs	$2,000,000	$1,900,000
Direct manufacturing labor costs	1,500,000	1,450,000
Manufacturing overhead costs	2,700,000	2,755,000

Required:

a. Compute the actual and budgeted manufacturing overhead rates for 2011.

b. During March, the job-cost record for Job 626 contained the following information:

Direct materials used	$40,000
Direct manufacturing labor costs	$30,000

Compute the cost of Job 626 using (a) actual costing and (b) normal costing.

c. At the end of 2011, compute the under- or overallocated manufacturing overhead under normal costing. Why is there no under- or overallocated overhead under actual costing?

2. Job costing, accounting for manufacturing overhead, budgeted rates.

The Lynn Company uses a normal job-costing system at its Minneapolis plant. The plant has a machining department and an assembly department. Its job-costing system has two direct-cost categories (direct materials and direct manufacturing labor) and two manufacturing overhead cost pools (the machining department overhead, allocated to jobs based on actual machine-hours, and the assembly department overhead, allocated to jobs based on actual direct manufacturing labor costs). The 2011 budget for the plant is as follows:

	Machining Department	Assembly Department
Manufacturing overhead	$1,800,000	$3,600,000
Direct manufacturing labor costs	$1,400,000	$2,000,000
Direct manufacturing labor-hours	100,000	200,000
Machine-hours	50,000	200,000

i. Present an overview diagram of Lynn's job-costing system. Compute the budgeted manufacturing overhead rate for each department.

ii. During February, the job-cost record for Job 494 contained the following:

	Machining Department	Assembly Dep't
Direct materials used	$45,000	$70,000
Direct manufacturing labor costs	$14,000	$15,000
Direct manufacturing labor-hours	1,000	1,500
Machine-hours	2,000	1,000

Compute the total manufacturing overhead costs allocated to Job 494.

iii. At the end of 2011, the actual manufacturing overhead costs were $2,100,000 in machining and $3,700,000 in assembly. Assume that 55,000 actual machine-hours were used in machining and that actual direct manufacturing labor costs in assembly were $2,200,000. Compute the over- or underallocated manufacturing overhead for each department.

3. Job costing, journal entries. The University of Chicago Press is wholly owned by the university. It performs the bulk of its work for other university departments, which pay as though the press were an outside business enterprise. The press also publishes and maintains a stock of books for general sale. The press uses normal costing to cost each job. Its job-costing system has two direct-cost categories (direct materials and direct manufacturing labor) and one indirect-cost pool (manufacturing overhead - MOH, allocated on the basis of direct manufacturing labor costs).

The following data (in thousands) pertain to 2011:

Direct materials and supplies purchased on credit	$ 800
Direct materials used	710
Indirect materials issued to various production departments	100
Direct manufacturing labor	1,300
Indirect manufacturing labor incurred by various production departments	900
Depreciation on building and manufacturing equipment	400
Miscellaneous manufacturing overhead incurred by various production departments (ordinarily would be detailed as repairs, photocopying, utilities, etc.)	550
Manufacturing overhead allocated at 160% of direct manufacturing labor costs	?

Cost of goods manufactured	4,120
Revenues	8,000
Cost of goods sold (before adjustment for under- or overallocated MOH)	4,020

Inventories, December 31, 2010 (not 2011):	
Materials Control	100
Work-in-Process Control	60
Finished Goods Control	500

i. Prepare an overview diagram of the job-costing system at the University of Chicago Press.

ii. Prepare journal entries to summarize the 2011 transactions. As your final entry, dispose of the year-end under- or overallocated manufacturing overhead as a write-off to Cost of Goods Sold. Number your entries. Explanations for each entry may be omitted.

iii. Show posted T-accounts for all inventories, Cost of Goods Sold, Manufacturing Overhead Control, and Manufacturing Overhead Allocated.

4. General ledger relationships, under- and overallocation. (S. Sridhar, adapted)

Needham Company uses normal costing in its job-costing system. Partially completed T-accounts and additional information for Needham for 2011 are as follows:

Direct Materials Control			Work-in-Process Control			Finished Goods Control		
1-1-2011	30,000	380,000	1-1-2011	20,000		1-1-2011	10,000	900,000
	400,000		Dir. manuf. labor	360,000			940,000	

Manufacturing Overhead Control	Manufacturing Overhead Allocated	Cost of Goods Sold
540,000		

Additional information follows:

a. Direct manufacturing labor wage rate was $15 per hour.

b. Manufacturing overhead was allocated at $20 per direct manufacturing labor-hour.

c. During the year, sales revenues were $1,090,000, and marketing and distribution costs were $140,000.

1. What was the amount of direct materials issued to production during 2011?

2. What was the amount of manufacturing overhead allocated to jobs during 2011?

3. What was the total cost of jobs completed during 2011?

4. What was the balance of work-in-process inventory on December 31, 2011?

5. What was the cost of goods sold before proration of under- or overallocated overhead?

6. What was the under- or overallocated manufacturing overhead in 2011?

7. Dispose of the under- or overallocated manufacturing overhead using the following:

a. Write-off to Cost of Goods Sold

b. Proration based on ending balances (before proration) in Work-in-Process Control, Finished Goods
Control, and Cost of Goods Sold

8. Using each of the approaches in requirement 7, calculate Needham's operating income for 2011.

9. Which approach in requirement 7 do you recommend Needham use? Explain your answer briefly.

5. Proration of overhead. The Ride-On-Wave Company (ROW) produces a line of non-motorized boats.

ROW uses a normal-costing system and allocates manufacturing overhead using direct manufacturing labor cost. The following data are for 2011:

Budgeted manufacturing overhead cost	$125,000
Budgeted direct manufacturing labor cost	$250,000
Actual manufacturing overhead cost	$117,000
Actual direct manufacturing labor cost	$228,000

Inventory balances on December 31, 2011, were as follows:

Account	**Ending balance**	**2011 direct manufacturing labor cost in ending balance**
Work in process	$ 50,700	$ 20,520
Finished goods	245,050	59,280
Cost of goods sold	549,250	148,200

i. Calculate the manufacturing overhead allocation rate.

ii. Compute the amount of under- or overallocated manufacturing overhead.

iii. Calculate the ending balances in work in process, finished goods, and cost of goods sold if under/overallocated manufacturing overhead is as follows:

a. Written off to cost of goods sold

b. Prorated based on ending balances (before proration) in each of the three accounts

c. Prorated based on the overhead allocated in 2011 in the ending balances (before proration) in each of the three accounts

6. Schedules of Cost of Goods Manufactured and Cost of Goods Sold (Ray Garrison, 14th Ed.)

Parmitan Corporation has provided the following data concerning last month's manufacturing operations.

Purchases of raw materials	$53,000
Indirect materials included in manufacturing overhead	$8,000
Direct labor	$62,000
Manufacturing overhead applied to work in process	$41,000
Underapplied overhead	$8,000

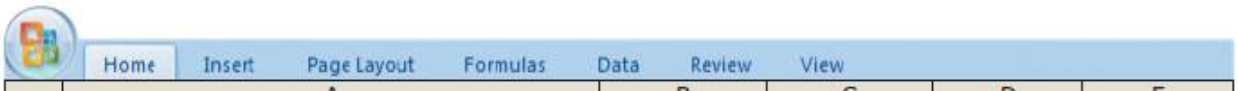
	Beginning	Ending
Inventories:		
Raw materials	$24,000	$6,000
Work in process	$41,000	$38,000
Finished goods	$86,000	$93,000

Required:

a. Prepare a schedule of cost of goods manufactured for the month.

b. Prepare a schedule of cost of goods sold for the month.

Process Costing: Bookworm, Inc., has two departments: printing and binding. Each department has one direct-cost category (direct materials) and one indirect-cost category (conversion costs). This problem focuses on the binding department. Books that have undergone the printing process are immediately transferred to the binding department. Direct material is added when the binding process is 80% complete. Conversion costs are added evenly during binding operations. When those operations are done, the books are immediately transferred to Finished Goods. Bookworm, Inc., uses the weighted-average method of process costing. The following is a summary of the April 2012 operations of the binding department.



	A	B	C	D	E
1		**Physical Units (books)**	**Transferred-In Costs**	**Direct Materials**	**Conversion Costs**
2	Beginning work in process	1,050	$ 32,550	$ 0	$13,650
3	Degree of completion, beginning work in process		100%	0%	50%
4	Transferred in during April 2012	2,400			
5	Completed and transferred out during April	2,700			
6	Ending work in process (April 30)	750			
7	Degree of completion, ending work in process		100%	0%	70%
8	Total costs added during April		$129,600	$23,490	$70,200

Using both Weighted Average and FIFO methods,

1. Summarize total binding department costs for April 2012, and assign these costs to units completed (and transferred out) and to units in ending work in process.

2. Prepare journal entries for April transfers from the printing department to the binding department and from the binding department to Finished Goods.

Chapter 4: Spoilage, Rework, and Scrap

The focus of this chapter is on three types of costs that arise as a result of defects—spoilage, rework, and scrap—and ways to account for them. We also describe how to determine (1) cost of products, (2) cost of goods sold, and (3) inventory values when spoilage, rework, and scrap occur.

Defining Spoilage, Rework and Scrap

While the terms used in this chapter may seem familiar, be sure you understand them in the context of management accounting.

Spoilage is units of production—whether fully or partially completed—that do not meet the specifications required by customers for good units and that are discarded or sold at reduced prices.

Rework is units of production that do not meet the specifications required by customers but that are subsequently repaired and sold as good finished units.

Scrap is residual material that results from manufacturing a product. Examples are short lengths from woodworking operations, edges from plastic molding operations, and frayed cloth & end cuts from suit-making operations. Scrap can sometimes be sold for relatively small amounts. In that sense, scrap is similar to byproducts. The difference is that scrap arises as a residual from the manufacturing process, and is not a product targeted for manufacture or sale by the firm.

Two Types of Spoilage

Accounting for spoilage aims to determine the magnitude of spoilage costs and to distinguish between costs of normal and abnormal spoilage. To manage, control, and reduce spoilage costs, companies need to highlight them, not bury them as an unidentified part of the costs of good units manufactured.

To illustrate normal & abnormal spoilage, consider M. Plastics, which makes casings for the iMac computer using plastic injection molding. In January 2012, M. incurs costs of $615,000 to produce 20,500 units. Of these 20,500 units, 20,000 are good units & 500 are spoiled units. M. Plastics has no beginning inventory and no ending inventory that month. Of the 500 spoiled units, 400 units are spoiled because the injection molding machines are unable to manufacture good casings 100% of the time. That is, these units are spoiled even though the machines were run carefully and efficiently. The remaining 100 units are spoiled because of machine breakdowns & operator errors.

Normal Spoilage

Normal spoilage is spoilage inherent in a particular production process. In particular, it arises even when the process is operated in an efficient manner. The costs of normal spoilage are typically included as a component of the costs of good units manufactured, because good units cannot be made without also making some units that are spoiled.

There is a tradeoff between the speed of production and the normal spoilage rate. Management makes a conscious decision about how many units to produce per hour with the understanding that, at the rate decided on, a certain level of spoilage is almost unavoidable. For this reason, the cost of normal spoilage is included in the cost of the good units completed. At M. Plastics, the 400 units spoiled because of the limitations of injection molding machines and despite efficient operating conditions are considered normal spoilage. The calculations are as follows:

Manufacturing cost per unit, $615,000 ÷ 20,500 units = $30	
Manufacturing costs of good units alone, $30 per unit * 20,000 units =	$600,000
Normal spoilage costs, $30 per unit * 400 units =	12,000
Manufacturing costs of good units completed (includes normal spoilage)	$612,000
Manufacturing cost per good unit = $612,000 ÷ 20,000 units =	$30.60

Because normal spoilage is the spoilage related to the good units produced, normal spoilage rates are computed by dividing units of normal spoilage by total *good units completed*, not total *actual units started* in production. At M. Plastics, the normal spoilage rate is therefore computed as 400 ÷ 20,000 = 2%.

Abnormal Spoilage

Abnormal spoilage is spoilage that is not inherent in a particular production process and would not arise under efficient operating conditions. If a firm has 100% good units as its goal, then any spoilage would be considered abnormal. At M. Plastics, the 100 units spoiled due to machine breakdowns and operator errors are abnormal spoilage.

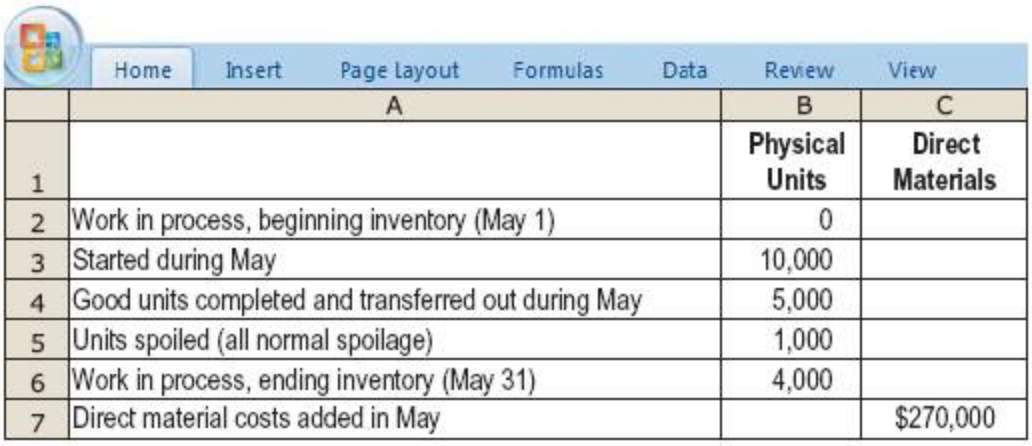
Abnormal spoilage is usually regarded as avoidable and controllable. Line operators and other plant personnel generally can decrease or eliminate abnormal spoilage by identifying the reasons for machine breakdowns, operator errors, etc., and by taking steps to prevent their recurrence. To highlight the effect of abnormal spoilage costs, companies calculate the units of abnormal spoilage and record the cost in the ***Loss from Abnormal Spoilage*** account, which appears as a separate line item in the income statement. At M. Plastics, the loss from abnormal spoilage is $3,000 ($30 per unit * 100 units). Issues about accounting for spoilage arise in both process-costing and job-costing systems. We discuss both instances next, beginning with spoilage in process-costing.

Spoilage in Process Costing Using Weighted-Average and FIFO

How do process-costing systems account for spoiled units? We have already said that units of abnormal spoilage should be counted and recorded separately in a Loss from Abnormal Spoilage account. But what about units of normal spoilage? The correct method is to count these units when computing output units—physical or equivalent—in a process-costing system. The following example and discussion illustrate this approach.

Count All Spoilage

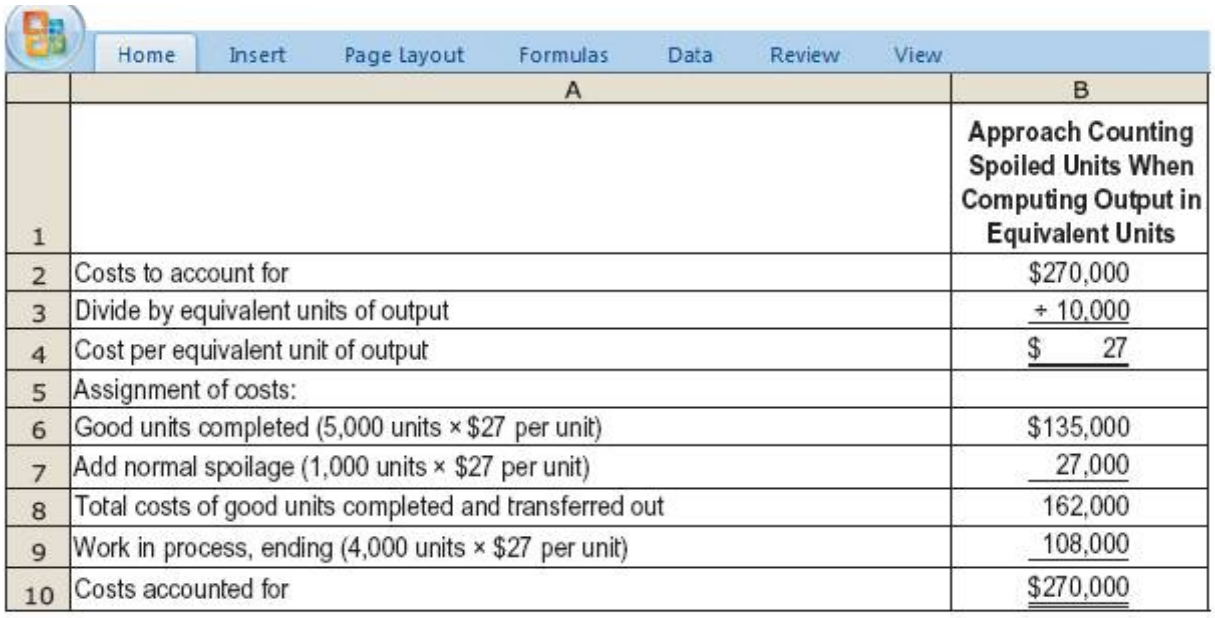
Example 1: Chipmakers, Inc., manufactures computer chips for television sets. All direct materials are added at the beginning of the production process. To highlight issues that arise with normal spoilage, we assume no beginning inventory and focus only on direct material costs. The following data are available for May 2012.



	A	B	C
1		**Physical Units**	**Direct Materials**
2	Work in process, beginning inventory (May 1)	0	
3	Started during May	10,000	
4	Good units completed and transferred out during May	5,000	
5	Units spoiled (all normal spoilage)	1,000	
6	Work in process, ending inventory (May 31)	4,000	
7	Direct material costs added in May		$270,000

Spoilage is detected upon completion of the process and has zero net disposal value. An **inspection point** is the stage of the production process at which products are examined to determine whether they are acceptable or unacceptable units. Spoilage is typically assumed to occur at the stage of completion where inspection takes place. As a result, the spoiled units in our example are assumed to be 100% complete with respect to direct materials. The Exhibit below calculates and assigns cost per unit of direct materials. Overall, Chipmakers generated 10,000 equivalent units of output: 5,000 equivalent units in good units completed (5,000 physical units * 100%), 4,000 units in ending work in process (4,000 physical units * 100%), and 1,000 equivalent units in normal spoilage (1,000 physical units * 100%). Given total direct material costs of $270,000 in May, this yields an equivalent-unit cost of $27. The total cost of good units completed and transferred out, which includes the cost of normal spoilage, is then $162,000 (6,000 equivalent units * $27), while the ending work in process is assigned a cost of $108,000 (4,000 equivalent units * $27).

There are two noteworthy features of this approach. First, the 4,000 units in ending work in process are not assigned any of the costs of normal spoilage. This is appropriate because the units have not yet been inspected. While the units in ending work in process undoubtedly include some that will be detected as spoiled when inspected, these units will only be identified when the units are completed in the subsequent accounting period. At that time, costs of normal spoilage will be assigned to the good units completed in that period. Second, the approach used in the next Exhibit delineates the cost of normal spoilage as $27,000. By highlighting the magnitude of this cost, the approach helps to focus management's attention on the potential economic benefits of reducing spoilage.



	A	B
1		**Approach Counting Spoiled Units When Computing Output in Equivalent Units**
2	Costs to account for	$270,000
3	Divide by equivalent units of output	÷ 10,000
4	Cost per equivalent unit of output	$ 27
5	Assignment of costs:	
6	Good units completed (5,000 units × $27 per unit)	$135,000
7	Add normal spoilage (1,000 units × $27 per unit)	27,000
8	Total costs of good units completed and transferred out	162,000
9	Work in process, ending (4,000 units × $27 per unit)	108,000
10	Costs accounted for	$270,000

Five-Step Procedure for Process Costing with Spoilage

Example 2: AZ Company manufactures a recycling container in its forming department. Direct materials are added at the beginning of the production process. Conversion costs are added evenly during the production process. Some units of this product are spoiled as a result of defects, which are detectable only upon inspection of finished units. Normally, spoiled units are 10% of the finished output of good units. That is, for every 10 good units produced, there is 1 unit of normal spoilage. Summary data for July 2012 are as follows:

	A	B	C	D	E
1		Physical Units (1)	Direct Materials (2)	Conversion Costs (3)	Total Costs (4) = (2) + (3)
2	Work in process, beginning inventory (July 1)	1,500	$12,000	$ 9,000	$ 21,000
3	Degree of completion of beginning work in process		100%	60%	
4	Started during July	8,500			
5	Good units completed and transferred out during July	7,000			
6	Work in process, ending inventory (July 31)	2,000			
7	Degree of completion of ending work in process		100%	50%	
8	Total costs added during July		$76,500	$89,100	$165,600
9	Normal spoilage as a percentage of good units	10%			
10	Degree of completion of normal spoilage		100%	100%	
11	Degree of completion of abnormal spoilage		100%	100%	

The five-step procedure for process costing used in previous Chapter needs only slight modification to accommodate spoilage.

Step 1: Summarize the Flow of Physical Units of Output. Identify the number of units of both normal and abnormal spoilage.

$$\text{Total Spoilage} = \left(\begin{array}{c}\text{Units in beginning}\\ \text{work-in-process inventory}\end{array} + \begin{array}{c}\text{Units}\\ \text{started}\end{array}\right) - \left(\begin{array}{c}\text{Good units}\\ \text{completed and}\\ \text{transferred out}\end{array} + \begin{array}{c}\text{Units in ending}\\ \text{work-in-process inventory}\end{array}\right)$$

Total Spoilage = (1,500 + 8,500) - (7,000 + 2,000) = 1,000 units

Recall that normal spoilage is 10% of good output at AZ Company. Therefore, normal spoilage = 10% of the 7,000 units of *good* output = 700 units.

Step 2: Compute Output in Terms of Equivalent Units. Compute equivalent units for spoilage in the same way we compute equivalent units for good units. As illustrated previously, all spoiled units are included in the computation of output units. Because AZ's inspection point is at the completion of production, the same amount of work will have been done on each spoiled and each completed good unit.

Step 3: Summarize Total Costs to Account For. The total costs to account for are all the costs debited to Work in Process. The details for this step are similar to Step 3 in previous Chapter.

Step 4: Compute Cost per Equivalent Unit. This step is similar to Step 4 in previous Chapter.

Step 5: Assign Total Costs to Units Completed, to Spoiled Units, and to Units in Ending Work in Process. This step now includes computation of the cost of spoiled units and the cost of good units.

We illustrate these five steps of process costing for the weighted-average and FIFO methods next.

Weighted-Average Method and Spoilage

Next Exhibit, Panel A, presents Steps 1 and 2 to calculate equivalent units of work done to date and includes calculations of equivalent units of normal and abnormal spoilage. Panel B, presents Steps 3, 4, and 5 (together called the production-cost worksheet).

Step 3 summarizes total costs to account for. Step 4 presents cost-per-equivalent-unit calculations using the weighted-average method. Note how, for each cost category, costs of beginning work in process and costs of work done in the current period are totaled and divided by equivalent units of all work done to date to calculate the weighted-average cost per equivalent unit. Step 5 assigns total costs to completed units, normal and abnormal spoiled units, and ending inventory by multiplying the equivalent units calculated in Step 2 by the cost per equivalent unit calculated in Step 4. Also note that the $13,825 costs of normal spoilage are added to the costs of the related good units completed and transferred out.

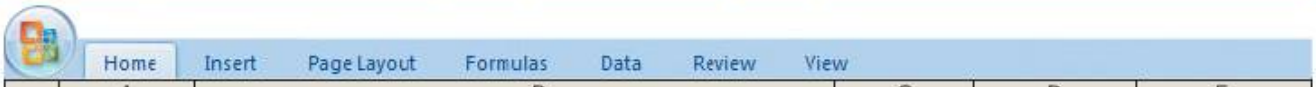
$$\text{Cost per good unit completed \& transferred out of the process} = \frac{\text{Total costs transferred out (including normal spoilage)}}{\text{Number of good units produced}}$$

$$= \$152{,}075 \div 7{,}000 \text{ good units} = \$21.725 \text{ per good unit}$$

This amount is not equal to $19.75 per good unit, the sum of the $8.85 cost per equivalent unit of direct materials plus the $10.90 cost per equivalent unit of conversion costs. That's because the cost per good unit equals the sum of the direct material and conversion costs per equivalent unit, $19.75, plus a share of normal spoilage, $1.975 ($13,825 ÷ 7,000 good units), for

a total of $21.725 per good unit. The $5,925 costs of abnormal spoilage are charged to the Loss from Abnormal Spoilage account and do not appear in the costs of good units.

PANEL A: Steps 1 and 2—Summarize Output in Physical Units and Compute Equivalent Units



	A	B	C	D	E
1			(Step 1)	(Step 2)	
2				Equivalent Units	
3		Flow of Production	Physical Units	Direct Materials	Conversion Costs
4		Work in process, beginning (given, p. 670)	1,500		
5		Started during current period (given, p. 670)	8,500		
6		To account for	10,000		
7		Good units completed and transferred out during current period	7,000	7,000	7,000
8		Normal spoilage[a]	700		
9		(700 × 100%; 700 × 100%)		700	700
10		Abnormal spoilage[b]	300		
11		(300 × 100%; 300 × 100%)		300	300
12		Work in process, ending[c] (given, p. 670)	2,000		
13		(2,000 × 100%; 2,000 × 50%)		2,000	1,000
14		Accounted for	10,000		
15		Equivalent units of work done to date		10,000	9,000
16					
17	[a]Normal spoilage is 10% of good units transferred out: 10% × 7,000 = 700 units. Degree of completion of normal spoilage				
18	in this department: direct materials, 100%; conversion costs, 100%.				
19	[b]Abnormal spoilage = Total spoilage – Normal spoilage = 1,000 – 700 = 300 units. Degree of completion of abnormal spoilage				
20	in this department: direct materials, 100%; conversion costs, 100%.				
21	[c]Degree of completion in this department: direct materials, 100%; conversion costs, 50%.				

PANEL B: Steps 3, 4, and 5—Summarize Total Costs to Account For, Compute Cost per Equivalent Unit, and Assign Total Costs to Units Completed, to Spoiled Units, and to Units in Ending Work Process

23			Total Production Costs	Direct Materials	Conversion Costs
24	(Step 3)	Work in process, beginning (given, p. 670)	$ 21,000	$12,000	$ 9,000
25		Costs added in current period (given, p. 670)	165,600	76,500	89,100
26		Total costs to account for	$186,600	$88,500	$98,100
27	(Step 4)	Costs incurred to date		$88,500	$98,100
28		Divide by equivalent units of work done to date (Panel A)		÷10,000	÷ 9,000
29		Cost per equivalent unit		$ 8.85	$ 10.90
30	(Step 5)	Assignment of costs:			
31		Good units completed and transferred out (7,000 units)			
32		Costs before adding normal spoilage	$138,250	(7,000[d] × $8.85) +	(7,000[d] × $10.90)
33		Normal spoilage (700 units)	13,825	(700[d] × $8.85) +	(700[d] × $10.90)
34	(A)	Total costs of good units completed and transferred out	152,075		
35	(B)	Abnormal spoilage (300 units)	5,925	(300[d] × $8.85) +	(300[d] × $10.90)
36	(C)	Work in process, ending (2,000 units)	28,600	(2,000[d] × $8.85) +	(1,000[d] × $10.90)
37	(A)+(B)+(C)	Total costs accounted for	$186,600	$88,500 +	$98,100
38					
39	[d]Equivalent units of direct materials and conversion costs calculated in Step 2 in Panel A.				

FIFO Method and Spoilage

In the Exhibits below, Panel A, presents Steps 1 and 2 using the FIFO method, which focuses on equivalent units of work done in the current period. Panel B, presents Steps 3, 4, and 5. Note how when assigning costs, the FIFO method keeps the costs of the beginning work in process separate and distinct from the costs of work done in the current period. All spoilage costs are assumed to be related to units completed during this period, using the unit costs of the current period.

PANEL A: Steps 1 and 2—Summarize Output in Physical Units and Compute Equivalent Units

Home Insert Page Layout Formulas Data Review View

	A	B	C	D	E
1			(Step 1)	(Step 2)	
2				Equivalent Units	
3		Flow of Production	Physical Units	Direct Materials	Conversion Costs
4		Work in process, beginning (given, p. 670)	1,500		
5		Started during current period (given, p. 670)	8,500		
6		To account for	10,000		
7		Good units completed and transferred out during current period:			
8		From beginning work in process[a]	1,500		
9		[1,500 × (100% – 100%); 1,500 × (100% – 60%)]		0	600
10		Started and completed	5,500[b]		
11		(5,500 × 100%; 5,500 × 100%)		5,500	5,500
12		Normal spoilage[c]	700		
13		(700 × 100%; 700 × 100%)		700	700
14		Abnormal spoilage[d]	300		
15		(300 × 100%; 300 × 100%)		300	300
16		Work in process, ending[e] (given, p. 670)	2,000		
17		(2,000 × 100%; 2,000 × 50%)		2,000	1,000
18		Accounted for	10,000		
19		Equivalent units of work done in current period		8,500	8,100
20					
21	[a]Degree of completion in this department: direct materials, 100%; conversion costs, 60%.				
22	[b]7,000 physical units completed and transferred out minus 1,500 physical units completed and transferred out from beginning				
23	work-in-process inventory.				
24	[c]Normal spoilage is 10% of good units transferred out: 10% × 7,000 = 700 units. Degree of completion of normal spoilage				
25	in this department: direct materials, 100%; conversion costs, 100%.				
26	[d]Abnormal spoilage = Actual spoilage – Normal spoilage = 1,000 – 700 = 300 units. Degree of completion of abnormal spoilage				
27	in this department: direct materials, 100%; conversion costs, 100%.				
28	[e]Degree of completion in this department: direct materials, 100%; conversion costs, 50%.				

PANEL B: Steps 3, 4, and 5—Summarize Total Costs to Account for, Compute Cost per Equivalent Unit, and Assign Total Costs to Units Completed, to Spoiled Units, and to Units in Ending Work in Process

			Total Production Costs	Direct Materials	Conversion Costs
30					
31	(Step 3)	Work in process, beginning (given, p. 670)	$ 21,000	$12,000	$ 9,000
32		Costs added in current period (given, p. 670)	165,600	76,500	89,100
33		Total costs to account for	$186,600	$88,500	$98,100
34	(Step 4)	Costs added in current period		$76,500	$89,100
35		Divide by equivalent units of work done in current period (Panel A)		÷ 8,500	÷ 8,100
36		Cost per equivalent unit		$ 9.00	$ 11.00
37	(Step 5)	Assignment of costs:			
38		Good units completed and transferred out (7,000 units)			
39		Work in process, beginning (1,500 units)	$ 21,000	$12,000	+ $9,000
40		Costs added to beginning work in process in current period	6,600	(0[f] × $9)	+ (600[f] × $11)
41		Total from beginning inventory before normal spoilage	27,600		
42		Started and completed before normal spoilage (5,500 units)	110,000	(5,500[f] × $9)	+ (5,500[f] × $11)
43		Normal spoilage (700 units)	14,000	(700[f] × $9)	+ (700[f] × $11)
44	(A)	Total costs of good units completed and transferred out	151,600		
45	(B)	Abnormal spoilage (300 units)	6,000	(300[f] × $9)	+ (300[f] × $11)
46	(C)	Work in process, ending (2,000 units)	29,000	(2,000[f] × $9)	+ (1,000[f] × $11)
47	(A)+(B)+(C)	Total costs accounted for	$186,600	$88,500	+ $98,100
48					
49					
50					
51	[f]Equivalent units of direct materials and conversion costs calculated in Step 2 in Panel A.				

Journal Entries

The information from Panel B of both WA and FIFO methods supports the following journal entries to transfer good units completed to finished goods and to recognize the loss from abnormal spoilage.

	Weighted Average	**FIFO**
Finished Goods	152,075	151,600
Work in Process—Forming	152,075	151,600
To record transfer of good units completed in July.		
Loss from Abnormal Spoilage	5,925	6,000
Work in Process—Forming	5,925	6,000
To record abnormal spoilage detected in July.		

Inspection Points and Allocating Costs of Normal Spoilage

Our AZ Co. example assumes inspection occurs upon completion of the units. Although spoilage is typically detected only at one or more inspection points, it might actually occur at

various stages of a production process. The cost of spoiled units is assumed to equal all costs incurred in producing spoiled units up to the point of inspection. When spoiled goods have a disposal value (e.g., carpeting sold as "seconds"), the net cost of spoilage is computed by deducting the disposal value from the costs of the spoiled goods that have been accumulated up to the inspection point.

The unit costs of normal and abnormal spoilage are the same when the two are detected at the same inspection point. However, situations may arise when abnormal spoilage is detected at a different point from normal spoilage. Consider shirt manufacturing. Normal spoilage in the form of defective shirts is identified upon inspection at the end of the production process. Now suppose a faulty machine causes many defective shirts to be produced at the halfway point of the production process. These defective shirts are abnormal spoilage and occur at a different point in the production process from normal spoilage. In such cases, the unit cost of abnormal spoilage, which is based on costs incurred up to the halfway point of the production process, differs from the unit cost of normal spoilage, which is based on costs incurred through the end of the production process.

Costs of abnormal spoilage are separately accounted for as losses of the accounting period in which they are detected. However, recall that normal spoilage costs are added to the costs of good units, which raises an additional issue: Should normal spoilage costs be allocated between completed units and ending work-in-process inventory? ***The common approach is to presume that normal spoilage occurs at the inspection point in the production cycle and to allocate its cost over all units that have passed that point during the accounting period.***

In the AZ Company example, spoilage is assumed to occur when units are inspected at the end of the production process, so no costs of normal spoilage are allocated to ending work in process. If the units in ending work in process have passed the inspection point, however, the costs of normal spoilage are allocated to units in ending work in process as well as to completed units. For example, if the inspection point is at the halfway point of production, then any ending work in process that is at least 50% complete would be allocated a full measure of normal spoilage costs, and those spoilage costs would be calculated on the basis of

all costs incurred up to the inspection point. If ending work in process is less than 50% complete, however, no normal spoilage costs would be allocated to it.

To better understand these issues, let us now assume that inspection at AZ Company occurs at various stages in the production process. How does this affect the amount of normal and abnormal spoilage? As before, consider the forming department, and recall that direct materials are added at the start of production, while conversion costs are added evenly during the process.

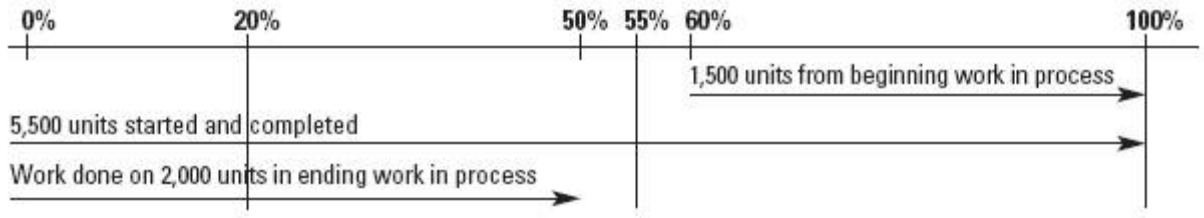
Consider three different cases: Inspection occurs at (1) the 20%, (2) the 55%, or (3) the 100% completion stage. The last option is the one we have analyzed so far. Assume that normal spoilage is 10% of the good units passing inspection.

A total of 1,000 units are spoiled in all three cases. Normal spoilage is computed on the basis of the number of *good units* that pass the inspection point *during the current period*.

The following data are for July 2012. Note how the number of units of normal and abnormal spoilage changes, depending on when inspection occurs.

	A	B	C	D
1		Physical Units: Stage of Completion at Which Inspection Occurs		
2	Flow of Production	20%	55%	100%
3	Work in process, beginning[a]	1,500	1,500	1,500
4	Started during July	8,500	8,500	8,500
5	To account for	10,000	10,000	10,000
6	Good units completed and transferred out			
7	(10,000 – 1,000 spoiled – 2,000 ending)	7,000	7,000	7,000
8	Normal spoilage	750[c]	550[d]	700[e]
9	Abnormal spoilage (1,000 – normal spoilage)	250	450	300
10	Work in process, ending[b]	2,000	2,000	2,000
11	Accounted for	10,000	10,000	10,000
12				
13	[a]Degree of completion in this department: direct materials, 100%; conversion costs, 60%.			
14	[b]Degree of completion in this department: direct materials, 100%; conversion costs, 50%.			
15	[c]10% × (8,500 units started – 1,000 units spoiled), because only the units started passed the 20% completion			
16	inspection point in the current period. Beginning work in process is excluded from this calculation because,			
17	being 60% complete at the start of the period, it passed the inspection point in the previous period.			
18	[d]10% × (8,500 units started – 1,000 units spoiled – 2,000 units in ending work in process). Both beginning and			
19	ending work in process are excluded since neither was inspected this period.			
20	[e]10% × 7,000, because 7,000 units are fully completed and inspected in the current period.			

The following diagram shows the flow of physical units for July and illustrates the normal spoilage numbers in the table. Note that 7,000 good units are completed and transferred out—1,500 from beginning work in process and 5,500 started and completed during the period—while 2,000 units are in ending work in process.



To see the number of units passing each inspection point, consider in the diagram the vertical lines at the 20%, 55%, and 100% inspection points. Note that the vertical line at 20% crosses

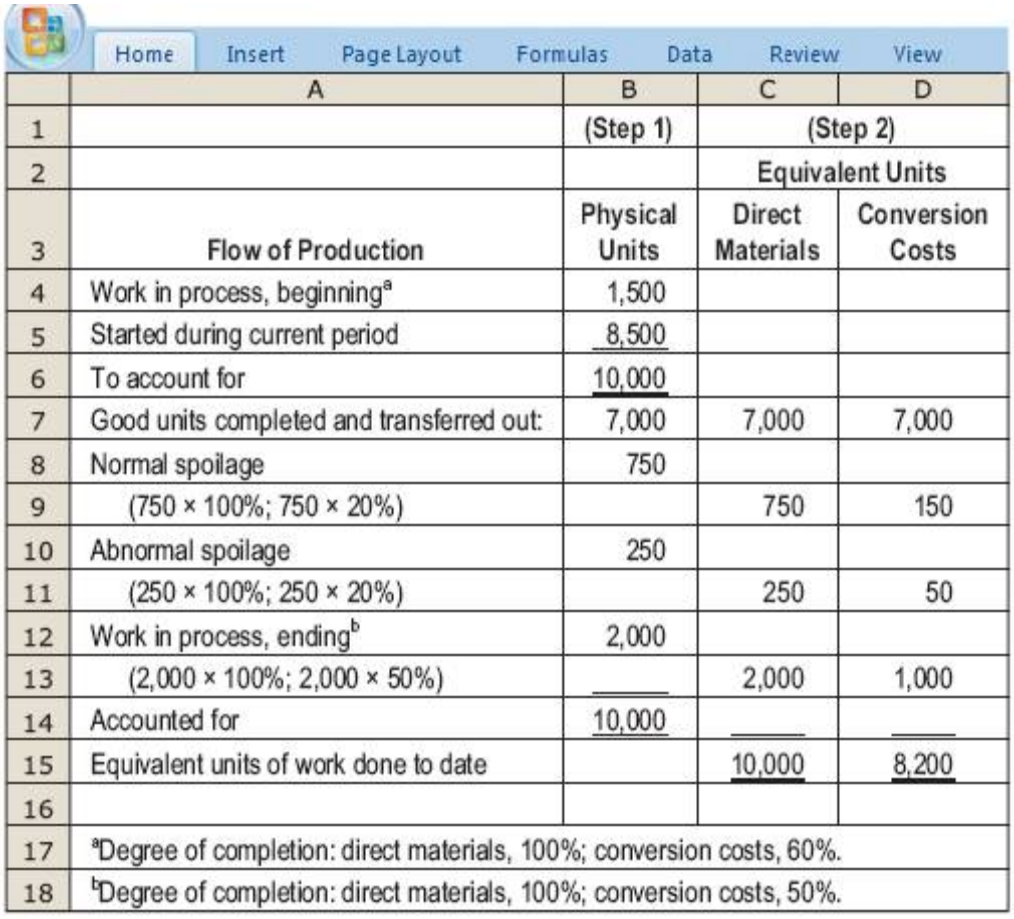
two horizontal lines—5,500 good units started and completed and 2,000 units in ending work in process—for a total of 7,500 good units. (The 20% vertical line does not cross the line representing work done on the 1,500 good units completed from beginning work in process, because these units are already 60% complete at the start of the period and, hence, are not inspected this period.) Normal spoilage equals 10% of 7,500 = 750 units. On the other hand, the vertical line at the 55% point crosses just the second horizontal line, indicating that only 5,500 good units pass this point. Normal spoilage in this case is 10% of 5,500 = 550 units. At the 100% point, normal spoilage = 10% of 7,000 (1,500 + 5,500) good units = 700 units.

Exhibit below shows the computation of equivalent units under the weighted-average method, assuming inspection at the 20% completion stage. The calculations depend on the direct materials and conversion costs incurred to get the units to this inspection point. The spoiled units have a full measure of direct materials and a 20% measure of conversion costs. Calculations of costs per equivalent unit and the assignment of total costs to units completed and to ending work in process are similar to calculations in previous illustrations in this chapter. Because ending work in process has passed the inspection point, these units bear normal spoilage costs, just like the units that have been completed and transferred out.

For example, conversion costs for units completed and transferred out include conversion costs for 7,000 good units produced plus 20% * (10% * 5,500) = **110** equivalent units of normal spoilage. *We multiply by 20% to obtain equivalent units of normal spoilage because conversion costs are only 20% complete at the inspection point.* Conversion costs of ending work in process include conversion costs of 50% of 2,000 = 1,000 equivalent good units plus 20% * (10% * 2,000) = **40** equivalent units of normal spoilage. Thus, the equivalent units of normal spoilage accounted for are 110 equivalent units related to units completed and transferred out plus 40 equivalent units related to units in ending work in process, for a total of 150 equivalent units, as shown in Exhibit below.

Early inspections can help prevent any further direct materials and conversion costs being wasted on units that are already spoiled. For example, if inspection can occur when units are 70% (rather than 100%) complete as to conversion costs and spoilage occurs prior to the 70% point, a company can avoid incurring the final 30% of conversion costs on the spoiled units. The downside to conducting inspections at too early a stage is that spoilage that happens at

later stages of the process may go undetected. It is for these reasons that firms often conduct multiple inspections and also empower workers to identify and resolve defects on a timely basis.



	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	Flow of Production	Physical Units	Direct Materials	Conversion Costs
4	Work in process, beginning[a]	1,500		
5	Started during current period	8,500		
6	To account for	10,000		
7	Good units completed and transferred out:	7,000	7,000	7,000
8	Normal spoilage	750		
9	(750 × 100%; 750 × 20%)		750	150
10	Abnormal spoilage	250		
11	(250 × 100%; 250 × 20%)		250	50
12	Work in process, ending[b]	2,000		
13	(2,000 × 100%; 2,000 × 50%)		2,000	1,000
14	Accounted for	10,000		
15	Equivalent units of work done to date		10,000	8,200
16				
17	[a]Degree of completion: direct materials, 100%; conversion costs, 60%.			
18	[b]Degree of completion: direct materials, 100%; conversion costs, 50%.			

Job Costing and Spoilage

The concepts of normal and abnormal spoilage also apply to job-costing systems. Abnormal spoilage is separately identified so companies can work to eliminate it altogether. Costs of abnormal spoilage are not considered to be inventoriable costs and are written off as costs of the accounting period in which the abnormal spoilage is detected. Normal spoilage costs in job-costing systems—as in process-costing systems—are inventoriable costs, although increasingly companies are tolerating only small amounts of spoilage as normal. When assigning costs, job-costing systems generally distinguish *normal spoilage attributable to a specific job* from *normal spoilage common to all jobs*.

We describe accounting for spoilage in job costing using the following example.

Example 3: In the Hull Machine Shop, 5 aircraft parts out of a job lot of 50 aircraft parts are spoiled. Costs assigned prior to the inspection point are $2,000 per part. When the spoilage is detected, the spoiled goods are inventoried at $600 per part, the net disposal value.

Our presentation here and in subsequent sections focuses on how the $2,000 cost per part is accounted for.

Normal Spoilage Attributable to a Specific Job

When normal spoilage occurs because of the specifications of a particular job, that job bears the cost of the spoilage minus the disposal value of the spoilage. The journal entry to recognize disposal value (items in parentheses indicate subsidiary ledger postings) is as follows:

Materials Control (spoiled goods at current net disposal value): 5 units*$600/unit	3,000	
Work-in-Process Control (specific job): 5 units * $600 per unit		3,000

Note, the Work-in-Process Control (specific job) has already been debited (charged) $10,000 for the spoiled parts (5 spoiled parts * $2,000 per part). The net cost of normal spoilage = $7,000 ($10,000 - $3,000), which is an additional cost of the 45 (50 - 5) good units produced. Therefore, total cost of the 45 good units is $97,000: $90,000 (45 units * $2,000 per unit) incurred to produce the good units plus the $7,000 net cost of normal spoilage. Cost per good unit is $2,155.56 ($97,000 ÷ 45 good units).

Normal Spoilage Common to All Jobs

In some cases, spoilage may be considered a normal characteristic of the production process. The spoilage inherent in production will, of course, occur when a specific job is being worked on. But the spoilage is not attributable to, and hence is not charged directly to, the specific job. Instead, the spoilage is allocated indirectly to the job as manufacturing overhead because the spoilage is common to all jobs. The journal entry is as follows:

Materials Control (spoiled goods at current disposal value): 5 units * $600/ unit	3,000	
Manufacturing Overhead Control (normal spoilage): ($10,000 - $3,000)	7,000	
Work-in-Process Control (specific job): 5 units * $2,000 per unit		10,000

When normal spoilage is common to all jobs, the budgeted manufacturing overhead rate includes a provision for normal spoilage cost. Normal spoilage cost is spread, through overhead allocation, over all jobs rather than allocated to a specific job. For example, if Hull produced 140 good units from all jobs in a given month, the $7,000 of normal spoilage overhead costs would be allocated at the rate of $50 per good unit ($7,000 ÷ 140 good units). Normal spoilage overhead costs allocated to the 45 good units in the job would be $2,250 ($50 * 45 good units). Total cost of the 45 good units is $92,250: $90,000 (45 units * $2,000 per unit) incurred to produce the good units plus $2,250 of normal spoilage overhead costs. Cost per good unit is $2,050 ($92,250 ÷ 45 good units).

Abnormal Spoilage

If the spoilage is abnormal, the net loss is charged to the Loss from Abnormal Spoilage account. Unlike normal spoilage costs, abnormal spoilage costs are not included as a part of the cost of good units produced. Total cost of the 45 good units is $90,000 (45 units $2,000 per unit). Cost per good unit is $2,000 ($90,000 ÷ 45 good units).

Materials Control (spoiled goods at current disposal value): 5 units * $600/unit	3,000	
Loss from Abnormal Spoilage ($10,000 - $3,000)	7,000	
Work-in-Process Control (specific job): 5 units * $2,000 per unit		10,000

Even though, for external reporting purposes, abnormal spoilage costs are written off in the accounting period and are not linked to specific jobs or units, companies often identify the particular reasons for abnormal spoilage, and, when appropriate, link abnormal spoilage with specific jobs or units for cost management purposes.

Job Costing and Rework

Rework is units of production that are inspected, determined to be unacceptable, repaired, and sold as acceptable finished goods. We again distinguish (1) normal rework attributable to a specific job, (2) normal rework common to all jobs, and (3) abnormal rework.

Consider the Hull Machine Shop data in ***Example 3***. Assume the five spoiled parts are reworked. The journal entry for the $10,000 of total costs (the details of these costs are assumed) assigned to the five spoiled units before considering rework costs is as follows:

Work-in-Process Control (specific job)	10,000	
Materials Control		4,000
Wages Payable Control		4,000
Manufacturing Overhead Allocated		2,000

Assume the rework costs equal $3,800 (comprising $800 direct materials, $2,000 direct manufacturing labor, and $1,000 manufacturing overhead).

Normal Rework Attributable to a Specific Job

If the rework is normal but occurs because of the requirements of a specific job, the rework costs are charged to that job. The journal entry is as follows:

Work-in-Process Control (specific job)	3,800	
Materials Control		800
Wages Payable Control		2,000
Manufacturing Overhead Allocated		1,000

Normal Rework Common to All Jobs

When rework is normal and not attributable to a specific job, the costs of rework are charged to manufacturing overhead and are spread, through overhead allocation, over all jobs.

Manufacturing Overhead Control (rework costs)	3,800	
Materials Control		800
Wages Payable Control		2,000
Manufacturing Overhead Allocated		1,000

Abnormal Rework

If the rework is abnormal, it is recorded by charging abnormal rework to a loss account.

Loss from Abnormal Rework	3,800	
Materials Control		800
Wages Payable Control		2,000
Manufacturing Overhead Allocated		1,000

Accounting for rework in a process-costing system also requires abnormal rework to be distinguished from normal rework. Process costing accounts for abnormal rework in the same way as job costing. Accounting for normal rework follows the accounting described for normal rework common to all jobs (units) because masses of identical or similar units are being manufactured.

Costing rework focuses managers' attention on the resources wasted on activities that would not have to be undertaken if the product had been made correctly. The cost of rework prompts managers to seek ways to reduce rework, for example, by designing new products or processes, training workers, or investing in new machines. To eliminate rework and to simplify the accounting, some companies set a standard of zero rework. All rework is then treated as abnormal and is written off as a cost of the current period.

Accounting for Scrap

Scrap is residual material that results from manufacturing a product; it has low total sales value compared with the total sales value of the product. No distinction is made between normal and abnormal scrap because no cost is assigned to scrap. The only distinction made is between scrap attributable to a specific job and scrap common to all jobs.

There are two aspects of accounting for scrap:

1. Planning and control, including physical tracking
2. Inventory costing, including when and how scrap affects operating income

Initial entries to scrap records are commonly expressed in physical terms. In various industries, companies quantify items such as stamped-out metal sheets or edges of molded plastic parts by weighing, counting, or some other measure. Scrap records not only help measure efficiency, but also help keep track of scrap, and so reduce the chances of theft.

Companies use scrap records to prepare periodic summaries of the amounts of actual scrap compared with budgeted or standard amounts. Scrap is either sold or disposed of quickly or it is stored for later sale, disposal, or reuse.

Careful tracking of scrap often extends into the accounting records. Many companies maintain a distinct account for scrap costs somewhere in their accounting system. The issues here are similar to the issues regarding the accounting for byproducts:

_ When should the value of scrap be recognized in the accounting records—at the time scrap is produced or at the time scrap is sold?
_ How should revenues from scrap be accounted for?

To illustrate, we extend our Hull example. Assume the manufacture of aircraft parts generates scrap and that the scrap from a job has a net sales value of $900.

Recognizing Scrap at the Time of Its Sale

When the dollar amount of scrap is immaterial, the simplest accounting is to record the physical quantity of scrap returned to the storeroom and to regard scrap sales as a separate line item in the income statement. In this case, the only journal entry is as follows:

Sale of scrap: Cash or Accounts Receivable 900
Scrap Revenues 900

When the dollar amount of scrap is material and the scrap is sold quickly after it is produced, the accounting depends on whether the scrap is attributable to a specific job or is common to all jobs.

Scrap Attributable to a Specific Job

Job-costing systems sometimes trace scrap revenues to the jobs that yielded the scrap. This method is used only when the tracing can be done in an economically feasible way.
For example, the Hull Machine Shop and its customers may reach an agreement that provides for charging specific jobs with all rework or spoilage costs and then crediting these jobs with all scrap revenues that arise from the jobs. The journal entry is as follows:

Scrap returned to storeroom: No journal entry.
[Notation of quantity received and related job entered in the inventory record]

Sale of scrap: Cash or Accounts Receivable 900
Work-in-Process Control 900
Posting made to specific job cost record.

Unlike spoilage and rework, there is no cost assigned to the scrap, so no distinction is made between normal and abnormal scrap. All scrap revenues, whatever the amount, are credited to the specific job. Scrap revenues reduce the costs of the job.

Scrap common to all jobs

The journal entry in this case is as follows:

Scrap returned to storeroom: No journal entry.

[Notation of quantity received and related job entered in the inventory record]

Sale of scrap: Cash or Accounts Receivable 900

Manufacturing Overhead Control 900

Posting made to subsidiary ledger—"Sales of Scrap" column on department cost record.

Scrap is not linked with any particular job or product. Instead, all products bear production costs without any credit for scrap revenues except in an indirect manner: Expected scrap revenues are considered when setting the budgeted manufacturing overhead rate.

Thus, the budgeted overhead rate is lower than it would be if the overhead budget had not been reduced by expected scrap revenues. This method of accounting for scrap is also used in process costing when the dollar amount of scrap is immaterial, because the scrap in process costing is common to the manufacture of all the identical or similar units produced (and cannot be identified with specific units).

Recognizing Scrap at the Time of Its Production

Our preceding illustrations assume that scrap returned to the storeroom is sold quickly, so it is not assigned an inventory cost figure. Sometimes, as in the case with edges of molded plastic parts, the value of scrap is not immaterial, and the time between storing it and selling or reusing it can be long and unpredictable. In these situations, the company assigns an inventory cost to scrap at a conservative estimate of its net realizable value so that production costs and related scrap revenues are recognized in the same accounting period. Some companies tend to delay sales of scrap until its market price is considered attractive. Volatile price fluctuations are typical for scrap metal. In these cases, it's not easy to determine some "reasonable inventory value."

Scrap Attributable to a Specific Job

The journal entry in the Hull example is as follows:

Scrap returned to storeroom: Materials Control 900
Work-in-Process Control 900

Scrap Common to All Jobs

The journal entry in this case is as follows:

Scrap returned to storeroom: Materials Control 900
Manufacturing Overhead Control 900

Observe that the Materials Control account is debited in place of Cash or Accounts Receivable. When the scrap is sold, the journal entry is as follows:

Sale of scrap: Cash or Accounts Receivable 900
Materials Control 900

Scrap is sometimes reused as direct material rather than sold as scrap. In this case, Materials Control is debited at its estimated net realizable value and then credited when the scrap is reused. For example, the entries when the scrap is common to all jobs are as follows:

Scrap returned to storeroom: Materials Control 900
Manufacturing Overhead Control 900

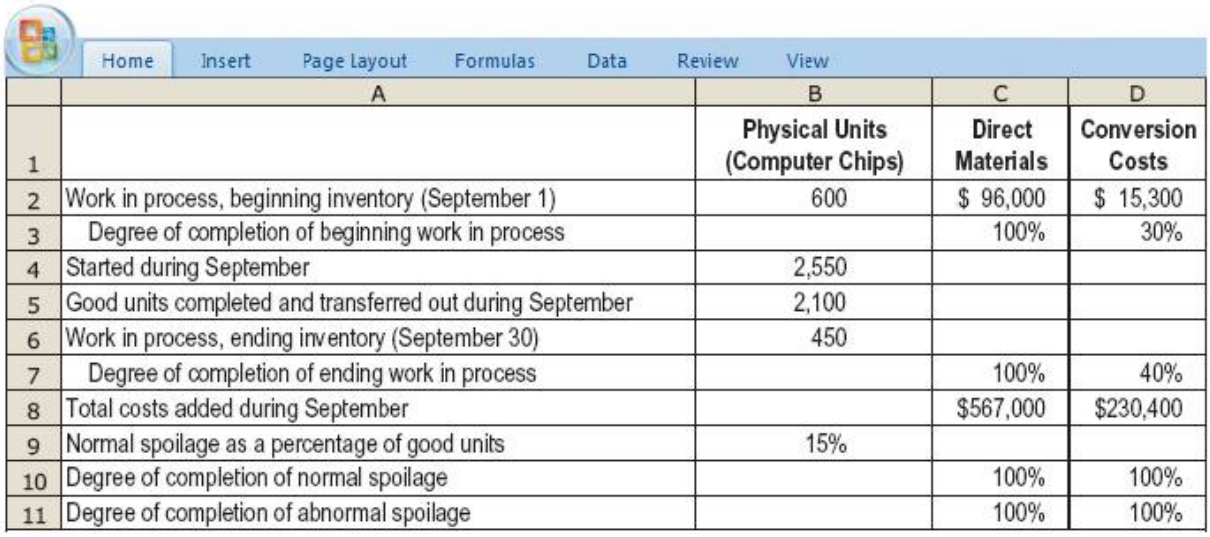
Reuse of scrap: Work-in-Process Control 900
Materials Control 900

Accounting for scrap under process costing is similar to accounting under job costing when scrap is common to all jobs. That's because the scrap in process costing is common to the manufacture of masses of identical or similar units.

Managers focus their attention on ways to reduce scrap and to use it more profitably, especially when the cost of scrap is high. For example, General Motors has redesigned its plastic injection molding processes to reduce the scrap plastic that must be broken away from its molded products. General Motors also regrinds and reuses the plastic scrap as direct material, saving substantial input costs.

Ex. 1. Weighted-average method, spoilage. Chipcity is a fast-growing manufacturer of computer chips. Direct materials are added at the start of the production process. Conversion costs are added evenly during the process. Some units of this product are spoiled as a result of defects not detectable before inspection of finished goods. Spoiled units are disposed of at zero net disposal value. Chipcity uses the weighted-average method of process costing.

Summary data for September 2011 are as follows:



Home Insert Page Layout Formulas Data Review View

	A	B	C	D
1		**Physical Units (Computer Chips)**	**Direct Materials**	**Conversion Costs**
2	Work in process, beginning inventory (September 1)	600	$ 96,000	$ 15,300
3	Degree of completion of beginning work in process		100%	30%
4	Started during September	2,550		
5	Good units completed and transferred out during September	2,100		
6	Work in process, ending inventory (September 30)	450		
7	Degree of completion of ending work in process		100%	40%
8	Total costs added during September		$567,000	$230,400
9	Normal spoilage as a percentage of good units	15%		
10	Degree of completion of normal spoilage		100%	100%
11	Degree of completion of abnormal spoilage		100%	100%

1. For each cost category, compute equivalent units. Show physical units in the first column of your schedule.

2. Summarize total costs to account for; calculate cost per equivalent unit for each cost category; and assign total costs to units completed and transferred out (including normal spoilage), to abnormal spoilage, and to units in ending work in process.

Ex. 2. FIFO method, spoilage. Refer to the information in Exercise 1 (above).

Do Exercise 2 using the FIFO method of process costing.

Ex. 3. Spoilage in job costing. CM Co. is a manufacturer of motorized carts for vacation resorts. Peter Cruz, the plant manager of CM Co., obtains the following information for Job #10 in August 2010. A total of 32 units were started, and 7 spoiled units were detected and rejected at final inspection, yielding 25 good units. The spoiled units were considered to be normal spoilage. Costs assigned prior to the inspection point are $1,450 per unit. The current

disposal price of the spoiled units is $230 per unit. When the spoilage is detected, the spoiled goods are inventoried at $230 per unit.

i. What is the normal spoilage rate?

ii. Prepare the journal entries to record the normal spoilage, assuming the following:

a. The spoilage is related to a specific job.

b. The spoilage is common to all jobs.

c. The spoilage is considered to be abnormal spoilage.

Ex. 4. Variable and Absorption Costing Unit Product Costs

XYZ Bicycle Co. produces an inexpensive, yet rugged, bicycle for use on the city's crowded streets that it sells for $500.

Selected data for the company's operations last year follow:

Units in beginning inventory	0
Units produced	10,000
Units sold	8,000
Units in ending inventory	2,000
Variable costs per unit:	
Direct materials	120
Direct labor	140
Variable manufacturing overhead	50
Variable selling and administrative	20
Fixed costs:	
Fixed manufacturing overhead	600,000
Fixed selling and administrative	400,000

Required:

1. Assume that the company uses absorption costing. Compute the unit product cost for one bicycle.

2. Assume that the company uses variable costing. Compute the unit product cost for one bicycle.

Refer to the data above Exercise 4 for XYZ Bicycle Co. The absorption costing income statement prepared by the company's accountant for last year appears below:

Sales	4,000,000
Cost of goods sold	2,960,000
Gross margin	1,040,000
Selling and administrative expense	560,000
Net operating income	480,000

Required:

i. Determine how much of the ending inventory consists of fixed manufacturing overhead cost deferred in inventory to the next period.

ii. Prepare an income statement for the year using variable costing. Explain the difference in net operating income between the two costing methods.

Chapter 5: Variable and Absorption Costing

This chapter describes two applications of the contribution format income statements. First, it explains how manufacturing companies can prepare *variable costing* income statements, which rely on the contribution format, for internal decision making purposes. The variable costing approach will be contrasted with *absorption costing* income statements, which are generally used for external reports. Ordinarily, variable costing and absorption costing produce different net operating income figures, and the difference can be quite large. In addition to showing how these two methods differ, we will describe the advantages of variable costing for internal reporting purposes and we will show how management decisions can be affected by the costing method chosen.

Second, the chapter explains how the contribution format can be used to prepare segmented income statements. In addition to companywide income statements, managers need to measure the profitability of individual *segments* of their organizations. A **segment** is a part or activity of an organization about which managers would like cost, revenue, or profit data. This chapter explains how to create contribution format income statements that report profit data for business segments, such as divisions, individual stores, geographic regions, customers, and product lines.

Overview of Variable and Absorption Costing

As you begin to read about variable and absorption costing income statements in the coming pages, focus your attention on three key concepts. ***First***, both income statement formats include product costs and period costs, although they define these cost classifications differently. ***Second***, variable costing income statements are grounded in the contribution format. They categorize expenses based on cost behavior—variable costs are reported separately from fixed costs. Absorption costing income statements ignore variable and fixed cost distinctions. ***Third***, as mentioned in the paragraph above, variable and absorption costing net operating income figures often differ from one another. The reason for these differences always relates to the fact the variable costing and absorption costing income statements account for fixed manufacturing overhead differently. *Pay very close attention to the two*

different ways that variable costing and absorption costing account for fixed manufacturing overhead.

Variable Costing

Under **variable costing,** only those manufacturing costs that vary with output are treated as product costs. This would usually include direct materials, direct labor, and the variable portion of manufacturing overhead. Fixed manufacturing overhead is not treated as a product cost under this method. Rather, fixed manufacturing overhead is treated as a period cost and, like selling and administrative expenses, it is expensed in its entirety each period. Consequently, the cost of a unit of product in inventory or in cost of goods sold under the variable costing method does not contain any fixed manufacturing overhead cost. Variable costing is sometimes referred to as *direct costing* or *marginal costing.*

Absorption Costing

Absorption costing treats *all* manufacturing costs as product costs, regardless of whether they are variable or fixed. The cost of a unit of product under the absorption costing method consists of direct materials, direct labor, and *both* variable and fixed manufacturing overhead. Thus, absorption costing allocates a portion of fixed manufacturing overhead cost to each unit of product, along with the variable manufacturing costs. Because absorption costing includes all manufacturing costs in product costs, it is frequently referred to as the *full cost* method.

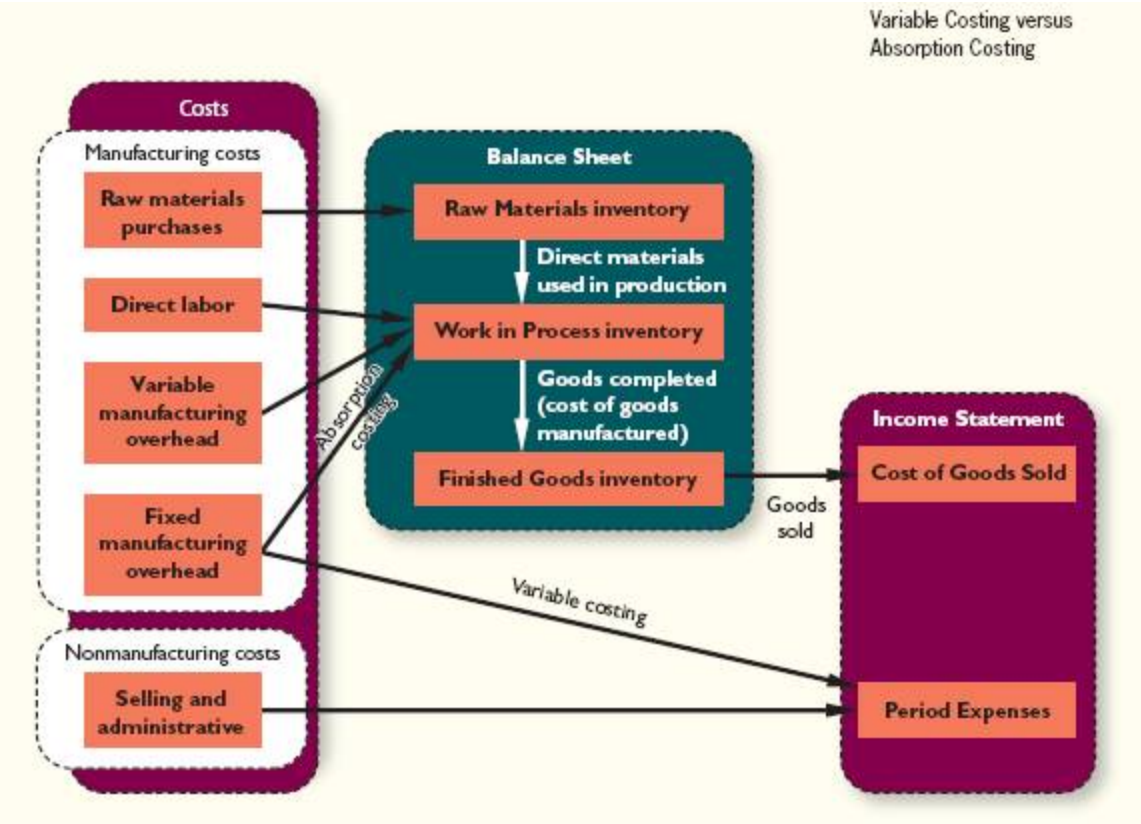
Selling and Administrative Expenses

Selling and administrative expenses are never treated as product costs, regardless of the costing method. Thus, under absorption and variable costing, variable and fixed selling and administrative expenses are always treated as period costs and are expensed as incurred.

Summary of Differences The essential difference between variable costing and absorption costing, as illustrated in Exhibit below, is how each method accounts for fixed manufacturing overhead costs—all other costs are treated the same under the two methods.

In absorption costing, fixed manufacturing overhead costs are included as part of the costs of work in process inventories. When units are completed, these costs are transferred to finished goods and only when the units are sold do these costs flow through to the income statement as part of cost of goods sold. In variable costing, fixed manufacturing overhead costs are

considered to be period costs—just like selling and administrative costs—and are taken immediately to the income statement as period expenses.



Variable and Absorption Costing—An Example

To illustrate the difference between variable costing and absorption costing, consider XYZ Co. that produces product X. Data concerning the company's operations appear below:

	Per Unit	Per Month
Selling price	$100,000	
Direct materials	$19,000	
Direct labor	$5,000	
Variable manufacturing overhead	$1,000	
Fixed manufacturing overhead		$70,000
Variable selling and administrative expenses	$10,000	
Fixed selling and administrative expenses		$20,000

	January	February	March
Beginning inventory	0	0	1
Units produced	1	2	4
Units sold	1	1	5
Ending inventory	0	1	0

As you review the data above, it is important to realize that for the months of January, February, and March, the selling price per unit, variable cost per unit, and total monthly fixed expenses never change. The only variables that change in this example are the number of units produced (January = 1 unit produced; February = 2 units produced; March = 4 units produced) and the number of units sold (January = 1 unit sold; February = 1 unit sold; March = 5 units sold).

We will first construct the company's variable costing income statements for January, February, and March. Then we will show how the company's net operating income would be determined for the same months using absorption costing.

Variable Costing Contribution Format Income Statement

To prepare the company's variable costing income statements for January, February, and March we begin by computing the unit product cost. Under variable costing, product costs consist solely of variable production costs. At XYZ Co., the variable production cost per unit is $25,000, determined as follows:

Variable Costing Unit Product Cost

Direct materials	$19,000
Direct labor	5,000
Variable manufacturing overhead	1,000
Variable costing unit product cost	$25,000

Since each month's variable production cost is $25,000 per unit, the variable costing cost of goods sold for all three months can be easily computed as follows:

Variable Costing Cost of Goods Sold

	January	February	March
Variable production cost (a)	$25,000	$25,000	$25,000
Units sold (b)	1	1	5
Variable cost of goods sold (a) × (b)	$25,000	$25,000	$125,000

And the company's total selling and administrative expense would be derived as follows:

Selling and Administrative Expenses

	January	February	March
Variable selling and administrative expense (@ $10,000 per unit sold)	$10,000	$10,000	$50,000
Fixed selling and administrative expense	20,000	20,000	20,000
Total selling and administrative expense	$30,000	$30,000	$70,000

Putting it all together, the variable costing income statements would appear as shown in Exhibit below. Notice, the contribution format has been used in these income statements. Also, the monthly fixed manufacturing overhead costs ($70,000) have been recorded as a period expense in the month incurred.

Variable Costing Contribution Format Income Statements

	January	February	March
Sales	$100,000	$100,000	$500,000
Variable expenses:			
Variable cost of goods sold	25,000	25,000	125,000
Variable selling and administrative expense	10,000	10,000	50,000
Total variable expenses	35,000	35,000	175,000
Contribution margin	65,000	65,000	325,000
Fixed expenses:			
Fixed manufacturing overhead	70,000	70,000	70,000
Fixed selling and administrative expense	20,000	20,000	20,000
Total fixed expenses	90,000	90,000	90,000
Net operating income (loss)	$ (25,000)	$ (25,000)	$235,000

A simple method for understanding how XYZ Co. computed its variable costing net operating income figures is to focus on the contribution margin per unit sold, computed as follows:

Contribution Margin per unit Sold

Selling price per unit		$100,000
Variable production cost per unit	$25,000	
Variable selling and administrative expense per unit	10,000	35,000
Contribution margin per unit		$ 65,000

The variable costing net operating income for each period can always be computed by multiplying the number of units sold by the contribution margin per unit and then subtracting total fixed costs. For XYZ Co., these computations would appear as follows:

	January	February	March
Number of units sold	1	1	5
Contribution margin per unit	x $65,000	x $65,000	x $65,000
Total contribution margin	$65,000	$65,000	$325,000
Total fixed expenses	90,000	90,000	90,000
Net operating income (loss)	$(25,000)	$(25,000)	$235,000

Notice, January and February have the same net operating loss. This occurs because one unit was sold in each month and, as previously mentioned, the selling price per unit, variable cost per unit, and total monthly fixed expenses remain constant.

Absorption Costing Income Statement

As we begin the absorption costing portion of the example, remember that the only reason absorption costing income differs from variable costing is that the methods account for fixed manufacturing overhead differently. Under absorption costing, fixed manufacturing overhead is included in product costs. In variable costing, fixed manufacturing overhead is not included in product costs and instead is treated as a period expense just like selling and administrative expenses.

The first step in preparing XYZ Co.'s absorption costing income statements for January, February, and March, is to determine the company's unit product costs for each month as follows:

Absorption Costing Unit Product Cost

	January	February	March
Direct materials	$19,000	$19,000	$19,000
Direct labor	5,000	5,000	5,000
Variable manufacturing overhead	1,000	1,000	1,000
Fixed manufacturing overhead ($70,000 ÷ 1 unit produced in January; $70,000 ÷ 2 units produced in February; $70,000 ÷ 4 units produced in March)	70,000	35,000	17,500
Absorption costing unit product cost	$95,000	$60,000	$42,500

(For simplicity, we assume in this section that an actual costing system is used in which actual costs are spread over the units produced during the period. If a predetermined overhead rate were used, the analysis would be similar, but more complex.)

Notice that in each month, XYZ Co.'s fixed manufacturing overhead cost of $70,000 is divided by the number of units produced to determine the fixed manufacturing overhead cost per unit. Given these unit product costs, the company's absorption costing net operating income in each month would be determined as shown in the Exhibit below.

The sales for all three months in the Exhibit are the same as the sales shown in the variable costing income statements. The January cost of goods sold consists of one unit produced during January at a cost of $95,000 according to the absorption costing system. The February cost of goods sold consists of one unit produced during February at a cost of $60,000 according to the absorption costing system. The March cost of goods sold ($230,000) consists of one unit produced during February at an absorption cost of $60,000 plus four units produced in March with a total absorption cost of $170,000 (= 4 units produced × $42,500 per unit). The selling and administrative expenses equal the amounts reported in the variable costing income statements; however they are reported as one amount rather than being separated into variable and fixed components.

Absorption Costing Income Statements

	January	February	March
Sales	$100,000	$100,000	$500,000
Cost of goods sold ($95,000 × 1 unit; $60,000 × 1 unit; $60,000 × 1 unit + $42,500 × 4 units)	95,000	60,000	230,000
Gross margin	5,000	40,000	270,000
Selling and administrative expenses	30,000	30,000	70,000
Net operating income (loss)	$(25,000)	$10,000	$200,000

Note that even though sales were exactly the same in January and February and the cost structure did not change, net operating income was $35,000 higher in February than in January under absorption costing. This occurs because one unit produced in February is not sold until March. This unit has $35,000 of fixed manufacturing overhead attached to it that was incurred in February, but will not be recorded as part of cost of goods sold until March.

Contrasting the variable costing and absorption costing income statements, note that net operating income is the same in January under variable costing and absorption costing, but differs in the other two months. We will discuss this in some depth shortly. Also note that the format of the variable costing income statement differs from the absorption costing income statement. An absorption costing income statement categorizes costs by function—manufacturing versus selling and administrative.

All of the manufacturing costs flow through the absorption costing cost of goods sold and all of the selling and administrative costs are listed separately as period expenses. In contrast, in the contribution approach, costs are categorized according to how they behave. All of the variable expenses are listed together and all of the fixed expenses are listed together. The variable expenses category includes manufacturing costs (i.e., variable cost of goods sold) as well as selling and administrative expenses. The fixed expenses category also includes both manufacturing costs and selling and administrative expenses.

Reconciliation of Variable Costing with Absorption Costing Income

As noted earlier, variable costing and absorption costing net operating incomes may not be the same. In the case of XYZ Co., the net operating incomes are the same in January, but differ

in the other two months. These differences occur because under absorption costing some fixed manufacturing overhead is capitalized in inventories (i.e., included in product costs) rather than currently expensed on the income statement. If inventories increase during a period, under absorption costing some of the fixed manufacturing overhead of the current period will be *deferred* in ending inventories.

For example, in February two units were produced and each carried with it $35,000 (= $70,000 ÷ 2 units produced) in fixed manufacturing overhead. Since only one unit was sold, $35,000 of this fixed manufacturing overhead was on February's absorption costing income statement as part of cost of goods sold, but $35,000 would have been on the balance sheet as part of finished goods inventories. In contrast, under variable costing *all* of the $70,000 of fixed manufacturing overhead appeared on the February income statement as a period expense. Consequently, net operating income was higher under absorption costing than under variable costing by $35,000 in February. This was reversed in March when four units were produced, but five were sold. In March, under absorption costing $105,000 of fixed manufacturing overhead was included in cost of goods sold ($35,000 for the unit produced in February and sold in March plus $17,500 for each of the four units produced and sold in March), but only $70,000 was recognized as a period expense under variable costing. Hence, the net operating income in March was $35,000 lower under absorption costing than under variable costing.

In general, when the units produced exceed unit sales and hence inventories increase, net operating income is higher under absorption costing than under variable costing. This occurs because some of the fixed manufacturing overhead of the period is *deferred* in inventories under absorption costing. In contrast, when unit sales exceed the units produced and hence inventories decrease, net operating income is lower under absorption costing than under variable costing. This occurs because some of the fixed manufacturing overhead of previous periods is *released* from inventories under absorption costing. When the units produced and unit sales are equal, no change in inventories occurs and absorption costing and variable costing net operating incomes are the same.

Variable costing and absorption costing net operating incomes can be reconciled by determining how much fixed manufacturing overhead was deferred in, or released from, inventories during the period:

Fixed Manufacturing Overhead Deferred in, or Released from,
Inventories under Absorption Costing

	January	February	March
Fixed manufacturing overhead in beginning inventories	$0	$ 0	$ 35,000
Fixed manufacturing overhead in ending inventories	0	35,000	0
Fixed MOH deferred in(released from) inventories	$0	$35,000	$(35,000)

The reconciliation would then be reported as shown in the Exhibit below:

Reconciliation of Variable Costing and Absorption Costing Net Operating Incomes

	January	February	March
Variable costing net operating income (loss)	$(25,000)	$(25,000)	$235,000
Add (deduct) fixed manufacturing overhead deferred in (released from) inventory under absorption costing	0	35,000	(35,000)
Absorption costing net operating income (loss)	$(25,000)	$ 10,000	$200,000

Again note that the difference between variable costing net operating income and absorption costing net operating income is entirely due to the amount of fixed manufacturing overhead that is deferred in, or released from, inventories during the period under absorption costing. Changes in inventories affect absorption costing net operating income—they do not affect variable costing net operating income, providing that variable manufacturing costs per unit are stable.

The reasons for differences between variable and absorption costing net operating incomes are summarized in the next Exhibit. When the units produced equal the units sold, as in January for XYZ Co., absorption costing net operating income will equal variable costing net operating income. This occurs because when production equals sales, all of the fixed manufacturing overhead incurred in the current period flows through to the income statement under both methods. For companies that use Lean Production, the number of units produced tends to equal the number of units sold. This occurs because goods are produced in response to customer orders, thereby eliminating finished goods inventories and reducing work in process inventory to almost nothing. So, when a company uses Lean Production differences in variable costing and absorption costing net operating income will largely disappear.

When the units produced exceed the units sold, absorption costing net operating income will exceed variable costing net operating income. This occurs because inventories have increased; therefore, under absorption costing some of the fixed manufacturing overhead incurred in the

current period is deferred in ending inventories on the balance sheet, whereas under variable costing all of the fixed manufacturing overhead incurred in the current period flows through to the income statement. In contrast, when the units produced are less than the units sold, absorption costing net operating income will be less than variable costing net operating income. This occurs because inventories have decreased; therefore, under absorption costing fixed manufacturing overhead that had been deferred in inventories during a prior period flows through to the current period's income statement together with all of the fixed manufacturing overhead incurred during the current period. Under variable costing, just the fixed manufacturing overhead of the current period flows through to the income statement.

Relation between Production and Sales for the Period	**Effect on Inventories**	**Relation between Absorption and Variable Costing Net Operating Incomes**
Units produced = Units sold	No change in inventories	Absorption costing net operating income = Variable costing net operating income
Units produced > Units sold	Inventories increase	Absorption costing net operating income > Variable costing net operating income*
Units produced < Units sold	Inventories decrease	Absorption costing net operating income < Variable costing net operating income†
*Net operating income is higher under absorption costing because fixed manufacturing overhead cost is *deferred* in inventory under absorption costing as inventories increase. †Net operating income is lower under absorption costing because fixed manufacturing overhead cost is *released* from inventory under absorption costing as inventories decrease.		

Advantages of Variable Costing and the Contribution Approach

Variable costing, together with the contribution approach, offers appealing advantages for internal reports. This section discusses four of those advantages.

Enabling CVP Analysis

CVP analysis requires that we break costs down into their fixed and variable components. Because variable costing income statements categorize costs as fixed and variable, it is much easier to use this income statement format to perform CVP analysis than attempting to use the absorption costing format, which mixes together fixed and variable costs. Moreover, absorption costing net operating income may or may not agree with the results of CVP analysis.

Explaining Changes in Net Operating Income

The variable costing income statements are clear and easy to understand. All other things the same, when sales go up, net operating income goes up. When sales go down, net operating income goes down. When sales are constant, net operating income is constant. The number of unit produced does not affect net operating income. Absorption costing income statements can be confusing and are easily misinterpreted.

To avoid mistakes when absorption costing is used, readers of financial statements should be alert to changes in inventory levels. Under absorption costing, if inventories increase, fixed manufacturing overhead costs are deferred in inventories, which in turn increases net operating income. If inventories decrease, fixed manufacturing overhead costs are released from inventories, which in turn decreases net operating income. Thus, when absorption costing is used, fluctuations in net operating income can be due to changes in inventories rather than to changes in sales.

Supporting Decision Making

The variable costing method correctly identifies the additional variable costs that will be incurred to make one more unit. It also emphasizes the impact of fixed costs on profits. The total amount of fixed manufacturing costs appears explicitly on the income statement, highlighting that the whole amount of fixed manufacturing costs must be covered for the company to be truly profitable. Under absorption costing, fixed manufacturing overhead costs appear to be variable with respect to the number of units sold, but they are not.

Misinterpreting absorption unit product costs as variable can lead to many problems, including inappropriate pricing decisions and decisions to drop products that are in fact profitable.

Adapting to the Theory of Constraints

The Theory of Constraints (TOC) suggests that the key to improving a company's profits is managing its constraints. For acceptable reasons, this requires careful identification of each product's variable costs. Consequently, companies involved in TOC use a form of variable costing. Variable costing income statements require one adjustment to support the TOC approach. Direct labor costs need to be removed from variable production costs and reported as part of the fixed manufacturing costs that are entirely expensed in the period incurred. The TOC treats direct labor costs as a fixed cost for three reasons. First, even though direct labor workers may be paid on an hourly basis, many companies have a commitment—sometimes enforced by labor contracts or by law—to guarantee workers a minimum number of paid hours. Second, direct labor is not usually the constraint; therefore, there is no reason to increase it. Hiring more direct labor workers would increase costs without increasing the output of saleable products and services. Third, TOC emphasizes continuous improvement to maintain competitiveness. Without committed and enthusiastic employees, sustained continuous improvement is virtually impossible.

Because layoffs often have devastating effects on employee morale, managers involved in TOC are extremely reluctant to lay off employees.

For these reasons, most managers in TOC companies regard direct labor as a committed-fixed cost rather than a variable cost. Hence, in the modified form of variable costing used in TOC companies, direct labor is not usually classified as a product cost.

Exercise: Management of XYZ Company uses the following unit costs for Z product it manufactured:

	Estimated cost per unit
Direct materials (all variable)	$60.00
Direct labor (all variable)	38.00
Manufacturing overhead:	
Variable	12.00
Fixed cost (based on 20,000 units per month)	10.00
Selling, general, and administrative:	
Variable	8.00
Fixed (based on 20,000 units per month)	5.60

The estimated selling price is $160 per unit. The fixed costs remain fixed within the relevant range of 8,000 to 32,000 units of production.

Management has also estimated the following data for the month of December 2019.

	Units
Beginning inventory	0
Production	20,000
Available for sales	20,000
Sales	20,000
Ending inventory	0

Required:

Prepare projected income statements for December 2019 for management purposes under each of the following product costing methods:

1. Absorption costing
2. Variable costing
3. Supporting schedules computing inventoriable production costs per unit under absorption and variable costing systems.

Chapter 6: Cost Allocation: Joint Products and Byproducts

Many companies, such as petroleum refiners, produce and sell two or more products simultaneously. Similarly, some companies, such as health care providers, sell or provide multiple services. The question is, "How should these companies allocate costs to 'joint' products and services?" Knowing how to allocate joint product costs isn't something that only companies need to understand. It's something that farmers have to deal with, too, especially when it comes to the lucrative production of corn to make billions of gallons of ethanol fuel. This chapter examines methods for allocating costs to joint products. The chapter also examines how cost numbers appropriate for one purpose, such as external reporting, may not be appropriate for other purposes, such as decisions about the further processing of joint products.

Joint-Cost Basics

Joint costs are the costs of a production process that yields ***multiple products simultaneously***. Consider the distillation of coal, which yields coke, natural gas, and other products. The costs of this distillation are joint costs. The **splitoff point** is the juncture in a joint production process when two or more products become ***separately identifiable***. An example is the point at which coal becomes coke, natural gas, and other products. **Separable costs** are all costs—manufacturing, marketing, distribution, and so on—incurred beyond the splitoff point that are assignable to each of the specific products identified at the splitoff point. At or beyond the splitoff point, decisions relating to the sale or further processing of each identifiable product can be made independently of decisions about the other products.

Industries abound in which a production process simultaneously yields two or more products, either at the splitoff point or after further processing. (Examples include: Cocoa beans into- Cocoa butter, cocoa powder, cocoa drink mix, tanning cream; Raw milk into- Cream, liquid skim; and Crude oil into - Gasoline, kerosene, benzene, naphtha). In each of these examples, no individual product can be produced without the accompanying products appearing, although in some cases the proportions can be varied. The focus of joint costing is on allocating costs to individual products at the splitoff point.

The outputs of a joint production process can be classified into two general categories: outputs with a ***positive sales value*** and outputs with a ***zero sales value***. For example, offshore processing of hydrocarbons yields oil and natural gas, which have positive sales value, and it also yields water, which has zero sales value and is recycled back into the ocean. The term **product** describes any output that has a ***positive total sales value*** (or an output that enables a company to avoid incurring costs, such as an intermediate chemical product used as input in another process). The total sales value can be high or low.

When a joint production process yields one product with a high total sales value, compared with total sales values of other products of the process, that product is called a **main product**. When a joint production process yields two or more products with high total sales values compared with the total sales values of other products, if any, those products are called **joint products**. The products of a joint production process that have low total sales values compared with the total sales value of the main product or of joint products are called **byproducts**.

Consider some examples. If timber (logs) is processed into standard lumber and wood chips, standard lumber is a main product and wood chips are the byproduct, because standard lumber has a high total sales value compared with wood chips. If, however, logs are processed into fine-grade lumber, standard lumber, and wood chips, fine-grade lumber and standard lumber are joint products, and wood chips are the byproduct. That's because both fine-grade lumber and standard lumber have high total sales values when compared with wood chips.

Distinctions among main products, joint products, and byproducts are not so definite in practice. For example, some companies may classify kerosene obtained when refining crude oil as a byproduct because they believe kerosene has a low total sales value relative to the total sales values of gasoline and other products. Other companies may classify kerosene as a joint product because they believe kerosene has a high total sales value relative to the total sales values of gasoline and other products. Moreover, the classification of products—main, joint, or byproduct—can change over time, especially for products such as lower-grade semiconductor chips, whose market prices may increase or decrease by 30% or more in a year. When prices of lower-grade chips are high, they are considered joint products together with higher-grade

chips; when prices of lower-grade chips fall considerably, they are considered byproducts. In practice, it is important to understand how a specific company chooses to classify its products.

Allocating Joint Costs

Before a manager is able to allocate joint costs, she must first look at the context for doing so. There are several contexts in which joint costs are required to be allocated to individual products or services. These include the following:

_ Computation of inventoriable costs and cost of goods sold. Recall from the Chapter on Variable and Absorption costing that, absorption costing is required for financial accounting and tax reporting purposes. This necessitates the allocation of joint manufacturing or processing costs to products for calculating ending inventory values.

_ Computation of inventoriable costs and cost of goods sold for internal reporting purposes. Many firms use internal accounting data based on joint cost allocations for the purpose of analyzing divisional profitability and in order to evaluate division managers' performance.

_ Cost reimbursement for companies that have a few, but not all, of their products or services reimbursed under cost-plus contracts with, say, a government agency. In this case, stringent rules typically specify the manner in which joint costs are assigned to the products or services covered by the cost-plus agreement.

_ Rate or price regulation for one or more of the jointly produced products or services. This issue is conceptually related to the previous point, and is of great importance in the extractive and energy industries where output prices are regulated to yield a fixed return on a cost basis that includes joint cost allocations. In telecommunications, for example, it is often the case that a firm with significant market power has some products subject to price regulation (e.g., interconnection) and other activities that are unregulated (such as end-user equipment rentals). In this case, it is critical in allocating joint costs to ensure that costs are not transferred from unregulated services to regulated ones.

_ Insurance-settlement computations for damage claims made on the basis of cost information of jointly produced products. In this case, the joint cost allocations are essential in order to provide a cost-based analysis of the loss in value.

_ More generally, any commercial litigation situation in which costs of joint products or services are key inputs requires the allocation of joint costs.

Approaches to Allocating Joint Costs

Two approaches are used to allocate joint costs.

* **Approach 1.** Allocate joint costs using ***market-based*** data such as revenues. This chapter illustrates three methods that use this approach:

1. Sales value at splitoff method

2. Net realizable value (NRV) method

3. Constant gross-margin percentage NRV method

* **Approach 2.** Allocate joint costs using ***physical measures***, such as the weight, quantity (physical units), or volume of the joint products.

In the other chapters, we used the cause-and-effect and benefits-received criteria for guiding cost-allocation decisions. Joint costs do not have a cause-and-effect relationship with individual products because the production process simultaneously yields multiple products. Using the benefits-received criterion leads to a

preference for methods under approach 1 because revenues are, in general, a better indicator of benefits received than physical measures. Mining companies, for example, receive more benefits from 1 ton of gold than they do from 10 tons of coal.

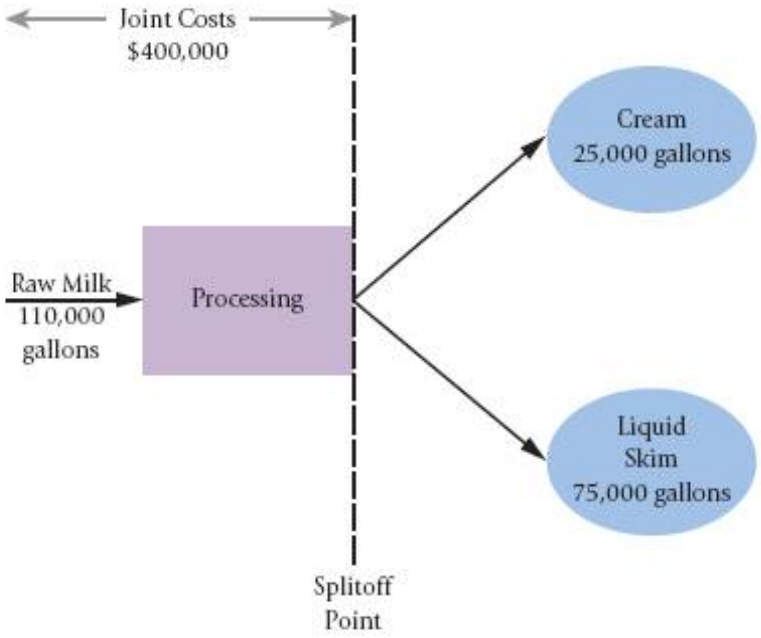
In the simplest joint production process, the joint products are sold at the splitoff point without further processing. Example 1 illustrates the two methods that apply in this case: the sales value at splitoff method and the physical-measure method. Then we introduce joint production processes that yield products that require further processing beyond the splitoff point. Example 2 illustrates the NRV method and the constant-gross margin percentage NRV method. To help you focus on key concepts, we use numbers and amounts that are smaller than the numbers that are typically found in practice.

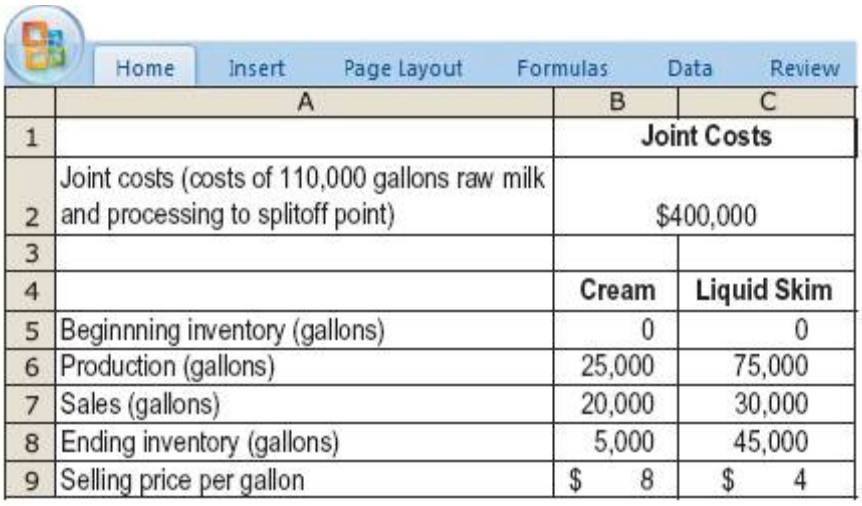
The exhibits in this chapter use the following symbols to distinguish a joint or main product from a byproduct:

To compare methods, we report gross-margin percentages for individual products under each method.

Example 1: FD Co. purchases raw milk from individual farms and processes it until the splitoff point, when two products—cream and liquid skim—emerge. These two products are sold to an independent company, which markets and distributes them to supermarkets and other retail outlets.

In May 2012, FD Co. processes 110,000 gallons of raw milk. During processing, 10,000 gallons are lost due to evaporation and spillage, yielding 25,000 gallons of cream and 75,000 gallons of liquid skim. Summary data follow:





	A	B	C
1		Joint Costs	
2	Joint costs (costs of 110,000 gallons raw milk and processing to splitoff point)	$400,000	
3			
4		Cream	Liquid Skim
5	Beginnning inventory (gallons)	0	0
6	Production (gallons)	25,000	75,000
7	Sales (gallons)	20,000	30,000
8	Ending inventory (gallons)	5,000	45,000
9	Selling price per gallon	$ 8	$ 4

How much of the $400,000 joint costs should be allocated to the cost of goods sold of 20,000 gallons of cream and 30,000 gallons of liquid skim, and how much should be allocated to the ending inventory of 5,000 gallons of cream and 45,000 gallons of liquid skim? We begin by illustrating the two methods that use the properties of the products at the splitoff point, the sales value at splitoff method and the physical-measure method.

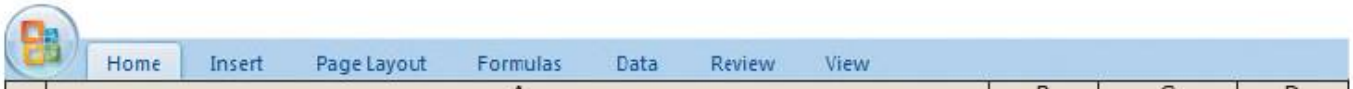
Sales Value at Splitoff Method

The **sales value at splitoff method** allocates joint costs to joint products produced during the accounting period on the basis of the relative total sales value at the splitoff point. Using this method for Example 1, Panel A from the following Exhibit shows how joint costs are allocated to individual products to calculate cost per gallon of cream and liquid skim for valuing ending inventory.

This method uses the sales value of the *entire production of the accounting period* (25,000 gallons of cream and 75,000 gallons of liquid skim), not just the quantity sold (20,000 gallons of cream and 30,000 gallons of liquid skim). The reason this method does not rely solely on the quantity sold is that the joint costs were incurred on all units produced, not just the portion sold during the current period. Panel B from the Exhibit below presents the product-line income statement using the sales value at splitoff method. Note that the gross-margin percentage for each product is 20%, because the sales value at splitoff method allocates joint costs to each product in proportion to the sales value of total production (cream: $160,000 ÷ $200,000 =

80%; liquid skim: $240,000 ÷ $300,000 = 80%). Therefore, the gross-margin percentage for each product manufactured in May 2012 is the same: 20%.

Joint-Cost Allocation and Product-Line Income Statement Using Sales Value at Splitoff Method: FD Co. for May 2012



	A	B	C	D
1	**PANEL A: Allocation of Joint Costs Using Sales Value at Splitoff Method**	**Cream**	**Liquid Skim**	**Total**
2	Sales value of total production at splitoff point			
3	(25,000 gallons × $8 per gallon; 75,000 gallons × $4 per gallon)	$200,000	$300,000	$500,000
4	Weighting ($200,000 ÷ $500,000; $300,000 ÷ 500,000)	0.40	0.60	
5	Joint costs allocated (0.40 × $400,000; 0.60 × $400,000)	$160,000	$240,000	$400,000
6	Joint production cost per gallon			
7	($160,000 ÷ 25,000 gallons; $240,000 ÷ 75,000 gallons)	$ 6.40	$ 3.20	
8				
9	**PANEL B: Product-Line Income Statement Using Sales Value at Splitoff Method for May 2012**	**Cream**	**Liquid Skim**	**Total**
10	Revenues (20,000 gallons × $8 per gallon; 30,000 gallons × $4 per gallon)	$160,000	$120,000	$280,000
11	Cost of goods sold (joint costs)			
12	Production costs (0.40 × $400,000; 0.60 × $400,000)	160,000	240,000	400,000
13	Deduct ending inventory (5,000 gallons × $6.40 per gallon; 45,000 gallons × $3.20 per gallon)	32,000	144,000	176,000
14	Cost of goods sold (joint costs)	128,000	96,000	224,000
15	Gross margin	$ 32,000	$ 24,000	$ 56,000
16	Gross margin percentage ($32,000 ÷ $160,000; $24,000 ÷ $120,000; $56,000 ÷ $280,000)	20%	20%	20%

Note how the sales value at splitoff method follows the benefits-received criterion of cost allocation: Costs are allocated to products in proportion to their revenue-generating power (their expected revenues). The cost-allocation base (total sales value at splitoff) is expressed in terms of a common denominator (the amount of revenues) that is systematically recorded in the accounting system. To use this method, selling prices must exist for all products at the splitoff point.

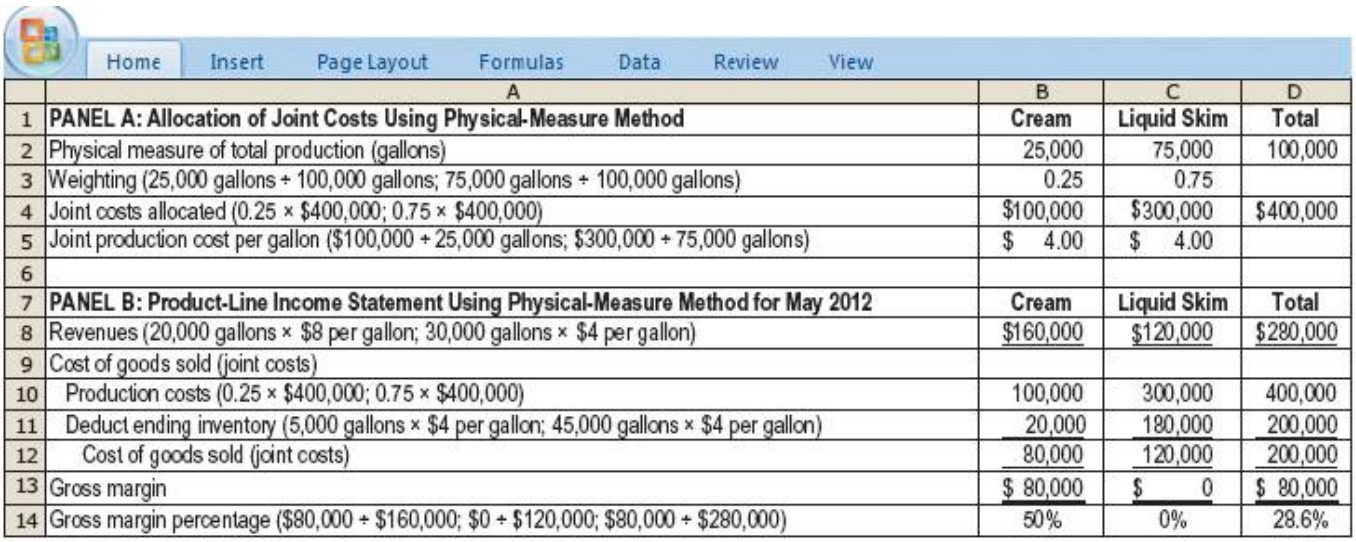
Physical-Measure Method

The **physical-measure method** allocates joint costs to joint products produced during the accounting period on the basis of a *comparable* physical measure, such as the relative weight, quantity, or volume at the splitoff point. In Example 1, the $400,000 joint costs produced 25,000 gallons of cream and 75,000 gallons of liquid skim. Using the number of gallons

produced as the physical measure, Panel A below shows how joint costs are allocated to individual products to calculate the cost per gallon of cream and liquid skim.

Because the physical-measure method allocates joint costs on the basis of the number of gallons, cost per gallon is the same for both products. In the Exhibit below, Panel B presents the product-line income statement using the physical-measure method. The gross-margin percentages are 50% for cream and 0% for liquid skim.

Joint-Cost Allocation and Product-Line Income Statement Using Physical-Measure Method: FD Co. for May 2012



	A	B	C	D
1	**PANEL A: Allocation of Joint Costs Using Physical-Measure Method**	**Cream**	**Liquid Skim**	**Total**
2	Physical measure of total production (gallons)	25,000	75,000	100,000
3	Weighting (25,000 gallons ÷ 100,000 gallons; 75,000 gallons ÷ 100,000 gallons)	0.25	0.75	
4	Joint costs allocated (0.25 × $400,000; 0.75 × $400,000)	$100,000	$300,000	$400,000
5	Joint production cost per gallon ($100,000 ÷ 25,000 gallons; $300,000 ÷ 75,000 gallons)	$ 4.00	$ 4.00	
6				
7	**PANEL B: Product-Line Income Statement Using Physical-Measure Method for May 2012**	**Cream**	**Liquid Skim**	**Total**
8	Revenues (20,000 gallons × $8 per gallon; 30,000 gallons × $4 per gallon)	$160,000	$120,000	$280,000
9	Cost of goods sold (joint costs)			
10	Production costs (0.25 × $400,000; 0.75 × $400,000)	100,000	300,000	400,000
11	Deduct ending inventory (5,000 gallons × $4 per gallon; 45,000 gallons × $4 per gallon)	20,000	180,000	200,000
12	Cost of goods sold (joint costs)	80,000	120,000	200,000
13	Gross margin	$ 80,000	$ 0	$ 80,000
14	Gross margin percentage ($80,000 ÷ $160,000; $0 ÷ $120,000; $80,000 ÷ $280,000)	50%	0%	28.6%

Under the benefits-received criterion, the physical-measure method is much less desirable than the sales value at splitoff method, because the physical measure of the individual products may have no relationship to their respective revenue-generating abilities. Consider a gold mine that extracts ore containing gold, silver, and lead. Use of a common physical measure (tons) would result in almost all costs being allocated to lead, the product that weighs the most but has the lowest revenue-generating power. In the case of metals, the method of cost allocation is inconsistent with the main reason that the mining company is incurring mining costs—to earn revenues from gold and silver, not lead. When a company uses the physical-measure method in a product-line income statement, products that have a high sales value

per ton, like gold and silver, would show a large "profit," and products that have a low sales value per ton, like lead, would show sizable losses.

Obtaining comparable physical measures for all products is not always straightforward. Consider the joint costs of producing oil and natural gas; oil is a liquid and gas is a vapor. To use a physical measure, the oil and gas need to be converted to the energy equivalent for oil and gas, British thermal units (BTUs). Using some physical measures to allocate joint costs may require assistance from technical personnel outside of accounting.

Determining which products of a joint process to include in a physical-measure computation can greatly affect the allocations to those products. Outputs with no sales value (such as dirt in gold mining) are always excluded. Although many more tons of dirt than gold are produced, costs are not incurred to produce outputs that have zero sales value. Byproducts are also often excluded from the denominator used in the physical-measure method because of their low sales values relative to the joint products or the main product. The general guideline for the physical-measure method is to include only the joint product outputs in the weighting computations.

Net Realizable Value Method

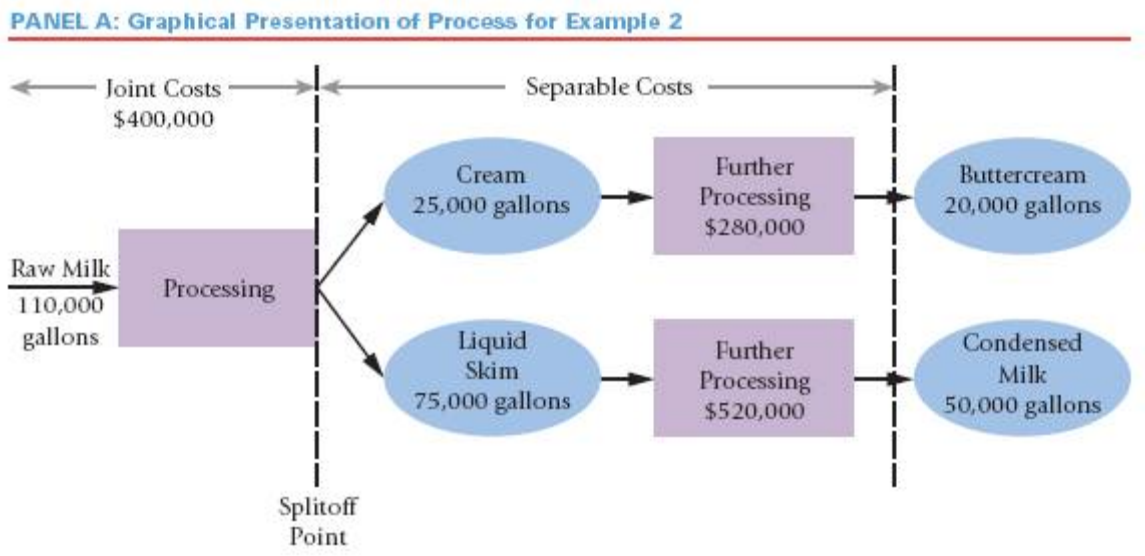
In many cases, products are processed beyond the splitoff point to bring them to a marketable form or to increase their value above their selling price at the splitoff point. For example, when crude oil is refined, the gasoline, kerosene, benzene, and naphtha must be processed further before they can be sold. To illustrate, let's extend the FD Co. example.

Example 2: Assume the same data as in Example 1 except that both cream and liquid skim can be processed further:

- Cream → Buttercream: 25,000 gallons of cream are further processed to yield 20,000 gallons of buttercream at additional processing costs of $280,000. Buttercream, which sells for $25 per gallon, is used in the manufacture of butter-based products.
- Liquid Skim → Condensed Milk: 75,000 gallons of liquid skim are further processed to yield 50,000 gallons of condensed milk at additional processing costs of $520,000. Condensed milk sells for $22 per gallon.

- Sales during May 2012 are 12,000 gallons of buttercream and 45,000 gallons of condensed milk.

Panel A below depicts how (a) raw milk is converted into cream and liquid skim in the joint production process, and (b) how cream is separately processed into buttercream and liquid skim is separately processed into condensed milk. Panel B shows the data for Example 2.



PANEL B: Data for Example 2

Home Insert Page Layout Formulas Data Review View

	A	B	C	D	E
1		Joint Costs		Buttercream	Condensed Milk
2	Joint costs (costs of 110,000 gallons raw milk and processing to splitoff point)	$400,000			
3	Separable cost of processing 25,000 gallons cream into 20,000 gallons buttercream			$280,000	
4	Separable cost of processing 75,000 gallons liquid skim into 50,000 gallons condensed milk				$520,000
5					
6		Cream	Liquid Skim	Buttercream	Condensed Milk
7	Beginning inventory (gallons)	0	0	0	0
8	Production (gallons)	25,000	75,000	20,000	50,000
9	Transfer for further processing (gallons)	25,000	75,000		
10	Sales (gallons)			12,000	45,000
11	Ending inventory (gallons)	0	0	8,000	5,000
12	Selling price per gallon	$ 8	$ 4	$ 25	$ 22

The **net realizable value (NRV) method** allocates joint costs to joint products produced during the accounting period on the basis of their relative **NRV—final sales value minus separable costs**. The NRV method is typically used in preference to the sales value at splitoff method only when selling prices for one or more products at splitoff do not exist. Using this method for Example 2, Panel A below shows how joint costs are allocated to individual products to calculate cost per gallon of buttercream and condensed milk.

Panel B presents the product-line income statement using the NRV method. Gross-margin percentages are 22.0% for buttercream and 26.4% for condensed milk.

Joint-Cost Allocation and Product-Line Income Statement Using NRV Method: FD Co. for May 2012

Home Insert Page Layout Formulas Data Review View

	A	B	C	D
1	**PANEL A: Allocation of Joint Costs Using Net Realizable Value Method**	**Buttercream**	**Condensed Milk**	**Total**
2	Final sales value of total production during accounting period			
3	(20,000 gallons × $25 per gallon; 50,000 gallons × $22 per gallon)	$500,000	$1,100,000	$1,600,000
4	Deduct separable costs	280,000	520,000	800,000
5	Net realizable value at splitoff point	$220,000	$ 580,000	$ 800,000
6	Weighting ($220,000 ÷ $800,000; $580,000 ÷ $800,000)	0.275	0.725	
7	Joint costs allocated (0.275 × $400,000; 0.725 × $400,000)	$110,000	$ 290,000	$ 400,000
8	Production cost per gallon			
9	([$110,000 + $280,000] ÷ 20,000 gallons; [$290,000 + $520,000] ÷ 50,000 gallons)	$ 19.50	$ 16.20	
10				
11	**PANEL B: Product-Line Income Statement Using Net Realizable Value Method for May 2012**	**Buttercream**	**Condensed Milk**	**Total**
12	Revenues (12,000 gallons × $25 per gallon; 45,000 gallons × $22 per gallon)	$300,000	$ 990,000	$1,290,000
13	Cost of goods sold			
14	Joint costs (0.275 × $400,000; 0.725 × $400,000)	110,000	290,000	400,000
15	Separable costs	280,000	520,000	800,000
16	Production costs	390,000	810,000	1,200,000
17	Deduct ending inventory (8,000 gallons × $19.50 per gallon; 5,000 gallons × $16.20 per gallon)	156,000	81,000	237,000
18	Cost of goods sold	234,000	729,000	963,000
19	Gross margin	$ 66,000	$ 261,000	$ 327,000
20	Gross margin percentage ($66,000 ÷ $300,000; $261,000 ÷ $990,000; $327,000 ÷ $1,290,000)	22.0%	26.4%	25.3%

The NRV method is often implemented using simplifying assumptions. For example, even when selling prices of joint products vary frequently, companies implement the NRV method using a given set of selling prices throughout the accounting period. Similarly, even though companies may occasionally change the number or sequence of processing steps beyond the splitoff point in order to adjust to variations in input quality or local conditions, they assume a specific constant set of such steps when implementing the NRV method.

Constant Gross-Margin Percentage NRV Method

The **constant gross-margin percentage NRV method** allocates joint costs to joint products produced during the accounting period in such a way that each individual product achieves an identical gross-margin percentage. The method works backward in that the overall gross margin is computed first. Then, for each product, this gross-margin percentage and any separable costs are deducted from the final sales value of production in order to back into the joint cost allocation for that product. The method can be broken down into three discrete steps. Panel A in the next Exihibit, shows these steps for allocating the $400,000 joint costs between buttercream and condensed milk in the FD Co. example.

As we describe each step, refer to Panel A in the same Exihibit, for an illustration of the step.

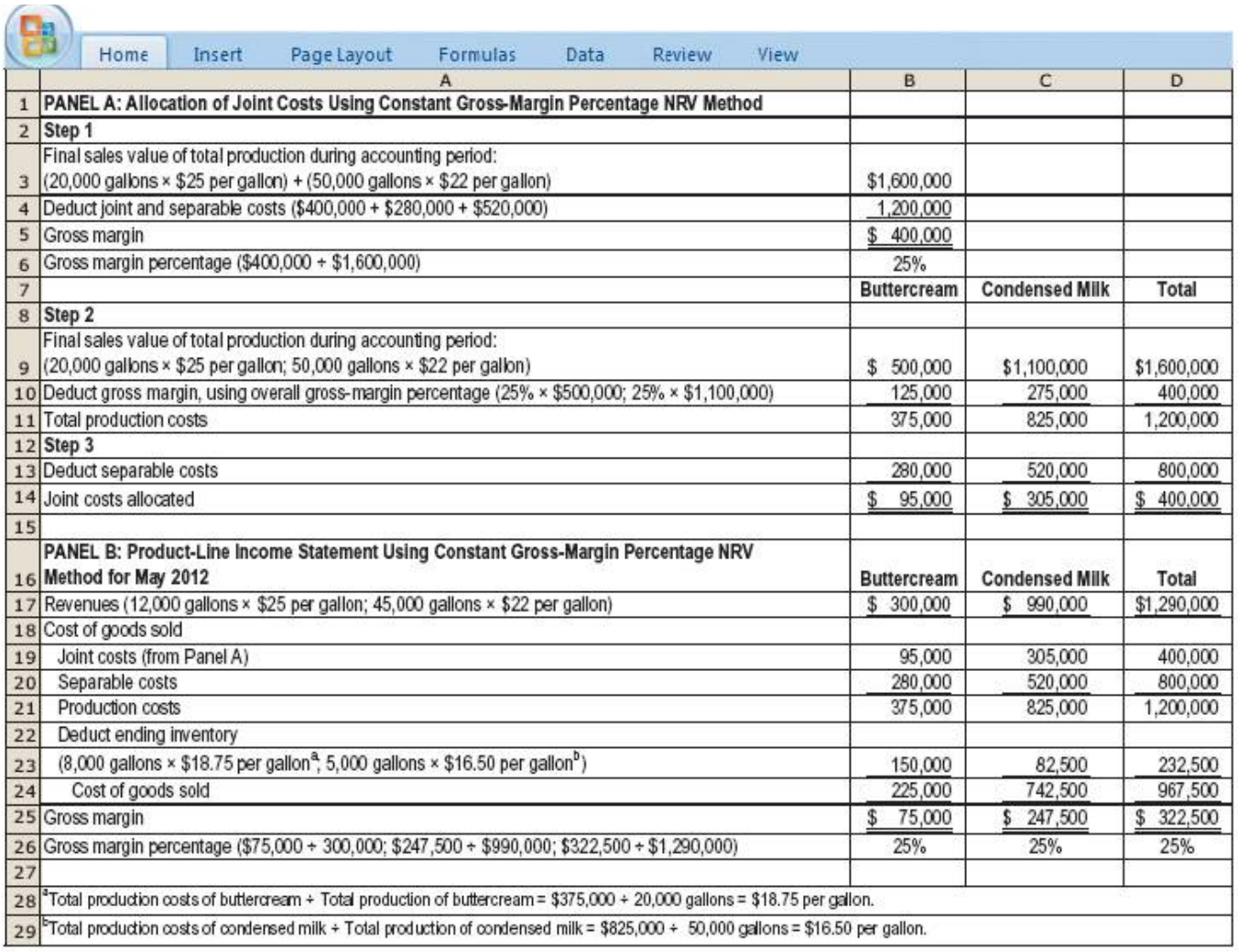
Step 1: Compute overall gross margin percentage. The overall gross-margin percentage for all joint products together is calculated first. This is based on the final sales value of *total production* during the accounting period, not the *total revenues* of the period. Note, Panel A in the Exhibit below, uses $1,600,000, the final expected sales value of the entire output of buttercream and condensed milk, not the $1,290,000 in actual sales revenue for the month of May.

Step 2: Compute total production costs for each product. The gross margin (in dollars) for each product is computed by multiplying the overall gross-margin percentage by the product's final sales value of total production. The difference between the final sales value of total production and the gross margin then yields the total production costs that the product must bear.

Step 3: Compute allocated joint costs. As the final step, the separable costs for each product are deducted from the total production costs that the product must bear to obtain the joint-cost allocation for that product.

Panel B in the next Exihibit, presents the product-line income statement for the constant gross margin percentage NRV method.

Joint-Cost Allocation and Product-Line Income Statement Using Constant Gross-Margin Percentage NRV Method: FD Co. for May 2012



Home Insert Page Layout Formulas Data Review View

	A	B	C	D
1	**PANEL A: Allocation of Joint Costs Using Constant Gross-Margin Percentage NRV Method**			
2	**Step 1**			
3	Final sales value of total production during accounting period: (20,000 gallons × $25 per gallon) + (50,000 gallons × $22 per gallon)	$1,600,000		
4	Deduct joint and separable costs ($400,000 + $280,000 + $520,000)	1,200,000		
5	Gross margin	$ 400,000		
6	Gross margin percentage ($400,000 ÷ $1,600,000)	25%		
7		**Buttercream**	**Condensed Milk**	**Total**
8	**Step 2**			
9	Final sales value of total production during accounting period: (20,000 gallons × $25 per gallon; 50,000 gallons × $22 per gallon)	$ 500,000	$1,100,000	$1,600,000
10	Deduct gross margin, using overall gross-margin percentage (25% × $500,000; 25% × $1,100,000)	125,000	275,000	400,000
11	Total production costs	375,000	825,000	1,200,000
12	**Step 3**			
13	Deduct separable costs	280,000	520,000	800,000
14	Joint costs allocated	$ 95,000	$ 305,000	$ 400,000
15				
16	**PANEL B: Product-Line Income Statement Using Constant Gross-Margin Percentage NRV Method for May 2012**	**Buttercream**	**Condensed Milk**	**Total**
17	Revenues (12,000 gallons × $25 per gallon; 45,000 gallons × $22 per gallon)	$ 300,000	$ 990,000	$1,290,000
18	Cost of goods sold			
19	Joint costs (from Panel A)	95,000	305,000	400,000
20	Separable costs	280,000	520,000	800,000
21	Production costs	375,000	825,000	1,200,000
22	Deduct ending inventory			
23	(8,000 gallons × $18.75 per gallon[a], 5,000 gallons × $16.50 per gallon[b])	150,000	82,500	232,500
24	Cost of goods sold	225,000	742,500	967,500
25	Gross margin	$ 75,000	$ 247,500	$ 322,500
26	Gross margin percentage ($75,000 ÷ 300,000; $247,500 ÷ $990,000; $322,500 ÷ $1,290,000)	25%	25%	25%
27				
28	[a]Total production costs of buttercream ÷ Total production of buttercream = $375,000 ÷ 20,000 gallons = $18.75 per gallon.			
29	[b]Total production costs of condensed milk ÷ Total production of condensed milk = $825,000 ÷ 50,000 gallons = $16.50 per gallon.			

The constant gross-margin percentage NRV method is the only method of allocating joint costs under which products may receive negative allocations. This may be required in order to bring the gross-margin percentages of relatively unprofitable products up to the overall average. The constant gross-margin percentage NRV method also differs from the other two market-based joint-cost-allocation methods described earlier in another fundamental way. Neither the sales value at splitoff method nor the NRV method takes account of profits earned either before or after the splitoff point when allocating the joint costs. In contrast, the constant gross-margin percentage NRV method allocates both joint costs and profits: Gross margin is allocated to the joint products in order to determine the joint-cost allocations so that the resulting gross-margin percentage for each product is the same.

Choosing an Allocation Method

Which method of allocating joint costs should be used? The sales value at splitoff method is preferable when selling-price data exist at splitoff (even if further processing is done). Reasons for using the sales value at splitoff method include the following:

1. **Measurement of the value of the joint products at the splitoff point.** Sales value at splitoff is the best measure of the benefits received as a result of joint processing relative to all other methods of allocating joint costs. It is a meaningful basis for allocating joint costs because generating revenues is the reason why a company incurs joint costs in the first place. It is also sometimes possible to vary the physical mix of final output and thereby produce more or less market value by incurring more joint costs.

In such cases, there is a clear causal link between total cost and total output value, thereby further validating the use of the sales value at splitoff method.

2. **No anticipation of subsequent management decisions.** The sales value at splitoff method does not require information on the processing steps after splitoff if there is further processing. In contrast, the NRV and constant gross-margin percentage NRV methods require information on (a) the specific sequence of further processing decisions, (b) the separable costs of further processing, and (c) the point at which individual products will be sold.

3. **Availability of a common basis to allocate joint costs to products.** The sales value at splitoff method (as well as other market-based methods) has a common basis to allocate joint costs to products, which is revenue. In contrast, the physical-measure at splitoff method may lack an easily identifiable common basis to allocate joint costs to individual products.

4. **Simplicity.** The sales value at splitoff method is simple. In contrast, the NRV and constant gross-margin percentage NRV methods can be complex for processing operations having multiple products and multiple splitoff points. This complexity increases when management makes frequent changes in the specific sequence of post-splitoff processing decisions or in the point at which individual products are sold.

When selling prices of all products at the splitoff point are unavailable, the NRV method is commonly used because it attempts to approximate sales value at splitoff by subtracting from selling prices separable costs incurred after the splitoff point. The NRV method assumes that all the markup or profit margin is attributable to the joint process and none of the markup is

attributable to the separable costs. Profit, however, is attributable to all phases of production and marketing, not just the joint process. More of the profit may be attributable to the joint process if the separable process is relatively routine, whereas more of the profit may be attributable to the separable process if the separable process uses a special patented technology. Despite its complexities, the NRV method is used when selling prices at splitoff are not available as it provides a better measure of benefits received compared with the constant gross-margin percentage NRV method or the physical-measure method.

The constant gross-margin percentage NRV method makes the simplifying assumption of treating the joint products as though they comprise a single product. This method calculates the aggregate gross-margin percentage, applies this gross-margin percentage to each product, and views the residual after separable costs are accounted for as the implicit amount of joint costs assigned to each product. An advantage of this method is that it avoids the complexities inherent in the NRV method to measure the benefits received by each of the joint products at the splitoff point. The main issue with the constant gross-margin percentage NRV method is the assumption that all products have the same ratio of cost to sales value. But such a situation is very uncommon when companies offer a diverse set of products.

Although there are difficulties in using the physical-measure method—such as lack of congruence with the benefits-received criterion—there are instances when it may be preferred. Consider rate or price regulation. Market-based measures are difficult to use in this context because using selling prices as a basis for setting prices (rates) and at the same time using selling prices to allocate the costs on which prices (rates) are based leads to circular reasoning. To avoid this dilemma, the physical-measure method is useful in rate regulation.

Not Allocating Joint Costs

Some companies choose to not allocate joint costs to products. The usual rationale given by these firms is the complexity of their production or extraction processes and the difficulty of gathering sufficient data for carrying out the allocations correctly. For example, a recent survey of nine sawmills in Norway revealed that none of them allocated joint costs. The study's authors noted that the "interviewed sawmills considered the joint cost problem very interesting, but pointed out that the problem is not easily solved. For example, there is clearly a shortcoming in management systems designed for handling joint cost allocation."

In the absence of joint cost allocation, some firms simply subtract the joint costs directly from total revenues in the management accounts. If substantial inventories exist, then firms that do not allocate joint costs often carry their product inventories at NRV. Industries that use variations of this approach include meatpacking, canning, and mining. Accountants do not ordinarily record inventories at NRV because this practice results in recognizing income on each product at the time production is completed and *before* sales are made. In response, some companies using this no-allocation approach carry their inventories at NRV minus an estimated operating income margin. When any end-of period inventories are sold in the next period, the cost of goods sold then equals this carrying value. This approach is akin to the "production method" of accounting for byproducts, which we describe in detail later in this chapter.

Accounting for Byproducts

Joint production processes may yield not only joint products and main products but also byproducts. Although byproducts have relatively low total sales values, the presence of byproducts in a joint production process can affect the allocation of joint costs. Let's consider a two-product example consisting of a main product and a byproduct.

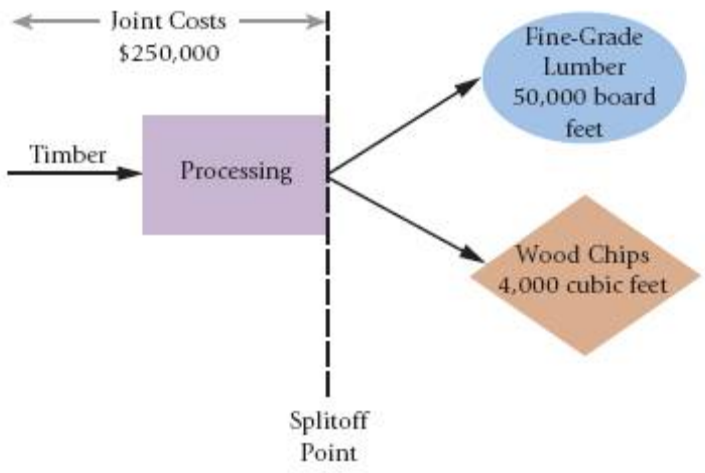
Example 3: The WW Co. processes timber into fine-grade lumber and wood chips that are used as mulch in gardens and lawns. Information about these products follows:

- Fine-Grade lumber (the main product)—sells for $6 per board foot (b.f.)
- Wood chips (the byproduct)—sells for $1 per cubic foot (c.f.)

Data for July 2012 are as follows:

	Beginning Inventory	Production	Sales	Ending Inventory
Fine-Grade lumber (b.f.)	0	50,000	40,000	10,000
Wood chips (c.f.)	0	4,000	1,200	2,800

Joint manufacturing costs for these products in July 2012 are $250,000, comprising $150,000 for direct materials and $100,000 for conversion costs. Both products are sold at the splitoff point without further processing, as shown below.



We present two byproduct accounting methods: the production method and the sales method. The production method recognizes byproducts in the financial statements at the time production is completed. The sales method delays recognition of byproducts until the time of sale. The Exhibit below presents the income statement of WW Co. under both methods.

	Production Method	Sales Method
Revenues		
Main product: Fine-grade lumber (40,000 b.f. × $6 per b.f.)	$240,000	$240,000
Byproduct: Wood chips (1,200 c.f. × $1 per c.f.)	—	1,200
Total revenues	240,000	241,200
Cost of goods sold		
Total manufacturing costs	250,000	250,000
Deduct byproduct revenue (4,000 c.f. × $1 per c.f.)	(4,000)	—
Net manufacturing costs	246,000	250,000
Deduct main-product inventory	(49,200)[a]	(50,000)[b]
Cost of goods sold	196,800	200,000
Gross margin	$ 43,200	$ 41,200
Gross-margin percentage ($43,200 ÷ $240,000; $41,200 ÷ $241,200)	18.00%	17.08%
Inventoriable costs (end of period):		
Main product: Fine-grade lumber	$ 49,200	$ 50,000
Byproduct: Wood chips (2,800 c.f. × $1 per c.f.)[c]	2,800	0

[a](10,000 ÷ 50,000) × net manufacturing cost = (10,000 ÷ 50,000) × $246,000 = $49,200.
[b](10,000 ÷ 50,000) × total manufacturing cost = (10,000 ÷ 50,000) × $250,000 = $50,000.
[c]Recorded at selling prices.

Production Method: Byproducts Recognized at Time Production Is Completed

This method recognizes the byproduct in the financial statements—the 4,000 cubic feet of wood chips—in the month it is produced, July 2012. The NRV from the byproduct produced is offset against the costs of the main product. The following journal entries illustrate the production method:

1. Work in Process 150,000
    Accounts Payable 150,000
    To record direct materials purchased and used in production during July.

2. Work in Process 100,000
    Various accounts such as Wages Payable and Accumulated Depreciation 100,000
    To record conversion costs in the production process during July; examples include energy, manufacturing supplies, all manufacturing labor, and plant depreciation.

3. Byproduct Inventory—Wood Chips (4,000 c.f. x $1 per c.f.) 4,000
    Finished Goods—Fine-Grade Lumber ($250,000 - $4,000) 246,000
    Work in Process ($150,000 + $100,000) 250,000
    To record cost of goods completed during July.

4a. Cost of Goods Sold [(40,000 b.f. ÷ 50,000 b.f.) x $246,000] 196,800
    Finished Goods—Fine-Grade Lumber 196,800
    To record the cost of the main product sold during July.

4b. Cash or Accounts Receivable (40,000 b.f. x $6 per b.f.) 240,000
    Revenues—Fine-Grade Lumber 240,000
    To record the sales of the main product during July.

5. Cash or Accounts Receivable (1,200 c.f. x $1 per c.f.) 1,200
    Byproduct Inventory—Wood Chips 1,200
    To record the sales of the byproduct during July.

The production method reports the byproduct inventory of wood chips in the balance sheet at its $1 per cubic foot selling price [(4,000 cubic feet - 1,200 cubic feet) x $1 per cubic foot = $2,800].

One variation of this method would be to report byproduct inventory at its NRV reduced by a normal profit margin ($2,800 - 20% x $2,800 = $2,240, assuming a normal profit margin of 20%). When byproduct inventory is sold in a subsequent period, the income statement will match the selling price, $2,800, with the "cost" reported for the byproduct inventory, $2,240, resulting in a byproduct operating income of $560 ($2,800 - $2,240).

Sales Method: Byproducts Recognized at Time of Sale

This method makes no journal entries for byproducts until they are sold. Revenues of the byproduct are reported as a revenue item in the income statement at the time of sale. These revenues are either grouped with other sales, included as other income, or are deducted from cost of goods sold. In the Westlake Corporation example, byproduct revenues in July 2012 are $1,200 (1,200 cubic feet x $1 per cubic foot) because only 1,200 cubic feet of wood chips are sold in July (of the 4,000 cubic feet produced). The journal entries are as follows:

1. and 2. Same as for the production method.

Work in Process 150,000
    Accounts Payable 150,000

Work in Process 100,000
    Various accounts such as Wages Payable and Accumulated Depreciation 100,000

3. Finished Goods—Fine-Grade Lumber 250,000
    Work in Process 250,000
    To record cost of main product completed during July.

4a. Cost of Goods Sold [(40,000 b.f. , 50,000 b.f.) * $250,000] 200,000
    Finished Goods—Fine-Grade Lumber 200,000
    To record the cost of the main product sold during July.

4b. Same as for the production method.

Cash or Accounts Receivable (40,000 b.f. * $6 per b.f.) 240,000

Revenues—Fine-Grade Lumber 240,000

5. Cash or Accounts Receivable 1,200

Revenues—Wood Chips 1,200

To record the sales of the byproduct during July.

Which method should a company use? The production method is conceptually correct in that it is consistent with the matching principle. This method recognizes byproduct inventory in the accounting period in which it is produced and simultaneously reduces the cost of manufacturing the main or joint products, thereby better matching the revenues and expenses from selling the main product. However, the sales method is simpler and is often used in practice, primarily on the grounds that the dollar amounts of byproducts are immaterial. Then again, the sales method permits managers to "manage" reported earnings by timing when they sell byproducts. Managers may store byproducts for several periods and give revenues and income a "small boost" by selling byproducts accumulated over several periods when revenues and profits from the main product or joint products are low.

Mekelle University
College of Business and Economics
Department of Accounting & Finance
Final Exam – Cost and Management Accounting I

Time Allowed: 2:30hrs.

Instruction:

Attempt all questions. Show your steps clearly. For your answers, use the separate answer sheet.

Part I – Multiple Choices (1 each)

Choose the best answer and put the letter of your choice in the separate answer sheet provided.

1. In traditional cost accounting, costs associated with the manufacturing process that can't be traced to the manufactured goods in an economically feasible way are:
a. prime costs b. direct costs c. manufacturing overhead costs d. conversion costs e. none

2. One of the following is ***true*** when a company uses job order costing;
a. actual MOH costs are recorded in work-in-process inventory account but not job cost sheet.
b. non traceable costs will not be recorded in job cost sheet when incurred.
c. if an order contains 1000 units in it, separate job cost sheet must be prepared for each unit.
d. clock card is the only labor related document which a company has to maintain.
e. none

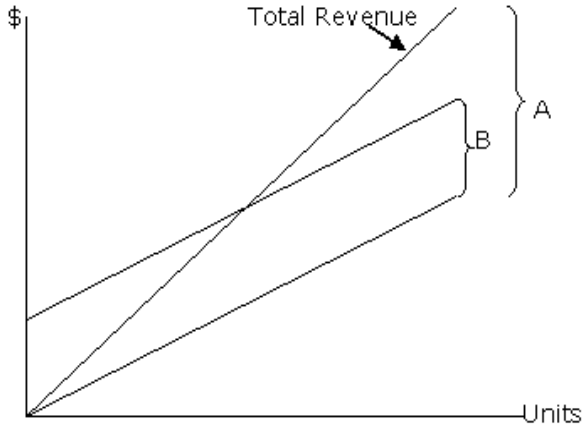
3. Which one of the following is ***not*** true?
a. The Equivalent Units of production under weighted average costing method is always less than or equal to that of FIFO method.
b. In process costing system, a company will have as many work-in-process accounts as the number of processing departments.
c. If there are no units in process at the beginning and end of period, the need for computation of equivalent units of production will be abolished.
d. In process costing, overhead costs are usually accumulated by departments or operations.
e. None

4. XYZ Co. has the following data:
Cost structure y=5x + 30,000
Selling price per unit is $8
One of the following is ***not*** true taking the above information into account:
a. Contribution margin ratio is 37.5%.
b. The company will be at breakeven if contribution margin totals $30,000.
c. Ceteris paribus, if variable cost doubles the company will always be at a loss.
d. The above information is not sufficient enough to determine the breakeven level.
e. None

5. One of the following is ***not*** true;
a. The breakeven level will be the same whether there is income tax or not.
b. The information about sales mix is not needed to carry out CVP analysis for a one product company.
c. In contribution format income statement, costs are organized by behavior.
d. At breakeven, sales minus total variable cost and total contribution margin is zero.
e. None

6. Which one of the following is ***true*** if XYZ Co. keeps its sales volume constant each year but allow production volume to vary? (Assuming constant selling price & variable MOH cost per unit).
a. In variable costing, change in production volume will affect net income.
b. Net income will be same in both variable and absorption costing systems.
c. Net income will be higher in variable costing system.
d. Net income will be higher in absorption costing system.
e. None

7.



In the above breakeven chart, if distance B represents 'Total Fixed Cost', then distance A is:
a. total cost b. total contribution margin c. total profit d. total revenue e. none

8. The overhead absorption rate for product Y is $2.50 per direct labor hour. Each unit of Y requires 3 direct labor hours. Inventory of product Y at the beginning of the month was 200 units and at the end of the month was 250 units. What is the difference in the profits reported for the month using absorption costing compared with marginal costing?
a. The absorption costing profit would be $375 less.
b. The absorption costing profit would be $125 greater.
c. The absorption costing profit would be $375 greater.
d. The absorption costing profit would be $1,875 greater.
e. None

9. Data for last year when production level was 10,000 units is as follows:

Direct material cost per unit	$8
Direct labor cost per unit	$2
Variable MOH cost per unit	$5
Variable S&A cost per unit	$3
Fixed MOH cost per unit	$4
Fixed S&A cost per unit	$6

Data for the current period:

Production	20,000 units
Sales	10,000 units

Total Fixed MOH cost and Total Selling and Administrative (S&A) costs are constant each year.
Based on the above data, determine the product cost (per unit) under absorption costing for the current year;
a. $19 b. $17 c. $28 d. $22 e. none

10. Under absorption costing, fixed manufacturing overhead costs:

a. Are deferred in inventory when production exceeds sales.
b. Are always treated as period costs.
c. Are released from inventory when production exceeds sales.
d. None of these.

Part II – Problems

Answer the following questions in the separate answer sheet provided.

1. The accountant for KK Co. has provided the following data for the years 2009 and 2010:

Selling price per unit	$20
Direct material cost per unit	$5
Direct labor cost per unit	$2
Variable MOH cost per unit	$1
Variable selling & admin. exp./unit sold	$2
Fixed MOH cost per year	$300,000
Fixed selling & admin. exp. per year	$275,000

The company uses FIFO cost flow assumption.

	Year 2009	***Year 2010***
Beginning Inventory	2,000 units	12,000 units
Production	60,000 units	50,000 units
Sales	50,000 units	55,000 units

Required:

a. Prepare Income statement for year 2010 under variable costing approach.
b. Determine net income or loss for year 2010 under absorption costing approach by using the reconciliation format (don't prepare income statement).

2. The Appleton Company makes wooden toys in its forming department, and it uses the weighted-average method of process costing. All direct materials are added at the beginning of the process, and conversion costs are added evenly during the process. Spoiled units are detected upon inspection at 65%. Summary data for October 2015 are as follows:

	Physical Units	**Direct Materials**	**Conversion Costs**
Work in process, beginning inventory (October 1)	4,000	$ 35,400	$21,800
Degree of completion of beginning work in process		100%	70%
Started during October	20,000		
Good units completed and transferred out during October	18,000		
Work in process, ending inventory (October 31)	2,600		
Degree of completion of ending work in process		100%	70%
Total costs added during October		$162,600	$186,000
Normal spoilage as a percentage of good units	10%		
Degree of completion for normal spoilage		100%	65%
Degree of completion for Abnormal spoilage		100%	65%

Required: - Based on the above information, answer the following questions:

A. For each cost category, compute equivalent units.
B. Summarize total costs to account for;
C. Calculate cost per equivalent unit for each cost category;
D. Assign total costs to units completed and transferred out (including normal spoilage), to abnormal spoilage, and to units in ending work in process.

3. The Wood Spirits Company produces two products—turpentine and methanol (wood alcohol) by a joint process. Joint costs amount to $200,000 per batch of output.

Joint cost	$ 200,000	
	Turpentine	**Methanol**
Beginning inventory (Gallons)	0	0
Production (Gallons)	12,000	18,000
Sales (Gallons)	12,000	12,000
Selling price per gallon @ split off point	$ 19	$ 26

Later, the Wood Sprit company decided to further process these two products. That is;
Turpentine is further processed by additional processing costs of $ $3 per gallon in order to produce 8,000 gallons of **Special chemical FX13** which has a selling price of $23 per gallon.
Methanol is further processed by additional processing costs of $4 per gallon in order to produce 9,000 gallons of **Special chemical FX15** which has a selling price of $ 32 per gallon.

Required: - Allocate the $ 200,000 joint costs by using

A. Sales value at split-off point method.
B. Net realizable value method.

Part III – Short Answer

Give short answers for the following questions. (Maximum 5 lines)

1. Discuss the difference between management accounting and financial accounting.
2. Why joint cost allocation? What factors need to be taken into account when choosing techniques to allocate joint costs?
3. Give three advantages of variable costing over absorption costing.