Chapter 2

Lecture Notes

**Chapter theme**: This chapter explains how managers need to rely on different cost classifications for different purposes. The four main purposes emphasized in this chapter include **preparing external financial reports, predicting cost behavior, assigning costs to cost objects, and decision making**.

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1. **General cost classifications** We’ll begin by looking at manufacturing companies because their basic activities include most of the activities found in other types of business organizations.

*Learning Objective 1: Identify and give examples of each of the three basic manufacturing cost categories.*

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* 1. **Classifications of manufacturing** **costs**
		1. **Direct materials** − Raw materials that become an integral part of the finished product and whose costs can be conveniently traced to it.

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* + 1. **Direct labor** − Labor costs that can be easily traced to individual units of product (also called touch labor).

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* + 1. **Manufacturing overhead** − Includes all manufacturing costs except direct materials and direct labor. These costs cannot be easily traced to specific units produced (also called indirect manufacturing cost, factory overhead, and factory burden).

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* + - 1. Includes **indirect materials** that are part of the finished product, but that cannot be easily traced to it.
			2. Includes **indirect labor costs** that cannot be conveniently traced to the creation of products.

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* + - 1. Other examples of manufacturing overhead include: maintenance and repairs on production equipment, heat and light, property taxes, depreciation and insurance on manufacturing facilities, etc.
	1. **Classifications of nonmanufacturing costs** (also called selling and administrative costs).
		1. **Selling costs** – Includes all costs necessary to secure customer orders and get the finished product into the hands of the customer.

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* + 1. **Administrative costs** – Includes all costs associated with the general management of an organization.

*Learning Objective 2: Distinguish between product costs and period costs and give examples of each.*

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#### Product costs versus period costs

* + 1. **Product costs** – Includes all the costs that are involved in acquiring or making a product. More specifically, it includes direct materials, direct labor, and manufacturing overhead.

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* + - 1. Product costs are expensed in the income statement when the products are sold.
		1. **Period costs** – Includes all selling and administrative costs.

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* + - 1. These costs are expensed in the income statement in the period incurred.

*Quick Check − product versus period costs*

 10-11

#### Prime costs and conversion costs

* + 1. **Prime cost** − Direct materials cost plus direct labor cost.

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* + 1. **Conversion cost** – Direct labor cost plus manufacturing overhead costs.

## **Cost** **classifications for predicting cost behavior**

*Learning Objective 3: Understand cost behavior patterns including variable costs, fixed costs, and mixed costs.*

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#### Cost behavior refers to how a cost will react to changes in the level of activity. The most commonly used classifications of cost behavior are variable, fixed, and mixed costs:

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* + 1. **Variable cost** − A cost that varies, in total, in direct proportion to changes in the level of activity. However, variable cost per unit is constant.

 15-16

* + - 1. An **activity base** (also called a cost driver) is a measure of what causes the incurrence of variable costs. As the level of the activity base increases, the total variable cost increases proportionally.

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* + 1. **Fixed cost** − A cost that remains constant, in total, regardless of changes in the level of the activity. However, if expressed on a per unit basis, the average fixed cost per unit varies inversely with changes in activity.

 18-19

* + - 1. **Committed fixed costs** represent investments with a multi-year planning horizon that cannot be easily adjusted in the short term.

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* + - 1. **Discretionary fixed costs** usually arise from annual decisions by management and they can be easily reduced in the short term.

*Helpful Hint: To illustrate fixed costs, ask students for the cost of a large pizza. Then ask: What would be the cost per student if two students buy a pizza? What if four students buy a pizza? This makes it clear why average fixed costs change on a per unit basis. To illustrate variable costs, add that a beverage costs $1 and each student eating the pizza has one beverage. So, if two people were eating the pizza, the total beverage bill would come to $2; if four people, $4. The cost per beverage remains the same, but the total cost depends on the number of people ordering a beverage.*

* + 1. **The linearity assumption and the relevant range** − Accountants usually assume that costs are strictly linear; however, economists point out that many costs are actually curvilinear**.** Nonetheless, within a narrow band of activity known as the relevant range, a curvilinear cost can be **satisfactorily approximated** by a straight line.

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* + - 1. The **relevant range** is that range of activity within which the assumptions made about cost behavior are valid.
		1. The relevant range of activity **pertains to fixed cost as well as variable costs**.
			1. For example, assume office space is available at a rental rate of **$30,000** per year in increments of **1,000** square feet.

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* + - 1. Fixed costs would increase in a step fashion at a rate of $30,000 for each additional 1,000 square feet.
		1. The relevant range for a fixed cost is the range of activity over which the graph of the cost is flat.

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* + 1. It is helpful to think about variable and fixed cost behavior in a **2x2 matrix**.

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*Quick Check – variable vs. fixed costs*

 25-26

* + 1. **Mixed cost** – A cost that contains both variable and fixed elements.
1. For example, utility bills often contain fixed and variable cost components.
	* + - 1. The fixed portion of the utility bill is constant regardless of kilowatt hours consumed. This cost represents the minimum cost that is incurred to have the service ready and available for use.

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* + - * 1. The variable portion of the bill varies in direct proportion to the consumption of kilowatt hours.
		1. An equation can be used to express the relationship between mixed costs and the level of the activity. This equation can be used to calculate what the total mixed cost would be for any level of activity.
			1. The equation is *Y* = *a + bX*

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* + - * 1. *Y =* The total mixed cost.
				2. *a =* The total fixed cost (the vertical intercept of the line).
				3. *b =* The variable cost per unit of activity (the slope of the line).
				4. *X =* The level of activity.
		1. For example*,* if your fixed monthly utility charge is $40, your variable cost is $0.03 per kilowatt hour, and your monthly activity level was 2,000 kilowatt hours, this equation can be used to calculate your total utility cost of $100.

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1. **The** **analysis of mixed costs**
	1. Account analysis and the engineering approach
		1. In **account analysis**, each account under consideration is classified as variable or fixed based on the analyst’s prior knowledge about how costs behave.
			1. This approach is limited in value in the sense that it glosses over the fact that some accounts may have both fixed and variable components.

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* + 1. The **engineering approach** classifies costs based upon an industrial engineer’s evaluation of production methods, material specifications, labor requirements, equipment usage, power consumption, and so on.
			1. This approach is particularly useful when no past experience is available concerning activity and costs.
	1. **Diagnosing** **cost behavior with a scattergraph plot**

*Learning Objective 4: Analyze a mixed cost using a scattergraph plot and the high-low method.*

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* + 1. Before analyzing a mixed cost you should plot the data on a scattergraph. For illustrative purposes, assume the following information, which would be plotted as follows:

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* + - 1. The maintenance cost, which is known as the dependent variable, is plotted on the *Y* (vertical) axis.
			2. The activity (hours of maintenance), which is known as the independent variable, is plotted on the *X* (horizontal) axis.
		1. After plotting the data, examine the dots on the scattergraph to see if they are linear, such that a straight line can be drawn that approximates the relation between cost and activity.

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* + - 1. If the dots are not linear, do not analyze the data any further. Instead, search for another independent variable that bears a stronger linear relationship with the dependent variable.
			2. In this example, the dots are linear so we can proceed to the high-low method.
	1. The **high-low method**
		1. This method can be used to analyze mixed costs if a scattergraph plot reveals a linear relationship between the *X* and *Y* variables. Let’s continue with our data from the scattergraph plot.

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* + 1. The first step is to choose the data points pertaining to the highest and lowest activity levels (high = 850 units; low = 450 units).
			1. Notice, this method relies on two data points to estimate the fixed and variable portions of a mixed cost.
		2. The second step is to determine the total costs associated with the two chosen points (high = $9,800; low = $7,400).

*Helpful Hint: Emphasize that the high and low points are identified by the level of activity and not by the level of the cost.*

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* + 1. The third step is to calculate the change in cost between the two data points ($2,400) and divide it by the change in activity level between the two data points (400 units).
			1. The quotient represents an estimate of variable cost per unit of activity ($6.00 per unit).
		2. The fourth step is to take the total cost at either activity level (in this case, $9,800) and deduct the variable cost component ($5,100). The residual represents the estimate of total fixed costs ($4,700).

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* + - 1. The variable cost component ($5,100) is determined by multiplying the level of activity (850 units) by the estimated variable cost per unit of the activity ($6.00 per unit).
		1. The fifth step is to construct an equation that can be used to estimate the total cost at any activity level (*Y* = $4,700 + $6.00*X*).

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*Quick Check − the high-low method*

37-40

* 1. The **least-squares regression method**
		1. This method can be used to analyze mixed costs if a scattergraph plot reveals an approximately linear relationship between the *X* and *Y* variables.
		2. This method uses **all of the data points** to estimate the fixed and variable cost components of a mixed cost. This method is superior to the high-low method that uses only two data points to estimate the fixed and variable cost components of a mixed cost.

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* + 1. The basic goal of this method is to fit a straight line to the data that **minimizes the sum of the squared errors**. The regression errors are the vertical deviations from the data points to the regression line.
		2. The formulas that are used for least-squares regression are complex. Fortunately, computers can perform the calculations quickly. The observed values of the *X* and *Y* variables are entered into the computer and the software does the rest.

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* + - 1. The output from the regression analysis can be used to create an equation that enables you to estimate total costs at any activity level.
		1. The high-low and least-squares regression methods provide **different estimates** of the fixed and variable cost components of a mixed cost. This is to be expected because each method uses differing amounts of the data points to provide estimates. Least-squares regression provides the most accurate estimates because it uses all of the data points.

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1. The **contribution approach income statement**

*Learning Objective 5 Prepare income statements for a merchandising company using the traditional and contribution formats.*

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* 1. The traditional and contribution formats differ as follows:
		1. The traditional approach separates product costs as required for external reporting purposes from selling and administrative expenses. It does not focus on cost behavior.

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* + 1. The contribution approach separates costs into fixed and variable categories. Sales − variable costs = contribution margin. The contribution margin − fixed costs = net operating income.
		2. The contribution approach is used as an internal planning and decision-making tool. For example, this approach is useful for:
			1. Cost-volume-profit analysis (Chapter 5).

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* + - 1. Budgeting (Chapter 8).
			2. Segmented reporting of profit data (Chapter 6).
			3. Special decisions such as pricing and make or buy analysis (Chapter 12).

*Helpful Hint: The income statement from the annual report of a well-known local manufacturing firm can be used to illustrate the functional income statement. Ask if the various expense categories on the income statement contain both fixed and variable costs. Also ask how to estimate the increase in profit that would result from a 4% increase in sales using the functional statement. There is no way to do this with reasonable accuracy, since there is no way to tell on a functional income statement what costs would increase*.

1. **Cost classifications for assigning** **costs to cost objects**

*Learning Objective 6: Understand the differences between direct and indirect costs.*

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#### Cost object − Anything for which cost data are desired including products, customers, jobs, organizational subunits, etc. For purposes of assigning costs to cost objects costs are classified two ways:

* + 1. **Direct costs** − Costs that can be easily and conveniently traced to a specified cost object.

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* + 1. **Indirect costs** − Costs that cannot be easily and conveniently traced to a specified cost object.
			1. **Common costs** − Indirect costs incurred to support a number of cost objects. These costs cannot be traced to any individual cost object.
1. **Cost classifications for decision making**

*Learning Objective 7: Understand cost classifications used in making decisions: differential costs, opportunity costs, and sunk costs.*

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#### It is important to realize that every decision involves a choice between at least two alternatives. The goal of making decisions is to identify those costs that are either relevant or irrelevant to the decision. To make decisions, it is essential to have a grasp on three concepts:

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* + 1. **Differential costs** (or **incremental costs**) − A difference in cost between any two alternatives (a difference in revenue between two alternatives is called **differential revenue**).

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* + - 1. Differential costs can be either fixed or variable.
		1. **Opportunity cost** − The potential benefit that is given up when one alternative is selected over another.

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* + - 1. These costs are not usually entered into the accounting records of an organization, but must be explicitly considered in all decisions.

*Helpful Hint: Ask students what opportunity costs they incur by attending class. Their opportunity cost is the value to them of the activity they would be doing otherwise (e.g., working, sleeping, partying, studying, etc.)*

* + 1. **Sunk cost** − A cost that has already been incurred and that cannot be changed now or in the future.

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Helpful Hint: Ask students: “Suppose you had purchased gold for $400 an ounce, but now it is selling for $250 an ounce. Should you wait for the gold to reach $400 an ounce before selling it?” Many students will say “yes” even though the $400 purchase is a sunk cost.

Quick Check − relevant costs

54-59

1. **Summary** **of the types of cost classifications**

#### We have looked at the cost classifications used for financial reporting, predicting cost behavior, assigning costs to cost objects, and making business decisions.

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1. **Appendix 2A: Least-Squares Regression Computations** (Slide #61 is a title slide)

*Learning Objective 8: Analyze a mixed cost using a scattergraph plot and the least-squares regression method.*

 62

* 1. The data set

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* + 1. Assume that you have the following data set and that you wish to use Microsoft Excel to estimate the variable and fixed cost components of your total meals cost.

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* + 1. You will need to calculate three key pieces of information: the estimated variable cost per unit (called the slope of the line), the estimated fixed cost (called the intercept), and the R2.

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* + - 1. To get these three pieces of information you will need three Excel functions, namely SLOPE, INTERCEPT, and RSQ.
		1. The first step within Excel is to place your cursor in cell F4 and press the = key. Click on the pull-down menu and scroll down to “More Functions.”

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* + 1. When the function box opens, click on the “Statistical” category and then on “SLOPE.”

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* + 1. Enter the cell range for the cost amounts in the “Known\_y’s” box. Enter the cell range for the quantity amounts in the “Known\_x’s” box.

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* + - 1. The slope, or estimated variable cost per unit, is identified on the screen as shown. Click “OK” to put this value on your spreadsheet.

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* + 1. Return to the function box and click on “Statistical” and then on “INTERCEPT.”

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* + - 1. Enter the cell range for the cost amounts in the “Known\_y’s” box. Enter the cell range for the quantity amounts in the “Known\_x’s” box.

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* + - 1. The estimated fixed cost is identified on the screen as shown.

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* + 1. Return to the function box and click on “Statistical” and then on “RSQ.”

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* + - 1. Enter the cell range for the cost amounts in the “Known\_y’s” box. Enter the cell range for the quantity amounts in the “Known\_x’s” box.

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* + - 1. The estimated R2 for your estimated cost function is identified on the screen as shown.
1. **Appendix** **2B: cost of quality (Slide #73 is the title slide)**

*Learning Objective 9: Identify the four types of quality costs and explain how they interact.*

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#### Quality costs − Costs incurred to prevent defects or that result from defects in products. Many companies are working hard to reduce their quality costs. Those companies that are succeeding have a high quality of conformance in the sense that the overwhelming majority of the products that they produce conform to design specifications and are free from defects.

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#### There are four broad categories of quality costs:

* + 1. **Prevention costs** − Are incurred to support activities whose purpose is to reduce the number of defects.

*Helpful Hint: Suppose an ice cream company has been having problems with unpleasant gritty ice crystals in its ice cream. Ask students how they would prevent the ice crystal defect. One approach would be to investigate the manufacturing process. Perhaps the gritty ice crystals are caused by temperature variations in the freezer. Controlled experiments could be run varying the temperature and inspecting for ice crystals. If this is the cause, the variation in temperature could be decreased or the ingredients changed so they would be less sensitive to temperature changes.*

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* + 1. **Appraisal costs** − Are incurred to identify defective products before the products are shipped to customers.

*Helpful Hint: Continuing the ice cream example, ask students how they would “inspect out” the ice crystal problem. This may be more difficult and expensive than it first appears. For example, the problem could occur only in half-gallon containers or at random in a small (but important) number of containers. Or, the ice crystals could only be detected by tasting ice cream near the bottom of the container. “Inspecting out” the problem would make a lot of ice cream unsaleable.*

* + 1. **Internal failure costs** − Are incurred as a result of identifying defects before they are shipped to customers.

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* + 1. **External failure costs** − Are incurred as a result of defective products being delivered to customers.

*Helpful Hint: Continuing with the ice cream example, ask students to identify examples of internal and external failure costs. Internal failure costs could result from throwing away defective ice cream. External failure costs could result from customers returning defective ice cream or failing to purchase the ice cream company’s product at a later date.*

* + 1. Examples of each type of quality cost include:
			1. **Prevention** − Quality training, quality circles, statistical process control activities, etc.
			2. **Appraisal** − Testing and inspection of incoming materials, final product testing, depreciation of testing equipment, etc.

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* + - 1. **Internal failure** − Scrap, spoilage, rework, etc.
			2. **External failure** − Cost of field servicing and handling customer complaints, warranty repairs, lost sales arising from reputation of poor quality, etc.
		1. **Distribution of quality costs** − Graphs are often used to depict the relationship between the four types of quality costs. The graph illustrates **four key concepts**.
			1. When the quality of conformance is low, total quality cost is high and most of this cost consists of internal and external failure costs.
			2. Total quality costs drop rapidly as the quality of conformance increases.
			3. Companies reduce their total quality costs by focusing their efforts on **prevention** and **appraisal** because the cost savings from reduced defects usually overwhelm the costs of additional prevention and appraisal.

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*Helpful Hint: Continuing with the ice cream example, the prevention activities mentioned earlier may reveal that, if fluctuating temperatures is the problem, a simple thermostat may solve the problem. The cost to identify the problem and install a thermostat is much less that the costs of scrapped ice cream, customer returns and complaints, and lost future business.*

* + - 1. Total quality costs are minimized when the quality of conformance is less than 100%. This is a debatable point in the sense that some experts believe that total quality costs are not minimized until the quality of conformance is 100%.

*Learning Objective 10: Prepare and interpret a quality cost report.*

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#### Quality cost report − This report details the prevention, appraisal, internal failure, and external failure costs that arise from a company’s current quality control efforts.

* + 1. When interpreting a cost of quality report managers should look for **two trends**. First, increases in prevention and appraisal costs should be more than offset by decreases in internal and external failure costs. Second, the total quality costs as a percent of sales should decrease.

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* + 1. Quality cost reports can also be prepared in graphic form. Managers should still look for the same two trends whether the data are presented in a graphic or table format.

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* + 1. **Uses of quality cost** **information:**
			1. It helps managers see the financial significance of defects.
			2. It helps managers identify the relative importance of the quality problems faced by the company.

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* + - 1. It helps managers see whether their quality costs are poorly distributed. In general, costs should be distributed more toward prevention and to a lesser extent appraisal than toward failures.
		1. **Limitations of quality cost** **information**

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* + - 1. Simply measuring and reporting quality cost problems does not solve quality problems.
			2. Results usually lag behind quality improvement programs. Initially, prevention and appraisal cost increases may not be offset by decreases in failure costs.

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* + - 1. The most important quality cost, lost sales arising from customer ill-will, is often omitted from quality cost reports because it is difficult to estimate.
1. **International** **aspects of quality**

#### The International Organization for Standardization, based in Geneva Switzerland, has established quality control guidelines, known as the ISO 9000 standards. For a company to become ISO 9000 certified by a certifying agency, it must demonstrate that:

* + 1. A quality control system is in use, and the system clearly defines an expected level of quality.

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* + 1. The system is fully operational and is backed up with detailed documentation of quality control procedures.
		2. The intended level of quality is being achieved on a sustained basis.

#### Although the ISO 9000 standards were developed in Europe they have become widely accepted elsewhere throughout the world, including the United States.