

# Implementing Quality Concepts



## LEARNING OBJECTIVES

*After completing this chapter, you should be able to answer the following questions:*

- 1 Why is the emphasis on quality in business unlikely to decline?
- 2 What is quality and from whose viewpoint should it be evaluated?
- 3 What primary characteristics comprise product quality and service quality?
- 4 Why do companies engage in benchmarking?
- 5 Why is total quality management significant and what conditions are necessary to yield its benefits?
- 6 What types of quality costs exist and how are those costs related?
- 7 How is cost of quality measured?
- 8 Why does a company need both a strategically based management accounting system and a financial accounting system?
- 9 How can quality be instilled as part of an organization's culture?

**S**olectron Corporation is the first company in the history of the Malcolm Baldrige National Quality Award program to have won that award twice (in 1991 and 1997). Solectron, which was founded in 1977 as a solar energy company, has received 200 quality and service awards from its customers. The company now provides customized electronics products, services, and solutions for original equipment manufacturers such as International Business Machines, Hewlett-Packard Co., Motorola, Inc., Polaroid Corporation, and Cisco Systems, Inc.

Solectron has more than 31,000 associates in 21 worldwide manufacturing facilities that encompass more than 6 million square feet. During the past seven years, the company has averaged a 53 percent compound annual growth rate. Revenues for the fiscal year 1998 were \$5.3 billion. When Solectron opened a New Product Introduction center just outside of Tokyo, it became the first United States-based electronics manufacturing services company to establish a manufacturing presence in Japan.

How does a company reach such quality heights? Rich Allen, director of quality at Solectron, believes the company's quality culture began with founder and former CEO, Winston Chen. Chen left IBM to start an American

company that could and would manufacture high-quality products in the United States, and that focused on giving customers exactly what they wanted. Chen noted that the quality principles being applied in Japan at the time were not being utilized in the United States. On the other hand, the innovations being used in the United States were not being applied in foreign countries as well as they could be. So Chen combined the innovative approaches currently applied quite well in the United States with some of the Japanese quality practices such as poka-yoke techniques, kaizen techniques, seven-step continuous improvement processes, and SPC tools, and saw how they fit and applied to the company. Then Solectron started doing grassroots training while implementing those quality programs in almost every manufacturing area.

Rich Allen commented that "the most important thing was not to let the tools disappear or filter out. With most quality programs, people don't understand that if you really don't reinforce and continually modify it to make it work for you, it just goes away. Then, what you have is a quality program-of-the-month. We've never had that. What we said was, 'This is what we're going to do, and we're going to make it work.'"

SOURCES: Holly Ann Suzik, "Solectron Tells Its Tale," *Business and Management Practices*, Responsive Database Services, Inc. (Vol. 38, April 1999), pp. 53ff; Scott Thurm, "Some Manufacturers Prosper by Facilitating Rise of 'Virtual' Firm," *The Wall Street Journal* (August 18, 1998), pp. A1, A6; PR Newswire, "Solectron Becomes First U.S.-Based EMS Company to Open Design and Manufacturing Center in Japan," *PR Newswire Association Inc.* (April 1, 1999), Financial News section; Todd Wallack, "Solectron to Expand," *The Boston Herald* (April 2, 1999), Finance section, p. 31.

Managers at Solectron Corporation and numerous other entities recognize that high quality is a fundamental organizational strategy for competing in a global economy. Businesses, both domestic and foreign, are scrambling to attract customers and to offer more choices to satisfy customer wants and needs than in the past. Competition usually brings out the best in companies and international competition has evoked even greater quality in company products and services.

Consumers are more aware of the greater variety of product choices. However, because they usually have limited funds and must make trade-offs among price, quality, service, and promptness of delivery, customers have a limited set of options. Even so, consumers are taking advantage of the enhanced extent of their options for quality, price, service, and lead time as afforded by the Internet and advanced technology.

Ready access, now being geometrically accelerated by the Internet, to multinational vendors has motivated producers to improve product quality and customer service. Consumers are delighted with their access to higher quality products and services and are thereby encouraged to enhance this access. Vendors are encouraged by the success of firms that delight customers and have adopted more dynamic

1

Why is the emphasis on quality in business unlikely to decline?

<http://www.ibm.com>

<http://www.hewlett-packard.com>

<http://www.mot.com>

<http://www.polaroid.com>

<http://www.cisco.com>

approaches to continuously improving the product, process, and service quality for their customers.

This chapter discusses issues such as benchmarking, total quality management, quality costs, quality cost measurement, and a cost management system as a support for quality initiatives. Because quality affects costs, accountants understand the long-run trade-offs involved between higher and lower product/service quality.

Many managers have realized that current expenditures on quality improvements may be more than regained through future cost reductions and sales volume increases. These improvements will benefit the firm now and in the future; thus, their costs should not be viewed as expenses or losses, but rather as recoverable investments with the potential for profit generation.

## WHAT IS QUALITY?

2

What is quality and from whose viewpoint should it be evaluated?

To improve its product or service quality, an organization must agree on a definition of the term. Originally, after the Industrial Revolution helped manufacturers to increase output and decrease cost, quality was defined as conformity to designated specifications. Conformity determination was left to quality control inspectors. The late Dr. W. Edwards Deming, famous expert on quality control, defined quality as “the pride of workmanship.”<sup>1</sup> On a less individualized basis, Philip Crosby (another noted quality expert) defines quality as “conformance to requirements.”<sup>2</sup> This definition was adopted by the American Society for Quality Control, which also defines requirements as follows: “Requirements may be documented as specifications, product descriptions, procedures, policies, job descriptions, instructions, purchase/service orders, etc., or they may be verbal. Requirements must be measurable or they are not valid.”<sup>3</sup> The following remarks stress conformity to requirements, but explain that conformity must be judged by customers.

*Quality is not what the planning and producing individuals may think or wish it to be. It is exactly what exists in the mind of the customer when he or she receives and personally appraises the product or service. This includes the internal customer, recipient of internal support service or work in process, as well as the external customer. In short, the meaning of quality is directly related to customer satisfaction; it is still best defined as “conformance to customer requirements.” Any other definition for quality leaves too much room for interpretation and bias, making it impossible to work with.<sup>4</sup>*

### quality

Thus, a fairly all-inclusive definition of **quality** is the summation of all the characteristics of a product or service that influence its ability to meet the stated or implied needs of the person acquiring it. Quality must be viewed from the perspective of the user rather than the provider and relates to both performance and value. This quality perspective arose because of increased competition, public interest in product safety, and litigation relative to products and product safety. The responsibility for quality is not simply a production issue; it has become a company profitability and longevity issue. The following News Note dramatizes the importance of competition. All entity processes (production, procurement, distribution, finance, and promotion) are involved in quality improvement efforts. Therefore, the two related perspectives of quality reflect the (1) totality of internal processes that generate a product or service and (2) customer satisfaction with that product or service.

<http://www.packardbell.com>

<http://www.nec-global.com>

<sup>1</sup> Rafael Aguayo, *Dr. Deming* (New York: Simon & Schuster, 1990), p. xi.

<sup>2</sup> Philip B. Crosby, *Quality Is Free* (New York: New American Library, 1979), p. 15.

<sup>3</sup> American Society for Quality Control, *Finance, Accounting and Quality* (Milwaukee, WI: ASQC, 1990), p. 3.

<sup>4</sup> Jack Hagan, *Management of Quality* (Milwaukee, WI: ASQC, 1994), p. 18. © 1994 American Society for Quality Control. Reprinted with permission.



### **Packard Bell to End Operations in the United States**

Packard Bell NEC Inc., once a leader in the home PC market, has become its latest casualty as consumers snap up cheaper offerings from competitors and turn their backs on a company with perceived quality problems.

The Packard Bell name and 1,600 jobs ceased to exist in the United States at the end of 1999, after the Sacramento-based company failed to meet performance goals set by its Tokyo-based parent, NEC Corp., spokesman Ron Fuchs said.

The pullout closed an era of rapid U.S. decline for Packard Bell NEC, once the largest domestic maker of personal computers, but only No. 6 by summer 1999, according to researcher Dataquest. The company lost \$650

million in 1998 and was on track to lose \$150 million, despite increased demand for its products.

“From our point of view . . . we made a lot of progress this year, but when all is said and done, we missed our commitment to shareholders by \$50 million,” Fuchs said. “We’ve got some great products, but it’s more niche products than it is volume products, and we don’t think we’re in the environment to survive in the low end of the PC side of the business when computers are going for \$499, \$399.”

SOURCE: The Associated Press, “Packard Bell to End Operations in U.S.,” *The Wall Street Journal* (November 4, 1999), pp. C-1, C-3. Permission conveyed through the Copyright Clearance Center.

## **Production View of Quality**

Productivity is measured by the quantity of good output generated from a specific amount of input during a time period. Any factor that either slows down (or stops) a production process or causes unnecessary work (redundancy) hinders productivity. Activity analysis can be used to highlight such factors. As explained in Chapter 4, the various repetitive actions performed in making a product or providing a service can be classified in value-added (VA) and non-value-added (NVA) categories. Value-added activities increase the worth of the product or service to the customer; non-value-added activities consume time and costs but add no value for the consumer. Minimizing or eliminating non-value-added activities increases productivity and reduces costs.

Three important NVA process activities include storing products for which there is little immediate demand, moving materials unnecessarily, and having unscheduled production interruptions. Another non-value-added activity is caused by supplier quality problems: having to inspect incoming components. To minimize or eliminate this NVA activity, some companies require their suppliers to provide only zero-defect components. To ensure compliance with this requirement, companies may do quality audits of their vendors.

Factors causing production redundancy include the need to reprocess, rework, replace, and repair those items that did not conform to specifications. The quality of the product design, materials used, and production process largely determine the product’s failure rate, longevity, and breakage tendencies. Further, the amount of waste, rework, and scrap generated by production efforts is related to production process quality.

Production technology, worker skill and training, and management programs can help significantly to control the production process quality. If the impediments to good production are reduced or eliminated, increases in productivity and higher quality products can be expected. Some techniques that increase productivity and enhance quality include having suppliers preinspect materials for quality, having employees monitor and be responsible for their own output, and fitting machinery for mistake-proof operations.

All attempts to reduce variability and defects in products reflect the implementation of **quality control (QC)**. QC places the primary responsibility for the quality

**quality control (QC)**

## statistical process control (SPC)

### control chart

of a product or service at the source—the maker or provider. Many companies use **statistical process control (SPC)** techniques to analyze where fluctuations occur in the process. SPC is based on the theory that a process has natural (common cause) variations over time, but that “errors,” which can result in defective goods or poor service, are typically produced at points of uncommon (nonrandom or special cause) variations. Often these variations are eliminated after the installation of computer-integrated manufacturing systems, which have internal controls to evaluate deviations and sense production problems.

To analyze the process variations, various types of **control charts** have been developed by recording the occurrences of some specified measure(s) of performance at preselected points in a process. Charts, such as the one shown in Exhibit 8–1, graph actual process results and indicate upper and lower control limits. For example, a process is considered to be “in” or “out of” control (i.e., stable or unstable) depending on whether the results remain within established limits and do not form telltale patterns that reflect some nonrandom or special-cause variation. In effect, SPC charts make use of the principle of “management by exception” by requiring that workers respond to occurrences greater than some predetermined limit or that form nonrandom, telltale patterns.

The charts must be prepared consistently and accurately for an intelligent analysis to be made about out-of-control conditions. Although development and use of such charts is outside the scope of this text, the management accountant is directly involved in selecting appropriate performance measures and helping to interpret the charts. Often the measures selected to prepare control charts are nonfinancial, such as number of defective parts, amount of waste created, and time taken to complete a task. Selection of performance measures to investigate quality is further discussed in Chapters 19 and 20. In effect, using SPC causes a process to “talk” to workers about what is occurring in the process. If workers “listen,” they can sometimes prevent potential product defects and process malfunctions from ever happening.

3

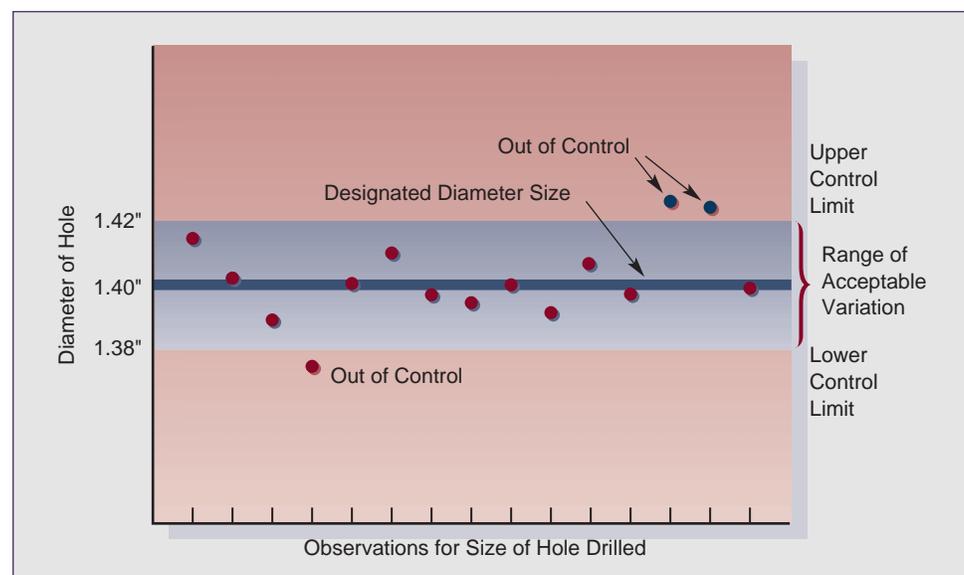
What primary characteristics comprise product quality and service quality?

## Consumer View of Quality

Every customer who acquires a product or service receives a set of characteristics encompassing a range of features, such as convenience, promptness in delivery, warranty, credit availability, and packaging. The consumer’s view of quality reflects more than whether the product or service delivers as it was intended, its rate of failure, or the probability of purchasing a defective unit. The customer perceives quality as

### EXHIBIT 8-1

Control Chart



a product's or service's ability to meet and satisfy all specified needs. When high-quality producers dominate a market, entering companies must understand both their own customers' quality expectations and their competitors' quality standards.

Exhibit 8–2 provides eight characteristics that would commonly be included in any customer's definition of product quality. An important difference exists between the first six and the last two characteristics: level of objectivity. The first six characteristics can be reasonably evaluated through objective methods, whereas the last two are strictly subjective. Thus, the first six are much more susceptible to control by an organization than the other two.

Note that the “product” of some companies such as hotels, hospitals, and accounting firms is itself a service. With some imagination, one can identify most if not all, of these eight product quality characteristics in the “service” provided by the company. For example, a hotel providing rooms with computer and fax hookups or a continental breakfast could be considered “features” by the Marriott chain. Additionally, Marriott could consider the ability to provide quiet rooms for guests as high “performance.”

Service quality reflects the manner in which a company's product or service is delivered to the customer and also has some common characteristics (Exhibit 8–3). Some firms use outside assessors to evaluate the level of service provided, as indicated in the News Note on page 308.

Not all customers can afford the same grade of product or service. **Grade** refers to one of the many levels that a product or service may have as related to the inclusion or exclusion of characteristics to satisfy needs, especially price. Customers try to maximize their satisfaction within the context of their willingness and ability to pay. They view a product or service as a **value** when it meets the highest number of their needs at the lowest possible cost (cost includes purchase price plus the costs of operating, maintaining, and disposing of an item). Thus, although customers may have a collective vision of what constitutes “high quality,” some of

<http://www.marriott.com>

**grade**

**value**

1. Performance—relates to a product's primary operating characteristics
2. Features—describes the secondary characteristics that supplement a product's basic function
3. Reliability—addresses the probability of a product's likelihood of performing properly within a specified period of time
4. Conformance—relates to the degree to which preestablished standards are matched by the product's performance and features
5. Durability—measures a product's economic and technical life
6. Serviceability—measures the ease with which the product is repaired
7. Aesthetics—relates to a product's appeal to the senses
8. Perceived quality—relates to image, brand names, and other indirect measures of quality

SOURCE: Reprinted from “What Does ‘Product Quality’ Really Mean?” by David Garvin, *Sloan Management Review* (Fall 1984), pp. 25–43 by permission of publisher. Copyright 1984 by the Sloan Management Review Association. All rights reserved.

### EXHIBIT 8–2

*Characteristics of Product Quality*

1. Reliability—the ability to provide what was promised, dependably and accurately
2. Assurance—the knowledge and courtesy of employees, and their ability to convey trust and confidence
3. Tangibles—the physical facilities and equipment, and the appearance of personnel
4. Empathy—the degree of caring and individual attention provided to customers
5. Responsiveness—the willingness to help customers and provide prompt service

SOURCE: A. Parasuraman, Leonard L. Berry, and Valarie Zeithaml, “Perceived Service Quality as a Customer-Based Performance Measure: An Empirical Examination of Organizational Barriers Using an Extended Service Quality Model,” *Human Resource Management* 30(3) (Fall 1991), pp. 335–364. Reprinted by permission of John Wiley & Sons, Inc.

### EXHIBIT 8–3

*Characteristics of Service Quality*



### ***Undercover with a Hotel Spy—He Checks to See If Bellhops Are Hopping***

J. C. Schaefer unscrews a light bulb from a bedside lamp in the posh Windsor Court Hotel and begins violently whacking it against the bedspread. He shakes the light bulb to make sure the filament inside is broken and then carefully screws it back into the lamp.

Mr. Schaefer isn't your average hotel guest. In fact, he isn't even J. C. Schaefer. His real name is David Richey, and he's a hotel spy who uses a variety of aliases to check out luxury hotels all over the world.

Over two days, he'll employ an extensive bag of tricks to see if the Windsor Court—rated last year as the top hotel in the world in a Conde Nast Traveler magazine poll—is as good as its reputation. The “burnt-out light bulb” test is one of the toughest. Only 11% of hotels tested by Mr. Richey's Chevy Chase, Maryland, firm,

Richey International, detect the burnt-out bulb on the housekeeping staff's first pass.

Some 2,000 hotels around the world pay Mr. Richey to check them out. The Windsor Court is a member of Preferred Hotels & Resorts Worldwide, a group of 120 independent luxury hotels that share a common reservations system. Preferred requires that all its hotels meet at least 80% of its standards in a test conducted annually by Richey International. In 1998, Preferred expelled three hotels that twice failed the test and then didn't take the necessary steps to improve their scores, says Robert Cornell, a Preferred Hotels senior vice president.

SOURCE: Adapted from Neal Templin, “Undercover with a Hotel Spy—He Checks to See If Bellhops Are Hopping,” *The Wall Street Journal* (May 12, 1999), p. B1.

<http://www.preferredhotels.com>

them may choose to accept a lower grade of product or service because it satisfies their functional needs at a lower cost. Note that high quality is a more encompassing concept than “high grade.” Someone with 20 minutes left for lunch may find more “value” in a fast-food hamburger than going to a sit-down restaurant for sirloin steak.

To illustrate the difference between quality and grade, assume Sally Smith is in the market for a new car. She needs the car to travel to and from work, run errands, and go on vacation and has determined that reliability, gas mileage, safety, and comfort are features that are most important to her. She may believe the Lexus to be the highest quality of car available, but her additional needs are that the car be within her price range and that repair parts and maintenance be readily available and within her budget. Thus, she will search for the highest quality product that maximizes her set of quality-characteristic preferences within the grade she can afford.

*Disney has long been viewed as “best-in-class” in equipment maintenance. Other organizations, regardless of the industry they are in, can use process benchmarking to compare their maintenance activities against this world-class leader.*



Customers often make quality determinations by comparing a product or service to an ideal level of a characteristic rather than to another product or service of the same type or in the same industry. For example, Sam Hill frequently stays at Marriott hotels on business trips. On a recent trip, he called a car rental agency to arrange for a car. Sam may compare the quality of service he received from the car rental agency with the high-quality service he typically receives from Marriott rather than how well another car rental company served him in the past. Sam is unconcerned that car rental agency employees may not have had the same customer satisfaction training as Marriott employees or that the Marriott corporate culture is dedicated to high quality, while the car rental agency may not have yet made such a commitment. This type of comparison, when formalized in organizations, is called competitive benchmarking.

**Benchmarking** means investigating, comparing, and evaluating a company's products, processes, and/or services against either those of competitors or companies believed to be the "best in class." Such comparisons allow a company to understand another's production and performance methods, so that the interested company can identify its strengths and weaknesses. Because each company has its own unique philosophy, products, and people, "copying" is neither appropriate nor feasible. Therefore, a company should attempt to imitate those ideas that are readily transferable but, more importantly, to upgrade its own effectiveness and efficiency by improving on methods used by others. There are codes of conduct that have been established for benchmarking activities. These codes address issues such as equal exchange of information, restricted use of learned data, avoidance of antitrust issues and illegalities, and interorganizational courtesy.<sup>5</sup>

There are two types of benchmarking: results and process. In **results benchmarking**, the end product or service is examined using a process called "reverse engineering" and the focus is on product/service specifications and performance results. Results benchmarking helps companies determine which other companies are "best in class." For example, Chrysler has tear-down facilities located at its product development centers. Information gathered in these facilities helps the company focus on its competitors and promote better interaction among engineering, design, and manufacturing. By studying design differences between its own and its competitors' products, the firm seeks vital information to support quality improvements.<sup>6</sup> However, if benchmarking involves making an exact replica of another's product, ethical and legal considerations are at issue.

Although benchmarking against direct competitors is necessary, it creates the risk of becoming stagnant. To illustrate, General Motors, Chrysler, and Ford historically competitively benchmarked among themselves and, over time, their processes became similar. But then import competition arrived, which had totally different—and better—processes. It was like three club tennis players who all had similar levels of skill and who knew each other's games inside and out—and then Pete Sampras walked on the court.<sup>7</sup>

For this reason, additional comparisons should be made against companies that are the best in a specific characteristic rather than necessarily the best in a specific industry. Focusing on how the best-in-class companies achieve their results is called **process benchmarking**. It is in this arena that noncompetitor benchmarking is extremely valuable. Some examples of U.S. companies that are recognized as world-class leaders in certain disciplines are Allen-Bradley (flexible manufacturing),

## BENCHMARKING

4

Why do companies engage in benchmarking?

### benchmarking

### results benchmarking

<http://www.gm.com>  
<http://www.chryslercorp.com>  
<http://www.fordvehicles.com>

### process benchmarking

<http://www.ab.com>

<sup>5</sup> Barbara Ettore, "Ethics, Anti-Trust and Benchmarking," *Management Review* (June 1993), p. 13.

<sup>6</sup> Paul A. Stergar and James H. Cypher, "Teardown Keeps Chrysler Focused on the Competition," *Cost Management Insider's Report* (June 1995), pp. 12–13.

<sup>7</sup> Beth Enslow, "The Benchmarking Bonanza," *Across the Board* (April 1992), p. 20.

<http://www.americanexpress.com>

<http://www.disney.go.com>

<http://www.fedex.com/us/>

<http://www.llbean.com>

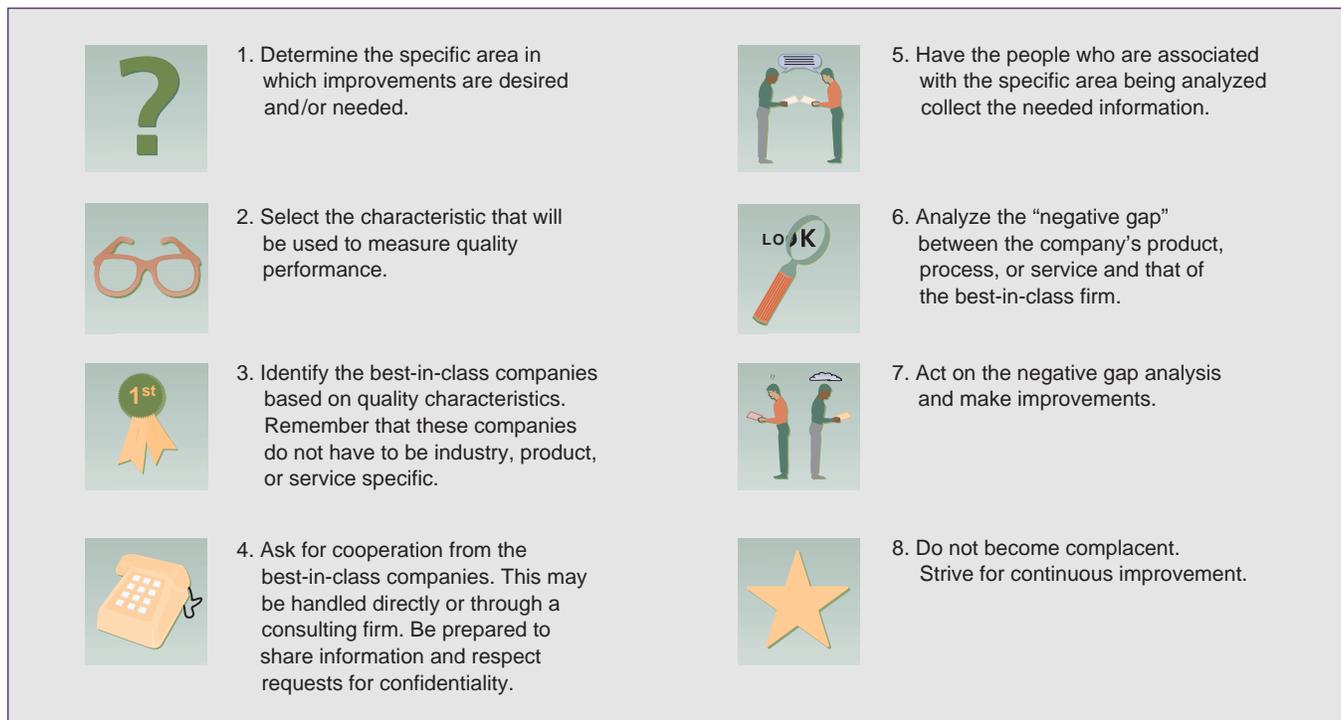
American Express (billing and collection), Disney (equipment maintenance), Federal Express (worker training), and L. L. Bean (distribution and logistics).<sup>8</sup>

It is against companies such as these as well as their international counterparts that others should benchmark. The process of implementing benchmarking is detailed in Exhibit 8–4. Some companies have more steps and others have fewer, but all have a structured approach. Once the negative gap analysis is made, everyone in the firm is expected to work both toward closing that gap and toward becoming a best-in-class organization.

Through benchmarking, companies are working to improve their abilities to deliver high-quality products from the perspectives of both how the products are made and how the customer perceives them. Integrating these two perspectives requires involvement of all organizational members in the implementation of a total quality management system.

## EXHIBIT 8-4

### Steps in Benchmarking



## TOTAL QUALITY MANAGEMENT

5

Why is total quality management significant and what conditions are necessary to yield its benefits?

### total quality management (TQM)

**Total quality management (TQM)** is a “management approach of an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society.”<sup>9</sup> Thus, TQM has three important tenets:

1. It necessitates an internal managerial system of planning, controlling, and decision making for continuous improvement.
2. It requires participation by everyone in the organization.
3. It focuses on improving goods and services from the customer’s point of view.

<sup>8</sup> “America’s World-Class Champs,” *Business Week* (November 30, 1992), pp. 74–75.

<sup>9</sup> ISO 8402, *Total Quality Management* (Geneva: ISO, 1994), definition 3.7.

## The Quality System

The total quality movement requires the implementation of a system that provides information about the quality of processes so managers can plan, control, evaluate performance, and make decisions for continuous improvement. Consideration of quality has not historically been part of the planning process. More often it involved an after-the-fact measurement of errors because a certain level of defects was simply tolerated as part of the “natural” business process. Action was not triggered until a predetermined error threshold was exceeded.

In contrast, a total quality system should be designed to promote a reorientation of thinking from an emphasis on inspection to an emphasis on prevention, continuous improvement, and building quality into every process and product. This reorientation should indicate any existing quality problems so that managers can set goals and identify methods for quality improvements. The system should also be capable (possibly through the use of statistical methods) of measuring quality and providing feedback on quality improvements. Last, the system should encourage teamwork in the quality improvement process. In other words, the system should move an organization away from product inspection (finding and correcting problems at the end of the process) to proactive quality assurance (building quality into the process so that problems do not occur).

## Employee Involvement

TQM recognizes that all organizational levels share the responsibility for product/service quality. These new interactions among employee levels are changing the way managers do their jobs. Upper-level management must be involved in the quality process, develop an atmosphere that is conducive to quality improvements, set an example of commitment to TQM, provide constructive feedback about opportunities for improvement, and provide positive feedback when improvements are made. Workers should believe they are part of the process of success, not the creators of problems. Encouraging employee suggestions and training workers to handle multiple job functions help improve efficiency and quality. At Solectron, for example, multi-functional work teams are commonly used to facilitate effective problem solving. The following News Note on page 312 discusses some U.K. companies' use of employee suggestion plans as an integral part of this continuous improvement process.

## Product/Service Improvement

Total quality management focuses attention on the relationship between the internal production/service process and the external customer. This approach has designated consumer expectations as the ultimate arbiter of satisfaction. Therefore, TQM requires that companies first know who their customers are.

In analyzing their customers, companies may want to stop serving some groups of customers based on cost-benefit analyses. Some customers simply cost more than they add in revenues and/or other benefits to the organization. Each revenue dollar does not contribute equally to organizational profitability because the cost to serve different customers may be unequal.

The concept that shedding one or more sets of customers would be good for business is difficult to believe at first, but most organizations have some clients who drain, rather than improve, those organizations' ability to provide quality products and service. Managers should be attuned to customers whose costs exceed their benefits and send them elsewhere. By doing this, the company can focus its attention on its worthy customers and make itself attractive to new worthwhile customers.

After identifying who its value-adding customers are, a company must then understand what those customers want. The primary characteristics currently desired

## NEWS NOTE



## INTERNATIONAL

**Suggestions are Power**

Have your employees come up with any good suggestions lately? At Triple 'A' Animal Hotel & Care Centre near Washington, Tyne and Wear, 28 members of staff dream up more than 1,200 ideas a year. Not all of these are implemented but that's not the point, says finance manager Michael Brown. "We believe all ideas are good ideas. It doesn't matter whether or not we can act on them all."

But for every Triple 'A,' there are many more companies where the staff suggestion box simply gathers dust. Moribund suggestion schemes, says Alex Bryson, a researcher in employee involvement at the Policy Studies Institute, result from poor planning and inadequate employer commitment. "Staff need to feel that their ideas will be viewed constructively and taken seriously. When introduced in isolation or into a company with no culture of employee involvement, suggestion schemes have no impact," he claims. Angela Baron, policy advisor at the Institute of Personnel and Development agrees. "If employees don't believe their organisation is really committed to a suggestion scheme, then it just won't work."

What works, argues Dave Jackson, managing director of organisational change consultants Novius, are

schemes that are integral to the organization's approach to continuous improvement. "Schemes need a very high level of commitment from the top but often work best when they are run by the employees themselves," he insists. The "Sir Gestion" scheme run by employees at credit card services company Credit Card Sentinel is a good example. There, the scheme is administered by employee volunteers who decide which ideas to implement. All suggestions are rewarded with gifts or money prizes. Cost-saving ideas are rewarded with a proportion of the money saved.

Car rental firm Avis attributes the success of its PIPS (Practical Ideas Profitable Solutions) scheme to ensuring employees remain involved with the progress of their ideas. Where possible, the people who come up with the ideas are encouraged to implement them. Director of Training Ian Jarvis stresses: "It is built into our Spirit of Avis program, which includes other forms of employee involvement and recognition."

SOURCE: Staff, "It's Time to Acknowledge the Power of Suggestion," *Management Today* (London; February 1998), p. 13.

<http://www.avis.com>

by customers appear to be quality, value, and "good" service. Good service is an intangible; it means different things to different people. But most customers would agree that it is reflective of the interaction between themselves and organizational employees. Frequently, only service quality separates one product from its competition. Solectron implements customer-focus teams and measurement techniques through its customer-satisfaction index process to learn what customers want and need. All Solectron customers have an associated customer-focus team that essentially works for them and with them and ensures that everything happens as intended. Customers grade the firm weekly with letter grades A through D in five categories:

- *Quality.* How well did the product work when you got it?
- *Delivery.* Did the product get delivered to your delivery target?
- *Communications.* Grade us anyway you want, in your understanding of our ability to communicate effectively.
- *Responsiveness or service ability.* Do we make you feel good as a customer? Do we treat you well?
- *Technology.* Are we actually moving ahead in the technology arena?<sup>10</sup>

The only acceptable grades for Solectron are A and A-. They are the ones above 95 percent. Any grades that are a B or less automatically demand a formal corrective action.<sup>11</sup>

<sup>10</sup> Holly Ann Suzik, "Solectron Tells Its Tale," *Quality* (April 1999), pp. 53ff.

<sup>11</sup> Ibid.

Poor service can be disastrous. Data indicate that “70 percent of customers stop doing business with companies because of perceived rude or indifferent behavior by an employee—over three times the total for price or product quality (20 percent).”<sup>12</sup> Although instituting “customer service” programs can improve a company’s image, such programs should not be taken to the extreme. As noted above, some customers are not cost beneficial. For instance, consider those who demand exorbitant service yet are not willing to pay the related price.

A company can increase its product and service quality by investing in **prevention costs**, which prevent product defects that result from dysfunctional processing. Amounts spent on improved production equipment, training, and engineering and product modeling are considered prevention costs. Complementary to prevention costs are **appraisal costs**, which represent costs incurred for monitoring and compensate for mistakes not eliminated through prevention activities. Both of these types of costs will cause a reduction in **failure costs**. These costs represent internal losses, such as scrap or rework, and external losses, such as warranty work, customer complaint departments, litigation, or defective product recalls.

**prevention cost**

**appraisal cost**

**failure cost**

The results of TQM indicate that increasing the amounts spent on prevention should decrease the amounts spent or incurred for appraisal and failure costs—resulting in an overall decline in costs. Also, by eliminating non-value-added activities and installing technologically advanced equipment, productivity and quality will increase.

Lower costs mean that the company can contain (or reduce) selling prices; customers, pleased with the higher quality at the same (or lower) price, perceive they have received value and will buy more. These factors create larger company profits that can be reinvested in research and development activities to generate new high-quality products or services. Or the profits can be used to train workers to provide even higher quality products and services than are currently available. This cycle of benefit will continue in a company that is profitable and secure in its market share—two primary goals of an organization.

## The Quality Goal

Any quality program should seek to meet the following three objectives:

1. The organization should achieve and sustain the quality of the product or service produced so as to continuously meet the purchaser’s stated or implied needs.
2. The organization should give its own management confidence that the intended quality level is being achieved and sustained.
3. The organization should give the purchaser confidence that the intended quality level is, or will be, achieved in the delivered product or service. When contractually required, this assurance may involve agreed demonstration requirements.<sup>13</sup>

The embodiment of TQM in the United States is the Malcolm Baldrige National Quality Award. This award focuses attention on management systems, processes, consumer satisfaction, and business results as the tools required to achieve product and service excellence. There are five categories of entrants: manufacturing, service, small business, education, and health-care organizations. To win the award, applicants must show excellence in the seven categories shown in Exhibit 8–5.

Corporate America has accepted the Baldrige award because it represents excellence. Products and services of companies winning the award are regarded as some of the best in the world. Such recognition invigorates workers and delights all stakeholders, and has caused the entire national economy to be strengthened by the enhanced awareness of and attention to quality and its benefits.

<sup>12</sup> Scott J. Simmerman, “Improving Customer Loyalty,” *Business & Economic Review* (April–June 1992), p. 4.

<sup>13</sup> A. Faye Borthick and Harold P. Roth, “Will Europeans Buy Your Company’s Products?” *Management Accounting* (July 1992), pp. 28–29.

**EXHIBIT 8-5**

Baldrige Award 1999 Criteria for Performance Excellence

1999 Categories/Items	Point Values
<b>1 Leadership</b>	<b>125</b>
1.1 Organizational Leadership	85
1.2 Public Responsibility and Citizenship	40
<b>2 Strategic Planning</b>	<b>85</b>
2.1 Strategy Development	40
2.2 Strategy Deployment	45
<b>3 Customer and Market Focus</b>	<b>85</b>
3.1 Customer and Market Knowledge	40
3.2 Customer Satisfaction and Relationships	45
<b>4 Information and Analysis</b>	<b>85</b>
4.1 Measurement of Organizational Performance	40
4.2 Analysis of Organizational Performance	45
<b>5 Human Resource Focus</b>	<b>85</b>
5.1 Work Systems	35
5.2 Employee Education, Training, and Development	25
5.3 Employee Well-Being and Satisfaction	25
<b>6 Process Management</b>	<b>85</b>
6.1 Product and Service Processes	55
6.2 Support Processes	15
6.3 Supplier and Partnering Processes	15
<b>7 Business Results</b>	<b>450</b>
7.1 Customer Focused Results	115
7.2 Financial and Market Results	115
7.3 Human Resource Results	80
7.4 Supplier and Partner Results	25
7.5 Organizational Effectiveness Results	115
<b>TOTAL POINTS</b>	<b>1000</b>

SOURCE: "Malcolm Baldrige National Quality Award 1999 Award Criteria," U.S. Department of Commerce, Technology Administration, National Institute of Standards and Technology, Washington, DC.

Japan's equivalent of the Malcolm Baldrige National Quality Award is the Deming prize. This award, named for the late W. Edwards Deming, has even more rigorous requirements than do those for the Baldrige award. Globally, the quality movement has progressed to the point that certain quality standards have been set, although these are not at the level of either the Baldrige award or the Deming prize. These standards are discussed in the appendix to this chapter.

## TYPES OF QUALITY COSTS

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What types of quality costs exist and how are those costs related?

As mentioned in the previous section, the TQM philosophy indicates that total costs will decline, rather than increase, as quality improvements are made in an organization. Thus, total quality management also includes the idea that it is the *lack* of high quality that is expensive. Understanding the types and causes of quality costs can help managers prioritize improvement projects and provide feedback that supports and justifies improvement efforts.

Two types of costs comprise the total quality cost of a firm: (1) cost of quality compliance or assurance and (2) cost of noncompliance or quality failure. The

cost of compliance equals the sum of prevention and appraisal costs. Compliance cost expenditures are incurred to reduce or eliminate the present and future costs of failure; thus, they are proactive on management's part. Furthermore, effective investments in prevention costs can even minimize the costs of appraisal. The cost of noncompliance results from production imperfections and is equal to internal and external failure costs. Exhibit 8-6 presents specific examples of each type of quality cost.

Information about production quality or lack thereof is contained in inspection reports, SPC control charts, and customer returns or complaints. Information about quality costs, on the other hand, is only partially contained in the accounting records and supporting documentation. Historically, quality costs have not been given separate recognition in the accounting system.

**EXHIBIT 8-6**

Types of Quality Costs

COSTS OF COMPLIANCE		COSTS OF NONCOMPLIANCE	
Prevention Costs	Appraisal Costs	Internal Failure Costs	External Failure Costs
<p><i>Employees:</i></p> <ul style="list-style-type: none"> <li>■ Hiring for quality</li> <li>■ Providing training and awareness</li> <li>■ Establishing participation programs</li> </ul> <p><i>Customers:</i></p> <ul style="list-style-type: none"> <li>■ Surveying needs</li> <li>■ Researching needs</li> <li>■ Conducting field trials</li> </ul> <p><i>Machinery:</i></p> <ul style="list-style-type: none"> <li>■ Designing to detect defects</li> <li>■ Arranging for efficient flow</li> <li>■ Arranging for monitoring</li> <li>■ Incurring preventive maintenance</li> <li>■ Testing and adjusting equipment</li> <li>■ Fitting machinery for mistake-proof operations</li> </ul> <p><i>Suppliers:</i></p> <ul style="list-style-type: none"> <li>■ Arranging for quality</li> <li>■ Educating suppliers</li> <li>■ Involving suppliers</li> </ul> <p><i>Product Design:</i></p> <ul style="list-style-type: none"> <li>■ Developing specifications</li> <li>■ Engineering and modeling</li> <li>■ Testing and adjusting for conformity, effective and efficient performance, durability, ease of use, safety, comfort, appeal, and cost</li> </ul>	<p><i>Before Production:</i></p> <ul style="list-style-type: none"> <li>■ Receiving inspection</li> </ul> <p><i>Production Process:</i></p> <ul style="list-style-type: none"> <li>■ Monitoring and inspecting</li> <li>■ Keeping the process consistent, stable, and reliable</li> <li>■ Using procedure verification</li> <li>■ Automating</li> </ul> <p><i>During and After Production:</i></p> <ul style="list-style-type: none"> <li>■ Conducting quality audits</li> </ul> <p><i>Information Process:</i></p> <ul style="list-style-type: none"> <li>■ Recording and reporting defects</li> <li>■ Measuring performance</li> </ul> <p><i>Organization:</i></p> <ul style="list-style-type: none"> <li>■ Administering quality control department</li> </ul>	<p><i>Product:</i></p> <ul style="list-style-type: none"> <li>■ Reworking</li> <li>■ Having waste</li> <li>■ Storing and disposing of waste</li> <li>■ Reinspecting rework</li> </ul> <p><i>Production Process:</i></p> <ul style="list-style-type: none"> <li>■ Reprocessing</li> <li>■ Having unscheduled interruptions</li> <li>■ Experiencing unplanned downtime</li> </ul>	<p><i>Organization:</i></p> <ul style="list-style-type: none"> <li>■ Staffing complaint departments</li> <li>■ Staffing warranty claims departments</li> </ul> <p><i>Customer:</i></p> <ul style="list-style-type: none"> <li>■ Losing future sales</li> <li>■ Losing reputation</li> <li>■ Losing goodwill</li> </ul> <p><i>Product:</i></p> <ul style="list-style-type: none"> <li>■ Repairing</li> <li>■ Replacing</li> <li>■ Reimbursing</li> <li>■ Recalling</li> <li>■ Handling litigation</li> </ul> <p><i>Service:</i></p> <ul style="list-style-type: none"> <li>■ Providing unplanned service</li> <li>■ Expediting</li> <li>■ Serving after purchase</li> </ul>

In most instances, the cost of quality is “buried” in a variety of general ledger accounts. For instance, Work in Process Inventory and Finished Goods Inventory contain costs for rework, scrap, preventive maintenance, and other overhead items; marketing/advertising expense contains costs for product recalls, image improvements after poor products were sold, and surveys to obtain customer information; personnel costs include training dollars; and engineering department costs include funds spent for engineering design change orders and redesign. Because quality costs are buried, managers have no idea how large or pervasive those costs are and, therefore, have little incentive to reduce them.

Because the accounting records are commonly kept primarily to serve requirements of financial accounting, the behavior of quality costs relative to changes in activity as well as the appropriate drivers for these costs must be separately developed or estimated for quality management purposes. The need to estimate quality costs makes it essential for the management accountant to be involved in all activities from system design to cost accumulation of quality costs.

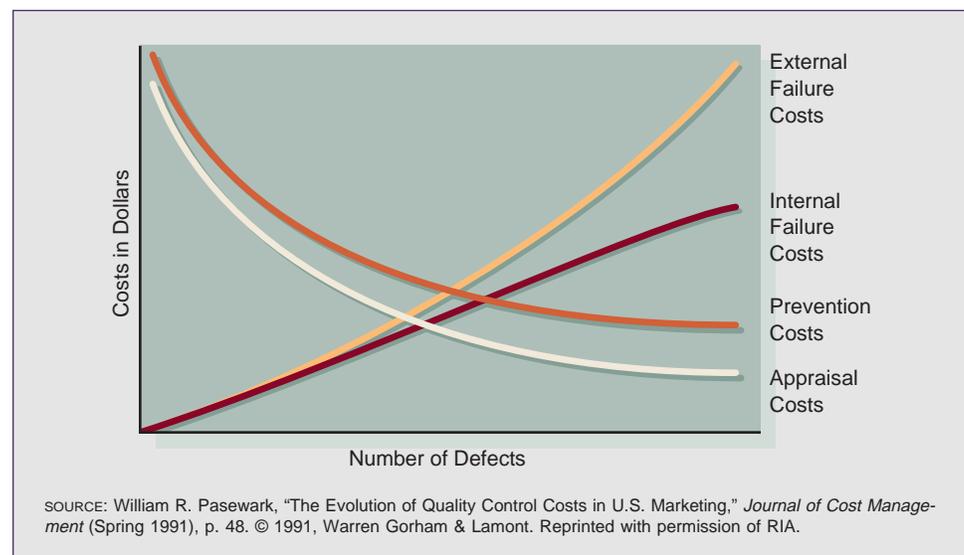
In determining the cost of quality, actual or estimated costs are identified for each item listed in Exhibit 8–6. If these costs were plotted on a graph, they would appear similar to the cost curves shown in Exhibit 8–7. If the firm spends larger amounts on prevention and appraisal costs, the number of defects is lower and the costs of failure are smaller. If less is spent on prevention and appraisal, the number of defects is greater and failure costs are larger. The external failure costs curve begins moving toward vertical when customers encounter a certain number of defects. The ultimate external failure cost is reached when customers will no longer buy a given product or any other products made by a specific firm because of perceived poor quality work.

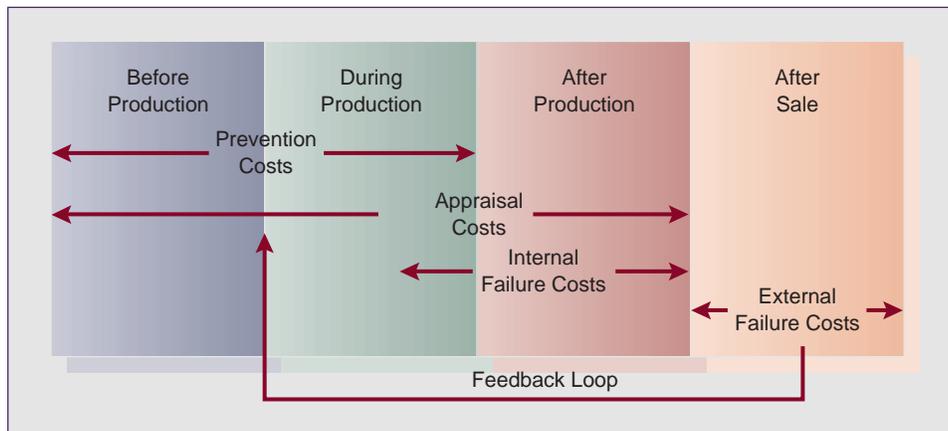
A system in which quality costs are readily available or easily determined provides useful information to managers trying to make spending decisions by pinpointing areas having the highest cost-benefit relationships. Additionally, quality cost information will indicate how a shift in one or more curves will affect the others.

Exhibit 8–8 shows where in the production–sales cycle quality costs are usually incurred. An information feedback loop should be in effect to link the types and causes of failure costs to future prevention costs. Alert managers and employees continuously monitor failures to discover their causes and adjust prevention activities to close the gaps that allowed the failures to occur. These continuous rounds of action, reaction, and action are essential to continuous improvement initiatives. The accompanying News Note discusses how GM tracks defect problems.

### EXHIBIT 8-7

Relationships among Quality Costs



**EXHIBIT 8-8**

*Time-Phased Model for Quality Costs*

## QUALITY



## NEWS NOTE

***CDC Tactics Used to Attack Auto Problems***

General Motors executives were impressed in 1997 when doctors from the federal Centers for Disease Control and Prevention took just days to trace a hepatitis outbreak among Michigan schoolchildren to a load of bad strawberries from Mexico.

The auto executives, under orders to slash more than \$1 billion from GM's annual repair bill for cars under warranty, figured the CDC's methods for tracking down disease-carrying fruit might offer some useful lessons. They adapted the CDC's epidemiological system to the industrial task of debugging cars and trucks.

Under GM's old way of handling warranty problems, word of breakdowns would filter up, with no consistent reporting rules, as dealers billed the manufacturer. It might take months for GM to find the source of a problem and correct it.

Adapting the CDC's approach to its own needs, GM standardized reporting of breakdowns across its dealer network and began tracking warranty repairs using samples of a few thousand vehicles for each vehicle model. Sophisticated computerized statistical models inspired by the CDC highlight emerging trends.

Newly discovered outbreaks [of warranty problems] are tagged with red dots and then, when a solution is put in place, with yellow dots. "If we can get it while the trail is still warm . . . we can usually get to the root cause within 24 hours," Mr. [Don] Mitchell [GM's warranty chief] says. The "first-time kill rate," or share of problems solved the first time, is 96%, he says.

In October 1998, the system revealed a surge in complaints that air conditioners on a range of brand-new cars and minivans were blowing hot air. Within three days, GM engineers had isolated the problem in the compressors and shipped samples of the defective parts to the supplier that made them. There, engineers traced the problem to a drilling machine that periodically clogged with metal shavings and made holes that were too big. Though the problem affected only about six of every 10,000 compressors, the equipment was retooled to prevent it from recurring. Problem-free output began within 10 days of GM's initial detection of the problem.

SOURCE: Adapted from Gregory L. White, "GM Takes Advice from Disease Sleuths to Debug Cars," *The Wall Street Journal* (April 8, 1999), pp. B1-B4.

**MEASURING THE COST OF QUALITY**

Theoretically, if prevention and appraisal costs were prudently incurred, failure costs would become zero. However, prevention and appraisal costs would still be incurred to achieve zero failure costs. Thus, total quality costs can never be zero. This is not to disregard the knowledge that the benefits of increased sales and greater efficiency should exceed all remaining compliance quality costs. In this sense, the cost of compliance quality is free. Management should analyze the quality cost relationships and spend money for quality in ways that will provide the

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How is cost of quality measured?

## pareto analysis

greatest benefit. Such an analysis requires that the cost of quality be measured to the extent possible and practical and the benefits of quality costs be estimated.

**Pareto analysis** is a technique used to separate the “vital few” from the “trivial many.” The technique is a widely used tool that has repeatedly shown that 20 to 30 percent of the items in a set of items accounts for 70 to 80 percent of the cost or values (e.g., inventory, donors to charity, sources of defects).

It is also one way management can decide where to concentrate its quality prevention cost dollars. This technique classifies the causes of process problems according to impact on an objective. For example, a company that makes computers might subclassify its warranty claim costs for the past year according to the type of product failure as follows:

### Cost by Type of Failure

Model	Monitor	CPU	Printer	Keyboard	Total Dollars
Alpha	\$15,000	\$16,000	\$12,000	\$ 3,000	\$ 46,000
Beta	10,000	15,000	7,000	3,000	35,000
All others	6,000	9,000	3,000	5,000	23,000
Total	<u>\$31,000</u>	<u>\$40,000</u>	<u>\$22,000</u>	<u>\$11,000</u>	<u>\$104,000</u>

Model	Dollars	Percent of Total	Cumulative % Total
Alpha	\$ 46,000	44	44
Beta	35,000	34	78
All others	<u>23,000</u>	<u>22</u>	100
Total	<u>\$104,000</u>	<u>100</u>	

Listing the total failure costs of all models in descending order of magnitude indicates that models Alpha and Beta account for 78 percent of total warranty cost claims. Also, the largest single source of warranty claims cost is caused by problems with CPUs. Therefore, management should focus efforts on further analysis on what causes models Alpha and Beta, and the CPUs on all models, to generate the greatest warranty claims costs. This knowledge will permit management to devote the appropriate portion of its prevention efforts to minimizing or eliminating these specific problems. This kind of analysis should be conducted sufficiently often for trends to be detected quickly and adjustments to be made rapidly. For example, Marriott uses Pareto analysis to prioritize service problems and, thus, focus on where to devote the majority of its problem-solving efforts.

A company desiring to engage in TQM and continuous improvement should record and report its quality costs separately so that managers can plan, control, evaluate, and make decisions about the activities that cause those costs. However, just having quality cost information available does not enhance quality. Managers and workers must consistently and aggressively use the information as a basis for creatively and intelligently advancing quality.

A firm's chart of accounts can be expanded to accommodate either separate tracing or allocating quality costs to new accounts. Exhibit 8-9 lists some suggested accounts that will help management focus on quality costs. Opportunity costs, including lost future sales and a measure of the firm's loss of reputation, are also associated with poor quality. Although opportunity costs are real and may be estimated, they are not recorded in the accounting system because they do not result from specific transactions.

If a firm has a database management system, transactions can simply be coded so that reports can be generated without expanding the chart of accounts. Coding permits quality transaction types and amounts to be accessible and a cost of quality report such as the one shown in Exhibit 8-10 (which uses assumed numbers) can be generated. Two important assumptions underlie this exhibit report: stable production

**EXHIBIT 8-9**

New Quality Accounts

Prevention Costs	Appraisal Costs
Quality Training	Quality Inspections
Quality Participation	Procedure Verifications
Quality Market Research	Measurement Equipment
Quality Technology	Test Equipment
Quality Product Design	
Internal Failure Costs	External Failure Costs
Reworking Products	Complaints Handling
Scrap and Waste	Warranty Handling
Storing and Disposing Waste	Repairing and Replacing Returns
Reprocessing	Customer Reimbursements
Rescheduling and Setup	Expediting

and a monthly reporting system. If wide fluctuations in production or service levels occur, period-to-period comparisons of absolute amounts may not be appropriate. Amounts may need to be converted to percentages to have any valid meaning. Additionally, in some settings (such as a just-in-time environment), a weekly reporting system would be more appropriate because of the need for continuous monitoring.

**EXHIBIT 8-10**

Cost Of Quality Report

	Cost of Current Period	Cost of Prior Period	Percent Change from Prior Period	Current Period Budget	Percent Change from Budget
<i>Prevention Costs</i>					
Quality training	\$ 5,800	\$ 5,600	+4	\$ 6,000	-3
Quality participation	8,200	8,400	-2	8,000	+4
Quality market research	9,900	7,700	+29	11,000	-10
Quality technology	9,600	10,800	-11	15,000	-36
Quality product design	16,600	12,200	+36	16,500	+1
Total	<u>\$ 50,100</u>	<u>\$ 44,700</u>	+12	<u>\$56,500</u>	-11
<i>Appraisal Costs</i>					
Quality inspections	\$ 3,300	\$ 3,500	-6	\$ 3,000	+10
Procedure verifications	1,200	1,400	-14	1,500	-20
Measurement equipment	2,700	3,000	-10	3,200	-16
Test equipment	1,500	1,200	+25	1,500	0
Total	<u>\$ 8,700</u>	<u>\$ 9,100</u>	-4	<u>\$ 9,200</u>	-5
<i>Internal Failure Costs</i>					
Reworking products	\$ 8,500	\$ 8,300	+0.2	N/A*	
Scrap and waste	2,200	2,400	-8	N/A	
Storing and disposing waste	4,400	5,700	-23	N/A	
Reprocessing	1,800	1,600	+13	N/A	
Rescheduling and setup	900	1,200	-25	N/A	
Total	<u>\$ 17,800</u>	<u>\$ 19,200</u>	-7		
<i>External Failure Costs</i>					
Complaints handling	\$ 5,800	\$ 6,200	-6	N/A	
Warranty handling	10,700	9,300	+15	N/A	
Repairing and replacing returns	27,000	29,200	-8	N/A	
Customer reimbursements	12,000	10,700	+12	N/A	
Expediting	1,100	1,300	-15		
Total	<u>\$ 56,600</u>	<u>\$ 56,700</u>	+0		
Total quality costs	<u>\$133,200</u>	<u>\$129,700</u>	+3	<u>\$65,700</u>	<u>+103</u>

\*TQM advocates planning for zero defects; therefore, zero failure costs would be included in the budget.

Exhibit 8–11 provides formulas for calculating an organization's total quality cost, using the prevention, appraisal, and failure categories. Some amounts used in these computations are, by necessity, estimates. It is better for businesses to use reasonable estimates than to ignore the costs because of a lack of verifiable or precise amounts. Consider the following April 2000 operating information for the Jing USA Company:

Defective units ( $D$ )	2,500	Units reworked ( $Y$ )	1,200
Profit for good unit ( $P_1$ )	\$25	Profit for defective unit ( $P_2$ )	\$15
Cost to rework defective unit ( $r$ )	\$5	Units returned ( $D_r$ )	400
Cost of return ( $w$ )	\$8	Prevention cost ( $K$ )	\$40,000
Appraisal cost ( $A$ )	\$7,200		

Substituting these values into the formulas provided in Exhibit 8–11 provides the following results:

$$Z = (D - Y)(P_1 - P_2) = (2,500 - 1,200)(\$25 - \$15) = \$13,000$$

$$R = (Y)(r) = (1,200)(\$5) = \$6,000$$

$$W = (D_r)(w) = (400)(\$8) = \$3,200$$

$$F = Z + R + W = \$13,000 + \$6,000 + \$3,200 = \$22,200 \text{ total failure cost}$$

$$T = K + A + F = \$40,000 + \$7,200 + \$22,200 = \$69,400 \text{ total quality cost}$$

### EXHIBIT 8-11

Formulas for Calculating Total Quality Cost

#### Calculating Lost Profits

Profit Lost by Selling Units as Defects = (Total Defective Units – Number of Units Reworked) × (Profit for Good Unit – Profit for Defective Unit)

$$Z = (D - Y)(P_1 - P_2)$$

#### Calculating Total Internal Costs of Failure

Rework Cost = Number of Units Reworked × Cost to Rework Defective Unit

$$R = (Y)(r)$$

#### Calculating Total External Costs of Failure

Cost of Processing Customer Returns = Number of Units Returned × Cost of a Return

$$W = (D_r)(w)$$

Total Failure Cost = Profit Lost by Selling Units as Defects + Rework Cost + Cost of Processing Customer Returns + Cost of Warranty Work + Cost of Product Recalls + Cost of Litigation Related to Products + Opportunity Cost of Lost Customers

$$F = Z + R + W + PR + L + O$$

#### Calculating the Total Quality Cost

Total Quality Cost = Total Compliance Cost + Total Failure Cost

$$T = (\text{Prevention Cost} + \text{Appraisal Cost}) + \text{Total Failure Cost}$$

$$T = K + A + F$$

Prevention and appraisal costs are total estimated amounts; no formulas are appropriate. As the cost of prevention rises, the number of defective units should decline. Additionally, as the cost of prevention rises, the cost of appraisal should decline; however, appraisal cost should never become zero.

SOURCE: Adapted from James T. Godfrey and William R. Pasewark, "Controlling Quality Costs," *Management Accounting* (March 1988), p. 50. Reprinted from *Management Accounting*. Copyright by Institute of Management Accountants, Montvale, NJ.

Of the total quality cost of \$69,400, Jing USA Company managers will seek to identify the causes of the \$22,200 failure costs and work to eliminate them. The results may also affect the planned amounts of prevention and appraisal costs for future periods.

High quality allows a company to improve current profits, either through lower costs or, if the market will bear, higher prices. But management is often more interested in business objectives other than short-run profits. An example of an alternative, competing objective is that of increasing the company's market share. Indeed, if increasing market share were an objective, management could combine the strategies of increasing quality while lowering prices to attract a larger market share. Giving greater attention to prevention and appraisal activities increases quality, with the result that overall costs decline and productivity increases. Lower costs and greater productivity support lower prices that, in turn, often stimulate demand. Greater market share, higher long-run profits, and, perhaps, even greater immediate profits result.

## OBTAINING INFORMATION FROM THE COST MANAGEMENT SYSTEM

Today's business strategy of focusing on customers and quality requires a firm to manage organizational costs so that a reasonable value-to-price relationship can be achieved. Although prices are commonly set in reference to the competitive market rather than being based on costs, companies lacking appropriate cost management skills cannot expect to succeed in the long run. Thus, it can be said that organizations need to engage in strategic cost management (SCM).

SCM can be viewed as the use of management accounting information for the purpose(s) of setting and communicating organizational strategies; establishing, implementing, and monitoring the success of methods to accomplish the strategies; and assessing the level of success in meeting the promulgated strategies.<sup>14</sup> Thus, an organization's management accounting system should accumulate and report information related to organizational success in meeting or exceeding customer needs and expectations as well as quality-related goals and objectives. Managers can analyze and interpret such information to plan and control current activities and to make decisions about current and long-term future courses of action, including expansion of the company's market base and/or technology installation.

In designing a management accounting system, consideration must be given to cost accumulation and process measurement activities. Costs that are accumulated for financial accounting purposes may be inadequate for strategy-based decisions. For example, financial accounting requires that research and development costs be expensed as incurred. However, a product's cost is largely determined during design. Design has implications for its perceived value, the complexity and variety of components required for the product's production, its manufacturability, and its durability and likelihood of failure. Consequently, strategy-based cost management would suggest that design cost be accumulated as part of product cost. This cost does not need to appear on the financial accounting statements, but it needs to exist for decision-making purposes in the management accounting system.

In contrast, financial accounting accumulates all production costs as inventoriable and does not distinguish whether they add value to the customer. A strategically based cost management system differentiates costs that add value from those that do not so that managers and employees can work to reduce the non-value-added costs and enhance continuous improvement.

Another example of the abilities of a strategically based management accounting system is in the area of process. Financial accounting is monetarily based and,

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Why does a company need both a strategically based management accounting system and a financial accounting system?

<sup>14</sup> The term *strategic cost management* was coined by Professors John K. Shank and Vijay Govindarajan of Dartmouth College. A full discussion of the concept is provided in their book, *Strategic Cost Management* (New York: The Free Press, 1993).

therefore, does not directly measure nonfinancial organizational activities. However, as indicated earlier in the chapter, many activities critical to success in a quality-oriented, global marketplace are related to time—a nonmonetary characteristic. A useful management accounting system ensures availability of information related to nonmonetary occurrences (such as late deliveries or defect rates). Such information can be translated into financial terms, if desired, to objectively analyze its significance to the company's profitability.

Finally, financial accounting reflects a short-term perspective of operating activity. An organizational goal of continuous improvement is not short term; it is uninterrupted into the long run. Gathering monetary information and forcing it into a particular annual period of time does not necessarily provide managers with a clear indication of how today's decisions will affect the organization's long-run financial success. For example, not investing in research and development would cause a company's short-run profitability to improve, but could be disastrous in the long run.

Thus, a strategically based management accounting system reports a greater number of the costs and benefits of organizational activities. Having this information in a form designed to meet managerial needs allows managers to make informed assessments of the company's performance in the value chain, of its position of competitive advantage (or disadvantage), and of its progress toward organizational goals.

## QUALITY AS AN ORGANIZATIONAL CULTURE

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How can quality be instilled as part of an organization's culture?

Quality, propelled by changing customer needs and better competition, must be viewed as a moving target; therefore, TQM is inseparable from the concept of continuous improvement. Higher and higher performance standards must be set for everyone in the organization (not just the production people) to provide the sense of working toward a common goal. This philosophy is expressed in the accompanying observations regarding a new basic focus for success:

*[Consultants Michael Treacy and Fred Wiersema] show that it's not the company with the best product that's going to win—or in other markets, the company with the lowest costs or the one with the best total solution to a customer's problem. Whatever a company does to create customer value, it's not how well it performs today that matters in the long run but how good it is at learning to do it better.<sup>15</sup>*

The behavior of managers and employees comprise the basis for TQM. Consistent and committed top management leadership is the catalyst for moving the company culture toward an *esprit de corps* in which all individuals, regardless of rank or position, are obsessed with exceeding customer expectations. Such an attitude should also permeate everything a company does, including customer relations, marketing, research and development, product design, production, and information processing. Management can effectively induce change in its organizational culture by providing an environment in which employees know the company cares about them, is responsive to their needs, and will appreciate and reward excellent results. This knowledge goes a long way in motivating employees toward greater cooperation and making them feel trusted, respected, and comfortable. Such employees are more likely to treat customers in a similar manner.

The firm must empower employees to participate fully in the quest for excellence by providing the means by which employees gain pride, satisfaction, and

<sup>15</sup> Tom Richman, "What Does Business Really Want from Government?" *The State of Small Business* (1995), p. 96.

substantive involvement. Encouragement, training, job enhancement, and the proper working environment and tools are what managers must provide. The work environment in the new corporate culture involves the effective use of teams in the appropriate settings. Employees should be recognized with praise and rewarded for being involved in team problem solving, contributing ideas for improvement, acting as monitors of their own work, and sharing their knowledge and enthusiastic attitudes with their colleagues. The true importance of empowerment is discussed in the following remarks:

*Making employees more involved in and responsible for their work activities increases the value of those individuals not only to the organization, but also to themselves and to society as a whole. The organizational benefits gained from empowerment are that employees have a sense of ownership of and work harder toward goals they have set for themselves. Thus, employee involvement automatically promotes a higher degree of effort on the part of the work force. We avoid the basis of the Marxist critique of capitalism: the exploitation and subsequent alienation and rebellion of the worker. Problems will be solved more quickly and, therefore, the cost of errors will be reduced.*<sup>16</sup>

With its focus on process and customers, TQM is founded on one very obvious and simple principle: Do the right things right the first time, all the time, on time and continuously improve. The accompanying News Note discusses this notion, and adds another dimension: bottom-line viability.

The heart of this principle is zero defects now and in the future. For example, a non-TQM production policy statement might read: “Do not allow defective

## GENERAL BUSINESS

## NEWS NOTE

**Getting It Right Produces Profits**

We all know the value of “doing things right the first time.” We have learned from experience that going back to fix things just doesn’t make business sense (and often never happens anyway once a program or system is implemented). So, why do we continue to hear stories about projects gone bad—schedules over-run and budgets over-spent?

The other night, as I listened to a presentation about yet another example of such a case, my blood began to boil! As the speaker discussed the trials and tribulations of a current product development project, a number of issues were raised by people in the audience about the long-term viability and stability of the product being developed. Would the product survive? Could it be expanded and improved? Would the ultimate customer (the taxpayer in this case) be satisfied with what was being delivered?

The speaker shuffled a bit and was obviously nervous—“Well, actually, they hadn’t really focused too much on

that; they were really just focused on getting the project done, on time, on budget”—their measure of success!

After all, quality is about both the “process” and the “product”—doing things right to end up with a product that is worth delivering. We all complain about the increased international competition and customer demands for better value, so why aren’t we successful at meeting these challenges? If we are going to remain competitive, we need to do something about the quality of our process. It doesn’t make any sense to deliver high-quality products that nobody wants or that don’t provide a measurable business benefit. We must follow a high-quality process that ensures that what we are doing is valuable and will result in a product that provides value to both the *customer* and the *business*.

SOURCE: Reprinted from an article, “Quality and Productivity: ‘Quality and Do-It-Right, First Time’ Has to Include Bottom-Line Viability,” appearing in CMA Management Magazine (formerly CMA Magazine), by Pamela Hollington, March 1997 (p. 33), with permission of CMA Canada.

<sup>16</sup> Cecily Raiborn and Dinah Payne, “TQM: Just What the Ethicist Ordered,” *Journal of Business Ethics* (Vol. 15, No. 9, 1996), p. 969.

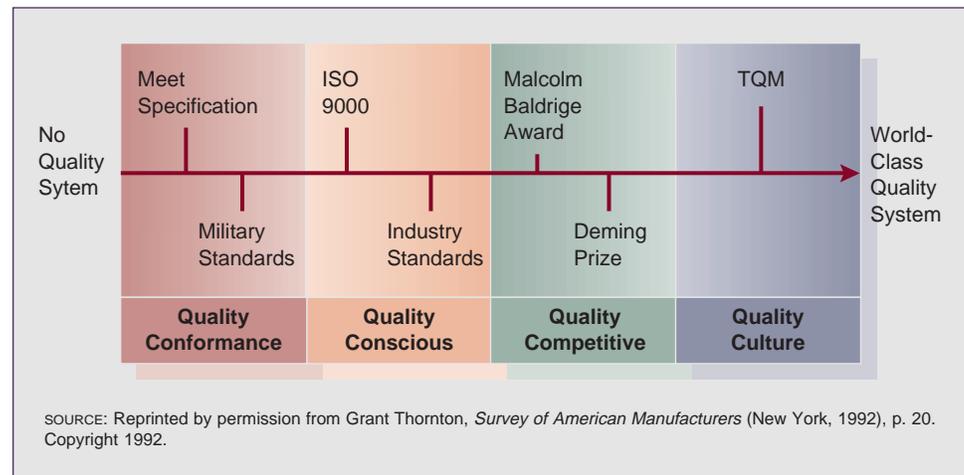
production to be greater than one percent of total production.” In contrast, total quality management would have the policy statement: “We will achieve zero-defect production.” It follows that management’s responsibility is to provide employees with the training, equipment, and quality of materials and other resources to meet this objective.

Exhibit 8–12 depicts the quality continuum along which companies move toward achieving world-class status. This continuum indicates that, at the most basic level of quality assurance, a company simply inspects to find defective products or monitors employees and surveys customers after the fact to find poor service. Implementing a variety of quality control techniques in the system to eliminate the possibilities of defective products or poor service means that the company has become quality conscious.

When the company’s (or a division of the company’s) quality system has progressed to a high level of development, the company (or division) may choose to compete against others for formal quality recognition. Finally, when the concept of quality has become a distinct element of the organizational culture and tolerances for defective products or poor service are set at zero percent, the company has achieved world-class status and can be viewed as the benchmark for others. But achieving world-class status does not mark an ending point. TQM is not a static concept; when one problem has been solved, another one is always waiting for a solution.

### EXHIBIT 8-12

Quality Continuum



## REVISITING

**Solectron  
Corporation**

<http://www.solectron.com>

**S**olectron’s *vision* is [to] “Be the best and continuously improve.” This vision statement reflects the company’s unceasing efforts to refine its business and its processes. The firm’s *mission* allows it to maintain successful partnerships with its customers and suppliers as a global provider of total design, supply chain and manufacturing solutions. The mission statement is as follows:

*Our mission is to provide worldwide responsiveness to our customers by offering the highest quality, lowest total cost, customized, integrated, design, supply chain and manufacturing solutions through long-term partnerships based on integrity and ethical business practices.*

Dr. Chen's vision in the 1970s and 1980s was to revitalize U.S. manufacturing competitiveness by making Solectron a world-class electronics manufacturing company setting an example for others to follow. His approach to achieving this vision was to benchmark Japanese manufacturing companies and combine American innovation with Japanese techniques. Dr. Chen used The Five S's to achieve that vision:

*Seiri*—Orderliness

Put things in order

Store all materials and information in an orderly fashion at all times

Tidy

Ready for use

Organized according to frequency

A place for everything and everything in its place

*Seiton*—Arrange Properly

Distinguish between those things that are needed and not needed

Keep only needed materials at the job site

Throw away all unneeded items immediately

*Seisou*—Cleanliness

Problems are more visible when everything is neat and clean

Find minor defects while "sweeping clean"

*Seiketsu*—Always Clean

Clean tools, equipment and job site immediately after use

Equipment that is kept clean runs better

*Shitsuke*—Discipline

Follow what has been decided daily

Follow standard procedure

SOURCE: "About Solectron," Solectron Corporation Web site, <http://www.solectron.com/about/mission/html> (October 13, 1998), home page.

## CHAPTER SUMMARY

Continuous quality improvement is essential to survival in the global marketplace. Quality is defined as conformity to requirements as judged by customers. Total quality management is a system involving all company personnel in the pursuit of a continuous improvement process that exceeds customer expectations.

The shared planning and decision making among personnel required by TQM is changing the way people perform their jobs. Enhanced technology in hardware, production processes, and management systems has made the new quality initiatives possible. Consumers are aware of greater variety by type and quality of products, and they discriminate in their purchases with regard to price, quality, service, and lead time. This intensified competition has motivated producers to adopt a more dynamic attitude about quality improvement and has heightened the use of competitive benchmarking to close any performance gaps.

Quality compliance costs include the costs of prevention and appraisal. These costs are incurred to reduce or eliminate the current costs of quality failure and to continuously improve in the future. Noncompliance costs are separated into internal and external failure costs.

The number of good units generated during a period measures productivity. Improving quality essentially increases productivity because quality improvement works to remove factors that slow down or halt the production process or that require production redundancy. Eliminating non-value-added activities also increases productivity.

The Malcolm Baldrige National Quality Award focuses attention on management systems, processes, and consumer satisfaction as the tools to achieve excellence. Winning this award is an indication that a company's products or services are among the nation's best. Such an accomplishment invigorates employees and enhances a company's reputation with all stakeholders.

Theoretically, quality can be said to be free if its benefits exceed its costs. However, management should still measure quality costs so that managers have specific information to plan, control, evaluate, and make decisions in a continuous improvement environment.

Strategically based cost management views management accounting as a means of assisting managers to set and communicate organizational strategies and to establish and monitor methods of accomplishing the intended results of those strategies. This type of cost management system differs from financial accounting by taking a longer range perspective, including an alternative view of product costs. For instance, a strategically based cost management system would include research and development costs in total product cost, but would exclude costs of activities that create no value in the value chain.

## APPENDIX

### International Quality Standards

Most large companies view their markets on an international, rather than a domestic, basis. To compete effectively in a global environment, companies must recognize and be willing to initiate compliance with a variety of standards outside their domestic borders. Standards are essentially the international language of trade; they are formalized agreements that define the various contractual, functional, and technical requirements that assure customers that products, services, processes, and/or systems do what they are expected to do.

#### ISO 9000

A primary international guideline for quality standards is the **ISO 9000** series. In 1987, the International Organization for Standardization, based in Geneva, Switzerland, developed a comprehensive list of quality standards known as the ISO 9000 series. The series of three compliance standards (ISO 9001, 9002, and 9003) and two guidance standards (ISO 9000 and 9004) resulted from discussions among quality standards boards of 91 countries. These directives are written in a general manner and prescribe the generic design, material procurement, production, quality control, and delivery procedures necessary to achieve quality assurance. These directives are not product standards and do not imply that companies using them have better products than competitors. The standards articulate what must be done to assure quality, but management must decide how to meet the standards. Exhibit 8–13 indicates the coverage of each of the five standards.

ISO 9000 registration is required for regulated products to be sold in the European Union. Unfortunately, there is no international organization to administer the program. Thus, companies seeking ISO certification have to qualify under an internationally accepted registration program that is administered by a national registrar. Examples of such registrars in the United States and Great Britain are, respectively, Underwriters Laboratories and the British Standards Institution.

#### quality audit

After an internal review, a company deciding that it can meet the standards may apply for ISO registration. To be registered, a company must first submit to a quality audit by a third-party reviewer. A **quality audit** involves a review of product design activities (not performed for individual products), manufacturing processes and controls, quality documentation and records, and management quality policy and philosophy. After registration, teams visit the company biannually to monitor compliance.

Although registration costs are high, certified companies believe the benefits are even higher. Internally, certification helps ensure higher process consistency and quality and should help to reduce costs. Externally, ISO 9000 certified companies have an important distinguishing characteristic from their noncertified competitors. Additionally, certified companies are listed in a registry of “approved” suppliers, which should increase business opportunities. The cost-benefit relationships of the quality system must be measured, documented, and reported under ISO 9000—all jobs for management accountants.

**EXHIBIT 8-13***Content of ISO 9000 Standards*

Standard #	Content
9000	Provides guidelines selection and use of the entire ISO standard series and explains basic quality terms and ideas; covers documentation, organizational quality objectives and responsibilities, process assurance, and management review and audit of the quality system.
9001	Covers requirements for conformance during product design, production, installation, and servicing; is applicable to architectural, engineering, construction, and manufacturing companies.
9002	Provides a model for assuring quality when only production and installation conformance is required; is applicable to companies in which product requirements are stated relative to established designs or specifications (such as chemical, foods, and pharmaceutical companies); ISO 9002 differs from ISO 9001 only because ISO 9001 includes the design function, whereas ISO 9002 does not.
9003	Provides a model for assuring quality when only final inspection and testing conformance is required; is applicable to companies (or internal organizational units) that inspect and test the products they supply (such as laboratories).
9004	Provides guidelines related to a company's internal quality management and developing and implementing a quality system; discusses the technical, administrative, and human factors that affect product and service quality.

ISO standards are not required to do business in the United States, but should be explored for possible implementation even by companies that do not sell overseas because of the operational and competitive benefits. And if a company's competitors are in compliance with and registered under ISO standards, good business sense would reveal the necessity of becoming ISO certified.

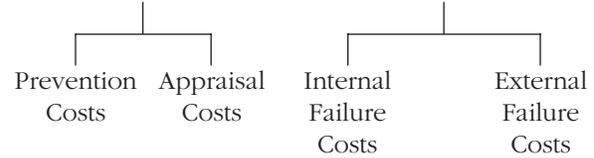
In 1996, the International Organization for Standardization issued the **ISO 14000** series, which provides criteria for an effective environmental management system. The standards in this series are designed to support a company's environmental protection and pollution prevention goals in balance with socioeconomic needs. One part of the series, ISO 14001, establishes requirements for certification or self-declaration regarding a firm's environmental management system.

**ISO 14000****KEY TERMS**

appraisal cost (p. 313)	process benchmarking (p. 309)
benchmarking (p. 309)	quality (p. 304)
control chart (p. 306)	quality audit (p. 326)
failure cost (p. 313)	quality control (QC) (p. 305)
grade (p. 307)	results benchmarking (p. 309)
ISO 9000 (p. 326)	statistical process control (SPC) (p. 306)
ISO 14000 (p. 327)	total quality management (TQM)
Pareto analysis (p. 318)	(p. 310)
prevention cost (p. 313)	value (p. 307)

## SOLUTION STRATEGIES

Total Quality Costs = Costs of Compliance + Costs of Noncompliance



Costs of noncompliance are inversely related to the costs of compliance and are a direct result of the number of defects.

Dimensions of product quality include:

- Conformity to specifications
- Effective and efficient performance
- Durability
- Ease of use
- Safety
- Comfort of use
- Appeal

### Cost of Quality Formulas

Profit Lost by Selling Units as Defects = (Total Defective Units – Number of Units Reworked) × (Profit for Good Unit – Profit for Defective Unit)

$$Z = (D - Y)(P_1 - P_2)$$

Rework Cost = Number of Units Reworked × Cost to Rework Defective Unit

$$R = (Y)(r)$$

Cost of Processing Customer Returns = Number of Defective Units Returned × Cost of a Return

$$W = (D_r)(w)$$

Total Failure Cost = Profit Lost by Selling Units as Defects + Rework Cost + Cost of Processing Customer Returns + Cost of Warranty Work + Cost of Product Recalls + Cost of Litigation Related to Products + Opportunity Cost of Lost Customers

$$F = Z + R + W + PR + L + O$$

Total Quality Cost = Total Compliance Cost + Total Failure Cost

$$T = (\text{Prevention Cost} + \text{Appraisal Cost}) + \text{Total Failure Cost}$$

$$T = K + A + F$$

## DEMONSTRATION PROBLEM

Scott Company's quality report for October 2000 showed the following information:

Total defective units	2,000
Number of units reworked	1,400
Number of customer units returned	650
Profit for a good unit	\$38
Profit for a defective unit	\$22
Cost to rework a defective unit	\$7
Cost to process a returned unit	\$10
Total prevention cost	\$27,000
Total appraisal cost	\$16,000
Litigation related to product failure	\$70,000

The company also estimated an opportunity cost of lost customers of \$50,000 while the litigation was being settled.

### Required:

Compute the following:

- Profit lost by selling unreworked defects
- Total rework cost
- Cost of processing customer returns
- Total failure cost
- Total quality cost

### Solution to Demonstration Problem

- $Z = (D - Y)(P_1 - P_2) = (2,000 - 1,400)(\$38 - \$22) = \$9,600$
- $R = (Y)(r) = (1,400)(\$7) = \$9,800$
- $W = (D_r)(w) = (650)(\$10) = \$6,500$
- $F = Z + R + W + L + O = \$9,600 + \$9,800 + \$6,500 + \$70,000 + \$50,000 = \$145,900$
- $T = K + A + F = \$27,000 + \$16,000 + \$145,900 = \$188,900$

## QUESTIONS

- Why are high-quality products and services so important in today's global business environment?
- Is the quality movement likely to fade away? Discuss the reasons for your conclusion.
- What is meant by the term *quality*? In defining quality, from what two perspectives can a definition be formulated? Why are both important?
- In conducting activity analyses, the presence of certain activities indicates low production process quality. List five of these activities.
- What variables can management manipulate to improve production process quality? How will these changes improve product quality?
- How can statistical process control techniques be used to evaluate the quality of a production process?
- What are the eight characteristics that comprise product quality from the consumer's perspective? What are the five characteristics that comprise service quality from the customer's perspective? How do these sets differ?
- Locate a product that is well described on the Internet. Discuss how that product exemplifies the eight product quality characteristics.
- "If a company has a high-quality manufacturing process, customers will naturally view the output of that process as high quality." Explain why this statement is true or false.
- You, your parents, and Bill Gates are all in the market for a new residence. Would each of you define "high quality" the same way? In making a choice of residence, would each of you assess the same things? Why or why not?



- 
11. Define benchmarking. Describe the two types of benchmarking presented in the chapter.
  12. Use the Internet to find a company that has engaged in benchmarking. Describe the type of benchmarking used and the benefits and costs of the company's experience.
  13. How does benchmarking allow a company to evaluate the quality of its processes?
  14. Describe the eight steps in benchmarking that can be used to improve a specific production process.
  15. What is TQM? What are the three important tenets of TQM and why are they important?
  16. Why is TQM significant? What must a company do to make it work?
  17. Use the Internet or other resources to find a company that has recently experienced quality problems. Discuss that company's problems and indicate what costs were incurred, why these costs were incurred, and how the costs should be classified (prevention, appraisal, internal failure, and external failure).
  18. What is the Malcolm Baldrige National Quality Award? What are the categories of entrants? What are the award criteria categories?
  19. What are the two types of costs that comprise the total quality cost of a firm? What are the two subtypes within each type? Given the trade-off between the two main types of quality costs, is quality ever free? Explain.
  20. What constructive adjustments can management make based on information learned from a company's internal and external failures?
  21. What are the sources of information for product quality costs within a firm (both financial and nonfinancial)?
  22. In the production–sales cycle, what are the four time phases in which quality costs are incurred? How are these costs interrelated through the phases?
  23. How can Pareto analysis help focus managerial efforts in reducing the costs of quality-related problems?
  24. Describe some additional accounts that can be added to financial records to attempt to better capture the costs of quality in the accounting records. Provide some examples of costs contained in the specified accounts.
  25. How does strategic cost management link information to corporate strategies?
  26. Use the Internet to find five companies that have a “quality culture.” Compare and contrast these cultures.
  27. What are the four stages or levels on the quality continuum? Where is TQM located on the continuum?
  28. (*Appendix*) Why do countries establish quality standards? Why is it desirable to have a common set of global quality standards?
  29. (*Appendix*) What role is served by the International Organization for Standardization?
  30. (*Appendix*) What is a quality audit?
- 

## EXERCISES

31. (*Terminology*) Match the following lettered terms on the left with the appropriate numbered description on the right.
 

<ol style="list-style-type: none"> <li>a. Appraisal cost</li> <li>b. Benchmarking</li> <li>c. Control chart</li> <li>d. Grade</li> <li>e. Pareto analysis</li> <li>f. Quality</li> <li>g. Quality audit</li> <li>h. Quality control</li> </ol>	<ol style="list-style-type: none"> <li>1. Method to rank causes of variation in a process</li> <li>2. Review of product design, manufacturing processes and controls, quality documentation, and records</li> <li>3. Technique to identify uncommon variations or errors in a process</li> </ol>
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- i. Statistical process control
  - j. Value
4. Cost incurred for monitoring and compensating for mistakes
  5. Graphical method of documenting when a process is in or out of control
  6. One combination of different product or service characteristics included to satisfy different customer needs
  7. Process of investigating how other firms conduct business
  8. Effect of meeting or exceeding customer needs
  9. Product or service characteristic relating to meeting the most customer needs at the lowest price
  10. Policy and/or practice designed to eliminate poor quality
32. (*True/false*) Mark each of the following statements as true or false and explain why the false statements are incorrect.
- a. The total quality cost is the sum of prevention cost plus failure cost.
  - b. Traditional accounting systems have separate accounts to capture quality costs.
  - c. Pareto analysis is used to help managers identify areas in which to focus quality-improvement efforts.
  - d. As the number of defective products manufactured rises, internal failure costs also rise, but external failure costs are expected to decline.
  - e. Higher quality yields lower profits but higher productivity.
  - f. Total quality management focuses on production processes rather than customer satisfaction.
  - g. Results benchmarking relies only on comparisons to firms within the same industry.
  - h. SPC control charts are used to plot the costs of quality over time.
  - i. Appraisal cost is used to monitor and correct mistakes.
  - j. Quality is free.
33. (*Control chart*) Pareto Pizza's has recently hired several college students to work part time making pizzas. Angelo Pareto, the owner, has a policy of putting 36 slices of pepperoni on a pizza, but (given diversity in size) he sometimes puts on between 34 and 38. After observing the students for a few days, Angelo gathered the following data on number of pepperoni slices:
- 11:00 a.m. to 5:00 p.m.  
13 pizzas were made containing the following number of pepperoni slices: 35, 37, 41, 33, 36, 36, 35, 39, 44, 37, 36, 36, 35
- 5:00 p.m. to 11:00 p.m.  
25 pizzas were made containing the following number of pepperoni slices: 35, 37, 41, 42, 36, 39, 44, 43, 44, 37, 48, 36, 35, 40, 39, 41, 29, 36, 36, 42, 45, 44, 37, 36, 36
- a. Prepare a control chart for pepperoni slices.
  - b. What information does the chart provide Angelo?
34. (*Quality characteristics*) Prepare a five-by-eight matrix of the five characteristics of service quality (horizontal axis) and the eight characteristics of product quality (vertical axis). Place a checkmark in the matrix where there is an approximate match in characteristics on both axes. Prepare a brief oral presentation for your classmates explaining the common quality characteristics in your matrix.



35. (*Definition of quality; quality characteristics*) In a team of three, role-play the following individuals who are visiting a car dealership in your community: (1) a 19-year-old college student, (2) a young married man/woman with two children, and (3) an elderly man/woman (postretirement age). Each of you is interested in purchasing a new automobile.
- How do each of you define quality in an automobile? Explain the reasons for your differences.
  - What vehicle characteristics are important to all of you? Which vehicle characteristics are unique to each of you?
36. (*Cost of quality*) Bronson's BronzeWorks has gathered the following data on its quality costs for 1999 and 2000:

Defect Prevention Costs	1999	2000
Quality training	\$8,000	\$9,500
Quality technology	6,000	8,000
Quality production design	4,000	9,000
<b>External Failure Costs</b>		
Warranty handling	\$15,000	\$10,000
Customer reimbursements	11,000	7,200
Customer returns handling	7,000	4,000

- Compute the percentage change in the two quality cost categories from 1999 to 2000.
  - Write a brief explanation for the pattern of change in the two categories.
37. (*Cost of quality*) Sparticus Electronics' accounting system reflected the following costs related to quality for 1999 and 2000:

	1999	2000
Customer refunds for poor product quality	\$24,000	\$18,000
Fitting machines for mistake-proof operations	8,400	12,800
Supply-line management	8,000	10,000
Disposal of waste	44,000	36,000
Quality training	28,000	30,000
Litigation claims	72,000	56,000

- Which of these are costs of compliance and which are costs of noncompliance?
  - Calculate the percentage change in each cost and for each category.
  - Discuss the pattern of the changes in the two categories.
38. (*Cost of quality*) Mathes Company wants to determine its cost of quality. The company has gathered the following information from records pertaining to August 2000:

Defective units	2,500
Units reworked	600
Defective units returned	200
Appraisal costs	\$6,800
Cost per unit for rework	\$6
Prevention costs	\$25,000
Profit per good unit produced and sold	\$30
Profit per defective unit sold	\$20
Cost per unit for customer returns	\$5
Cost of warranty work	\$2,500

Compute the following:

- Lost profits from selling defective work
- Total costs of failure
- Total quality cost



39. (*Cost of quality*) Alpine Sunglasses Company has gathered the following information pertaining to quality costs of production for June 2000 of heavy-duty sunglasses for skiing:

Total defective units	300
Number of units reworked	190
Number of units returned	50
Total prevention cost	\$12,000
Total appraisal cost	\$6,000
Per-unit profit for defective units	\$10
Per-unit profit for good units	\$28
Cost to rework defective units	\$8
Cost to handle returned units	\$5

Using these data, calculate the following:

- Total cost to rework
  - Profit lost from not reworking all defective units
  - Cost of processing customer returns
  - Total failure costs
  - Total quality cost
40. (*Cost of quality*) Klein Computers is evaluating its quality control costs for 2000 and preparing plans and budgets for 2001. The 2000 quality costs incurred in the CPU Division follow:

Prevention costs	\$150,000
Appraisal costs	50,000
Internal failure costs	175,000
External failure costs	50,000
Total	<u>\$425,000</u>

Prepare a memo to the company president on the following issues:

- Which categories of quality costs would be affected by the decision to spend \$750,000 on new computer chip-making equipment (to replace an older model)? Why?
  - If projected external failure costs for 2001 can be reduced 60 percent (relative to 2000 levels) by either spending \$25,000 more on appraisal or \$40,000 more on prevention, why would the firm opt to spend the \$40,000 on prevention rather than the \$25,000 on appraisal?
41. (*Control of quality costs; team activity*) The following summary numbers have been taken from a quality cost report of North Carolina Fine Furniture Inc., for 2000. The firm manufactures a variety of Early American furniture products.

Prevention costs	\$2,500,000
Appraisal costs	1,500,000
Internal failure costs	1,500,000
External failure costs	500,000
Total quality costs	<u>\$6,000,000</u>

The company is actively seeking to identify ways to reduce total quality costs. The company's current strategy is to increase spending in one or more quality cost categories in hopes of achieving greater spending cuts in other quality cost categories. In a team of three or four individuals, prepare an oral presentation to answer the following questions:

- Which spending categories are most susceptible to control by managers? Why?
- Why is it more logical for the company to increase spending in the prevention cost and appraisal cost categories than in the failure cost categories?
- Which cost category is the most likely target for spending reductions? Explain.
- How would the adoption of a TQM philosophy affect the focus in reducing quality costs?

<http://www.toyota.com>

42. (*Quality information system; team activity*) Your company is interested in developing information about quality, but has a traditional accounting system that does not provide such information directly. In a three- or four-person team, prepare a set of recommendations about how to improve the company's information system to eliminate or reduce this deficiency. In your recommendations, also explain in what areas management would have the most difficulty satisfying its desire for more information about quality and why these areas were chosen.
43. (*Supplier quality*) Assume that Toyota paid for a full-page advertisement in *The Wall Street Journal*. The ad did not tout Toyota products nor was it in reference to year-end earnings or a new stock issuance. Instead, the ad was to inform readers that "buying quality parts is not a foreign idea to us." The ad named Toyota suppliers and identified their locations. Prepare a brief essay to answer the following questions.
- Why would Toyota want other companies to know what suppliers it uses?
  - Do you think this advertisement had any benefit for Toyota itself? Discuss the rationale for your answer.
44. (*Differences from benchmarks*) For a benchmark, assume that the average firm incurs quality costs in the following proportions:

Prevention	25%
Appraisal	25%
Internal failure	25%
External failure	<u>25%</u>
Total costs	<u>100%</u>

With a partner, explain why the following industries might be inclined to have a spending pattern on quality costs that differs from the benchmark:

- Pharmaceutical company
- Department store
- Computer manufacturer
- Used car retailer
- Lawn service company

## PROBLEMS



45. (*Pareto analysis*) Leading Edge Computers has identified the following failure costs during 2000:

Model	COST OF TYPE OF FAILURE				Total
	CPU	Internal Drive	External Drive	All Other	
Laptop	\$ 8,000	\$ 7,000	\$ 5,000	\$ 3,000	\$23,000
Desktop	7,000	6,000	12,000	5,000	30,000
Mini	<u>3,000</u>	<u>1,000</u>	<u>8,000</u>	<u>3,000</u>	<u>15,000</u>
Total	<u>\$18,000</u>	<u>\$14,000</u>	<u>\$25,000</u>	<u>\$11,000</u>	<u>\$68,000</u>

- Rearrange the rows in descending order of magnitude based on the total dollars column and prepare a table using Pareto analysis with the following headings:

Model	Dollars	Percentage of Total	Cumulative Percentage of Total
-------	---------	---------------------	--------------------------------

- Which models account for almost 80 percent of all failure costs?

- c. Focusing on the models identified in part (b), prepare a table using Pareto analysis to identify the types of failure causing the majority of failure costs. (*Hint*: Rearrange the cost of failure types in descending order of magnitude.) Use the following headings for your table:

Failure Type	Dollars	Percentage of Total	Cumulative Percentage of Total
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- d. Describe the problem areas for which to seek preventive measures first. How, if at all, does this answer reflect the concept of leverage?
46. (*Pareto analysis*) Select Refrigerators has identified the following warranty costs during 2000 according to the type of product failure as follows:

Model	Electrical	Motor	Structural	Mechanical	Dollars
Chic	\$25,000	\$27,000	\$15,000	\$ 5,000	\$ 72,000
Elegant	28,000	32,000	26,000	6,000	92,000
All others	8,000	15,000	6,000	9,000	38,000
Total	<u>\$61,000</u>	<u>\$74,000</u>	<u>\$47,000</u>	<u>\$20,000</u>	<u>\$202,000</u>

- a. Rearrange the rows in descending order of magnitude based on the total dollars column and prepare a table using Pareto analysis with the following headings:

Model	Dollars	Percentage of Total	Cumulative Percentage of Total
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- b. Which model(s) account for the vast proportion of all failure costs? Discuss.
- c. Devise a plan to address prioritizing projects regarding development of preventive measures based on the findings in the Pareto analysis you just conducted for Select Refrigerators.
47. (*Cost of quality*) Lampposts-R-Us, Ltd., manufactures hardwood lampposts for the discriminating homeowner. The firm produced 3,000 lampposts during its first year of operations. At year-end, there was no inventory of finished goods. The company sold 2,700 through regular market channels (some after rework), but 300 units were so defective that they had to be sold as scrap. For this first year, the firm spent \$30,000 on prevention costs and \$15,000 on quality appraisal. There were no customer returns. An income statement for the year follows.



Sales: Regular channel	\$270,000	
Scrap	<u>12,000</u>	\$282,000
Cost of goods sold:		
Original production costs	\$150,000	
Rework costs	22,000	
Quality prevention and appraisal	<u>45,000</u>	(217,000)
Gross margin		\$ 65,000
Selling and administrative expenses (all fixed)		<u>(90,000)</u>
Net loss		<u>\$ (25,000)</u>

- a. Compute the total profits lost by the company in its first year of operations by selling defective units as scrap rather than selling the units through regular channels.
- b. Compute the total failure costs for the company in its first year.
- c. Compute total quality costs incurred by the company in its first year.
- d. What evidence indicates the firm is dedicated to manufacturing and selling high-quality products?
48. (*Cost of quality*) ClearTone makes portable telephones, and produced 20,000 phones during 2000, its first year of operations. It sold all it produced that first year but 500 phones had a particular defect. Of these, 200 were reworked and

sold through regular channels at the original price while the rest were sold as “seconds” without rework. In 2000, ClearTone spent \$25,000 for prevention measures and \$18,000 on appraisal. Following is ClearTone’s 2000 income statement. ClearTone is a partnership; thus, no income taxes are presented on the income statement.

Regular sales (19,700 units)	\$1,970,000	
Sales of seconds (300 units)	<u>21,000</u>	\$1,991,000
Cost of goods sold:		
Original production costs	\$ 800,000	
Rework costs (200 units)	2,000	
Prevention and appraisal costs	<u>43,000</u>	<u>(845,000)</u>
Gross margin		\$1,146,000
Selling and administrative expenses (all fixed)		<u>(600,000)</u>
Net income		<u>\$ 546,000</u>

- a. Compute the total revenue lost by ClearTone in its first year of operations by selling defective units as seconds rather than reworking the units and selling them at the regular price.
  - b. Compute the total failure costs for the company in 2000.
  - c. Compute total quality costs incurred by the company in 2000.
  - d. What evidence indicates the firm is dedicated to manufacturing and selling high-quality products?
49. (*Cost of quality*) Golf courses are demanding in their quest for high-quality carts because of the critical need for lawn maintenance. Ride-in-Style manufactures golf carts and is a recognized leader in the industry for quality products. In recent months, company managers have become more interested in trying to quantify the costs of quality in the company. As an initial effort, the company was able to identify the following 2000 costs, by categories that are associated with quality:

<i>Prevention Costs</i>	
Quality training	\$15,000
Quality technology	50,000
Quality circles	32,000
<i>Appraisal Costs</i>	
Quality inspections	\$18,000
Test equipment	14,000
Procedure verifications	9,000
<i>Internal Failure Costs</i>	
Scrap and waste	\$ 6,500
Waste disposal	2,100
<i>External Failure Costs</i>	
Warranty handling	\$ 9,500
Customer reimbursements/returns	7,600

Managers were also aware that in 2000, 250 of the 8,000 carts that were produced had to be sold as scrap. These 250 carts were sold for \$80 less profit per unit than “good” carts. Also, the company incurred rework costs amounting to \$6,000 to sell 200 other carts through regular market channels.

- a. Using these data, find Ride-in-Style’s 2000 expense for the following:
  1. Lost profits from scrapping the 250 units
  2. Total failure costs
  3. Total quality costs
- b. Assume that the company is considering expanding its existing full 5-year warranty to a full 7-year warranty in 2001. How would such a change be reflected in quality costs?

50. (*Cost of quality*) Tanks-a-Lot Ltd. is very aware that its scuba diving tanks must be of high quality to maintain its reputation of excellence and safety. You have been retained as a consultant by the company and have suggested that quantifying the costs of quality would be important to an understanding of and management of quality. Your experience as a cost accountant helped you determine the following year 2000 costs of quality from the company's accounting records:

<i>Prevention Costs</i>	
Foolproofing machinery	\$10,000
Quality training	30,000
Educating suppliers	22,000
<i>Appraisal Costs</i>	
Quality inspections	\$12,000
Recording defects	9,000
Procedure verifications	6,000
<i>Internal Failure Costs</i>	
Waste disposal	\$ 4,500
Unplanned downtime	1,400
<i>External Failure Costs</i>	
Warranty handling	\$ 6,400
Customer reimbursements/returns	5,100

You also determined that 1,200 of the 100,000 tanks made in 2000 had to be sold as scrap for \$70 less profit per tank than the nondefective tanks. Tanks-a-Lot also incurred \$4,000 of rework costs that had been buried in overhead (in addition to the failure costs presented above) in producing the tanks sold at the regular price.

- a. Tanks-a-Lot management has asked you to determine the year 2000 "costs" of the following:
  1. Lost profits from scrapping the 1,200 units
  2. Total failure costs
  3. Total quality costs
- b. Assume that the company is considering expanding its existing full 2-year warranty to a full 3-year warranty in 2001. How would such a change be reflected in quality costs?

## REALITY CHECK

51. Use the Internet to find four definitions of quality.
  - a. Compare and contrast each of the four definitions, with specific emphasis on whether the definition is conformity or customer oriented.
  - b. Assume that you are the manager of (1) a copy store and (2) a kitchen blender manufacturer. Prepare definitions of quality to distribute to your employees and discuss how you would measure service/product adherence to those definitions.
52. Institutions of higher education have a variety of internal and external customers. Use a team of three or four individuals to answer the following.
  - a. List three internal and two external customers of a college or university.
  - b. How would each of the constituents from part (a) define quality of product or service? Do any of these views conflict and, if so, how?
  - c. Are a college or university's internal customers as important as external customers? Explain the rationale for your answer.



53. By building quality into the process, rather than making quality inspections at the end of the process, certain job functions (such as that of quality control inspector) can be eliminated. Additionally, the installation of automated equipment to monitor product processing could eliminate some line worker jobs.

In a nation with fairly high unemployment, would employers attempting to implement valid quality improvements that resulted in employee terminations be appreciated or condemned? Discuss your answer from the standpoint of a variety of concerned constituencies, including the consumers who purchase the company's products.

54. Assume that you are in charge of a social service agency that provides counseling services to welfare families. The agency's costs have been increasing with no corresponding increase in funding. In an effort to implement some cost reductions, you implement the following ideas:
1. Counselors are empowered to make their own decisions about the legitimacy of all welfare claims.
  2. To emphasize the concept of "do it right the first time," counselors are told not to review processed claims at a later date.
  3. To discourage "out-of-control" conditions, an upper and lower control limit of 5 minutes is set on a standard 15-minute time for consultations.
- Discuss the ethics as well as the positive and negative effects of each of the ideas listed.
55. Sometimes a company, in its efforts to reduce costs, might also reduce quality.
- a. What kinds of costs could be reduced in an organization that would almost automatically lower product/service quality?
  - b. If quality improvements create cost reductions, why would cost reductions not create quality improvements?
  - c. Are there instances in which cost reductions would create quality improvements?
56. *Increasing numbers of U.S. businesses have been seeking to comply with the ISO 9000 standards simply because of real or perceived market forces. Some of the most commonly given reasons for seeking ISO 9000 registration or compliance follow:*

- *"Our customers are demanding it, often by putting ISO 9000 into contracts."*
- *"Our customers say they will treat ISO 9000-registered suppliers preferentially."*
- *"Our competitors are achieving registration, so we must also."*
- *"We need to improve quality; ISO 9000 seems like a practical, no-nonsense, and internationally accepted approach."*
- *"Our customers demand quality; ISO 9000 registration makes a statement about our commitment to quality."*
- *"Our European divisions already have ISO 9000 registration, and they are putting pressure on us to conform."*
- *"Our industry seems to be moving toward ISO 9000."*

*The rapid growth of ISO 9000 implementation shows that the forces of the marketplace (whether the direct forces at work in regulated industries or the indirect ones that govern the free markets) are an effective influence in getting companies to adopt standards and, more importantly, to use them to improve their processes.*

SOURCE: Stanley A. Marash and Donald W. Marquardt, "Quality Standards and Free Trade," *Quality Progress* (May 1994), p. 29. © 1994 American Society for Quality. Reprinted with permission.

- a. Why do you think customers are insisting that suppliers meet ISO 9000 standards?

- b. Does meeting ISO 9000 standards mean that a supplier's products or services are superior to those of competitors? Elaborate on what such conformance means.
- c. Why would the fact that a supplier's industry is moving toward ISO 9000 motivate the supplier to seek registration?
- d. How would complying with ISO 9000 help a company improve quality?

57. Find the Web page for Collins Printed Circuits of Rockwell Avionics. What products does this company make? How does the company use statistical process controls to control the quality of output? What is the role of the firm's group testing lab in controlling quality?



58. Find The Benchmarking Exchange on the Internet. What are the top five business processes that are currently the focus of benchmarking by members of The Benchmarking Exchange? Why have benchmarking processes related to managing human resources remained so highly ranked?



59. *Just how tired were Delta Air Lines Capt. Roscoe McMillan and his crew last Wednesday when he diverted his Atlanta-to-Tokyo flight to Portland, Oregon, and called it a day? Too tired, in his judgment, based on more than 30 years as a Delta pilot, to continue safely with the 14-hour journey to Narita International Airport, according to what the captain told Delta officials. The problem: Two of the other pilots couldn't sleep in the aircraft's controversial new berths, and based on earlier experience, Capt. McMillan figured he couldn't either.*

<http://www.delta-air.com>

*Capt. McMillan, who has a perfect flying record and a reputation for being outspoken, has been campaigning against the bunks from the start. In a recent posting on the pilots' union private Web site, he wrote of the new setup: "I think it stinks."*

*Delta adopted the new berths as part of a redesign of its international service. Among other things, the new bunks allow for more seats, which Delta says will translate into \$40 million in additional revenue from the five altered planes over the next five years. Shortly after the incident, the Air Line Pilots Association filed a grievance and lodged a complaint over the issue of the berths with the FFA.*

SOURCE: Adapted from Martha Branigan, "This Is Your Captain: Prepare for Landing, It's Time for My Nap," *The Wall Street Journal* (April 15, 1999), p. A1.

- a. Who are the stakeholders in this situation? What do you think are the ethical issues?
- b. If you were asked by Delta and the pilots union to mediate this issue, what are the facts you might need to determine?
- c. What are the economic benefits and risks that should concern an airline in such a case?
- d. What are the issues that should concern the pilots and the union?

60. *In a move that clears the way for a wave of high-tech interactive gadgets in cars and trucks, five of the world's biggest automakers announced they are pursuing a common wiring standard for new vehicles. General Motors Corp., Ford Motor Co., DaimlerChrysler AG, Toyota Motor Corp., and Renault SA said they signed a memorandum of agreement to develop an industrywide standard so their new vehicles can accommodate the array of communications and entertainment equipment being developed for the auto industry. Additional automakers are expected to sign onto the agreement in coming months, industry executives said.*

<http://www.daimlerchrysler.com>

<http://www.renault.com>

SOURCE: Jeffrey Ball, "Five of the World's Top Auto Makers Agree to Develop Technology Standard," *The Wall Street Journal* (April 28, 1999), p. B6.

- a. What are some advantages to an automaker of having a single industry quality standard?

- b. What are some advantages to automaker customers of having a single industry quality standard?
  - c. How would a nation benefit if all major companies in an industry were to subscribe to a single quality standard?
61. *Words of wisdom from Dennis K. Pawley, retired manufacturing chief of the former Chrysler Corp. and now a management consultant, are as follows:*
- 1. *“The biggest reason companies fail is a failure to reflect. They become egotistical.”*
  - 2. *“If it ain’t broke, break it.”*
  - 3. *“Heroes exist in a company because of a lack of a system.”*
  - 4. *“It’s easy to be process-centered when things are going good. But when things go bad, that’s the real test.”*
  - 5.  *$D \times V \times F > R$ . Translation: (Dissatisfaction with the status quo)  $\times$  (Vision of the future)  $\times$  (Courage to take the first steps) must be greater than (Resistance to change).*

SOURCE: Jeffrey Ball, “Your Career Matters: A Car Veteran Explains Why  $IPC = (A + W + P - I) \times S$ ,” *The Wall Street Journal* (June 8, 1999), p. B1. Permissions conveyed through the Copyright Clearance Center.

In your own words, compose a brief explanation of what you think Mr. Pawley meant by each of the “words of wisdom.”



<http://www.sony.com>

62. *Several years ago, Sony Corp., the consumer electronics and entertainment giant, halted shipments of its much-ballyhooed 18-inch digital satellite dish system following a rash of consumer complaints. The problems, which involved television picture reception, were said to have included the appearance of horizontal green lines and images freezing motionless on the screen.*

*“We estimate that only 2.5% of our consumers have experienced the problems, but we’re taking the matter seriously,” said a Sony spokesman.*

SOURCE: Adapted from Jeffrey A. Trachtenberg, “Sony Confirms It Halted Sales of Satellite Dish,” *The Wall Street Journal* (September 7, 1995), p. B1.

- a. Do you think admitting the product was defective hurt or helped Sony’s reputation?
- b. Discuss the costs and benefits of halting sales?
- c. Use the Internet to find an example of a company that has continued to sell its product in spite of complaints and other negative feedback about quality. What have been the results?