Introduction to Quality

CHAPTER OBJECTIVES

After completing this chapter, the reader should be able to:

- discuss the development of quality as a discipline;
- discuss the complexity of defining quality;
- compare and contrast the leading approaches to defining quality;
- discuss the differences between defining quality for manufactured goods and for services;
- discuss the major contributors to the quality profession; and
- define key quality management terms.

This book is about quality. Quality is a very important part of life today. It is important to effectively compete in business—both manufacturing and service. It plays an important role in assuring the safety of consumers. Quality of life is an increasingly used term that brings the concepts of quality into our personal lives.

But quality is also a frequently misunderstood and misapplied concept. Some believe that quality is still the responsibility of the quality department rather than of everyone in the organization. Some believe that quality is simply avoiding doing things that will dissatisfy customers. Others believe that quality is a manufacturing concept with limited applicability to services. Still others view quality as a sort of "magic bullet," as if nominally implementing some quality program or another will magically improve performance without changing the culture of the organization.

From a theoretical perspective, this book is designed to further the understanding of quality and its relationship to management systems. From a practical perspective, this book will help the reader understand the basic fundamentals and tools of quality, the interrelationship between quality and other functions in the organization, and how to use this knowledge to materially improve quality and impact the performance of the organization.

WHY STUDY QUALITY?

In larger organizations such as Dow Chemical, General Electric, Motorola, Bank of America, MBNA, and Mayo Clinics, it is difficult to find a job that does not require knowledge of quality principles. Many smaller organizations such as Huntsville Memorial Hospital, El Chico, and Gallery Furniture also have made quality a central component of their strategic plans and management systems. Mrs. Fields' Cookies was founded on the basis of quality as the source of competitive advantage. Xerox used quality as the major building block in restructuring and revitalizing their company. Many governmental, charitable, and religious (Boggs, 2004) organizations have also embraced quality. In order to prepare for employment in the current environment and to prepare for increasing responsibilities within modern business, governmental, and service organizations, knowledge of quality principles is becoming increasingly important.

HISTORY OF QUALITY

Quality is not a new concept. The very survival of early humanoids depended upon the quality of the tools that they fabricated from stone and bone, and later bronze and iron. Quality was fully integrated into the manufacturing processes that were passed along from one generation to the next. As civilization evolved, specialization of labor began to develop. The earliest recorded civilizations had experts in weaving, ceramics, metal working, and other crafts, who developed their techniques within various sorts of organizations such as guilds, masters-apprenticeships, and unions. To this point in history, quality was the responsibility of the craftsperson creating the product or rendering the service.

Beginning in the late eighteenth century, progressing through the Industrial Revolution and into the early twentieth century, industry moved from the craft concept to the concepts of specialization of labor, scientific management, and mass production. The invention of interchangeable parts that began in the 1700s made adherence to specifications vital. No longer were individual craftspeople free to adapt designs as they saw fit to create unique products and services for their customers. Each worker had to be sure that the parts he or she created were as identical as possible to those created by other workers in the organization. With many workers producing parts that had to fit together to form the final product, management had a need for systems to define material quality, work methods, and specifications and to control the processes that produced the parts. This led to the formalization of quality as a discipline.

THE DEFINITION OF QUALITY

What is quality? This is a much more complex question than it first appears. Yet how do we go about studying quality, measuring quality, and designing quality into products and services, or improving quality if we do not know what it is? *Quality* is

a much more complicated term than it appears. A historian of ideas suggests Plato should be credited with inventing the term *quality*.

> The more common a word is and the simpler its meaning, the bolder very likely is the original thought which it contains and the more intense the intellectual or poetic effort which went into its making. Thus, the word *quality* is used by most educated people every day of their lives, yet in order that we should have this simple word Plato had to make the tremendous effort (it is perhaps the greatest effort known to man) of turning a vague feeling into a clear thought. He invented a new word "poiotes," "what-ness," as we might say, or "of-what-kind-ness," and Cicero translated it by the Latin "qualitas," from "qualis." (Barfield, 1988)

Early debates over the definition of quality are dramatized by Plato in a number of his dialogues—for example, the one between Socrates and the sophist Hippias in *Greater Hippias*. In this dialogue, Socrates, after criticizing parts of an exhibition speech by Hippias as not being fine, asks the question, "What the fine is itself?" Cooper (1997), the editor of a translation of Plato, translates the Greek word *kalon* as "fine." This word is widely applicable as a term "of highly favorable evaluation, covering our 'beautiful,' 'noble,' 'admirable,' 'excellent,' and the like." What Socrates is seeking "is a general explanation of what feature any object, or action, or person, or accomplishment of any kind, has to have in order correctly to be characterized as highly valued or worth valuing in this broad way (i.e. as being fine)."

The philosophical development of the idea of quality can be traced beyond Plato (circa 400 BC) through Augustine (circa 600 AD), Smith (circa 1700), and Mill (circa 1800) to the modern quality movement beginning with Shewhart (circa 1930). Among the definitions of quality of things in *The Oxford English Dictionary* (1989), definition 9c most expresses the concept of quality in modern use by quality professionals: "Peculiar excellence or superiority." But dictionary definitions are usually inadequate in helping a quality professional understand the concept. Quality must be defined in ways that can be assessed and measured. Measurement of "excellence" and "superiority" is difficult because these terms are subject to differences in perceptions among individuals.

Modern Definitions of Quality

The quality movement began in a systematic way in the United States during the late 1920s with the work of Walter Shewhart. The first modern quality revolution occurred in the United States during the World War II years, after which it declined in this country until the early 1970s. The second quality revolution occurred in Japan in the 1950s with the work of W. Edwards Deming, Joseph Juran, and Armand Feigenbaum, and it resulted in Japan's emergence as an economic power. The third quality revolution began in the United States during the early 1970s when the work of Deming, Juran, Feigenbaum, and Phillip Crosby was finally recognized and put into practice in this country.

During each of these revolutions, attention was paid to defining just what this "quality" was. The first modern definition of quality was offered by Shewhart during the first quality revolution. Most modern formal definitions trace back to the second quality revolution—primarily to the work of Juran and Feigenbaum. During the third

quality revolution, David Garvin weighed in with a comprehensive analysis of the meaning of quality. The American Society for Quality has published its definition of quality. But as we have seen, these efforts to define quality are by no means the first.

> ASQ defines quality as "a subjective term for which each person has his or her own definition. In technical usage, quality can have two meanings: (1) the characteristics of a product or service that bear on its ability to satisfy stated or implied needs and (2) a product or service free of deficiencies."
>
> (Quality Glossary, 2002, p. 56)

Walter Shewhart (1931) was the first modern era quality expert to wrestle with the definition of quality. Shewhart suggested that quality has two aspects. The objective aspect refers to quality of a thing as "an objective reality independent of the existence of man." The subjective aspect refers to quality as "what we think, feel, or sense as a result of the objective reality." According to Shewart, although it is the objective aspect of quality that we usually attempt to measure, it is the subjective aspect that is of commercial interest. Deming (1933), in his last book, *The New Economics for Industry, Government, Education*, agreed that quality is subjective and must have commercial value. "What is quality? A product or service possesses quality if it helps somebody and enjoys a good and sustainable market. Trade depends on quality."

Building on Shewhart's work, Juran (1970) defined quality as "fitness for use" and Feigenbaum (1951) defined it as "best for certain customer conditions." These definitions form the basis for the modern definition of quality.

Parasuraram and others define quality as meeting or exceeding customer expectations. But in Deming's (1993, 30) words, "Just to have the customer satisfied is not enough . . . You have to do better than that." To operationalize the customer-focused definition, one must define who the customer is. *External customers* usually come to mind first. These are the people outside our organization who receive our goods and services. But even here there is some confusion. If we sell our products to a wholesaler, is he our only customer? How about the retailer and the ultimate consumer? *Internal customers* are often forgotten or taken for granted. These are the people inside our organization who receive our work services. In an assembly-line operation, the next station downstream from ours is an internal customer for our work. The Purchasing Department which receives a control report from the Accounting Department is the latter's internal customer. Every process has a customer.

Once the customer has been defined, ways must be found to meet or exceed customer expectations. Meeting customer expectations results in a satisfied customer. But where is the competitive advantage in that? Have you eaten in a restaurant in the past month? If so, did you select a restaurant that you expected would dissatisfy you? Probably not. You selected from a list of restaurants that you expected would. So

satisfying customers merely keeps you in the game. Delighting customers (exceeding customer expectations) is where competitive advantage can be found. Restaurants that deliver larger-than-expected portions or lower-than-expected prices or better-than-expected service or better-than-expected ambiance have a competitive advantage over restaurants that simply satisfy customers.

Product Quality

There is widespread agreement that quality is a multidimensional construct. A number of scholars in the quality field have developed lists of dimensions that define quality for a product and/or a service. David Garvin (1984) developed a list of eight dimensions of product quality, shown in Table 1.1, that are widely accepted as being applicable to most products albeit with varying levels of importance on particular dimensions. These dimensions were proposed to facilitate strategic quality analysis by breaking "down the word quality into manageable parts" so that management "can define the quality niches in which to compete."

The relative importance of each of these eight dimensions varies considerably. In fact, Garvin proposed that product design often cannot simultaneously maximize each of these eight dimensions. There are always tradeoffs to be considered. For example, compromises might have to be made in aesthetics in order to improve access to a computer CPU case to increase serviceability. Garvin suggests that it is the role of strategic quality management to select the dimensions on which to compete and to manage the tradeoffs.

TABLE 1.1.   Garvin's (1987) Eight Dimensions of Product Quality

Dimension	Description	Example for Personal Computer
Performance	A product's primary operating characteristics	Clock speed; RAM; hard drive size
Features	Characteristics that supplement basic functioning	Wireless mouse; flat-screen monitor; DVD-RW
Reliability	Probability of a product malfunctioning within a specific time period	Mean time between failures
Conformance	The degree to which a product's design and operating characteristics meet established standards	Underwriter Laboratories labeled; mouse, monitor, keyboard included with CPU
Durability	Expected product life	Time to technical obsolescence; rated life of monitor
Serviceability	Speed, courtesy, competence, and ease of repair	Warranty conditions; availability of customer service and replacement parts
Aesthetics	How a product looks, feels, sounds, tastes, or smells	Computer housing color scheme; keyboard "touch"
Perceived Quality	Reputation and other indirect measures of quality	Brand name; advertising

Service Quality

Defining the dimensions of service quality is a more daunting task. A number of scholars have developed lists of service quality dimensions. These consist of five to ten dimensions and are general lists that serve as good starting points. But current research indicates that in terms of service quality, the dimensions and the relative emphases on each are different for different industries. So dimensions developed in one or a group of service industries may not be directly applicable to another group of service industries.

The SERVQUAL (Parasuraman, et al., 1988) instrument is often used to assess customer satisfaction in service industries. It measures quality by comparing customer perceptions of the quality of a service experience to customer expectations for that experience. The instrument is based on ten overlapping dimensions of service quality that is eventually distilled down to five dimensions shown in Table 1.2. The instrument was developed in four different service industries: banking, credit card, repair and maintenance, and long distance telephone.

Although SERVQUAL has been criticized and its applicability to other service industries questioned (Babacus & Boller, 1992; Cronin & Taylor, 1992), it provides a basis for understanding service quality and its dimensions. It would be dangerous, however, to utilize SERVQUAL or any other instrument without first validating that it is applicable in a particular industry.

Developing a list of quality dimensions for a specific service industry requires determining what is important to customers in that industry. Methodologies that are appropriate for this would include focus groups and surveys. The quality dimensions for hospitals (KQCAH Scale), shown in Table 1.3, were developed using focus groups conducted with recently discharged patients and their families, and with hospital personnel (Sower, et al., 2001). Knowledge of these dimensions facilitates the measurement of patient satisfaction by hospitals. Hospitals know that they are

TABLE 1.2. SERVQUAL Dimensions of Service Quality (Parasuraman, et al., 1988)

Dimension	Description	Example for Bank
Tangibles	Physical facilities, equipment, and appearance of personnel	ATM access; lobby layout; tellers dressed professionally
Reliability	Ability to perform the promised service dependably and accurately	Promised deadlines met; reassuring problem resolution
Responsiveness	Willingness to help customers and provide prompt service	Respond quickly to customer requests; willingness to help customers
Assurance	Knowledge and courtesy of employees and their ability to inspire trust and confidence	Trustworthiness; safe environment around ATMs; polite tellers
Empathy	Caring, individualized attention the firm provides its customers	Personal attention to customers; convenient hours

TABLE 1.3.   Eight Dimensions of Hospital Service Quality (Sower, et al., 2001)

Dimension	Description	Example for Hospital
Respect & Caring	The way in which hospital staff interacts with the patient	Staff paid attention to patient and was reassuring; privacy was protected; staff was friendly
Effectiveness & Continuity	Transition from unit to unit or hospital to home handling	Preparations for discharge; provision of necessary home care.
Appropriateness	Physical facilities and staff professionalism	Comfort and cleanliness of facilities; lighting; staff dress and behavior
Information	Keeping patient and family members informed	Quick provision of information about condition; availability of doctors; availability of counselors
Efficiency	Billing	Understandability of bill; availability of staff to explain bill; complaint handling
Meals	Quality and efficiency of meal service	Taste; timeliness; temperature
First Impression	First contact with hospital	Admission experience; hospital entrance
Staff Diversity	Staff composition generally reflective of community composition	Racial, gender diversity; availability of multilingual personnel

measuring dimensions that are important to patients. But these dimensions are unlikely to define quality for other service industries such as restaurants, automobile repair shops, or banks.

The foregoing discussion could lead to the following definition of quality: Quality is a multidimensional construct, the dimensions of which must be uniquely established for each category of product or service being evaluated. Even though this definition might be philosophically unsatisfying, it does provide the basis for operationalizing quality in measurable ways.

Different Approaches to Defining Quality

Another concept that developed during the 1990s is the strategic concept of order qualifiers and order winners (Hill, 2000). Order qualifiers are minimum characteristics that a product or service must have in order to be considered to be of acceptable quality. A flashlight that does not provide light would not be considered a quality item under this definition. One might make the argument that a product or service not meeting order qualifier standards would have no quality. In this context order qualifiers are those dimensions necessary to produce customer satisfaction. Order

winners are those enhancements that exceed the minimum characteristics. Order winners could include enhanced battery life, custom fit to the hand, or enhanced beam focus in the case of a flashlight. One could conceive of order winners providing the basis for differentiating various levels of quality in a product or service and therefore leading to customer delight.

Five Approaches to Defining Quality

David Garvin (1984) identified five major approaches to defining quality:

1. The Transcendent Approach. In this view "quality is synonymous with 'innate excellence'" and is "absolute and universally recognizable." This is the approach that most closely aligns with Socrates' question "What is the fine?" from *Greater Hippias* (Cooper, 1997). This approach implies that there is a construct called quality that is universally applicable. This approach is the basis for philosophical debate—but some say it is of little practical utility. Others argue that the transcendent approach is "the fundamentally most important approach to thinking about quality—particularly in the quality of design of breakthrough products and services" (Sower & Fair, 2005).

2. The Product-based Approach. In this view quality is "a precise and measurable variable" that is a composite of all the attributes that describe the degree of excellence of a product. This approach is illustrated by a draft of the ISO 8402 standard (1990) which stated that "quality...is the degree to which a...product possesses a specified set of attributes necessary to fulfill a stated purpose."

3. The User-based Approach. In this view quality is in the eye of the beholder—the customer. This approach has spawned tools such as quality function deployment (QFD). QFD is a structured approach to assure that the customer's voice is heard during product design. Although this approach has proven to be of practical value in the design of products based on incremental innovations, it is of limited value in designing products based on radical innovations. Products based on radical innovation enter a market that may not exist and where customers may not be able to articulate their needs. In the case of radical innovation, the transcendent approach may be of more than just philosophical interest.

"If we were to go back in time 100 years and ask a farmer what he'd like if he could have anything, he'd probably tell us he wanted a horse that was twice as strong and ate half as many oats. He would not tell us he wanted a tractor. Technology changes things so fast that many people aren't sure what the best solutions to their problems might be."

(Quigley, 2000)

4. The Manufacturing-based Approach. In this view quality is "conformance to (engineering and manufacturing) requirements." W. Edwards Deming (Walton, 1986) criticizes this approach as "the absurdity of meeting specifications . . . Specifications don't tell you what you need . . . Just to meet specifications—what you think the customer requires—no. That won't keep you in business" (Walton, 1986). Taguchi argued that the manufacturing-based approach was fundamentally flawed. He argued that simply meeting specifications is not good enough. He developed the quadratic loss function which shows that losses increase exponentially as a parameter deviates from its target value even if it still meets specifications. Others argue that conformance to specifications is a practical approach to defining quality if and only if the specifications derive from customer requirements (user-based approach). Philip Crosby (1979) goes so far as to say that "we must define quality as 'conformance to requirements' if we are to manage it. Instead of thinking of quality in terms of goodness or desirability (transcendent approach) we are looking at it as a means of meeting requirements . . . Quality means conformance. Nonquality is nonconformance."

5. The Value-based Approach. In this approach, quality is defined "in terms of costs and prices . . . A quality product is one that provides performance at an acceptable price or conformance at an acceptable cost." (Garvin, 1984) Philip Crosby (1979) also endorses this approach: "Quality is precisely measured by the cost of quality which . . . is the expense of nonconformance (to requirements)." This blends the value-based approach with the manufacturing-based approach.

It seems that every quality expert defines quality in a somewhat different way. There is a variety of perspectives that can be taken in defining quality (e.g., customer's perspective, specification-based perspective). Are there commonalities among these definitions? Is any one definition "more correct" than the other? Is one quality expert "right" and the other "wrong"? Quality professionals constantly debate these questions. More than 2,400 years after Plato's time we find ourselves still asking the question "What is quality?"

MAJOR CONTRIBUTORS TO OUR UNDERSTANDING OF QUALITY

Walter Shewhart is considered by many to be the founder of the modern quality movement and an innovator in the application of statistics to quality. His seminal contributions were based on his work at Bell Telephone Laboratories and were published in two books: *Economic Control of Quality of Manufactured Product* in 1931 and *Statistical Method from the Viewpoint of Quality Control* in 1939. Interestingly, W. Edwards Deming authored the foreward in the 1939 book. Shewhart wrestled with the definition of quality and proposed that quality has both an objective and a subjective side. While acknowledging that the subjective side is of great commercial interest, he focused his attention on the objective side of quality. He stressed the need for operational definitions that are easily communicable.

Walter Shewhart. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)

W. Edwards Deming. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)

Besides contributing his thoughts on the definition of quality, Shewhart provided great insight into the collection, analysis, and presentation of data in the quality discipline. He recognized that processes are subject to variation from two sources: chance causes that are inherent in the system, and assignable or special causes that are signs of trouble in the system. He developed control charts that provide a statistical basis for separating these two types of variation. He defined the state of statistical control as a state of predictability that exists when there are is no assignable or special cause variation in a process.

He was an advocate of a systems approach to quality control. Shewhart recognized that the focus on the consumer was central and that all parts of the production process from raw materials, to methods, to inspection practices were crucial to producing quality products. He was also an advocate of continual improvement. He developed the Shewhart cycle for continual improvement: plan—do—check—act (PDCA). "The application of statistical methods in mass production makes possible the most efficient use of raw materials and manufacturing processes, and makes possible the highest economic standards of quality for the manufactured goods used by all of us" (Shewhart, 1939).

W. Edwards Deming invited Walter Shewhart to present a series of lectures before the Graduate School of the Department of Agriculture, lectures that eventually developed into Shewhart's 1939 book. Deming is best known for helping to lead the Japanese manufacturing sector out of the ruins of World War II to become a major presence in the world market. The highest quality award in Japan, The Deming Prize, is named in his honor. He is also known for his 14 points (a new philosophy for competing on the basis of quality), for the Deming chain reaction,
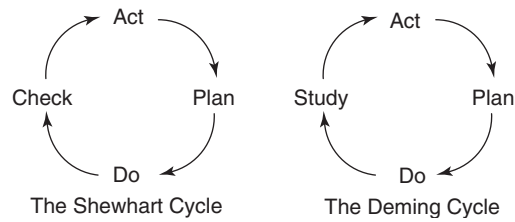
Figure 1.1. PDCA and PDSA

and for the theory of profound knowledge. (For an excellent summary of the theory of profound knowledge, go to http://www.maaw.info/DemingExhibit.htm). He also slightly modified the Shewhart cycle (plan, do, check, act), as shown in Figure 1.1, to what is now referred to as the Deming cycle (plan, do, study, act–PDSA).

Deming advocated improving the system rather than criticizing the workers. He believed that workers were already doing their best with the systems that management provided to them. But doing one's best without direction results in poor results. It is the responsibility of management to provide the direction that workers need, and this cannot be done by the use of management by objectives (which Deming referred to as management by fear) or annual performance reviews (which he condemned). The plan he proposed for management is embodied in his 14 points, shown in Figure 1.2, that must be implemented in their entirety in order to be effective. To skip one point will inhibit the effectiveness of the other 13 according to Deming.

1. Create constancy of purpose for improvement of product & service.
2. Adopt the new philosophy.
3. Cease dependency on mass inspection.
4. End the practice of awarding business on price tag alone.
5. Improve constantly and forever the system of production & service.
6. Institute training.
7. Institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the workforce.
11. Eliminate numerical quotas.
12. Remove barriers to pride of workmanship.
13. Institute a vigorous program of education & retraining.
14. Take action to accomplish the transformation.

Figure 1.2. Deming's (1981–1982) 14 Points for Management

Mattress Mack, Gallery Furniture, and W. Edwards Deming

One advocate of the Deming approach to management is Jim "Mattress Mack" McIngvale, owner of Gallery Furniture in Houston, Texas—the biggest single retail store in America. Gallery thrived during the early 1980s, but began to feel the effect of the decline in the local economy in the late 1980s. After attending a Philip Crosby quality seminar, Mack was convinced that he should reinvent Gallery around quality. One thing bothered Mack about the Crosby approach—the idea of zero defects. That didn't seem reasonable in the retail environment. After hearing of W. Edwards Deming and attending two Deming seminars, Mack took what he referred to as a "hop of faith" and implemented some of Deming's points. It wasn't until he attended additional Deming seminars that he decided to take the leap of faith of implementing all 14 points.

Prior to implementing the Deming philosophy, Gallery operated on the traditional furniture retail model. Salespersons were on commission and ranked each month using an appraisal system that Mack characterizes as an "adult report card." Early on, Mack decided to fire the salesperson who had the lowest sales each month. In this environment customers sometimes felt as if they were walking into a flock of vultures when they entered Gallery Furniture. Each salesperson competed with all the others for each customer. The incentive was to sell the customer the highest-priced merchandise in order to maximize sales. Mack would rant and yell at employees who brought him bad news, creating an environment of fear.
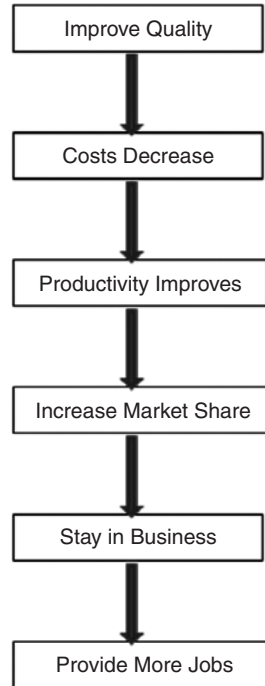
After taking his leap of faith, Mack did away with commissions and the appraisal system. He found that managing by walking around—talking, listening, and watching employees and customers—was more effective. Rather than reacting negatively to bad news, Mack learned to thrive on it. He recognized that employees who are properly trained and empowered can bring problems to light early and assist in using bad news to fix and adjust the system. The result was a Gallery Furniture that was focused on customer delight, not on rating employees. Gallery Furniture's single-site store sells more furniture per square foot than any other store in the world. It is the most productive furniture store in the world.

(McIngvale, 2002, and various public speeches made by Mattress Mack)

The Deming chain reaction, shown in Figure 1.3, was first presented in 1950—early in Deming's time in Japan after World War II. It illustrated Shewhart's concept that productivity improves as variation is reduced and quality is improved. According to Deming, this became a way of life in Japanese industry.

Deming's theory of profound knowledge says that a production system is composed of many interacting subsystems. Management's job is to set the purpose for the system and to optimize the system. Variation is an inherent part of any system. Common causes of variation account for 80–90 percent of the total variation;

The Deming Chain Reaction

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┌─────────────────────────┐
│      Improve Quality     │
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│      Costs Decrease      │
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            │
            ▼
┌─────────────────────────┐
│   Productivity Improves  │
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│   Increase Market Share  │
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│      Stay in Business    │
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            ▼
┌─────────────────────────┐
│     Provide More Jobs    │
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Figure 1.3.   Adapted from Deming 1982

assignable causes account for the rest; and only management can address common causes of variation. Knowledge is not possible without theory. Experience alone does not establish a theory. Copying an example of someone else's success without understanding it with theory can lead to disaster.

Beginning in the early 1980s Deming finally came to prominence in the United States and played a major role in quality becoming a major competitive issue in American industry. His book, *Out of the Crisis* (1982), is considered a quality classic. Read more about Dr. Deming and his philosophy at the W. Edwards Deming Institute Home Page (http://www.deming.org/).

Joseph Juran also assisted the Japanese in their reconstruction after World War II. Juran first became well known in the quality field in the United States as the editor of the *Quality Control Handbook* (1951) and later for his paper introducing the quality trilogy: quality planning, quality control, and quality improvement (see Table 1.4). Quality planning provides a system that is capable of meeting quality standards. Quality control is used to determine when corrective action is required. Quality improvement seeks better ways of doing things. Questioning which of the quality trilogy is most important is similar to asking which leg of a stool is most important. Without all three, the stool (and the quality system) cannot function effectively as shown in Figure 1.4.
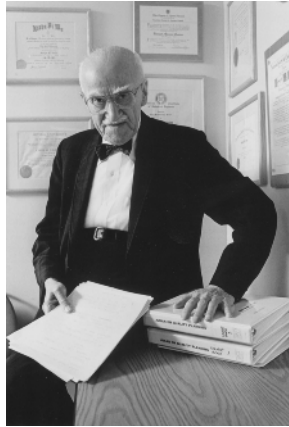
Joseph Juran. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)

TABLE 1.4. Juran's (1986) Basic Quality Processes

Quality Planning

Identify internal and external customers.

Determine customer needs.

Develop product and service features that respond to customer needs.

Establish quality goals that meet the needs of customers and suppliers at a minimum combined cost.

Develop a process that can produce the needed product/service features.

Prove process capability—that the process can meet the quality goals under operating conditions.

Quality Control

Choose what to control.

Choose units of measurement.

Establish measurement.

Establish standards for performance.

Measure actual performance.

Interpret the difference between actual and standard.

Take action on the difference.

Quality Improvement

Prove the need for improvement.

Identify specific projects for improvement.

Organize for discovery of causes.

Diagnose to find the causes.

Provide remedies.

Prove that the remedies are effective under operating conditions.

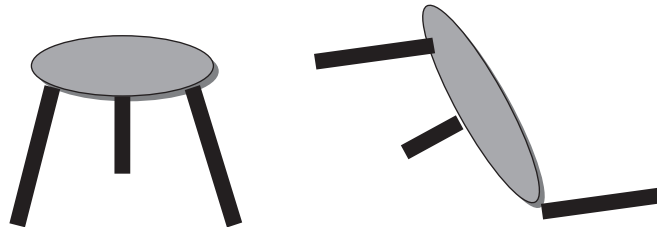Provide for control to hold the gains.

Figure 1.4.   Juran's Quality Trilogy

Although Deming's approach is revolutionary (i.e., throw out your old system and adopt the new philosophy of his 14 points), Juran's approach is more evolutionary (i.e., we can work to improve your current system). Deming refers to statistics as the language of business while Juran says that money is the language of business and quality efforts must be communicated to management in their language. Juran agrees with Deming that more than 80 percent of defects are caused by the system rather than the workers, and he listed motivation of workers as a nonsolution to quality problems. Read more about Dr. Juran and his philosophy at the Juran Institute Web site (http://www.juran.com/).

Armand Feigenbaum is credited with creating the idea of total quality control in his 1951 book, *Quality Control—Principles, Practice, and Administration*, and in his 1956 article, "Total Quality Control." The Japanese version of this concept is called company-wide quality control, while it is called total quality management (TQM) in the United States and elsewhere. He was also the first to classify quality costs into costs of prevention, appraisal, and internal and external failure.

Armand Feigenbaum. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)

Philip Crosby came to national prominence with the publication of his book *Quality is Free* (1979). He established the absolutes of quality management that includes "the only performance standard (that makes any sense) is Zero Defects," and the basic elements of improvement.

Philip Crosby. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)

Although Crosby, like Deming and Juran, stresses the importance of management commitment and error-cause removal, some aspects of Crosby's approach to quality are quite different from Deming's. Zero Defects, central to Crosby's philosophy, was criticized by Deming as being directed at the wrong people (workers) and generating worker frustration and resentment. Goal setting, central to Crosby, leads to negative accomplishment according to Deming. The reality is that Deming was probably reacting to the inappropriate uses of slogans and goals. Deming may not have condemned them were they always used properly within the Crosby system. Read more about Philip Crosby at the Phillip Crosby Associates II Web site (http://www.philipcrosby.com/).

Kaoru Ishikawa is credited with developing the idea of company-wide quality control in Japan. He pioneered the use of quality circles and championed the use of quality tools to understand the root causes of problems. He developed one of those tools, the cause and effect diagram, shown in Figure 1.5, which is also referred to as the Ishikawa diagram or the fishbone diagram.

Kaoru Ishikawa. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)
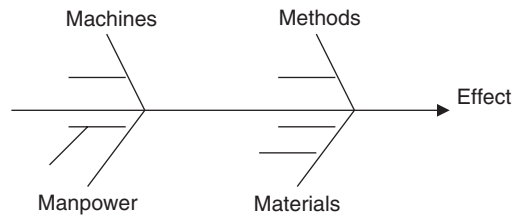
Figure 1.5. Ishikawa Diagram

Genichi Taguchi developed approaches to assess the outside influences (which he referred to as noise) on processes that he used to establish the signal-to-noise ratio as a measure of the quality of a process. He devised a quadratic function, referred to as the Taguchi loss function, which quantified the loss to society of the variation in processes that result in products not being produced exactly at the target values. He developed Taguchi Methods, an approach using orthogonal arrays and linear graphs, to understand and to optimize the performance of processes. He also developed the idea of robustness, which is the ability of a process or product to perform even in the face of uncontrollable outside influences (noise).

Genichi Taguchi. (Photo courtesy American Society for Quality www.asq.org. No further distribution allowed without permission.)

SUMMARY

Quality is a difficult term to define. There is no single, simple definition that will suffice for all products, services, and situations. Perhaps the best modern definition that comes closest to universality is, quality is meeting or exceeding customer expectations. Customer expectations are often represented as dimensions of quality. The dimensions that matter most for specific products and services vary. This makes more difficult the process of defining quality in a way that facilitates assessment and improvement.

Many individuals have contributed to the body of knowledge that we characterize as quality management. Among the most prominent are Shewhart, Deming, Juran, Crosby, Feigenbaum, Ishikawa, and Taguchi. Although each of these "gurus" has made distinct contributions to the body of knowledge, there are many consistencies in their contributions and ideas. The fingerprints of each of these "gurus" may be found throughout this book.

Quality Definitions

Different terms are used to describe approaches to quality. Often these terms are misunderstood and used incorrectly. It is important in an introductory chapter of a quality book to define some of the key terms used in modern quality control.

Strategic quality management (SQM) is a "systematic approach for setting and meeting quality goals throughout the company...with upper management participation in managing for quality to an unprecedented degree" (Juran, 1988); SQM involves the complete integration of quality into the strategic management process.

Total quality management (TQM) is "a management approach to long-term success through customer satisfaction. It is based on the participation of all members of an organization in improving processes, products, services, and the culture they work in" (Quality Glossary, 2002).

Quality management is the totality of functions involved in the determination and achievement of quality (includes quality assurance and quality control) (ASQ Statistics Division, 1983).

Quality assurance (QA) is a broad concept that focuses on the entire quality system, including suppliers and ultimate consumers of the product or service. It includes all activities designed to produce products and services of appropriate quality. According to ASQ, quality assurance includes all those planned or systematic actions necessary to provide adequate confidence that a product or service will satisfy given needs (ASQ Statistics Division, 1983).

Quality control (QC) has a narrower focus than quality assurance. Quality control focuses on the process of producing the product or service with the intent of eliminating problems that might result in defects. According to ASQ, QC includes the operational techniques and the activities that sustain a quality of product or service that will satisfy given needs as well as the use of such techniques and activities (ASQ Statistics Division, 1983).

DISCUSSION QUESTIONS

1. Briefly discuss why it is important to study quality.

2. Why might a dictionary definition of quality be inadequate for a quality professional? Which of the definitions discussed in this chapter do you feel is best? Why?

3. Explain the difference between internal and external customers.

4. List Garvin's 8 dimensions of product quality. Would these dimensions be equally applicable to services? Explain.

5. List SERVQUAL's 5 dimensions of service quality.

6. Discuss which of Garvin's 5 approaches to defining quality makes the most sense to you.

7. What might be some of the dangers of relying solely on customer input when designing or improving a product or service? What other inputs should be taken into account?

8. Compare and contrast Deming's, Juran's, and Crosby's philosophies about quality.

9. Discuss potential sources of resistance to the implementation of Deming's 14 points for management.

10. What is the difference between quality control and quality assurance?

CASE STUDY 1.1: *The Battle of the Gurus*

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The voices from the conference room were loud and animated. Everyone on the first floor could tell that a heated debate was underway. Knowing that Bill Reyes and George Hales were in there, no one was surprised. They were like oil and water. If one claimed the sky is blue, the other would hotly debate the claim.

The debate concerned the direction that the company's quality system would take. Bill, the operations manager, had just read *The Deming Management Method* and was convinced that Deming's way was the only way. George had recently read *Quality is Free* and felt equally strongly that Crosby's was the right path.

Finally, the division VP had heard enough. She turns to you and says, ''Obviously we need a neutral party to sort this out. You learn all you can about the Deming and Crosby systems and tell me which is best. I want your report next week. Next agenda item!''

1. Prepare a report summarizing the two quality systems and showing where they are similar and where they differ.

2. Is there a ''best'' system for all organizations? Discuss.

3. What types of organizational cultures would favor each of the two approaches?

EXERCISES AND ACTIVITIES

1. Propose your own definition of quality. Compare and contrast your definition with other definitions of quality discussed in this chapter. Purchase three brands of low cost, disposable, medium point, black ink ball point pens. Use your definition of quality to determine which of these three pens is of the highest quality. Summarize your findings in a short paper.

2. Determine who are the customers for the following and classify the customers as internal or external:

   a. Manufactured goods that are sold to a wholesaler.
   b. Higher education.
   c. Financial statements prepared by the Accounting Department for use by company management.
   d. Applications for student housing filled out in the University Admissions Office and sent to Resident Life.
   e. Orders taken in a restaurant by a server and which are transmitted to the kitchen staff for preparation.

3. Consider your purchase of a hamburger at a fast food restaurant. What combination of Garvin's dimensions of product quality and the SERVQUAL dimensions of service quality would be applicable in assessing the quality of your experience?

4. Select two participants to play the roles of workers in two different departments. Have them sit at opposite ends of a table. Place a barrier in the center of the table that prevents the workers from seeing what the other is doing.

   Worker #1: Provide the first worker with a black marker and a ruler and instruct the worker to draw two 1-inch squares on a 3"×5" card. When the worker completes the task, drop the card over the barrier.

   Worker #2: Provide the second worker with a bottle of White-Out® and a red marker. Instruct the second worker to use the White-Out® to cover the black line forming the right side of the squares and to replace the black lines with red lines.

Allow the work to proceed for several minutes. Then inform each worker individually that you are instituting a process of continuous improvement and that you want them to think of ways they can increase their productivity. Implement their ideas and tally the results of their improvement efforts. An example of an idea for Worker #1 would be replacing the ruler with a square template to enable drawing the squares faster and more accurately (higher quality).

Then remove the barrier and allow the workers to interact and to see what the other is doing. Inform them that they are to work as a team to improve their processes. Implement their ideas and tally the results. An example of an idea here would be to have Worker #1 omit the black right-hand line so that Worker #2 does not have to use the White-Out® to cover it before drawing the red line.

Debrief the exercise using Deming's Point Number 9 as a basis.

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