

---

# Contents

<i>List of Figures and Tables</i> . . . . .	<i>vii</i>
<i>Preface</i> . . . . .	<i>ix</i>
<i>Notes to the Reader</i> . . . . .	<i>xi</i>
<i>Acknowledgments</i> . . . . .	<i>xiii</i>
<b>Part I Quality Basics</b> . . . . .	<b>1</b>
1 Quality Terms, Concepts, and Principles . . . . .	3
A. Terms, Concepts, and Principles . . . . .	4
1. Quality . . . . .	5
2. Systems and Processes . . . . .	8
3. The Importance of Employees . . . . .	9
4. Quality Planning . . . . .	10
5. Variation . . . . .	12
2 Quality Benefits, Philosophies, and Models . . . . .	15
B. Benefits of Quality . . . . .	16
C. Quality Philosophies and Models . . . . .	19
<b>Part II Teams</b> . . . . .	<b>35</b>
3 Team Structure and Function . . . . .	37
A. Types of Teams . . . . .	38
0. Natural Teams . . . . .	38
1. Improvement Teams . . . . .	38
2. Cross-Functional Teams . . . . .	39
3. Project Teams . . . . .	40
4. Self-Directed Teams . . . . .	40
5. Virtual Teams . . . . .	41
B. Roles and Responsibilities . . . . .	41
C. Team Formation and Group Dynamics . . . . .	47
1. Initiating Teams . . . . .	47
2. Selecting Team Members . . . . .	47
3. Groupthink . . . . .	49
4. Team Stages . . . . .	50
5. Team Conflict . . . . .	52
6. Team Leader As Coach . . . . .	53

- Part III Continuous Improvement . . . . . 57**
- 4 Continuous Improvement Concepts and Tools . . . . . 59
  - A. Incremental and Breakthrough Improvement . . . . . 60
  - B. Improvement Cycles . . . . . 66
  - C. Quality Improvement Tools . . . . . 84
- 5 Improving Customer–Supplier Relationships . . . . . 123
  - D. Customer–Supplier Relationships . . . . . 124
    - 1. Internal and External Customers . . . . . 124
    - 2. Customer Feedback . . . . . 129
    - 3. Internal and External Suppliers . . . . . 133
    - 4. Supplier Feedback . . . . . 135
  
- Part IV Appendices . . . . . 139**
- A. ASQ Certified Quality Improvement Associate Body of Knowledge . . . . . 141
- B. ASQ Code of Ethics . . . . . 145
- C. Quality Glossary . . . . . 147
- D. Additional Reading . . . . . 169
  
- Index . . . . . 175*

*Appendix E Supplement*

- E. Sample Test Questions, Answers, and Cross-References
  - 1. Quality Improvement Associate—Sample Test . . . . . 1
  - 2. Answer Key . . . . . 20
  - 3. Sample Questions Cross-Referenced to BoK (sorted by item number) . . . . . 21
  - 4. Sample Questions Cross-Referenced to BoK (sorted by BoK category) . . . . . 23
  - 5. Sample Questions Cross-Referenced to Suggested Reference Material . . . . . 26

---

# Chapter 1

## Quality Terms, Concepts, and Principles

---

*This chapter should help you:*

- Define and use the term *quality* correctly
- Understand systems and processes, how they relate to each other, and how the components of a process affect the total system
- Understand the importance of all employees in an organization
- Define a quality plan and understand its purpose in the organization
- Understand variation and common and special causes

*The topics of this chapter are:*

- A. Terms, Concepts, and Principles
  1. Quality
  2. Systems and Processes
  3. The Importance of Employees
  4. Quality Planning
  5. Variation

*Look beneath the surface, let not the quality nor its worth escape thee.*

—Marcus Aurelius

*We are what we repeatedly do. Excellence, then, is not an act, but habit.*

—Aristotle

*Quality is about making products that don't come back for customers that do.*

—Margaret Thatcher

## A. TERMS, CONCEPTS, AND PRINCIPLES

### A Short History

While the history of quality goes back to ancient times, this short review starts with the current quality movement that had its beginning in the 1920s. The quality profession as we know it today had its start when Walter Shewhart of Bell Laboratories developed a system for measuring variance in production systems, known as statistical process control. Statistical process control is still used to help monitor consistency and diagnose problems in work processes. Shewhart also created the Plan–Do–Check–Act (PDCA) cycle, which applies a systematic approach to improving work processes. When the PDCA cycle is applied consistently, it can result in continuous process improvement.

During World War II, the U.S. War Department hired Dr. W. Edwards Deming, a physicist and Census Bureau researcher, to teach statistical process control to the defense industry. Quality control and statistical methods were critical factors in the successful war effort. Unfortunately, most of the companies in America stopped using these statistical tools after the war.

The U.S. occupation forces in Japan invited Deming to help Japan with its postwar census. He was also invited to lecture business leaders on statistical process control and quality. The Japanese acceptance and use of Dr. Deming’s techniques had a profound positive effect on the economy of Japan.

Two other American experts, Dr. Joseph Juran and Armand Feigenbaum, also worked with the Japanese. Both Deming and Juran, a former investigator at the Hawthorne Works experiments, drew on Shewhart’s work and recognized that system problems could be addressed through three fundamental managerial processes—planning, control, and improvement—and that satisfying the customer’s needs was important. Feigenbaum stressed the need to involve all departments of a company in the pursuit of quality, something he called “total quality control.” The Japanese expanded Juran’s customer concept to include internal customers, those people within the organization who depend on the output of other workers.

Kaoru Ishikawa, a Japanese engineer and manager, enlarged Feigenbaum’s ideas to include all employees, not just department managers in the total quality control concept. Ishikawa also helped to create “quality circles”: small teams of managers, supervisors, and workers trained in statistical process control, the PDCA cycle, and group problem solving. Applying these techniques created a flow of new ideas for improvement from everyone in the organization and continuous small improvements that led to better performance. The quality circles were the original models for our current Process Improvement Teams. By the 1970s, most large Japanese companies had adopted what Ishikawa called “companywide quality control (CWQC),” resulting in a perception that Japan produced world-class quality products.

The Japanese success caused American organizations to embrace the teachings of Deming, Juran, Feigenbaum, and other quality “gurus” and to apply their successful quality management techniques in many types of business. Beginning in the mid 1980s, American organizations began to experience improved quality results and enhanced customer satisfaction.

In 1987, the criteria for the first Malcolm Baldrige National Quality Award were published. At the same time, ISO 9001, *Quality Systems—Model for quality assurance in design, development, production, installation, and servicing* was published. These documents have resulted in profound changes in the way the quality profession operates.

By the end of 2000, 150-plus countries were using the ISO 9000 standards and more than 408,000 quality system certificates had been issued. Many industry-specific quality management system documents have evolved from ISO 9000.

More than a million copies of the Malcolm Baldrige National Quality Award criteria have been distributed, and many state and local quality award programs have developed their own criteria based on the national award criteria. Although very few organizations actually apply for the national award, thousands use the criteria to evaluate and improve their quality management systems. Healthcare and education versions of the award criteria have been published in the last few years, further expanding the applicability and value of the criteria.

## 1. Quality

There are many definitions of quality, which include the following:

- Quality is the composite of all the attributes or characteristics, including performance, of an item or product (MIL-STD-109B, 1969).
- Quality relates the features and characteristics of a product or service to the ability of that product or service to satisfy stated or implied needs (ANSI/ASQC A3-1987).
- Quality is 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 (“The Quality Glossary,” ASQC *Quality Progress*, 1993).

More recently, international quality management system standards have defined quality as the degree to which a set of inherent characteristics fulfills requirements (ANSI/ISO/ASQ Q9000-2000, *Quality Management Systems—Fundamentals and Vocabulary*, December 2000).

Over the past 50 years, many of the better-known quality “gurus” have developed their own definitions of quality. Some of these will be discussed later in this book, in the section on quality philosophies and models. Many other quality-related terms are defined in Appendix C, “Quality Glossary.”

Currently, practicing quality professionals deal with interrelated sets of requirements that form quality management systems. The two most frequently used quality management system models are (1) the Baldrige National Quality Program Criteria for Performance Excellence,<sup>1</sup> and (2) the eight quality management principles that form the basis of the ISO 9000:2000 family of quality management system standards. These quality models provide an insight into the components of a quality management system and define quality as it is practiced today.

## **2002 Baldrige National Quality Program Criteria for Performance Excellence Categories<sup>1</sup>**

### **1 Leadership**

- 1.1 *Organizational Leadership*
- 1.2 *Public Responsibility and Citizenship*

The Leadership category examines how an organization's senior leaders address values, directions, and performance expectations as well as how they focus on customers and other stakeholders, empowerment, innovation, and learning. It also deals with how an organization addresses its responsibilities to the public and supports its key communities.

### **2 Strategic Planning**

- 2.1 *Strategy Development*
- 2.2 *Strategy Deployment*

The Strategic Planning category examines how an organization develops strategic objectives and action plans. It is also concerned with how strategic objectives and action plans are deployed and how progress is measured.

### **3 Customer and Market Focus**

- 3.1 *Customer and Market Knowledge*
- 3.2 *Customer Relationships and Satisfaction*

The Customer and Market Focus category examines how an organization determines the requirements, expectations, and preferences of customers and markets. It also deals with how an organization builds relationships with customers and determines the key factors that lead to customer acquisition, satisfaction, and retention, and to business expansion.

### **4 Information and Analysis**

- 4.1 *Measurement and Analysis of Organizational Performance*
- 4.2 *Information Management*

The Information and Analysis category examines the organization's information management and performance measurement systems and how the organization analyzes performance data and information.

### **5 Human Resource Focus**

- 5.1 *Work Systems*
- 5.2 *Employee Education, Training, and Development*
- 5.3 *Employee Well-Being and Satisfaction*

The Human Resource Focus category examines how the organization motivates and enables employees to develop and utilize their full potential in alignment with the organization's overall objectives and action plans. Also examined are the organization's efforts to build and maintain a work environment and an employee support climate conducive to performance excellence and to personal and organizational growth.

### **6 Process Management**

- 6.1 *Product and Service Processes*
- 6.2 *Business Processes*
- 6.3 *Support Processes*

The Process Management category examines the key aspects of the organization's process management, including customer-focused design, product and service delivery, key business, and support processes. The category encompasses all key processes and all work units.

## **7 Business Results**

- 7.1 *Customer-Focused Results*
- 7.2 *Financial and Market Results*
- 7.3 *Human Resource Results*
- 7.4 *Organizational Effectiveness Results*

The Business Results category examines the organization's performance and improvement in key business areas: customer satisfaction, product and service performance, financial and marketplace performance, human resource results, and supplier and operational performance. Also examined are performance levels relative to competitors.

### **ANSI/ISO/ASQ Q9000-2000 Quality Management Principles**

A quality management principle is a comprehensive and fundamental rule or belief for leading and operating an organization; it is aimed at continually improving performance over the long term by focusing on customers while addressing the needs of all other stakeholders. The eight quality management principles that form the basis of current international quality management requirements, which are very similar to the Baldrige criteria, are as follows:

**Customer Orientation.** Organizations must focus on understanding their customers' needs and requirements. Successful organizations try to anticipate and exceed the customers' expectations.

**Leadership.** Organizations need strong leaders to establish common goals and direction. Effective leaders establish open environments in which all employees can participate in meeting their organization's goals.

**Involvement.** People are the most important part of any organization. Managers must ensure that employees at all levels of the organization can fully participate and use all their skills to make the organization successful.

**Process Management.** The most successful organizations understand that they must manage all their activities as processes.

**System Management.** Successful organizations understand that their many individual processes are interrelated and that, in addition to being managed individually, they must be managed within an overall system.

**Continual Improvement.** Continual improvement is the key to long-term success and high performance. Successful managers recognize that processes must be reviewed and improved continuously to ensure that their organization stays competitive.

**Fact-Based Decisions.** Organizations that base their decisions on factual data are more likely to make the correct decision than those that do not.

**Close Supplier Relationships.** Organizations that partner and work closely with their suppliers ensure that both the organization and the suppliers are better able to achieve success.

A side-by-side review of the Baldrige and the ISO 9000:2000 quality models reveals many similarities. They both stress strong organizational leadership, a focus on customers, the development and involvement of the organization's people, gathering, analyzing, and using information to make decisions, and process management. Together these characteristics define quality as it is practiced in many successful organizations.

## 2. Systems and Processes

A system can be defined as a set of interrelated or interacting processes. A process is a set of interrelated or interacting activities that transform inputs into outputs.

As an example, the quality audit process uses various inputs (trained auditors, procedures, employee interviews, checklists, and so on) to develop an output (the audit report) that is used to improve the organization's overall quality management system. The quality management system is composed of many individual processes that interact with each other and contribute to improving the organization's overall performance.

Using a system of interrelated processes to manage an organization is called a process approach to management, or process management. The process management approach is based on the ability of an organization to identify all its processes, recognize the inputs and outputs of each process, document the processes so they can be easily implemented, identify who the owners of each process are, implement the processes, measure the outcomes of the implementation, and continually improve the efficiency and effectiveness of the processes. The objectives of an organization are achieved more efficiently when related resources and activities are managed as processes and when the individual processes work together to form an integrated management system.

Processes can be divided into various categories:

- *Product/service development processes* deal with how the organization:
  - Designs new and improved products and services
  - Changes old products and services to meet new customer requirements
  - Incorporates improvements in technology
  - Anticipates customers' future needs
- *Product/service production processes* deal with how the organization:
  - Produces products and services in the most efficient and economical way
  - Ensures that the products and services meet all technical requirements
  - Delivers the products and services in the time frame required by the customer
  - Uses customer and employee feedback
- *Business processes* deal with how the organization:
  - Accounts for its resources
  - Develops and uses measures of performance
  - Continually improves its operations
  - Trains, evaluates, and rewards its employees



Process documentation might include these components:

1. A short, simple description of the process and its purpose
2. A description of the process's starting and ending activities
3. A list of inputs required at the process starting points and who provides the inputs, or the process supplier
4. A list of outputs at the process ending point and who receives the outputs, or the process customer
5. A flowchart of the process; that is, a process map identifying the interfaces of the process with other functions of the organization
6. Identification of the process owner, establishing clear responsibility, authority, and accountability for managing the process
7. The measurements used to identify that the process has been completed successfully
8. A statement of the overall capability of the process

Using the process approach to management leads to more predictable results, better use of resources, prevention of errors, shorter cycle times, and lower costs, as well as a better understanding of the capability of processes and more predictable outputs.

The Baldrige and ISO models encourage the use of a process and system approach to management. They also stress the importance of integrating different business processes, such as design, production, quality, packaging, and shipping, into one interlinked system. All processes have inputs and outputs. The inputs into a process being worked on usually come as outputs from another process, and the outputs of the process being worked on usually serve as the inputs to another process.

Parts manufactured and inspected to meet customer requirements are sent to the packaging department for preparation for shipment. The packaged parts are sent to the shipping department for transfer to a transportation company. The outputs of the manufacturing and inspection processes are inputs to the packaging process. The outputs of the packaging process are inputs to the shipping process. These interrelationships must be understood by managers to develop an efficient overall system.

This business methodology, sometimes called a "system of processes" or a "process approach," is critical to the efficient and effective operation of modern organizations. Also critical to this methodology is the concept that all processes generate data (information) that must be "fed back" to other interrelated processes. Information about deficient product found at inspection must be "fed back" to the manufacturing process so that corrective action can be taken to cure the process defect that created the deficient product.

### 3. The Importance of Employees

The two predominant quality models (Baldrige and ISO 9000) stress the importance of the participation of all employees in an organization's quality efforts. Organizations work to motivate and enable their employees to develop and utilize their full potential in support of the organizations' overall goals and objectives. Organizations also work

to build and maintain work environments that support their employees and create a climate conducive to performance excellence and to personal and organizational growth. People at all levels are the essence of any organization, and empowering them to fully use their abilities and to be fully involved in the organization's processes benefits the organization.

Empowerment means that employees have the authority to make decisions and take actions in their work areas without prior approval. Allowing employees to work as active members of process improvement teams is one way to empower them to fully use their collective wisdom and decision-making skills. But they must also be given the training, tools, materials, equipment, processes, and procedures to accomplish their individual tasks. Providing these critical resources shows employees that the organization truly values their minds, not just their bodies.

Each employee must recognize that the outputs of his or her individual activities provide the inputs to the next person's process. Employee involvement allows employees the right to participate at some level in decision making, provides the necessary skills to accomplish the required task, and carefully defines responsibilities and authority. Employee involvement also provides recognition and rewards for accomplishments and enables communication with all levels of the organization's structure.

Managers must do more than just tell employees that they have the authority to participate fully in processes. They must also relinquish some of their authority and show by their actions that they expect full employee involvement and that they support actions taken by employees and decisions made by them to further the organization's goals and objectives. Giving employees the authority to act also gives them responsibility and accountability for what they do. To fully participate, employees must understand the organization's mission, values, and systems.

Organizations sometimes have formal "suggestion systems" that allow employees to provide input on problems and suggestions on how to improve existing processes. Many of these suggestion systems are tied to incentives or rewards for suggestions that are accepted.

## 4. Quality Planning

Quality planning is the process of developing a master plan linked to organizational strategy, goals, and objectives that pertain to the quality of products or services to be delivered to customers. The quality plan includes key requirements, performance indicators, and commitment of resources to ensure that customer needs are met.

Although it is separate from the three phases of organizational planning, quality planning is dependent upon the decisions and processes established by management during these phases. Key quality requirements and performance indicators must be established in the design, development, and implementation of all products and services for final customer delivery. Quality initiatives must be understood in their relation to all three levels of the organization:

- *Strategic planning* deals with developing the long-range strategies of the organization, including:
  - Its basic goals and objectives
  - External customers' needs and expectations

- The needs and expectations of internal stakeholders (employees, shareholders, and so on)
- Risks that must be taken into account
- Regulatory requirements
- Competitors' capabilities
- Business systems needed to operate the organization effectively and efficiently
- *Tactical planning* (sometimes called action or project planning) deals with translating strategic objectives into actionable activities that must occur, on a near-term basis, to support the achievement of the strategic plans. These are the measurable steps and events that result from the deployment of the strategic plans downward.
- *Operational planning* deals with developing day-to-day operating procedures that ensure the quality of individual products and services. Operational plans address areas such as:
  - Resources needed to develop and create the organization's products and services
  - Materials and supplies required for creating and delivering the products and services
  - Knowledge and skills required of its employees
  - Processes and procedures required to create the organization's products and services
  - Unique tools or equipment required
  - Documentation (specifications, standards, drawings, visual aids, and so on) required
  - Examination, inspection, or testing requirements
  - Administrative support and follow-up for customer communication
  - Records required to document the creation of the organization's products and services
  - Process improvement methods to continually improve the organization's deliverables

**Quality Planning.** At the day-to-day level, meeting a specific customer's requirements sometimes requires a "quality plan" for an individual contract or purchase order. To develop such a working plan means looking at the particular order and determining the resources (time, materials, equipment, process steps, skills, and so on) that will be required to complete the individual transaction to the customer's satisfaction and provide an adequate return on the resource investment. This type of quality plan is usually completed as part of the process that organizations use to quote on new or repeat work for their customers.

Overall, a consistent planning, monitoring, and reviewing approach is required for organizations using established quality systems based on criteria such as the Baldrige National Quality Program or the ISO 9001:2000 standard. The approach taken by an organization becomes the guiding policy in producing a valued product or service that remains competitive in the marketplace. The planning must include:

- A comprehensive focus on customer needs and expectations
- Support of quality goals and strategies by upper management
- A balance of resources between short-term and long-term requirements, including capital expenditures, training, and continuous improvement
- Ongoing interpretation of long-term goals into tactical and operating plans
- Development of processes for evaluation and process improvement
- Integration of quality activities into the daily work of the front-line associates

## 5. Variation

Variations are differences, usually minor, from the designed and expected outputs of a process. Some variation is found in all processes. The key to controlling processes is to control variation as much as possible.

All variation has some cause. Knowing the causes of variation is important in order to determine the actions that must be taken to reduce the variation. It is most important to distinguish between *special cause* variation and *common cause* variation.

Special cause variation results from unexpected or unusual occurrences that are not inherent in the process. As an example:

*A new school bus driver is on her way to pick up her first student in the morning when the engine stalls because of an oil leak.*

This occurrence is not inherent in the student pick-up process. Special causes of variation account for approximately 15 percent of the observed variation in processes. They are usually very easy to detect and correct. No major modifications to the process are required. These special causes are sometimes called assignable causes, because the variation they result in can be investigated and assigned to a particular source.

Common cause variation results from how the process is designed to operate and is a natural part of the process. As an example:

*A school bus driver starts her route of assigned streets on time, makes her required stops, and arrives at the school nine minutes later than usual but within the overall time allowance of her schedule. She experienced a slowdown due to a fender-bender accident that caused two lines of traffic to merge in order to pass the accident.*

Common causes of variation account for approximately 85 percent of the observed variation in processes. When the process is in control, as it was in this example, there is no need to take action. Common causes are sometimes called system causes, because the variations they result in are inherent in the system.

Making minor adjustments to a process because of perceived common cause variation is called “tampering.” Tampering can drive a process into further variation because it entails making unnecessary changes to a stable process.

Process owners should recognize that the special cause variations in production or quality within manufacturing or service processes can usually be detected and removed by the individuals operating the process and that common cause variations usually require management action to change some inherent feature of the process. This is sometimes called the “85/15 rule,” recognizing that management is responsible for providing the necessary inputs to correct the majority of variation problems.

One of the first goals of successful organizations is to concentrate on developing reliable processes. A reliable process is one that produces the desired output each time with very little variation. Once reliable processes are established and the system becomes stable, the next goal is to continually improve the process (further reduce variation) to produce output that is even better able to meet customer requirements.

Many processes, particularly long-term, high-quantity production processes, lend themselves to the use of statistical process control (SPC). SPC is a method of monitoring a process during its operation in order to control the quality of the products or services while they are being produced rather than relying on inspection of the products or services after completion. SPC involves gathering information (data) on the product or service as it is being created, developing the range of acceptable product (upper and lower control limits) for the process, graphically charting the information on one of several types of charts, and following the progress of the process to detect unwanted variation.

Once a process is under control and shows very little variation, process capability studies can be run to calculate the maximum capability of the process. Once a process is running near its maximum capability, making any additional changes to the process is usually not economical.

## Endnotes

1. The categories of these criteria that are listed are derived from the *Baldrige National Quality Program* (National Institute of Standards and Technology, 2002).

## Additional Readings

- American National Standards Institute. *ANSI/ISO/ASQ Q9000-2000*. Milwaukee: ASQ Quality Press, 2000. (The series consists of ISO 9000, ISO 9001, and ISO 9004.)
- Juran, J. M., ed. *A History of Managing for Quality*. Milwaukee: ASQC Quality Press, 1995.
- Juran, J. M., and A. B. Godfrey, (co-editors-in-chief). *Juran's Quality Handbook*. 5th ed. New York: McGraw-Hill, 1999.
- National Institute of Standards and Technology. *Baldrige National Quality Program Criteria for Performance Excellence*. Gaithersburg, MD: NIST, 2002.
- Naval Leader Training Unit. *Introduction to Total Quality Leadership*. Washington, D.C.: U.S. Department of the Navy, 1997.
- Navy Total Quality Leadership Office. *Handbook for Basic Process Improvement*. Washington, D.C.: U.S. Department of the Navy, 1996.
- Oakes, D., and R. T. Westcott, eds. *The Certified Quality Manager Handbook*. 2nd ed. Milwaukee: ASQ Quality Press, 2001.

