

# Total Quality Management

Second  
Edition

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Glen H. Besterfield  
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# **Total Quality Management**

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## **SECOND EDITION**

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# Preface

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This book provides a fundamental, yet comprehensive, coverage of Total Quality Management (TQM). It covers not only the principles and practices, but also the tools and techniques. A practical state-of-the-art approach is stressed throughout. Sufficient theory is presented to ensure that the reader has a sound understanding of the basic concepts. Mathematical techniques are reduced to simple mathematics or developed in the form of tables and charts.

The book will serve the instructional needs of business, education, engineering, health-care, and technology students in higher education institutions. All sizes and types of organizations—service, manufacturing, government, military, construction, education, small business, health care, and nonprofit entities—will find this book an excellent training and reference manual for all personnel.

The book is divided into two parts. Part I covers the principles and practices of TQM. After an introductory chapter, the next six chapters cover the basic TQM concepts of leadership, customer satisfaction, employee involvement, continuous process improvement, supplier partnership, and performance measures.

Part II of the book covers the tools and techniques of TQM. Chapters discuss statistical process control (SPC), quality systems, benchmarking, quality function deployment (QFD), quality by design, experimental design, Taguchi's quality engineering, products liability, Failure Mode and Effect Analysis (FMEA), total productive maintenance (TPM), ISO 14000, and management tools.

The authors wish to express their sincere appreciation for the contributions of Alan Lasley on total productive maintenance. We also wish to express our sincere appreciation to Helen Jane Ball, who edited the manuscript; Ron Bathje, who drew many of the figures; and Ginny Sutter, who keyed a number of chapters into the computer.

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# 1

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## Introduction

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### Definition

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Total Quality Management (TQM) is an enhancement to the traditional way of doing business. It is a proven technique to guarantee survival in world-class competition. Only by changing the actions of management will the culture and actions of an entire organization be transformed. TQM is for the most part common sense. Analyzing the three words, we have

*Total*—Made up of the whole.

*Quality*—Degree of excellence a product or service provides.

*Management*—Act, art, or manner of handling, controlling, directing, etc.

Therefore, TQM is the art of managing the whole to achieve excellence. The Golden Rule is a simple but effective way to explain it: Do unto others as you would have them do unto you.

TQM is defined as both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. It is the application of quantitative methods and human resources to improve all the processes within an organization and exceed customer needs now and in the future. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach.

## Basic Approach

---

TQM requires six basic concepts:

1. A committed and involved management to provide long-term top-to-bottom organizational support.
2. An unwavering focus on the customer, both internally and externally.
3. Effective involvement and utilization of the entire work force.
4. Continuous improvement of the business and production process.
5. Treating suppliers as partners.
6. Establish performance measures for the processes.

These concepts outline an excellent way to run an organization. A brief paragraph on each of them is given here. The next six chapters cover these concepts in greater detail.

1. Management must participate in the quality program. A quality council must be established to develop a clear vision, set long-term goals, and direct the program. Quality goals are included in the business plan. An annual quality improvement program is established and involves input from the entire work force. Managers participate on quality improvement teams and also act as coaches to other teams. TQM is a continual activity that must be entrenched in the culture—it is not just a one-shot program. TQM must be communicated to all people.

2. The key to an effective TQM program is its focus on the customer. An excellent place to start is by satisfying internal customers. We must listen to the “voice of the customer” and emphasize design quality and defect prevention. Do it right the first time and every time, for customer satisfaction is the most important consideration.

3. TQM is an organization-wide challenge that is everyone’s responsibility. All personnel must be trained in TQM, statistical process control (SPC), and other appropriate quality improvement skills so they can effectively participate on project teams. Including internal customers and, for that matter, internal suppliers on project teams is an excellent approach. Those affected by the plan must be involved in its development and implementation. They understand the process better than anyone else. Changing behavior is the goal. People must come to work not only to do their jobs, but also to think about how to improve their jobs. People must be empowered at the lowest possible level to perform processes in an optimum manner.

4. There must be a continual striving to improve all business and production processes. Quality improvement projects, such as on-time delivery, order entry efficiency, billing error rate, customer satisfaction, cycle time, scrap reduction, and supplier management, are good places to begin. Technical techniques such as SPC, benchmarking,

quality function deployment, ISO 9000, and designed experiments are excellent for problem solving.

5. On the average 40% of the sales dollar is purchased product or service; therefore, the supplier quality must be outstanding. A partnering relationship rather than an adversarial one must be developed. Both parties have as much to gain or lose based on the success or failure of the product or service. The focus should be on quality and life-cycle costs rather than price. Suppliers should be few in number so that true partnering can occur.

6. Performance measures such as uptime, percent nonconforming, absenteeism, and customer satisfaction should be determined for each functional area. These measures should be posted for everyone to see. Quantitative data are necessary to measure the continuous quality improvement activity.

The purpose of TQM is to provide a quality product to customers, which will, in turn, increase productivity and lower cost. With a higher quality product and lower price, competitive position in the marketplace will be enhanced. This series of events will allow the organization to achieve the objectives of profit and growth with greater ease. In addition, the work force will have job security, which will create a satisfying place to work.

As previously stated, TQM requires a cultural change. Table 1-1 compares the previous state with the TQM state for typical quality elements. This change is substantial and will not be accomplished in a short period of time. Small organizations will be able to make the transformation much faster than large organizations.

TABLE 1-1  
**New and Old Cultures**

<i>Quality Element</i>	<i>Previous State</i>	<i>TQM</i>
Definition	Product-oriented	Customer-oriented
Priorities	Second to service and cost	First among equals of service and cost
Decisions	Short-term	Long-term
Emphasis	Detection	Prevention
Errors	Operations	System
Responsibility	Quality control	Everyone
Problem Solving	Managers	Teams
Procurement	Price	Life-cycle costs, partnership
Manager's Role	Plan, assign, control, and enforce	Delegate, coach, facilitate, and mentor

## Awareness

An organization will not begin the transformation to TQM until it is aware that the quality of the product or service must be improved. Awareness comes about when an organization loses market share or realizes that quality and productivity go hand-in-hand. It also occurs if TQM is mandated by the customer or if management realizes that TQM is a better way to run a business and compete in domestic and world markets.

Automation and other productivity enhancements might not help a corporation if it is unable to market its product or service because the quality is poor. The Japanese learned this fact from practical experience. Prior to World War II, they could sell their products only at ridiculously low prices, and even then it was difficult to secure repeat sales. Until recently, corporations have not recognized the importance of quality. However, a new attitude has emerged—quality first among the equals of cost and service. To sum it up, the customer wants value.

Quality and productivity are not mutually exclusive. Improvements in quality can lead directly to increased productivity and other benefits. Table 1-2 illustrates this concept. As seen in the table, the improved quality results in a 5.6% improvement in productivity, capacity, and profit. Many quality improvement projects are achieved with the same work force, same overhead, and no investment in new equipment.

Recent evidence shows that more and more corporations are recognizing the importance and necessity of quality improvement if they are to survive domestic and worldwide competition. Quality improvement is not limited to the conformance of the prod-

TABLE 1-2

### Gain in Productivity with Improved Quality

<i>Item</i>	<i>Before Improvement 10% Nonconforming</i>	<i>After Improvement 5% Nonconforming</i>
Relative total cost for 20 units	1.00	1.00
Conforming units	18	19
Relative cost for nonconforming units	0.10	0.05
Productivity increase		$(100)(1/18) = 5.6\%$
Capability increase		$(100)(1/18) = 5.6\%$
Profit increase		$(100)(1/18) = 5.6\%$

Adapted from W. Edwards Deming, *Quality, Productivity, and Competitive Position* (Cambridge, Mass.: Massachusetts Institute of Technology, Center for Advanced Engineering Studies, 1982).

uct to specifications; it also involves the inherent quality in the design of the system. The prevention of product and process problems is a more desirable objective than taking corrective action after the product is manufactured or a service rendered.

TQM does not occur overnight; there are no quick remedies. It takes a long time to build the appropriate emphasis and techniques into the culture. Overemphasis on short-term results and profits must be set aside so long-term planning and constancy of purpose will prevail.

## Defining Quality

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When the expression “quality” is used, we usually think in terms of an excellent product or service that fulfills or exceeds our expectations. These expectations are based on the intended use and the selling price. For example, a customer expects a different performance from a plain steel washer than from a chrome-plated steel washer because they are a different grade. When a product surpasses our expectations we consider that quality. Thus, it is somewhat of an intangible based on perception. Quality can be quantified as follows:

$$Q = P / E$$

where  $Q$  = quality  
 $P$  = performance  
 $E$  = expectations

If  $Q$  is greater than 1.0, then the customer has a good feeling about the product or service. Of course, the determination of  $P$  and  $E$  will most likely be based on perception with the organization determining performance and the customer determining expectations.

Quality has nine different dimensions. Table 1-3 shows these nine dimensions of quality with their meanings and explanations in terms of a slide projector.

These dimensions are somewhat independent; therefore, a product can be excellent in one dimension and average or poor in another. Very few, if any, products excel in all nine dimensions. For example, the Japanese were cited for high-quality cars in the 1970s based only on the dimensions of reliability, conformance, and aesthetics. Therefore, quality products can be determined by using a few of the dimensions of quality.

Marketing has the responsibility of identifying the relative importance of each dimension of quality. These dimensions are then translated into the requirements for the development of a new product or the improvement of an existing one.



TABLE 1-3  
**The Dimensions of Quality**

<i>Dimension</i>	<i>Meaning and Example</i>
Performance	Primary product characteristics, such as the brightness of the picture
Features	Secondary characteristics, added features, such as remote control
Conformance	Meeting specifications or industry standards, workmanship
Reliability	Consistency of performance over time, average time for the unit to fail
Durability	Useful life, includes repair
Service	Resolution of problems and complaints, ease of repair
Response	Human-to-human interface, such as the courtesy of the dealer
Aesthetics	Sensory characteristics, such as exterior finish
Reputation	Past performance and other intangibles, such as being ranked first

Adapted from David A. Garvin, *Managing Quality: The Strategic and Competitive Edge* (New York: Free Press, 1988).

## Historical Review

The history of quality control is undoubtedly as old as industry itself. During the Middle Ages, quality was to a large extent controlled by the long periods of training required by the guilds. This training instilled pride in workers for quality of a product.

The concept of specialization of labor was introduced during the Industrial Revolution. As a result, a worker no longer made the entire product, only a portion. This change brought about a decline in workmanship. Because most products manufactured during that early period were not complicated, quality was not greatly affected. In fact, because productivity improved there was a decrease in cost, which resulted in lower customer expectations. As products became more complicated and jobs more specialized, it became necessary to inspect products after manufacture.

In 1924, W. A. Shewhart of Bell Telephone Laboratories developed a statistical chart for the control of product variables. This chart is considered to be the beginning of statistical quality control. Later in the same decade, H. F. Dodge and H. G. Romig, both of Bell Telephone Laboratories, developed the area of acceptance sampling as a substitute for 100% inspection. Recognition of the value of statistical quality control became apparent by 1942. Unfortunately, U.S. managers failed to recognize its value.

In 1946, the American Society for Quality Control was formed. Recently, the name was changed to American Society for Quality (ASQ). This organization, through its publications, conferences, and training sessions, has promoted the use of quality for all types of production and service.