Managing Quality

The Strategic and Competitive Edge

David A. Garvin

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Introduction

Quality is fast becoming one of the competitive issues of the 1980s and 1990s. A wave of imports, federal and state programs, and increased customer sensitivity have combined to give it new visibility. Pressures for improvement have become intense. The result is a heightened interest in quality management at many U.S. companies and a growing recognition of quality's strategic importance.

The challenge is vast. A 1981 survey reported that nearly 50 percent of U.S. consumers felt that the quality of American products had dropped during the previous five years.[1] Other surveys, repeated between 1973 and 1983, found that one-quarter of respondents were "not at all confident" that they could depend on industry to deliver reliable products.[2] In selected businesses, the picture is even bleaker. In 1973, 12 percent of U.S. consumers felt that Japanese cars were of better quality than American cars; a decade later, the figure had more than tripled, to 40 percent.[3]

The need for quality improvement is thus painfully evident. Yet, despite intense application, progress has been slow. Few U.S. companies have achieved dramatic breakthroughs in quality peformance; still fewer have matched the quality and reliability levels of their overseas competitors. The problem has not been a lack of interest, for managers in countless industries have joined the quality bandwagon. Programs have proliferated, as have tools and techniques. A lack of understanding, however, has impeded progress on several fronts.

Quality is an unusually slippery concept, easy to visualize and yet exasperatingly difficult to define. It remains a source of great confusion to managers, leading to the frequent but empty claim, "I know it when I see it."[4] Quality improvement is unlikely in such settings. Moreover, even when quality has been defined precisely, programs

have lacked competitive impact. Many programs have been narrowly focused on the factory floor or have relied primarily on traditional methods of quality control. Little attention has been paid to the underlying sources of superior quality: the relative contributions of product design, vendor selection and management, and production and work force management. Tools and techniques have dominated instead, with short-term improvement projects often pursued at the expense of long-term quality planning. Links to competitive strategy have been few and far between.

Japanese companies provide an instructive contrast. Their quality performance has been enviable, with dramatic improvements since World War II. Today the quality and reliability of Japanese products are sources of great competitive advantage. Moreover, progress has been achieved through a carefully orchestrated campaign of micro and macro policies, top management involvement, and shop-floor activities. Little has been left to chance. An overriding philosophy has encouraged a holistic approach rather than a focus on technique. Short-term projects have therefore meshed neatly with long-term objectives, lending a strategic character to Japanese quality programs.

The aim of this book is to provide a deeper understanding of successful quality management by drawing on evidence from both the United States and Japan. Part I focuses on conceptual issues: the history and meaning of quality in the United States. Chapter 1 begins by tracing the history of the American quality movement from its roots in inspection through statistical quality control and quality assurance. It provides background and context, while also introducing a number of basic techniques: process control charts, sampling plans, cost of quality calculations, and reliability engineering. Chapter 2 focuses on strategic quality management, the last, and least understood, period in America's quality evolution. Elements of the strategic approach are carefully enumerated, and several examples are provided to distinguish the era from preceding ones, since many companies mistakenly assume that they have already adopted its precepts. Chapters 3 and 4 take the strategic approach a step further, reviewing the literature on quality and then breaking the concept into eight separate dimensions: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. Each of these dimensions can be a source of competitive advantage. And because tradeoffs among the dimensions are inevitable, positioning on quality becomes vastly more complex. Chapter 5

pursues the empirical implications of this argument. It reviews the evidence connecting quality and price, market share, advertising, cost, productivity, and profitability, and then shows that the direction and strength of these relationships depend largely on how quality has been defined.

The analysis in Part II is more focused, for it involves a case study of quality in a single U.S. industry, room air conditioning. Limiting the analysis in this way avoids mixing apples with oranges and ensures that all comparisons are firmly grounded. It also permits a rigorous application of the concepts of the preceding section. Chapter 6 begins by exploring consumers' perceptions of room air conditioner quality using the eight dimensions introduced in Chapter 4; it then compares consumers' quality rankings with the rankings of three expert panels: *Consumer Reports,* appliance servicemen and -women, and first-line supervisors. Chapter 7 presents objective measures of quality for the same industry. Both in-plant and field measures are reviewed, cross-sectionally and over time. The resulting industry portrait shows wide and persistent gaps between the best and poorest quality performers. Chapters 8 and 9 attempt to explain these gaps, the former by examining such sources of quality as product design, vendor selection and management, and production and work force management; and the latter by examining differences in companies' quality policies and management attitudes. Appendixes A, B, and C supplement the chapters in Part II with a fuller description of the room air conditioning study, an explanation of the methods used to classify plants by quality performance, and several statistical analyses.

In Part III, U.S. and Japanese approaches to quality management are compared. Chapter 10 begins with a historical review of the quality movement in Japan and then contrasts that movement, which was enormously successful, with the less effective American quality movement described in Chapter 1. Japan's success is traced to a combination of forces, including massive training programs, government policies such as the Industrial Standardization Law, and the leadership of such organizations as the Union of Japanese Scientists and Engineers. Chapter 11 takes a more microanalytic approach, exploring Japanese quality management at the factory level. Again, data from the room air conditioning industry are used. Seven Japanese plants are compared with the eleven U.S. plants examined in Chapters 6 through 9, using such categories as attitudes and philosophy; quality programs, policies, and systems; product design; vendor se-

lection and management; and production and work force management. The last chapter of the book provides a brief conclusion, including a summary of key findings and a discussion of their implications for managers and researchers.

Throughout, a single theme dominates the analysis: the importance of understanding quality well enough to manage it. There are already far too many books on quality that emphasize methods and techniques at the expense of implementation. At the same time, most management guides lack rigor, offering simple solutions to quality problems but little supporting evidence. *Managing Quality* takes a different approach. By blending theory and practice, analysis and action, it shows how a more sophisticated understanding of quality can lead to long-term competitive advantage.

Contents

Part III
Japanese Quality Management
177

Part
I

The Concept of Quality

Chapter
1

History and Evolution

As a concept, quality has been with us for millennia. Only recently has it emerged as a formal management function. The discipline is still evolving. In its original form, it was reactive and inspection-oriented; today, quality-related activities have broadened and are seen as essential for strategic success. Once the exclusive province of manufacturing and operations departments, quality now embraces functions as diverse as purchasing, engineering, and marketing research, and commands the attention of chief executive officers.

How have these changes come about? Most modern approaches to quality have emerged gradually, arriving through steady evolution rather than dramatic breakthroughs. They are the product of a series of discoveries stretching back over a century. In the United States, these discoveries can be organized into four distinct "quality eras": inspection, statistical quality control, quality assurance, and strategic quality management.[1] The first three are discussed in this chapter; the fourth, a more recent innovation, is reserved for Chapter 2.

THE RISE OF INSPECTION

In the eighteenth and nineteenth centuries, quality control as we know it today did not yet exist. Most manufacturing was performed by artisans and skilled craftsmen or by journeymen and apprentices who were supervised by masters at the trade.[2] Goods were produced in small volumes; parts were matched to one another by hand, and after-the-fact inspection to ensure high quality was conducted informally, if at all. A well-performing product was viewed as the natural

outgrowth of reliance on skilled tradesmen for all aspects of design, manufacturing, and service.[3]

Formal inspection became necessary only with the rise of mass production and the need for interchangeable parts. As volumes increased, parts could no longer be fitted to one another by hand: The process required a large pool of skilled labor and was both costly and time-consuming. Prices were often beyond the reach of the average consumer, especially for machinery and equipment. Nor was the federal government able to purchase large quantities of high-quality firearms at low cost.

These pressures gave rise to what has been called the American system of manufacturing: the use of special-purpose machinery to produce interchangeable parts by following a preestablished sequence of operations.[4] Most initial efforts were connected with the military's demand for armaments and were closely coordinated by the United States Ordnance Department, the national armory at Springfield, Massachusetts, and the Harpers Ferry Armory. In consumer products, the Singer Company, which manufactured sewing machines, and the McCormick Harvesting Company, which made farm equipment, later adopted the same techniques.

From a quality control standpoint, the key breakthrough was the development of a rational jig, fixture, and gauging system in the early 1800s.[5] Jigs and fixtures are devices that position tools or hold parts while they are being worked on, keeping them fixed to the equipment so that machining operations can be performed accurately and precisely. Since every part that is worked on is held in place in exactly the same way—all jigs and fixtures having been designed from a standard model of the product to be manufactured—a high degree of interchangeability is assured. Nevertheless, parts may still deviate from one another: They may have been mounted improperly during machining, built from imperfect raw materials, or made on worn tooling. To minimize problems at final assembly, when parts are matched together for the first time, accurate inspection is required during the process of manufacture. A system of gauges is often used for that purpose; like jigs and fixtures, gauges are based on a standard model of the product to ensure uniformity.

By 1819, an elaborate gauging system was in place at the Springfield Armory. It gave inspection a new respectability, for activities that were previously conducted by eye were replaced by a more objective, verifiable process.[6] Two inspectors using a gauge were much

more likely to reach the same result than two who were relying on personal judgment alone.

As the American system of manufacturing matured, gauging became more refined, and inspection became even more important. In the early 1900s, Frederick W. Taylor, the father of "scientific management," gave the activity added legitimacy by singling it out as an assigned task for one of the eight functional bosses (foremen) required for effective shop management:

> The inspector is responsible for the quality of the work, and both the workmen and the speed bosses [who see that the proper cutting tools are used, that the work is properly driven, and that cuts are started in the right part of the piece] must see that the work is finished to suit him. This man can, of course, do his work best if he is a master of the art of finishing work both well and quickly.[7]

Inspection activities were linked more formally to quality control in 1922, with the publication of G. S. Radford's *The Control of Quality in Manufacturing*.[8] For the first time, quality was viewed as a distinct management responsibility and as an independent function. The book even touched on a number of principles regarded as central to modern-day quality control: the need to get designers involved early in quality activities, the need for close coordination among the various departments affecting quality, and the association of quality improvement with increased output and lower costs. Its primary focus, however, was inspection. Nine of the book's twenty-three chapters were devoted to that subject alone. Topics included the purpose of inspection (to "exercise the duty of viewing the work closely and critically so as to ascertain the quality, detect the errors, and present them to the attention of the proper persons in such a way as to have the work brought up to standard");[9] the evolution of inspection (from visual to dimensional checks); types of inspection (material, office, tool, and process); sampling methods (including 100 percent and random sampling, but without any statistical foundation); gauging techniques; and the organization of the inspection department. Throughout, the emphasis was on conformance and its link with inspection; according to Radford, the purchaser's "principal interest in quality [was] that evenness or uniformity which results when the manufacturer adheres to his established requirements."[10]

Here matters stood for several years. Quality control was limited to inspection and to such narrow activities as counting, grading, and

repair. Troubleshooting was considered beyond the reach of the average inspection department.[11] In the next decade, however, the role of the quality professional would be redefined. The stimulus for change was research conducted at Bell Telephone Laboratories; the result was what is today called statistical quality control.

STATISTICAL QUALITY CONTROL

The year 1931 marked a watershed for the quality movement. W. A. Shewhart's *Economic Control of Quality of Manufactured Product* was published that year, giving the discipline a scientific footing for the first time.[12] Much of modern-day quality control can be traced to that single volume. In it, Shewhart gave a precise and measurable definition of manufacturing control, developed powerful techniques for monitoring and evaluating day-to-day production, and suggested a variety of ways of improving quality.

Shewhart was in fact part of a larger group at Bell Telephone Laboratories that was investigating problems of quality. The group's research was prompted by the concerns of engineers at Western Electric, the manufacturing arm of the Bell System, who were seeking greater standardization and uniformity in the nationwide telephone network. Most attention was focused on the complex equipment being built at the company's Hawthorne Works. How, the engineers wondered, could the maximum amount of information about the quality of these units be extracted from the minimum amount of inspection data? And how should that data be presented? In 1924, an Inspection Engineering Department was established at Western Electric to address such questions; it later became the Quality Assurance Department of Bell Laboratories. The group, which included such luminaries as Shewhart, Harold Dodge, Harry Romig, G. D. Edwards, and later Joseph Juran, was largely responsible for creating the present-day discipline of statistical quality control.[13]

Process Control —

The initial breakthrough was Shewhart's. He was the first to recognize that variability was a fact of industrial life and that it could be understood using the principles of probability and statistics. Shewhart observed that no two parts were likely to be manufactured to precisely the same specifications. Raw materials, operator skills,