SANDIA REPORT
SAND2012-7060
Unlimited Release
Printed August 2012

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Prepared by
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Albuquerque, New Mexico 87185 and Livermore, California 94550

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Abstract

The quality movement's long history traces back to the Industrial Revolution and continues through the more modern concepts of Total Quality Management (TQM). This report provides an overview of the history of quality in industry, from its roots through its later movements, including quality inspections, the statistical quality control methods championed by W. Edwards Deming and others, and the influence of Japanese quality management on current American industrial practices.

CONTENTS

1. THE HISTORY OF QUALITY IN INDUSTRY

The history of modern quality assurance has spanned over two centuries as well as over several cultures, continents, and major historical events. The different individuals and philosophies associated with the quality movement have shaped the current state of quality management and quality engineering, as well as attested to the difference a quality-driven approach can make in delivering a successful product.

1.1. The Early History of Quality

The Industrial Revolution, which arose in the United Kingdom in the early nineteenth century before spreading throughout Europe and the rest of the world, introduced the concept of specialization of labor into the workforce. It instituted the first factories in the United States and Europe, which altered the traditional craftsmanship model of production and divided craftsmen and shop owners into the new roles of factory workers and production supervisors. The factory system ensured product quality by relying on the skill of laborers, supplemented by occasional audits.

In the United States in the early twentieth century, an influential industrial engineer named Frederick Winslow Taylor formulated a new approach to factory management, which he called scientific management. According to Taylor's philosophy of scientific management, human performance could be defined and controlled through work standards and rules, which could increase productivity without increasing the number of skilled craftsmen needed at a factory. Taylor used time-and-motion studies to dismantle jobs into simple, separate steps for workers to perform repetitively without deviation. Along with scientific management came minimal complexity and maximal efficiency, which stripped factory workers of power and had a largely negative effect on quality.

Taylor's scientific management system, despite its flaws, was a product of its time: it evolved during an era of mass immigration, when the American labor system was being flooded with unskilled, uneducated workers, many of whom lacked advanced skills in English. Taylor believed that his system provided an efficient way to employ these laborers in large numbers, as well as to reduce conflict and labor strife in a time of frequent public labor disputes. His program of scientific management would leave little discretion to either workers or supervisors, leading to a rule-bound management style, which despite its high productivity could be rigid and slow to adjust to market conditions.

1.2. Quality Inspection and Quality Control

In the years following the Industrial Revolution, more manufactured products became more complicated and jobs became more specialized, thus introducing the need to inspect products for quality after manufacture. Compounding the problem was the poor quality performance of the scientific management system. Factory managers created inspection

departments to keep defective products from reaching customers, a practice that focused more on the end results than on the process of manufacturing.

In the 1920s and the 1930s, the concept of evaluating manufacturing processes to promote product quality entered the American system. Statisticians in Germany and America applied statistical methods for analyzing and controlling quality variations in the product manufacturing process. In 1924, Walter A. Shewhart of Bell Telephone Laboratories developed a statistical chart for the control of product variables in manufacturing, an innovative milestone that is considered to be the beginning of an approach to quality known as statistical quality control. Shewhart later wrote a handbook called *Statistical Method from the Viewpoint of Quality Control* in 1939; his published work gained recognition from both statisticians and engineers. Working alongside Shewhart and contributing to his ideas in the 1920s were H.F. Dodge and H.G. Romig, both of Bell Telephone Laboratories, who developed the area of acceptance sampling as a substitute for full product quality inspection.

1.3. The Deming Years and the Quality Movement in Japan

Statistical quality control continued in the mid-twentieth century under the influence of William Edwards Deming, who became the most widely known proponent of statistical quality control and quality management. After obtaining his Ph.D. in physics from Yale, Deming worked as a mathematical physicist in the U.S. Department of Agriculture, then took charge of the groundbreaking statistical sampling program for the 1940 census, where he was able to demonstrate that statistical controls could be used in clerical as well as in industrial operations. At the beginning of World War II, along with Ralph Wareham of General Electric and Charles Mummery of the Hoover Corporation, Deming began teaching ten-day courses in statistical quality control methods to engineers, inspectors, and other workers at companies engaged in wartime production. Deming's contributions to this new national focus on quality led to the formation of the American Society for Quality Control, of which he was a charter member, in 1946. That same year, Deming left his work at the U.S. Census Bureau to establish a private practice as a statistical consultant, as well as joined the faculty of New York University as a professor at the Graduate School of Business Administration, where he taught sampling and quality control.

In 1947, the Supreme Command for the Allied Powers (SCAP) recruited Deming to help the Japanese prepare for their 1951 census. After accepting the assignment, Deming arrived to witness a Japan that had been severely ravaged by World War II. Cities had been destroyed, Japanese civilians had scattered to the countryside, consumer goods were scarce, and national morale had collapsed. The Japanese industrial system, already weaker than the system in the West, was sagging. Not only had Japan lost traditional markets like China and Manchuria due to the war, but the quality of industrial production that did exist was notoriously abysmal. MADE IN JAPAN stamped on a piece of merchandise, as several quality historians have noted, was a synonym for junk.

Around the same time as Deming's arrival in Japan, a newly enacted group called the Japanese Union of Scientists and Engineers (JUSE) had begun meeting to discuss the

reconstruction of their country. Prompted by other Americans from the Bell Telephone Laboratories, these Japanese engineers had become fascinated by Shewhart's theories on statistical quality control. Upon learning of Deming, who had studied Shewhart's methods at the USDA in the 1930s, JUSE members asked Deming to deliver a lecture course to Japanese research workers, plant managers, and engineers on quality control methods. He agreed, and by 1950 had begun teaching not only Japanese engineers and workers, but also managers, engineers, and senior industrialists about the importance of quality as well as methods of statistical quality control. According to Deming's philosophy, charts and checklists, as well as an uncompromising focus on the consumer as the most important part of the production line, were essential factors to building a quality product.

The Japanese quality turnaround was surprisingly rapid. Soon buyers all over the world were clamoring for Japanese products, making headlines as far away as London and the United States. In 1951, the Japanese established the Deming Prize to honor Deming's major contributions to quality promotion in the country. The prize continues to be one of the world's most prestigious acknowledgements of quality management and continues to fulfill its purpose of advancing the management of quality within Japanese industry. By 1954, the concept of total quality control (TQC) was adopted by Japanese management, who had simplified, augmented, and modified Deming's ideas for broad application at the shop floor. Total quality control, as the Japanese developed it, is an effective system for integrating the quality development, maintenance, and improvement efforts of various groups in an organization to enable economical production and service that create full customer satisfaction.

With TQC, Japanese productivity continued to rise. New brands like Honda and Sony entered global markets and claimed their share of customers. In 1960, Deming was awarded the Second Order of the Sacred Treasure in Japan, in honor of his work in enabling such a vibrant rebirth of Japanese industry on an international scale. Japan had not only recovered from the war; by embracing Deming's quality management methods and combining them with a commitment to productivity and hard work, the East Asian nation was rising to become an economic superpower.

1.4. The American Approach to Quality: The Postwar Years

During his time working as an instructor of statistical quality control for the War Production Board, Deming had only taught his principles of quality to the engineers and technical workers involved in direct production, and not to American managers and policymakers. As a result of his bottom-up approach, his vision had failed to penetrate the American management system and American corporations' visions of quality. It was a mistake he would later regret, as well as one he did not repeat in Japan.

In postwar America, where Deming's approach to statistical quality control did not prevail, the face of industrial quality was very different than it was in Japan. Following the Great Depression and World War II, quantity, instead of quality, was the key to management decisions in American industry. Quite simply, up until the 1950s and 1960s the success of the American economy had rested on its ability to make *more* of any product, as well as to achieve productivity

better than any other country in the twentieth century. This emphasis on quantity had arisen partly out of necessity. Without the American aptitude for efficient mass production, the outcome of World War II might have been different: part of the Allies' victory in the war had rested on swift American production of wartime materials, including weapons, guns, and provisions, as well as Americans' ability to deliver these materials quickly to the frontlines. The Germans and Japanese, despite being formidable enemies, had not quite been able to equal the American mass-production machine. In the years surrounding the war, craftsmanship in America had given way to efficiency.

Under the postwar American system, quality control came to mean end-of-the-line product inspection. Resources were plentiful in the postwar economic boom, America was the recognized world leader in manufacturing, and corporations had enough profits to rework any defects found at the end of the production process. Some Americans did make progress in defining quality standards: Armand V. Veigenbaum publicized his idea of total quality control with his now famous book *Total Quality Control,* first published in 1951 under the title *Quality Control: Principles, Practice, and Administration.* The American Society for Quality Control continued to promote the use of quality control for all types of production and service. The Department of Defense issued the first quality system standards, the MIL-Q-9858A, in 1957. But management largely regarded the quality techniques that Deming and his colleagues had taught in the 1940s as time-consuming and unnecessary, and they faded from use.

As the 1950s rolled on, many Americans did not realize the rules of the global market were changing. No longer did success mean making more of a product, but making that product of better quality. It would be several years until Japanese share increased in American markets, prompting executives to take immediate action.

1.5. Total Quality Management and Modern Industrial Approaches to Quality

By the 1970s, Japanese products were increasingly threatening America's ascendancy in the global economic market. In the late 1970s and early 1980s, American managers made frequent trips to Japan to learn about the Japanese approach to manufacturing. What they found was not what they expected. The Japanese were not more competitive because of low labor rates, because of new factories and state-of-the-art manufacturing equipment, or because of cheap exports. Instead, they worked with many of the same materials that American companies did. In their focus on companywide quality control (a variation on TQC), they had taken the time to understand the manufacturing process at all management levels and had worked hard to continually improve it. Their approach enabled them to produce higher-quality exports at lower prices.

In 1980, thirty years after he first taught the Japanese his methods, Deming was "rediscovered" in America. "If Japan Can… Why Can't We?", a NBC-TV special report broadcasted in June 1980, produced by Clare Crawford-Mason and featuring Deming's history and philosophy, became one of the most successful documentaries in television history. After the program aired, companies such as Ford and General Motors enlisted Deming's aid for their

corporate quality programs. His four-day seminars in the 1980s, which advocated his Fourteen Points of quality, began attracting hundreds of managers from such companies as AT&T, Procter and Gamble, and Xerox.

Other professional advocates of quality also influenced quality management in the United States through the 1970s and 1980s, though their individual definitions of quality vary. Philip Crosby, a noted quality professional and consultant, first published his widely acknowledged book *Quality is Free* in 1979 and promoted the concept of "zero defects," in which quality is defined as conformance to requirements. Joseph M. Juran, who had predicted decades earlier that the quality of Japanese goods would overtake the quality of American goods by the mid-1970s, had published the first edition of his influential *Quality Control Handbook* in 1951. The now-classic volume was later edited into several more editions, during which time Juran continued teaching his "Managing for Quality" course both in America and overseas and published *Quality Planning and Analysis* in 1970.

Total Quality Management (TQM), the American response to the Japanese economic threat, arose in the 1980s as a result of the teachings of these quality management professionals. TQM emphasizes not only statistics but also quality-based approaches that embrace the entire organization, similar to the concepts found in Japan. Quality management philosophies and programs other than TQM soon followed, as more American companies improved their corporate-wide industrial and management processes. In 1987, the first International Organization for Standardization (ISO) 9000 quality management standards were published. Also in 1987, U.S. Congress established the Baldrige National Quality Program and Malcolm Baldrige National Quality Award, which seeks to recognize as well as promote awareness of quality performance excellence.

Through the 1990s, American business leaders came to consider TQM as little more than a fad, though the quality movement continued to mature in other ways. Award-winning methodologies like Six Sigma, pioneered by Motorola in 1986, rose to prominence as a way to improve business processes by minimizing defects. The ISO 9000 standards have been expanded to include industry sector-specific versions for quality management. In addition, the concept of quality has expanded beyond the manufacturing sector to influence other business and public sector areas such as service, healthcare, education, and government. In sum, although the specific terms and processes associated with quality continue to evolve, the practice of assuring quality has rooted itself in the American and global industrial system.

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