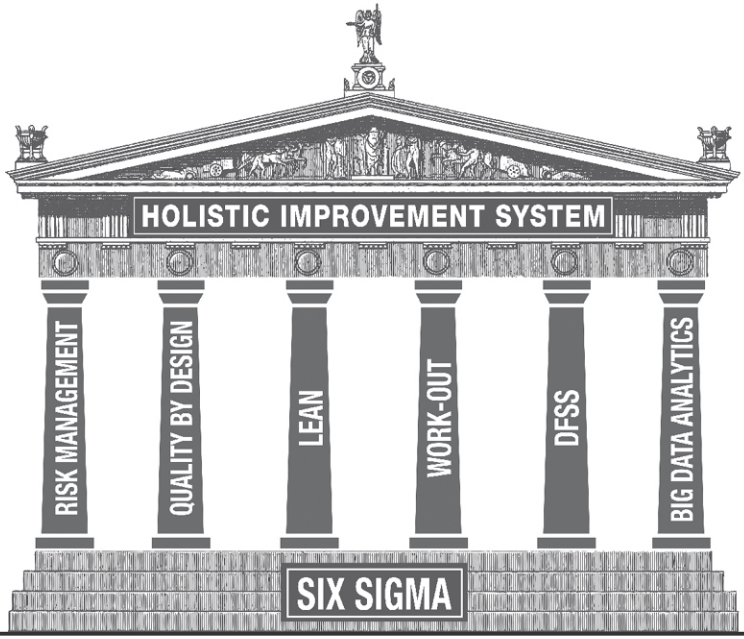
Leading Holistic Improvement *with* Lean Six Sigma 2.0



SECOND EDITION

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In summary, although GE was not the originator of Six Sigma, it clearly had a critical role in its development and evolution, not to mention its popularity. In particular, GE can be viewed as the primary developer of Version 1.1 and also played a key role in developing Versions 1.2 and 1.3 (refer back to Table 4.1).

Case Study: The DuPont Story

The DuPont Company was founded in 1802 to produce high quality black powder. At that time, the quality of black powder in the United States was very poor (DuPont Company, 1952). Guides at the Hagley Museum in Wilmington Delaware, the site of DuPont's original powder mill on the Brandywine River, explain that DuPont's advantages partly came from developing a device to measure the explosive charge of gunpowder in manufacturing, which then enabled the company to reduce variation below that of their competitors (Hoerl, 1990).

The DuPont Company has gone through many changes during its more than 200 years. Science and technology have been at its core, with DuPont's businesses focused on bringing innovative, high-quality products to market. In 2002, the company had annual revenues of $24 billion. Such a large and diverse company, often led by scientists and engineers, naturally produces many different approaches to improvement.

The DuPont Story is important to this book's theme of holistic improvement because it shows how a major global company can build on its improvement history, deploy improvement across the corporation to all its businesses, and expand and integrate improvement methodologies as it encounters new improvement challenges and opportunities.

Improvement at DuPont: 1950–1990s

Before we get to the story of Six Sigma at DuPont, we need to look at the various approaches the company used before the deployment of Six Sigma. We will see that DuPont continually focused on improving products and processes. We will also see that, as the discipline of continuous improvement advanced, DuPont utilized an evolution of approaches, retaining the useful aspects of the current approaches and adding newer approaches to overcome the limitations (Snee, 2004a).

Beginning in the 1950s, DuPont utilized formal approaches to design, control, and improvement of products and processes in various parts of the company. Statistical quality control (SQC), statistical process control (SPC), and design of experiments (DOE) were used in varying degrees in different parts of the company. These methods were applied and promoted by DuPont's Applied Statistics Group (ASG), which was part of the Engineering Department. Arthur E. Hoerl (Roger Hoerl's father) was the first member of this group and the first statistician DuPont hired in 1950. Ron Snee worked in the group from 1968 to 1991. Roger Hoerl served as a summer intern in the group in 1981 and 1982 while in graduate school.

Over the years, DuPont personnel broadly used formal techniques for improvement. During the 1960s and into the 1970s, ASG taught many workshops on Strategy of Experimentation (SOE) which relied heavily on DOE techniques. Courses and workshops were also offered on SQC and SPC and related statistical methods. Additionally, ASG developed and distributed software to implement these techniques, which was a novel contribution at that time.

Strategy of Experimentation

As noted previously, ASG promoted the use of design of experiments utilizing a strategic approach called Strategy of Experimentation (SOE). The SOE approach put business needs first and then provided a strategy to identify what experiments should be run to solve the stated problem, meet the objectives of the study, and so on. The SOE approach integrated a variety of DOE concepts, methods, and tools to accomplish this goal. SOE is itself an example of a holistic approach to experimentation. As of 2015, more than 40,000 DuPont employees had participated in the SOE workshop (Bailey, 2017b). Beginning in the mid-1970s, DuPont externally marketed SOE.

Product Quality Management

In the mid-1970s, DuPont's Dacron fiber business experienced a quality crisis that threatened the future of the business. Leadership felt that greater product consistency was needed across the eight global manufacturing sites. To accomplish these objectives, procedures were needed for

the consistent application of improvement tools to meet business needs, and novel approaches were needed to manage the connections between technology and business functions. The global business systems concept and Product Quality Management (PQM) were born within DuPont. PQM had two components:

- A framework for managing the quality of a product or service
- An operational system that enabled marketing, R&D, production, and support personnel to work together to meet increasingly stringent customer requirements

The PQM system technology consisted of sampling and data collection strategies, production process control, measurement process control, product release, and product and process audits and reviews. Here we see another early instance of integration of diverse tools and approaches, a hallmark of holistic improvement.

Although statistical tools were used to address most of these needs, the paradigm was now reversed. DuPont was leading with the business need, not the technology. The business needs addressed follow:

- Setting specifications
- Handling product characterization and release
- Improving process and product performance
- Communicating with customers
- Managing and improving test methods
- Measuring and monitoring progress
- Keeping the system up-to-date

Within a year the quality crisis was resolved and a new era had begun. Richard E. Heckert, DuPont Chairman and CEO, commented: "Within two years product quality had improved to the point of commanding a marketplace advantage and more than $30 million had been gained in operating cost improvements. The data-based Product Quality Management system developed for Dacron was expanded to other products with further contributions in earnings" (Heckert, 1986).

Other Approaches

Several other quality initiatives were launched within DuPont in the same general time frame. In the early 1980s, for example, the "quality revolution" began in the United States in response to foreign competition. Much of this competition came from Japan and fueled the NBC whitepaper, *If Japan Can, Why Can't We?* Foreign competition was also affecting DuPont. Two of DuPont's biggest businesses, Polymers and Textile Fibers, were major leaders in this effort. Textiles had begun its own quality revolution in the 1970s with its development of and focus on PQM. Now DuPont's Project Engineering Division used a Quality in Engineering initiative to focus on improvement within engineering.

With the advent of the Malcolm Baldrige National Quality Award (MBNQA) in 1988, DuPont turned its focus to a Corporate Continuous Improvement System based on the Baldrige Criteria. Motorola had won the Baldrige Award in 1988 and was requiring its suppliers, one of which was DuPont Electronics, to apply for the award. Several DuPont businesses proceeded to develop improvement initiatives based on the Baldrige Criteria. The Textile Fibers and Polymer Products businesses subsequently applied for the MBNQA.

The ISO 9000 quality standard was released in the late 1980s and became important to DuPont in two ways. First, it provided a minimal system for establishing the quality of products and processes. More important, however, ISO certification was being required to do business in Europe. The DuPont Applied Statistics Group, which became known as the Quality Management and Technology Center (QMTC), led the way in this initiative, providing training and consultation on ISO certification. In the 2000s the ISO Quality work was transferred elsewhere in DuPont and the QMTC returned to its focus on applied statistics under the banner of The DuPont Applied Statistics Group.

Six Sigma Begins in 1998

The approaches discussed previously were in use in DuPont in the 1990s and served as a basis for the deployment of Six Sigma, which began in 1998. The deployment approach used at DuPont relied heavily on the experiences of GE and AlliedSignal, which had initiated their Six Sigma deployments earlier in the 1990s. Here we discuss the overall

deployment of Six Sigma at DuPont, with a focus on the growth, breadth, and depth of the deployment as it grew into a holistic approach. Harry and Linsenmann (2006) provide further details of the deployment and some of the significant improvement projects conducted.

DuPont Specialty Chemicals was the first business unit to deploy Six Sigma in 1998. As discussed previously, DuPont had a strong foundation on which to build because many of the tools and approaches of Six Sigma were already in place. Six Sigma provided the integrating framework to lead improvement in an effective way.

This decision was followed by a corporate-wide deployment beginning in 1999, led by CEO Chad Holliday. Don Linsenmann was appointed Vice President of Six Sigma Deployment to lead the effort. The Six Sigma Academy was contracted to provide the initial Six Sigma training. The initial focus was on operations, first manufacturing in 1999 and then transactions in 2000.

Following GE's lead, DuPont moved Six Sigma into marketing and sales in 2002, focusing on top line growth (TLG) and providing a closer focus on the customer. The push for TLG, which also utilized Design for Six Sigma, involved more than 2,500 TLG projects producing more than $1.5 billion in revenue (Harry and Linsenmann, 2006).

As at GE, the program was called At the Customer, for the Customer. In this initiative, Six Sigma was used to help DuPont customers solve problems, enabling customers to have more effective businesses. This was a reinvigoration of what some DuPont businesses had been doing for a long time. For example, Ron Snee spent eight years of his tenure at DuPont providing statistical and data analytic services to customers of DuPont's Organic Chemicals business.

In 2004, DuPont started to utilize Six Sigma in the R&D function using the Design for Six Sigma (DFSS) approach. The specific project framework utilized was DMADV: Define, Measure, Analyze, Design, Verify. One major reason for the relative ease of internalization of Six Sigma methods in the R&D organizations could be that DuPont did not emphasize Six Sigma as a standalone initiative. Instead it was embedded within the larger, stage-gated new product commercialization framework, alongside strategic marketing methods. The emphasis was never on the methodology, but on the commercially viable end result for the customer.

Lean manufacturing was reintroduced in 2005, producing Lean Six Sigma. We say that Lean was *reintroduced* DuPont had utilized it in the 1980s under the name of continuous flow manufacturing (CFM). Lean Six Sigma integrated the two process objectives, managing the flow of information and materials, as well as improving quality and creating robust processes.

So during the 1999–2004 time frame, DuPont moved its improvement approach from Cost to Cost and Growth, to Cost, Growth, and Customer. The integration of the improvement initiative was accomplished on two main fronts: improvement methodologies and focus of the improvement work. Various improvement methodologies, including Lean and DMADV, were integrated during this time period. Diverse corporate functions became involved and cooperated on the effort—manufacturing, administration, marketing and sales, and R&D, for example.

Important to DuPont's success was the development of a supporting infrastructure for the Lean Six Sigma initiative (Bailey 2017a):

- Overall governance of Lean Six Sigma deployment from the corporate level into the businesses and to the operational units at the process level
- Human resource practices to support deployment, including recognition and reward, certification, and promotion plans
- Information technology tools such as statistical analysis systems, process mapping and modelling, project tracking, and metrics management scorecards
- Creation of database systems, including project management systems and project execution tools
- Finance practices related to project financial return validation rules and audits

In all instances, the supporting infrastructure was integrated with existing systems to eliminate any duplication of work.

Creating a Holistic System

The preceding discussion shows how DuPont Lean Six Sigma involved a number of businesses and management functions. Further evidence of this evolution toward a holistic improvement system is illustrated by the