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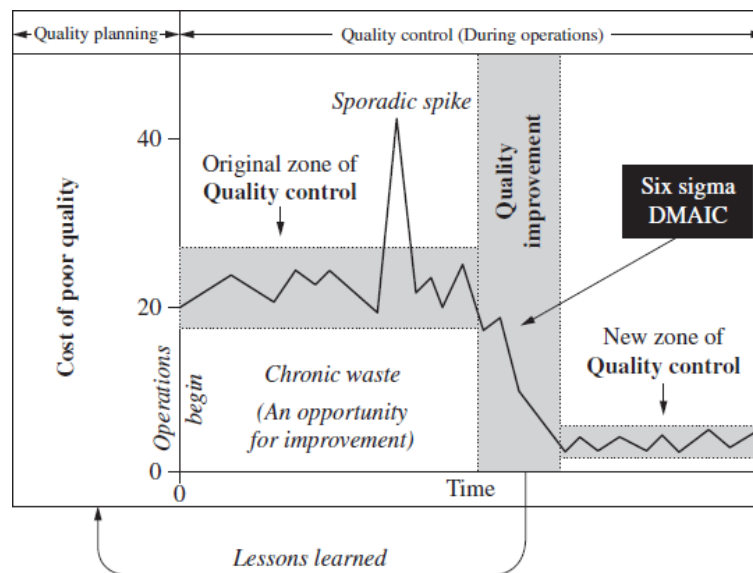
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15.2. Six Sigma: A New Global Standard for Improvement

Six Sigma and Lean Six Sigma (which adds Lean tools to the basic methodology) are quality improvement methods with value-added enhancements of computers and an increasing array of statistical and other software packages. For simplicity, we will refer to the full range of quality improvement methods and tools simply as Six Sigma for this chapter ([Fig. 15.1](#)).

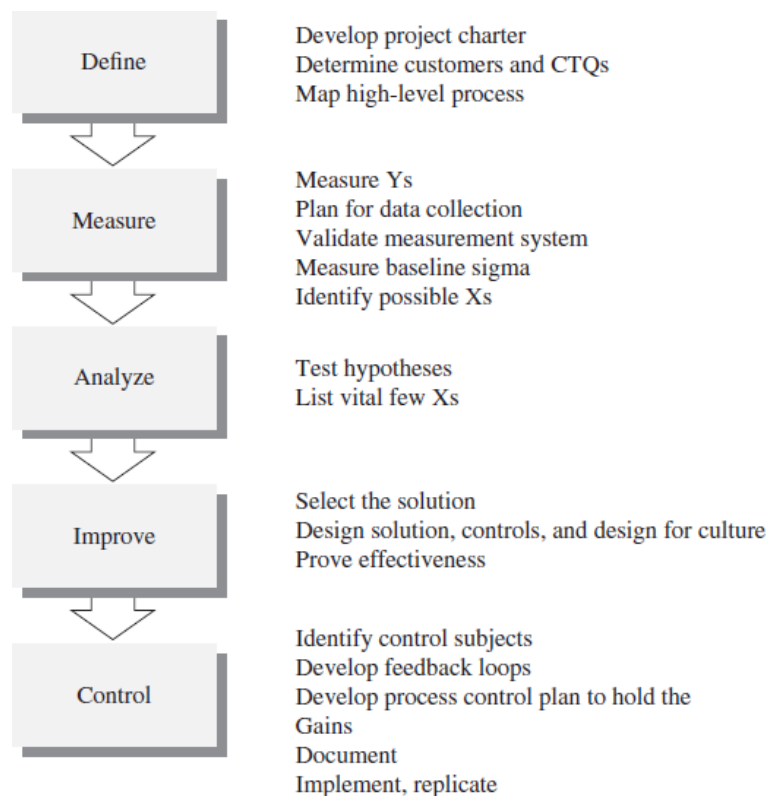
Figure 15.1 *Six Sigma and the Juran Trilogy. (Juran Institute, Inc., Southington, CT.)*



If solutions to your problems are elusive, or if you must attain quality levels measured in parts per million or approaching perfection, Six Sigma will place your ailing process under a microscope to find solutions. [Figure 15.2](#) presents the Six Sigma or DMAIC steps and tools most often used with it. The DMAIC steps are

1. *Define* the problem as clearly as one can in words.
2. *Measure* the current level of performance and voice of the customers.
3. *Analyze* collected data to determine the cause(s) of the problem.
4. *Improve* by selecting the right solutions to solve the problem.
5. *Control* to hold the gains.

Figure 15.2 *Six Sigma phases and steps.*

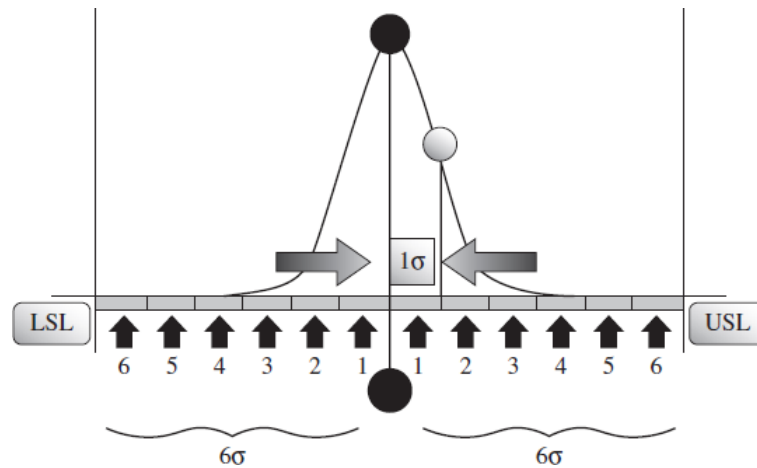


With these fundamental steps, Six Sigma is enabling many organizations around the world to succeed in achieving performance breakthroughs where they had failed before. The smart companies recognize this as not simply a "fix" to one-time problems, but truly a new way of doing business. Business challenges do not go away in a free marketplace; rather, they continually change in degree and form. Organizations worldwide are under continuing pressure to control costs, maintain high levels of safety and quality, and meet growing customer expectations. This breakthrough improvement process of Six Sigma has been adopted by many companies, including Samsung Electronics, General Electric, Honeywell, and other organizations, as the most effective method for achieving these and other goals.

More than just a formal program or discipline, Six Sigma is an operating philosophy that can be shared beneficially by everyone: customers, shareholders, employees, and suppliers. Fundamentally, it is also a customer-focused methodology that drives out waste, raises levels of quality, and improves the financial and time performance of organizations to breakthrough levels. Six Sigma's target for perfection is to achieve no more than 3.4 defects, errors, or mistakes per million opportunities, whether it involves the design and production of a product or a customer-oriented service process.

It is from this target that the "Six Sigma" name originated. Usually written as a small sigma in the Greek alphabet, sigma (σ) is the symbol used to denote the standard deviation or measure of variation in a process. A process with less variation will be able to fit more standard deviations, or "sigmas," between the process center and the nearest specification limit than a process that is highly variable. The greater the number of sigmas within the specifications, the fewer the defects. The smaller the variation, the lower the cost. A higher sigma level means the process of delivering a good, product, or customer service has greater consistency. **Figure 15.3** demonstrates a Six Sigma level of performance. This means that one can fit in six standard deviations, or six sigmas, between the process center and the nearest specification limit.

Figure 15.3 Six Sigma level of performance.



Most organizations operate at the Three Sigma level, or about 66,800 defects per million opportunities (DPMO) for most of their processes and at a Four or Five Sigma level in some of the mission-critical processes. Comparisons of Sigma levels, yields, and the corresponding defect rates are shown in [Table 15.1](#). It would be foolish, however, to try to achieve Six Sigma levels of performance for every process in the organization. This is because not all processes are equally important. For example, the process for requesting time off for vacation is not as critical as the order fulfillment process. What really counts is significant improvement in the mission-critical areas—that is, critical as defined by the customer.

Table 15.1 Sigma Level, Yield, and Defect Level

Process Sigma (Short Term)	Long-Term Yield	Defects Per Million
6	99.99966%	3.4
5.5	99.9968%	32
5	99.9767%	230
4.5	99.8650%	1340
4	99.3790%	6200
3.5	97.725%	22,700
3	93.319%	66,800
2.5	84.13%	158,000
2	69.15%	308,000
1.5	50%	499,000
1	31%	691,000
0.5	16%	841,000

15.2.1. Six Sigma Is Customer Focused—Organization Examples of Success

Why does Six Sigma work as well as it does? In large part, it is because of a strong emphasis on the customer. While the saying "the customer is always right" is not literally true, customers hold the key that can unlock unrealized potential in your business. Basically, the DMAIC process translates a customer's needs into actionable, operational terms and defines the critical processes and tasks that must be done well to meet the customer needs. Although the details vary, depending on the analysis and improvement interventions that follow. Six Sigma consistently will drive the performance of products, services, and processes to breakthrough levels, that is, to new and sustained levels of performance. Breakthroughs are achieved not by massive teams or flashy initiatives, but by using a steady and concerted project-by-project approach. In this manner, the Six Sigma approach will help organizations:

- Improve cycle times, quality, and cost
- Improve effectiveness and efficiency of processes, including e-commerce
- Design products and services that will sell well
- Reduce chronic waste, or the cost of poor quality (COPQ)
- Grow profits by improving revenue and reducing costs

In short, Six Sigma is financially rewarding. Our experience indicates returns on investment (ROI) are achievable ranging from 10:1 to more than 100:1.

15.2.2. Samsung Electronics

When the decision was made by Samsung Electronics Company, Ltd., Vice Chairman and CEO Jong-Yong Yun to position the company for the future, the catalyst was Six Sigma. Samsung Electronics began its journey with training as the first essential step to prepare for implementing the methodology. Starting initially in manufacturing operations and R&D in 2000, the company expanded to transactional business processes and the entire supply chain, ultimately obtaining significant savings and financial benefits in all 16 of its business units in South Korea and internationally. The methodology's philosophy and methods continue to be integrated still more deeply throughout the company by developing the internal specialists needed to teach, implement, maintain, and grow this competence in the future. No single person, nor any operation in Samsung Electronics, is exempted from the process, and the company is not looking back.

15.2.3. General Electric

Mr. Jack Welch, General Electric's retired CEO, was one of the first high visibility executives who became a Six Sigma leader and advocate. As an international business role model, he was vocal in expressing his views as to what leaders must do to achieve superior results. GE became an early adopter of Six Sigma, and through its demonstrated success and bottom-line results, enabled Mr. Welch to vault Six Sigma from the mailroom to the boardroom. In his book *Winning*, he said "Six Sigma, originally focused on reducing waste and elevating the quality in our products and processes, has delivered billions of dollars to GE's bottom line in savings. Six Sigma has grown from an internally focused activity to an outside focus—also improving the productivity and efficiency of our customers' operations. Increasing the intimacy between GE and its customer base is making everyone more productive and helps all of us grow through tough economic environments." "Today," Mr. Welch explained, "Six Sigma has evolved to an even larger role in GE. Its rigorous process discipline and relentless customer focus has made it the perfect training ground and vehicle for the future leadership of GE. Our best and brightest employees are moving into Six Sigma assignments. I'm confident that when the board picks a successor to Jeffrey Immelt 20 years from now, the man or woman chosen will be someone with Six Sigma in his or her blood. Six Sigma has become the language of leadership in our company in GE. Its rigorous process discipline and relentless customer focus has made it the perfect training ground and vehicle for the future leadership of GE."

15.2.4. Six Sigma Works for Production, Service, and Transactional Processes

The Six Sigma movement gained interest in health care, financial services, legal services, engineering, consulting, and almost all organizations. In addition to achieving major improvement in manufacturing goods, managing inventory, delivering products, and managing repetitive processes, the Six Sigma methods have migrated to transactional processes. Processes that avoided continuous improvement because, as many stated, "the tools did not apply to us" have joined the Six Sigma bandwagon. Processes like completing an invoice, writing a contract, and boarding passengers on an airline, banking, hospitals, insurance, government, and other service organizations have tried Six Sigma. Most succeeded in

- Optimizing equipment usage
- Experiencing fewer rejects or errors
- Cutting response times to customer inquiries
- Reducing inspection, maintenance, inventory, and supply chain costs
- Creating more satisfied customers, external as well as internal

When implemented strategically, Six Sigma also

- Helps turn over working capital faster
- Reduces capital spending
- Makes existing capacity available and new capacity unnecessary
- Fosters an environment that motivates employees
- Improves morale, teamwork, and career potential

15.2.5. Telefónica

One of the biggest names in business in Spain and in the Spanish- and Portuguese-speaking world has a long tradition of quality management practices and achievements. So when the company embarked on a pilot Six Sigma program toward the end of 2000, the scale and ambition of the effort reflected the company's experience of business improvement initiatives. Between March and July 2001, some 21 first-phase projects were completed. Efficiency savings from these projects amounted to more than 22 million euros; customer satisfaction levels were at all-time highs. Telefónica committed itself to 300 Six Sigma projects for the following year and estimated that it will have conducted 3000 projects during the next 3 years after that (European Quality, 2002).

The Six Sigma Model for Improvement has been widely used to address repetitive production-like processes and ones that address repetitive transactional processes.

We need to clearly establish the difference between production (aka, manufacturing) and service or transactional processes. All processes are transformations that result in the change of state of one or more things that can be physical objects or services. *Production processes* directly transform raw materials or semi-finished goods into a final physical product (aka, goods). The output of production processes is a transformed physical product; these processes are deterministic, workflow-oriented, highly procedural, and, therefore, highly repeatable. Because of this, production processes are well suited for representation by the traditional, workflow-based triple role of input-process-output (IPO) or supplier-input-process-output-customer (SIPOC) models.

A process to produce goods is a series of work activities performed by people and other resource-consuming assets in order to transform given input(s) into output(s).

A service process or transactional process (sometimes also called people or paper processes) directly transforms one state or condition of one or more things (objects, abstractions such as information, data, symbolic representations, etc.) into another. One execution of a transactional process results in a transformation, the outcome of which, in turn, may be a change of state in a number of things (physical objects such as inventories, data and information, people, etc.). Examples of transactional processes include

- Value-added service processes related to production (transporting, installing, storing, repairing, maintaining, etc.)
- Support or back-office processes in manufacturing and service organizations (selling, purchasing, subcontracting, warehousing, billing, human resources, etc.)
- Value-added processes in service industries (banking, insurance, transportation, health care, hospitality, education, etc.)
- Value-added processes in the public sector (including the military) and the not-for-profit sector (legislative and administrative processes, planning, command and control, fundraising, etc.)

The output of transactional processes is a change of state or condition, defined by the transaction. These processes are information (communication)-driven in that successive executions of a transactional process depend on the informational inputs (requests, offers, etc.) received at the outset of each execution. Accordingly, successive executions may be different with different results. Therefore, these processes are not always repeatable in the same sense as stamping out millions of identical parts, but are self-regulating and highly adaptable. A transactional process is a logical set of customer-supplier tasks that drive work activities performed by people.

Transactional process characteristics that differentiate them from production processes may include

- Scarcity of measurement data; available measurements are primarily discrete (attribute)
- Measurement system is partially or entirely I/T defined (e.g., reporting)
- The definition of quality includes information quality
- Dominant variables: people and information
- High-cost labor
- Disproportionately large financial leverage