

---

# Six Sigma

**APOORVA PAREEK**  
Assistant Professor, NDIM

---

## What is Six-Sigma?

Six-Sigma is a business concept that answers customers' demand for high quality and defect-free business processes. Customer satisfaction and its improvement should be the highest priorities of any business. In other words, Six-Sigma is about abandoning the uncertainty of goals and forecasts. It is also a statistical measure of process capability that lets you measure the quality of your business' products and services. A level of six-sigma (about 3 defects per every million) represents the highest quality - virtually all products and business processes are defect-free. But most companies today function at only 3-4 sigma and lose 10-15% of their total revenue due to defects. 4-sigma still means 6,210 defects per million opportunities!

It is a powerful set of statistical and management tools and methodologies that can create dramatic increase in customer satisfaction, productivity and shareholder value. It is based on improving process targeting and reducing variation in a business process. It can also be a great way to improve organization and cultural development.

It is a business method for improving quality by removing defects and their causes in business process activities. It concentrates on those outputs, which are important to customers. The method uses various statistical tools to measure business processes. In technical terms Six-Sigma means there are 3.4 defects per million events. The main goal is continuous improvement.

*In short six-sigma is several things:*

- A statistical basis of measurement: 3.4 defects

per million opportunities

- A philosophy and a goal: as perfect as practically possible
- A methodology
- A symbol of quality

## **History of the Concept**

There have always been many statistical methods for measuring and improving quality. Six-Sigma was born when Motorola published its Six-Sigma quality program in 1987. Mikel J. HARRY developed Six-Sigma. The program gained publicity when Motorola won the Malcolm Baldrige quality prize. The further development took place in the turn of the decade in ABB where Harry worked as a vice-president in charge of quality systems development.

The Six-sigma approach has been used with great success in leading companies such as GE, Johnson and Johnson, Allied Signal, and Quest Diagnostics.

Sigma ( $\sigma$ ) is character of the Greek alphabet, which is used, in mathematical statistics to define standard deviation. The standard deviation indicates how tightly all the various examples are clustered around the mean in a set of data.

Let's take an example of lost luggage at the airport. In general terms, the baggage handling capability of many airlines is performing at around the three-sigma level. That means there are about 66,000 "defects" for every one million-luggage transaction, which equates to an approximate 94%

probability that you'll get your luggage. Is that good enough? Certainly, not for the customers whose bags are among the "defects". The "defects" increase costs for the airlines, because employees must deal with misplaced luggage and unhappy passengers. And those "defects" can result in lost business in the future.

If the airlines move to Six Sigma in luggage handling, it clearly pays off in terms of lower costs and happy passengers, who are then more likely to fly with that airline again.

Table below indicates operating at anything less than six sigma levels means the processes have higher probabilities of delivering defects.

Probability of defects of different sigma levels.

It may appear that three sigma is good enough. After all, if there are 66,807 defects out of a million, that means that 933,193 things went well-93.319% perfection.

But if the airline is taking comfort in those

Sigma Level (Process Capability)	Defects per Million Opportunities
2	308,537
3	66,807
4	16,210
5	233
6	3.4

How many customers any business can afford to lose? How much money can a company afford to lose because of mistakes? Why accept it as normal to be running processes at only three sigma or four sigma when by changing the way company manages their processes, the company could get a lot closer to six sigma and all the resulting benefits.

### **Essentials of Six-Sigma**

Six-Sigma uncovers the layers of process variables in data terms that the company people must understand and control to eliminate defects and wasteful costs. It's a management approach that aims to achieve the apex of quality by measuring, analyzing,

statistics, it's losing money and losing customers. Consider this three-sigma level from another perspective.

For customers three-sigma represents highly unsatisfactory performance. The airline is not meeting their most basic expectation - that their luggage will be put on the same flight, to travel with them to the same destination. So the airlines are likely to be losing many of those frustrated customers.

Three-sigma is also costing money. Variations-time, waste, and errors-around in the baggage-handling process: misrouting the baggage, reporting the problem, processing the report, searching, retrieving, and finally delivering the lost luggage.

When the 6% probability gap of missing luggage is translated into monetary terms, the hard cost of this defect can be much higher than 6% of the overall cost of handling luggage-perhaps several million dollars per year. If the baggage-routing process were improved, the margin for error would be reduced and the allocation of resources, both human and monetary, could be much more profitably used.

improving, and controlling processes to root out defects and boost bottom-line results.

Many people associate six-sigma with quality. Sigma professionals recognize this as an approach as a roadmap for improvement. It is based on a few key concepts:

- **Defect** - A measurable characteristic of the process or its output that is not within the acceptable customer limits i.e. not conforming to specifications.
- **Variation** - Any quantifiable difference between a specified measurement or standard in the

---

output of a process. Variation in output can result from many causes in the functioning and management process.

**Critical-to-Quality (CTQ)** - Elements of a process that significantly affect the output of the process. Identifying these elements is vital to figure out how to make the improvements that can dramatically reduce costs and enhance quality.

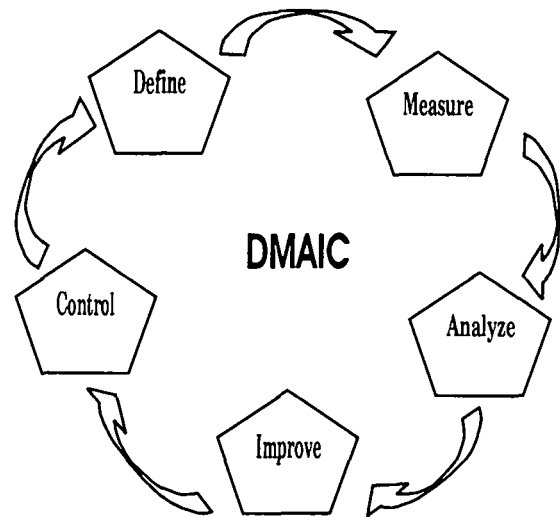
- Actually, CTQ is the connecting link between customer satisfaction and process improvement, and therefore the use of the word critical in this phrase. In order to reveal accurate requirements from customer research, the research should ensure the following:
- Surveys must contain a basic objective that will narrow the customer's options and will lead them to be certain about their answers.
- Random selection of participants as samples.
- The entire population of consumers should be represented by the survey.
- Customer Need Matrix' is a method that helps to characterize CTQ according to the analysis of 'voice of the customer' research. The method is known also as Quality Function Deployment (QFD) and both, Japanese and American industries are using it extensively and they have developed it almost to a fine art.

**Process capability** - A statistical measure of inheritance variation for a given event in a stable process. It's usually defined as the process width (normal variation) divided by six-sigma and quantified using capability index (Cp). More generally it is the ability of the process to achieve certain result, based on the performance testing.

**Design of Six-Sigma** - The six Sigma methodologies eliminates the use of opinion -"I think", "I feel", or "I believe". Six-Sigma drives the organization to move scientific means of decision-making by basing everything on measurable data.

#### **Implementing Six Sigma**

How can you make quality part of the culture, not just the procedure?



The downside of Six-Sigma is that there are currently no standards, nor an official certifying institution, to make sure that everyone walks the talk.

Generally, Six-Sigma criteria are not comparable to the ISO 9000 criteria than to that of the Malcolm Baldrige National Quality Award. Companies that have won the Baldrige Award have already learned that successful quality management encompasses many business management tools, including leadership, strategic planning, customer and market focus, information and analysis, human resource focus, process management, and results orientation.

Six-Sigma is carried out as projects. Most common type is the **DMAIC** method.

#### **DMAIC - Model**

- **Define** the projects and goal, and the deliverables to customer (Internal and External). At the top level the goals will be the strategic objectives of the organization, such as a higher ROI or market share. At the operations level, a goal might be to increase the throughput of a production department. At the project level goals might be to reduce the defect level and increase throughput. Apply data mining methods to identify potential improvement opportunities.
- **Measure** the current performance of the process. Establish valid and reliable metrics to help

---

monitor progress towards the goal(s) defined at the previous step. Begin by determining the current baseline. Use exploratory and descriptive data analysis to help you understand the data.

- *Analyze* and determine the root cause(s) of the defect. Analyze the system to identify ways to eliminate the gap between the current performance of the system or process and the desired goal. Apply statistical tools to guide the analysis
- *Improve* the process to eliminate defects. Be creative in finding new ways to do things better, cheaper, or faster. Use project management and other planning and management tools to implement the new approach. Use statistical methods to validate the improvement
- *Control* the performance of the process and the new system. Institutionalize the improved system by *modifying compensation and incentive systems, policies, procedures, MRP, budgets, operating instructions and other management systems.* You may wish to utilize systems such as ISO 9000 to assure that documentation is correct.

This methodology is not rigid. Approaches vary, sometimes significantly. One of the variations is in the phases: some approaches use all five of the phases listed above, while others do not include the Define phase. Six sigma professionals recognize that this approach is a kind of roadmap for improvement, and it doesn't matter if it's called DMAIC, MAIC, POOCR (Priority, Characterize, Optimize, and Realize), GETS (from GE Transportation Systems - gather, evaluate, transform, and sustain). The point is that this is a set of tools aimed at helping managers and employees to understand and improve critical processes.

The Six Sigma methodology uses statistical tools to identify the vital few factors, the factors that matter most for improving the quality of processes and generating bottom -line results .It consists of four or five phases:

**DCAM:** Design for Customer Satisfaction and Manufacturability

**DMAIC:** Define, Measure, Analyze, Improve, and Control

**DSSS:** Developing Six Sigma Software

**TQSS:** Transactional Quality Using Six sigma

**CFPM:** Cross Functional Process Mapping

Six-Sigma focuses on defects and variations. It begins by identifying the critical-to-quality (CTQ) elements of the process attributes most important to the customer.

Consumers' research should reveal clear requirements to the process. Though, requirements cannot serve the process measurement system, and should be translated to numerical values that are associated with the elements that are 'Critical To Quality'. These elements will be the fundamentals of the process improvement stage. Actually, CTQ is the connecting link between customer satisfaction and processes improvement.

First, the project and the process to be improved are defined after which the performance of the process is measured. The data is then analyzed and bottlenecks and problems identified. After analysis, improvement program is defined and defects removed. A management group controls this development program. After DMAIC circle it is time to define a new project.

Six-Sigma was developed to pursue the same target as the Baldrige criteria: completely satisfying customer needs profitably. One major difference seems to be that Baldrige criteria show just the shell of targets within those criteria whereas Six-Sigma also describes a proven box of powerful tools and strict guidelines for applying them.

#### **How is Six-sigma different?**

Is Six-sigma really different from other approaches? Although many of the tools are old, Six-sigma gives you:

- A top-down approach, linked to strategy, sponsored by leaders
- Puts customer requirements first
- Applicable to all business processes - administrative, sales, marketing, R&D, etc.

- Fact based, data driven
- Results-oriented, hands-on way to develop critical managerial skills
- Projects based on top and bottom-line impact
- Exponential improvement targets

When done correctly, Six-Sigma becomes a way toward organization and cultural development. It is more than a set of tools! It allows you to achieve the constancy of purpose that is the secret to success, by focusing your effort on understanding the variation in your process and the defects that result.

### **What Six Sigma Is Not**

Six-Sigma is a methodology/set of tools/process-not a strategy. A common misconception in today's manufacturing circles concerns Six-Sigma. Companies frequently announce they have adopted Six-Sigma as their strategy to improve customer service, profitability or even share price.

GE, Honeywell and others have achieved the financial and customer service improvement that resulted from deploying Six-Sigma. Many other manufacturers, particularly discrete manufacturers, are considering adopting Six Sigma as their strategy to reap the same kinds of benefits touted by the industry leaders, already on the Six Sigma path.

Six-Sigma is not another quality program. Businesses exist for one purpose - to profitability serve customers. So it follows that any problem solving initiative should do the same, Six Sigma uses resources to fix identifiable, chronic problems. It proves its value by connecting outcomes to bottom line.

Quality programs are valuable in that they can create a quality perspective and culture. But Six-Sigma fixes identifiable, chronic problems that directly impact bottom line. Six Sigma projects are selected to reduce or eliminate waste, which translates into real money.

Six-Sigma is not a theory. It's a practice of discovering the vital few processes that matter most. It defines, measures, analyzes, improves, and controls them to tie quality improvement directly to bottom

line results.

Six-Sigma is an active, involved effort that puts practical tools to work to root defects at all levels of the organization.

Since the success of Six-Sigma is directly linked to monetary outcomes, it generates real-world results. It uses the most readily available resources in an organization - its human assets. It means that positive, tangible results consistently show up wherever and whenever people are engaged in implementing Six Sigma techniques.

Six-Sigma is not a training program. Practitioners are trained in the methodology to ensure correct implementations and results. Six-Sigma is a business strategy that fosters a cultural shift at all levels. Permeating departments, functional groups, and all levels of management, Six-Sigma changes the outlook and practice of everyone in the organization.

From workers on assembly lines and bookkeepers in accounting to operations managers and human resources personnel, training exists only to instill the method, facilitating, transformation, and get financial results by attacking chronic defects with proven statistical tools.

There are many myths and misunderstanding about Six-Sigma. These are as follows :

### **Six Sigma Myths:**

*Works only in manufacturing* - Much of the initial success in applying Six-Sigma was based on manufacturing applications; however, recent publications have addressed other applications of Six-Sigma. Breyfogle (1999), *Implementing Six Sigma*, includes many transactional/ service applications. In GE's 1997 Annual Report (GE, 1997).

*Ignores the customer in search of bottom-line benefits* - This statement is not myth, but rather misinterpretation. Projects worthy of Six Sigma investments should (1) be of primary concern to the customer, and (2) have the potential for significantly improving the bottom line. Both criteria must be met. The customer is driving this boat. In today's competitive environment, there is no surer way of going out of

---

business than to ignore the customer in a blind search for profits.

*Creates a parallel organization* - An objective of Six Sigma is to eliminate every ounce of organizational waste that can be found and then reinvest a small percentage of those savings to continue priming the pump for improvements. With the large amount of downsizing that has taken place throughout the world during the past decade, there is no room or inclination to waste money through the duplication of functions. Many functions are understaffed as it is. Six-Sigma is about nurturing any function that adds significant value to the customer while adding significant revenue to the bottom line.

*Is an add-on effort* - This is simply the myth "creates a parallel organization" in disguise. Same question, same response.

*Requires massive training and Large team* - There are many books and articles within business literature declaring that teams have to be small if they are to be effective. If teams are too large, the thinking goes, a combinatorial explosion occurs in the number of possible communication channels between team members, and hence no one knows what the other person is doing.

*Creates bureaucracy* - A dictionary definition of bureaucracy is "rigid adherence to administrative routine." The only thing rigid about wisely applied Six Sigma methodology is its relentless insistence that customer needs be addressed.

*Is just another quality program* - Based upon the poor performance of untold quality programs during the past three to five decades (Micklethwait and Wooldridge, 1997), an effective quality program would be welcome. More to the point (Pyzdek,

1999c), Six Sigma is "an entirely new way to manage an organization."

*Requires complicated, difficult statistics* - There is no question that a number of advanced statistical tools are extremely valuable in identifying and solving process problems. We believe that practitioners need to possess an analytical background and understand the wise use of these tools, but do not need to understand all the mathematics behind the statistical techniques. The wise application of statistical techniques can be accomplished through the use of statistical analysis software.

*Is not cost-effective* - If Six-Sigma is implemented wisely, organizations can obtain a very high rate of return on their investment within the first year.

Six-Sigma actively links people, processes, and outcomes in a rigorous, adaptable way to get the results. If the industry, business, product or services apply Six Sigma, tangible results will be there.

### ***Six-Sigma as applied to IT***

Software Six-Sigma can be viewed as a mechanism for data driven continuous improvement. It provides a rigorous approach to implementing software process improvements that move an organization up the CMM maturity scale at any level. The emphasis on measurable improvements in Six Sigma provides a way for an organization to assess the return on its CMM investment. Without this level of rigor, organizations typically take longer to move up the maturity scale and have a higher probability of failure. It is extremely difficult to sustain an improvement activity without statistically measurable benefits.