

## Appendix (4)

### **What is Six Sigma?**

What is Six Sigma (both a simple and a complex question)?

In mathematical terms, six sigma is a statistically derived performance target for operating with only 3.4 defects per million (i.e., a target in which a process performs in such a way that the control limits are six standard deviations apart relative to the mean output). In contrast, three sigma reflects operations with as many as 66,800 defects per million.

The *Six Sigma Quality Management System* (Six Sigma) is a systematic approach for improving the quality of manufacturing and organizational-work processes. Six Sigma starts with the customer to clearly define process demand, and then links ambitious process-improvement goals with a set of quantitative metrics and statistical tools. Six Sigma was originally developed at Motorola in the 1980s and then adopted by GE and Allied Signal in the mid-1990s prior to its wide-spread corporate acceptance during the past two years. Six Sigma is all about creating a constancy of purpose toward the improvement of quality and productivity of a process (Deming). Six Sigma is being applied as much to marketing, service, financial and sales work processes as it is being applied to engineering and manufacturing processes.

Six Sigma is the rigorous implementation of an array of proven quality principles and statistical techniques that have been best practices for the past two decades. It is a highly quantitative and analytical approach to continuous improvement with the disciplined use of facts, data and statistical analysis, and the diligent attention to managing and improving processes. Six Sigma provides a perspective on the variance of a process to fully understand the “real” performance (no longer hiding behind the averages). Six Sigma helps an organization focus on defect prevention, cycle time reduction and eliminating non-value added activities.

### **Quality – what is it in a Six Sigma world?**

At the heart of Six Sigma is the notion that quality saves money. Quality in the Six Sigma system is a measure of how well your customer’s needs are being met, not merely meeting internal specifications. The sigma value is a quality metric that indicates how well a process is performing. Six Sigma is not a quality assurance plan but a work-process control strategy.

Sigma Value	Process Yield*	Defects per Million*
1.0	30.9%	690,000
2.0	69.2%	308,000
3.0	93.3%	66,800
4.0	99.4%	6,210
5.0	99.98%	320
6.0	99.999%	3.4

\*assuming the mean output of a process may drift up to 1.5 sigma from the target output.

### Why use Six Sigma?

Incorporation of Six Sigma into our performance management systems will establish the following business priorities:

- ↑ greater focus on the customer
- ↑ data-driven work-process management
- ↑ focus towards process efficiency and improvement
- ↑ well informed, proactive decision making
- ↑ improve collaboration across business units

The benefits from successful implementation of Six Sigma include:

- ↑ increased efficiency and higher profit margins
- ↑ timely execution of strategic change
- ↑ further enhanced value to customers
- ↑ sustained success for continuous improvement programs
- ↑ common goals and consistent metrics throughout the organization.

### How is Six Sigma applied?

The systematic approach to executing a Six Sigma project includes five steps:

1. *define* the expectations for the process
2. *measure* the quality attributes for the process
3. *analyze* when and where defects occur
4. *improve* the process to obtain the desired quality
5. *control* the process to sustain the new level of performance

*The above material taken from the following: GEpower.com, honeywell.com, DOW.com, www.qa\_inc.com <[http://www.qa\\_inc.com](http://www.qa_inc.com)> (The Complete Guide to Six Sigma by Thomas Pyzdek), www.bestpracticedatabase.com <<http://www.bestpracticedatabase.com>>, and Six Sigma: The Breakthrough Strategy by M. Harry and R. Schroeder.*

## SIX SIGMA AND DATA MINING

The Six Sigma methodology entails the application of statistical techniques, which are used to identify the relationships between variables that underpin a given process. These statistical techniques can include:

- ↑↑ Chi-Square tests
- ↑↑ t-tests
- ↑↑ Analysis of Variance tests
- ↑↑ Multivariate Analytical tests

Data mining methodologies such as segmentation, regression and to some extent neural network methodologies incorporate many of the statistical techniques above. Hence the connection of 6 Sigma to data mining.

### **In a regression application:**

The various forms of regression analysis concentrate on using existing data to predict future results. The most common is “Linear Regression” (or simple regression), which is used for two variables. This can be illustrated by using a copier example:

Percy’s Copy Repair Shop wants to show clients the value of its maintenance service contract. Having gathered data on the relationships between Time Maintenance and Copy Defects, they found that defect rates tend to increase by 15 percent for every two-week period without maintenance. Using the tool of Linear Regression, they were able to predict to a prospective customer that by the third month after their last “emergency” service call, they’d be getting about 25% “defective” copies. The prediction turned out to be pretty accurate, and now the customer has a bi-weekly service agreement with Percy’s.

Multiple Regression, like Multivariate analysis, examines the relationship among several factors and the results. In a process environment, examples could include all those shown in the following table.

Using Multiple Regression, you would be able to quantify the impact of each of these X’s on the Y’s – and to see how they interact. In more advanced applications,

Multiple Regression is applied to create models to predict the results when combinations of factors interact under various conditions.

*Table I.*

Process	Unit or Item	X1 (Input variable)	X2 (Process variable)	X3 (Process variable)	Y (Output or result variable)
Software Installation	Software Package	Size of Software (MB)	Number of Users On Network	Server Processor Speed (MHz)	System Downtime during Install (Minutes)
Hotel Reservation and Check-In	Reservation	Hold Time to talk to Reservation Agent (seconds)	Number of days reserved	Number of Agents on duty in Call Center	Time to check in a guest (minutes)

*Above material taken from "Six Sigma Way," Pande, 336, 367.*

As was mentioned in this work, neural network data mining techniques are also suitable for the above analysis.