

StatSoft®

Business White Paper

## **Six Sigma Methodology and *STATISTICA***

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## Table of Contents

What is Six Sigma?.....	3
Why is Six Sigma so popular? .....	3
Technically Speaking.....	3
How does it work? .....	4
Six Sigma and <i>STATISTICA</i> .....	5
Six Sigma Tools in <i>STATISTICA</i> at the Desktop Level.....	5
Six Sigma Tools in <i>STATISTICA</i> at the Enterprise Level.....	6

## What is Six Sigma?

Six Sigma is a well structured data-driven methodology for eliminating defects, waste, or quality control problems of all kinds in manufacturing, service delivery, management, and other business activities. Six Sigma methodology is based on the combination of well established statistical quality control techniques, simple and advanced data analysis methods, and the systematic training of all personnel at every level in the organization involved in the activity or process targeted by Six Sigma.

## Why is Six Sigma so popular?

Six Sigma methodology has gained wide popularity because it has proven to be successful not only at improving quality but also at producing large cost savings along with those improvements. Some spectacular Six Sigma success stories at large corporations have been widely publicized, and they captured the attention of many business leaders.

For example, Jack Welch, a CEO of General Electric (one of the largest manufacturing businesses in the world), says, “Six Sigma is the most important initiative GE has ever undertaken – it is part of the genetic code of our future leadership.” He credits Six Sigma with cost savings at GE in the range of billions of dollars.

Many other companies have also reported savings of literally astronomical magnitude after incorporating Six Sigma methodology throughout their manufacturing facilities. For example, Motorola (the leading member of a consortium of companies that developed the Six Sigma approach) reported over 11 billion dollars in savings since the use of Six Sigma in its factories. Allied Signals reported over 1 billion dollars in cost savings due to Six Sigma in just a few years.

## Technically Speaking...

The term Six Sigma (a trademark of Motorola, where it originated in the '80s) reflects the statistical objective of the approach, namely striving to achieve a negligible number of defects, corresponding to the probability associated with a (“corrected” – see below) six sigma value for the normal curve: applying the normal curve, Six Sigma attempts to relegate defects and quality problems to the very tails of the distribution, making such problems literally rare exceptions in a process that operates almost without defects. To achieve this “six Sigma objective,” a process must not produce more than 3.4 defects per million opportunities to produce such defects (where a “defect” is defined as any kind of unacceptable outcome produced by the process under scrutiny.). Note that the 3.4 defects-per-million criterion actually corresponds to a normal z value of 4.5 because the Six Sigma approach allows for a

1.5 times sigma worth of so-called “drift” or process “slop” (termed by Motorola the “Long-Term Dynamic Mean Variation”). Hence, the most basic statistical tool for the Six Sigma effort is the Six Sigma calculator, which will compute the number of defects given the respective one, two, . . . , six sigma process. In addition, a wide variety of much more complex analytical techniques are recommended by the Six Sigma approach and need to be used at the consecutive stages of the Six Sigma project, depending on the nature of the process.

## How does it work?

The power of Six Sigma lies in its “empirical,” data-driven approach (and its focus on using quantitative measures of how the system is performing) to achieve the goal of the process improvement and variation reduction. That is done through the application of so-called “Six Sigma improvement projects,” which, in turn, follow the “Six Sigma DMAIC” sequence of steps (Define, Measure, Analyze, Improve, and Control). Specifically:

- **Define.** The *Define* phase is concerned with the definition of project goals and boundaries, and the identification of issues that need to be addressed to achieve the higher (better) sigma level.
- **Measure.** The goal of the *Measure* phase of the Six Sigma strategy is to gather information about the current situation to obtain baseline data on current process performance and to identify problem areas.
- **Analyze.** The goal the *Analyze* phase of the Six Sigma quality effort is to identify the root cause(s) of quality problems, and to confirm those causes using the appropriate data analysis tools.
- **Improve.** The goal of the *Improve* phase is to implement solutions that address the problems (root causes) identified during the previous (*Analyze*) phase.
- **Control.** The goal of the *Control* phase is to evaluate and monitor the results of the previous phase (*Improve*).

There is also a variation of the fundamental Six Sigma *DMAIC* sequence, called *DMADV*, applicable to the design of new processes. In the *DMADV* sequence, the **Define** stage is identical to the one in *DMAIC* (see above); the **Measure** stage focuses on the measurement of the customer and/or market/application needs, the **Analyze** stage deals with the analysis of the process options and, finally, the **Improve** and **Control** stages are replaced by the **Design** (design the process to meet the customer and/or market/application needs) and **Verify** (verify the design performance and ability to meet the criteria as set at the Design level) stages.

Each of these steps involves using specific analytic (quantitative) methods from a wide selection of methods recommended by the Six Sigma approach (depending on the nature of the process). For a comprehensive overview of Six Sigma techniques, refer to *Implementing Six Sigma* (1999) by F. W. Breyfogle III. For more information, two authoritative books

including comprehensive discussions of the Six Sigma methodology and its applications are: *Six Sigma: The Breakthrough Management Strategy* (2000) by M. J. Harry and P. Schroeder and *The Six Sigma Handbook* (2001) by T. Pyzdek.

## Six Sigma and *STATISTICA*

*STATISTICA* is specifically designed to address the data collection and analysis needs at each stage of the Six Sigma project. Hence, the program serves as the basic analytic foundation for Six Sigma programs and implementations at companies of any size.

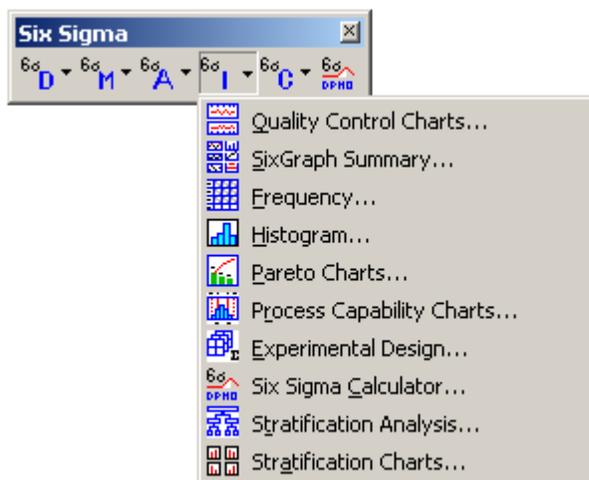
### Six Sigma Tools in *STATISTICA* at the Desktop Level

*STATISTICA* is unique among QC-related applications that are currently on the market not only in terms of:

- a) the comprehensiveness of Six Sigma tools available (*STATISTICA* offers more of the relevant tools than any other commercially available application), which also include such designated Six Sigma tools as the Six Sigma Calculator, Six Sigma-style integrated reports with multiple graphics displays, and the Ishikawa (cause-and-effect) Diagrams,

but also:

- b) the organization, accessibility of the Six Sigma tools, and the Six Sigma orientation of the user-interface. Specifically, the *Industrial Statistics & Six Sigma* menu of *STATISTICA* provides the power and comprehensiveness of the complete *STATISTICA* analytic routines, which have been refined and proven effective in industrial and business applications for more than two decades; these tools are organized into groups of relevant methods according to the *Six Sigma (DMAIC) Shortcuts* strategy, following the *DMAIC* sequence of steps (as discussed above). An additional option enables the user to launch a Six Sigma toolbar with five submenus representing the five *DMAIC* steps:



To customize *STATISTICA* further, a designated Six Sigma pull-down menu can be added to the main menu bar of the *STATISTICA* application. Every one of these alternative shortcut methods (to access the Six Sigma tools directly) is fully customizable (simply by dragging options to and from the toolbars or menus) so that the user can tailor the Six Sigma user interface to the needs of the specific Six Sigma program implemented at his/her organization.

## **Six Sigma Tools in *STATISTICA* at the Enterprise Level**

*STATISTICA Enterprise* is specifically designed to facilitate collaborative work using a comprehensive (and fully customizable to the local needs and conditions) software environment. Based on state-of-the-art connectivity technologies, *STATISTICA Enterprise* is designed for local and global enterprise quality control and improvement Six Sigma applications. It offers real-time monitoring and alarm notification for the production floor, a comprehensive set of analytical tools for engineers, and sophisticated reporting features for management. It also offers:

- Web-enabled user interface and specific Six Sigma reporting tools and options with interactive querying tools,
- User-specific interfaces for operators, engineers, managers, analysts, etc., that not only comply but directly follow the Six Sigma requirements,
- User-specific interfaces for all professional levels involved in the Six Sigma effort – from simple interfaces and shortcuts for support personnel and more advanced tools for green belts, to the most sophisticated data analysis and data mining and graphing environment for master black belts,
- Groupware functionality for sharing queries, special applications, etc., that is invaluable in the implementation of Six Sigma projects,
- Open-ended alarm notification including cause/action prompts, and
- Fully automated graphical monitoring of processes and quality improvements using the most advanced graphics technologies available to date.

And:

- *STATISTICA Enterprise* not only provides the most advanced environment for Six Sigma data analysis and data mining, but, because of available shortcuts and customizability, it creates the ideal training environment for professionals at all levels participating in the Six Sigma effort,
- *STATISTICA Enterprise* is scalable, customizable, and integrates into existing database/ERP systems.

In short, companies that deploy *STATISTICA Enterprise* systems will find a complete arsenal of tools specifically “pre-configured” for implementations of Six Sigma strategies at any level of the organization, and a unique set of customization facilities will enable them to quickly convert *STATISTICA* into a tool that will look and work as if it were originally developed *only* to meet the needs of their specific organization.