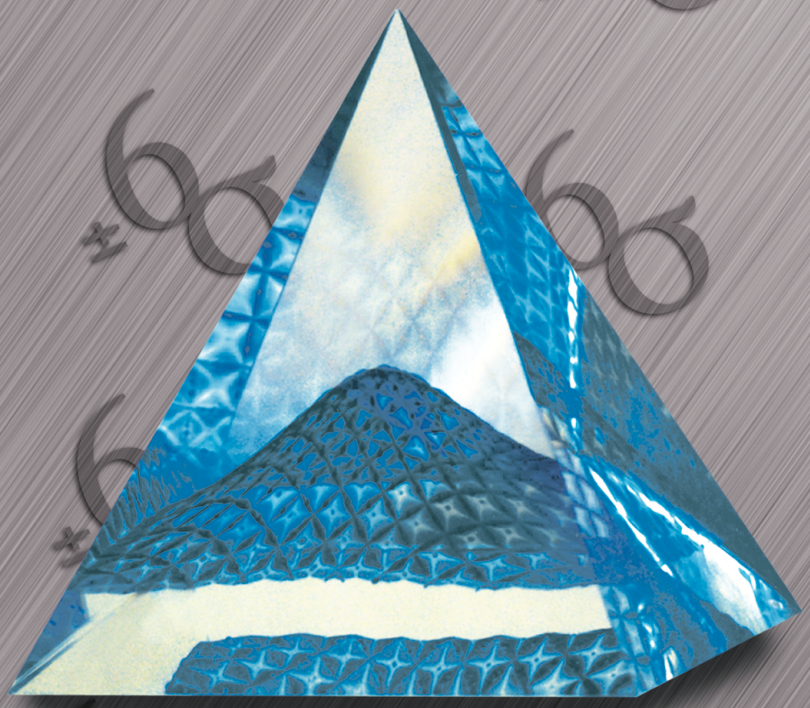
SIX SIGMA

by Mario Perez-Wilson



Understanding the Concept, Implications and Challenges

Six Sigma -
Understanding the Concept, Implications and Challenges

by Mario Perez-Wilson

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Six Sigma
- Understanding The Concept, Implications and Challenges -

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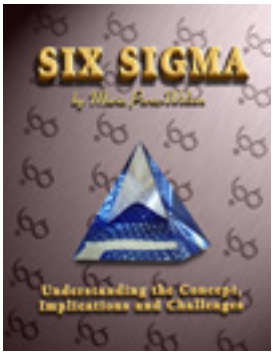

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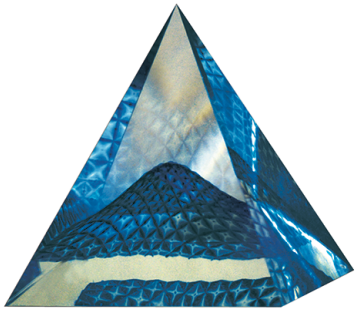

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The original manuscript was pleasurely hand written with a MontBlanc Meisterstuck - Agatha Christie - Limited Edition Fountain Pen #08626

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Preface

Recently, the concept of Six Sigma has catapulted back to the forefront of many a quality professional's interest in a growing number of organizations. Unfortunately, it has been elevated to almost mythological heights by cure-all claims made both by industry leaders and the myriad consultants who are now jumping into the Six Sigma bandwagon. Instead of clarity and understanding, the clamor of these born-again cheerleaders seems to be muddying the waters, adding confusion to an already misunderstood subject.

Six Sigma is about treating most operations as systems and about improving the processes that occur within those systems. It is about reducing process variation and about reducing the value of the sigma (the standard deviation), so as to fit twelve standard deviations within the specification limits. Six Sigma is NOT about having the process average shift ±1.5 sigmas and it is NOT about producing defects, errors or mistakes at a 3.4 ppm level. On the contrary, it is about NOT having the process average shift at all and about producing defects, errors or mistakes at a mere 0.002 ppm level - for all practical purposes, it is about reducing defects, errors and mistakes to virtually zero.

No doubt, Six Sigma attempts to provide a scientific approach and discipline to the practice or pursuit of process improvement and can seem quite technical. Nevertheless, in this book, I have made a serious effort to explain the concept of Six Sigma in a fashion that I hope will be understood by most

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everybody, not just by technical people. As consultants, we often find ourselves in the role of teachers; and, as teachers, we have the duty to use our expertise to simplify matters and put in an extra effort to explain them in a fashion that serves our students - or our customers - well.

During a visit to the Czech Republic, I was able to witness the production of artifacts in lead crystal, an art the Czech people have mastered and passed along from generation to generation.

The pyramid crystal in the cover page is the personification of Six Sigma. The pyramid represents the robust approach to excellence embraced by Six Sigma. The crystal represents the clear philosophical vision of Six Sigma. And the 3-D bell-shaped curve represents the Normal distribution, the statistical foundation of Six Sigma.

The first part of the book is a novel, told in a series of vignettes. I suggest you read it carefully because, intertwined within the narrative of each vignette, you will find much useful and practical information about Six Sigma. I prefer not to make any further comments; I just hope you find it interesting, enlightening and somewhat entertaining.

The second part of the book is my serious attempt at demystifying and clarifying Six Sigma. I have tried to provide a clear, layman's explanation of what it is and how it can be achieved. It is a subject well-worth understanding because Six Sigma can provide a crystal clear vision and a robust structure to bring about change and excellence in an organization.

I've also included a Glossary and an Index, which I hope you find useful, and a section that answers most of the questions I have been receiving in Emails. In the spirit of this new and exciting age of information prompted by the Internet, this section is appropriately entitled "Frequently Asked Questions" or FAQs. If after reading the book you still have questions about Six Sigma, please write to me at the address on the next to last page of the book and I'll try to further clarify the subject and answer your questions.

Mario Perez-Wilson
Prague, Czech Republic
May 6th, 1998

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Motorola Inc., launched their "Six Sigma Quality Program", and that changed how six sigma would be understood from then forward.

Motorola's Six Sigma Quality Program

On Thursday, January 15, 1987, Motorola Inc., launched a long term quality program they called "The Six Sigma Quality Program". The program was launched by Bob Galvin, Chief Executive Officer of Motorola, Inc., with a speech that was distributed throughout his organization in writing and on videotape. The video was distributed to every sector, group and division Vice President and General Manager and viewed by the GM's staff, which was later viewed by their staff, thereby cascading throughout the organization comprised of about ninety-nine thousand people around the world in about 53 major facilities.

In his speech, Mr. Galvin explained that for the previous six months he had, with some frequency, visited many customers and although they had mentioned they liked doing business with Motorola, they also expressed a desire to be better served. They wanted better service in delivery, order completeness, accuracy in records on each transaction, etc. They further suggested, if they would be served better, with total quality emphasis, Motorola could expect from 5% to 20% more business from them in the future. Mr. Galvin, suggested company employees rise to the challenge and offer the customer the expected level of quality service, and that it be done with a deep sense of urgency.

Additionally, Mr. Galvin took the opportunity to emphasize to management their special role and responsibility to lead the implementation of this program. He stated the Corporate Quality Goal had been updated to include this new challenge.

Finally, Mr. Galvin accepted the challenge himself, by saying: "I must do my job perfectly in the execution of each daily detail as observed by the customer." and he challenged everyone by saying: "You must move to the same objective."

Six Sigma after January 15, 1987

The program was a corporate program which established Six Sigma as the required capability level to approach the standard of zero-defects. This new standard of zero-defects was to be done in everything, that is, in products, process, services and administration.

The Corporate Policy Committee of Motorola, then updated the Quality Goal as follows:

"Improve product and services quality ten times by 1989, and at least one hundred fold by 1991. Achieve Six Sigma capability by 1992. With a deep sense of urgency, spread dedication to quality to every facet of the corporation, and achieve a culture of continual improvement to assure Total Customer Satisfaction. There is only one ultimate goal: zero-defects - in everything we do."

for quantifying defectives, defects, errors and mistakes.

The ppm is a simple calculation, but that is when we determine it from inspection. In most cases, the response that we would be characterizing would be a characteristic as it deviates from its specification, and for that we use the Normal distribution.

What is the ppm for Six Sigma?

The parts-per-million defective associated with Six Sigma is 0.002 ppm. This value is about two parts-per-billion defective. The 0.002 parts-per-million is an estimate that stipulates, that if 1,000,000 units were produced, not even one would be defective. If one billion units were produced, only 2 would be defective.

Is Six Sigma 3.4 ppm?

Six Sigma is not 3.4 ppm. The whole misunderstanding about 3.4 ppm resulted from Motorola's document "Our Six Sigma Challenge". In it Motorola asserted if a process was made to be Six Sigma by having the design specifications be twice the process-width, the process would be extremely robust. Such a process would be robust, even if it was surprised by a significant or detrimental shift in average, as high as +1.5 sigma, the customers would not perceive a degradation in quality. At worst case, a shift of 1.5 sigma, would make a zero-defects product be 3.45 ppm and the customer would only perceive an increase from zero to 3

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products defective, assuming a production run of 1,000,000. This was supposed to be the warranty Six Sigma processes brought to the customer, not actual ppm levels for Six Sigma. The problem became widespread, when Dr. Mikel Harry [1] attempted to find a mathematical justification for a ±1.5 sigma shift in average by erroneously quoting an article written by David H. Evans.

In the series of articles "Statistical Tolerancing: The State of the Art", and more specifically in Part III. Shifts and Drifts [4], Evans discusses a tolerance stacking problem in which multiple disks are staked to produce a final stack assembly. He states "...that a slight shift in the mean thickness of the disks could cause a drastic increase" in the fraction out-of-tolerance of the final stack assembly. He also states a good quality control program would detect any shift in means in the components or disks. But, he states a proposed solution suggested by A. Bender in setting tolerances, which is to take the variance of the linear combination of the individual disk variances, take its square root and multiply it by a factor of 1.5, and use this as the standard deviation of the final stack assembly.

In other words, Bender suggested amplifying the standard deviation by a factor of 1.5 to compensate for any shift in mean of any individual disk, and to compensate for the lack of prediction. Nowhere, do Evans or Bender suggest the mean be shifted by any constant, far less a 1.5 sigma shift. Furthermore, Evans states that "...it is almost impossible to predict quantitatively the changes in the distribution of a component [disks] value."

Dr. Mikel Harry had erroneously misinterpreted a 1.5 magnitude of inflating the estimator of the standard deviation with a shift in mean of 1.5 sigma.

What is a ±1.5 Sigma Shift?

The plus or minus 1.5 sigma shift surfaced when Motorola in their explanation of "Why Six Sigma?", used it as a worst case scenario of a significant shift in process average. They stated that a ±1.5 sigma shift would not show a detriment in the out-of-tolerance percentage to their customers if their processes were designed to have their specification limits be at twice the process width, or at Six Sigma levels.

It does NOT imply a process mean shifts about ±1.5 sigma over time or as an average.

Defective

A product or part is said to be defective when it does not conform to specification. A product could be defective or non-defective. A defective product may have one defect or many defects. A product to be defective may need only one defect. To have more defects does not increase the level of defective of a product. There are only two conditions in this classification, defective or non-defective, and this is referred to as a dichotomy. When we classify product by defective or non-defective we are in essence dealing with a binomial population and binomial distributions.

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