



Quarter 3/4 2000

**MISSION**

**B**e a premier provider of management consulting services to industry in the high technology, manufacturing / design, services, healthcare, education and government fields.

Be the best partner a business leader can have to help accelerate the move along the path of continuous quality improvement and quality system enhancement, rethinking and changing the way our client's business is done internally and for the marketplace and industry our client serves.

Implement operational improvements across all functions and levels of our client's organization to achieve improved strategic and marketplace position, delivering value added measurable results.

Provide a positive, rewarding, collaborative work environment within PIVOT that fosters personal growth, fulfillment and success for our associates, suppliers and clients.

**VISION**

**T**ogether we will. . .

Work to fully understand the requirements of our jobs, the requirements of our clients and the systems that support us.

Provide error free services, analysis information, education and skills training on time to our clients.

Practice ethical, honest and fair behavior in our interactions with clients, associates and suppliers. We will not promise anything we cannot honestly deliver.

Inspire trust and respect by our clients, associates and suppliers, through PIVOT's proven commitment to our mutual success.

Have fun!

# THE PIVOT PALETTE

A quarterly publication of PIVOT Management Consultants

**SIX SIGMA**

**SELECTED ABSTRACTS**

Over the last couple of years "Six Sigma" has taken off and has become the new "buzz-word" at organizations trying to make the next move up in their efforts to improve customer satisfaction and their bottom lines. In an effort to help you better understand what it all may mean, we list here some abstracts, from article published in recent issues of *Industry Week*:

"Applied in its broadest sense, Six Sigma methodology is improving Allied Signal's product-development process. While the corporate growth office at Allied Signal is charged with improving the very processes of innovation and product development. To meet that challenge, the company has expanded the role of Six Sigma quality methodology. Traditionally associated with statistical methods of reducing variability and increasing robustness of manufacturing ... "

"... Six Sigma also includes concurrent engineering principles, multifunctional teaming, program management, active inclusion of voice of the customer, and design ... "

".. Barry Siadat, the company's chief growth officer. "In the last year, we have started to make this as professional and controlled as possible. Six Sigma helps us make commercialization a process that we can map, and then apply tools that put some rigors in it, and make it a fact-based decision ... "

"... the greatest customer-impact issues for us are lower cost of ownership and increased reliability," says Russ Ford, vice president of quality and Six Sigma, Engines Div., Phoenix. "Both of these tie directly to engine design, so if you design a product to last for a certain number of hours or cycles, it doesn't matter how good the manufacturing capability is, you have some inherent limits to the product put in place by the design. Six Sigma principles allow us to reduce variation in performance up front in the design." ... to project completion by 30%, and variability in fan mod-

ules by 50%, eliminating much of the adjustments required to tune an engine. While Six Sigma quality is the goal for any product design at AlliedSignal, the design prediction for the AS900 engine is currently 5.2 Sigma, up from 2.3 Sigma for engines designed just two years ago. "We have been building engines for 50 years, so we have a long history and opportunity to advance the quality and production levels, but Six Sigma has shown the most promise of anything we have used," says Ford. Understanding of Six Sigma principles is so important in the engines group that it is the division's goal to have its 5,600 employees certified as Six Sigma "green belts," which requires 40 hours of training and 40 hours of project work to be completed by the end of 1999. Overall, application of Six Sigma ... "

"... paying attention to the nearly four pages in GE's 1997 annual report that Welch devotes to the seemingly arcane subject of Six Sigma quality. (Six Sigma provides a statistical methodology for improving quality, with the goal of experiencing less than four defects out of 1 million.) Welch writes ... "

"... with a customer-oriented, disciplined methodology of defining, measuring, analyzing, improving, and controlling process. Welch expects this Six Sigma regimen to move every GE product and service "toward near-perfect quality." Early results have been impressive. For example, Six Sigma designs have produced a ten-fold increase in the life of CT scanner X-ray tubes. GE's industrial diamond business has quadrupled its return on investment and, through improving yields, has added a decade's worth of capacity without investing in new plants and equipment. GE's operating margin, about 10% pre-Six Sigma, is now approaching 16%. Welch figures that Six Sigma delivered more than \$300 million to operating income in 1997."

We hope this gives you a better understanding of what is being written about six sigma.

## OFFERINGS AT PIVOT

As we get to the start of the 'real' 21st century, we are excited about some of the changes at PIVOT. We will start offering training at the executive, champion and shop floor level, in various topics and methodologies. Although our focus in the past has been primarily on-site consulting, our clients and prospects have indicated a desire for training. We are listening and here are some of the areas we have identified:

- Baldrige Criteria for Improvement
- Benchmarking
- Concurrent Engineering
- Cost of Quality
- Cycle Time Analysis
- Defect Prevention & Corrective Action
- Design for Manufacturability
- Effective Design Reviews
- ESD in Electronics
- Geometric Dimensioning & Tolerancing
- Kaizen
- Lean Manufacturing
- Making World Class Presentations
- Problem Solving / Team Building
- Putting Pull Systems in Place
- Quality Systems
  - \* ISO 9000 - Preparing for Implementation
  - \* ISO 9000 - Internal Auditor
  - \* AS9000 Aerospace Quality System
  - \* D1-9000A Boeing Quality System
  - \* TL 9000 - Telecommunications Quality System
  - \* Quality System Basics
  - \* Quality Tools (Basic Seven)
  - \* Quality Tools (Management Seven)
- Reengineering
- SPC
- Six Sigma Methodologies and Certification
- Supplier Management
- Teams for Excellence & Innovation
- Theory of Constraints
- Tools for Thinking & Problem Solving
- TQM Basics

In Southern California and Colorado we have formed alliances with local colleges and may even be able to offer some courses jointly with them. This may give you access to state funds for training, in addition to the opportunity for your employees to earn a College Certificate for training we provide. Let us discuss your training needs.

## JIM SCHAMING

Our founding partner, James S. Schaming, PE, after sharing his expertise with most of our clients, has decided to retire. But not all is lost - he will continue to serve with us and guide us in his new role as Consulting Partner. He may even take on some projects on a selective basis. We wish him all the best and envy the time he will be spending with his family. He also intends to catch up with all the reading he has been putting off.

## SIX SIGMA QUALITY?

Since the late 1970s and 1980s the quality revolution has had a great impact on manufacturing companies. In the United States, entire industries disappeared as consumers discovered and embraced defect-free, long-lasting imported products that were priced significantly below the products they had previously been offered.

Quality, which for many American companies meant simply an inspection function, had been completely redefined. Competitors were building quality into the structure and the culture of their companies and eliminating waste, returns and nonvalue-added activities from their production processes. More importantly, they were actually lowering their production costs as they improved quality.

For close to a decade now, this concept has spread through every aspect of manufacturing - in many plants it seems to be their sole objective. At the 72 manufacturing plants that have won IndustryWeek's annual America's Best Plants awards since 1990 it has become an integral part of their operations. However, the stakes on this gaming table are always rising.

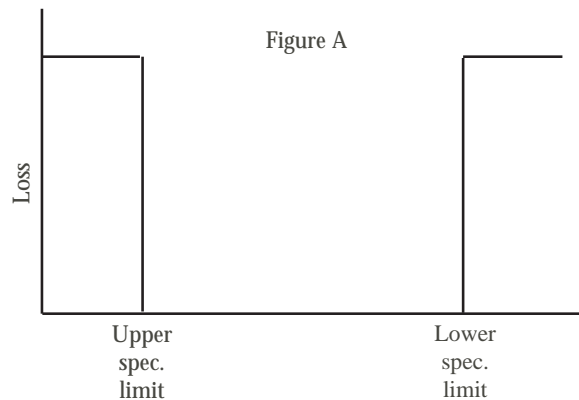
In fact, modern quality goals require new standards of measure. Six-sigma quality, which translates into a defect rate of 3.4 parts per million and was originally established by Motorola Inc. as an internal stretch goal, is the de facto standard at many of the Best Plants. Nippondenso, for example, reported a customer claim rate of a mere 1.2 ppm in 1991. In their 1995 Best Plants application, General Motors' Grand Rapids, Michigan, valve lifter plant reported 18 months of shipments to a major customer without a single defect. The plant concluded 1994 with a defective parts per million rate of 2. Two of four production teams worked at a level of less than 1 ppm. How do you measure up?

**If you have any comments/suggestions, please contact:**  
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## AN ARGUMENT FOR REDUCING VARIABILITY

Most organizations are happy if they can meet customer specifications for a product. Inspection typically involves checking whether or not the part manufactured meets specifications. The focus is on merely meeting specifications, not on reducing variability. The thinking behind this is that if the part dimensions are on either side of the specification limit, it results in a loss for the organization. Graphically, we could represent it as shown in Figure A.

This seems to suggest that all parts outside of specification limits are equally nonconforming, while those inside of the specification limits are equally conforming.



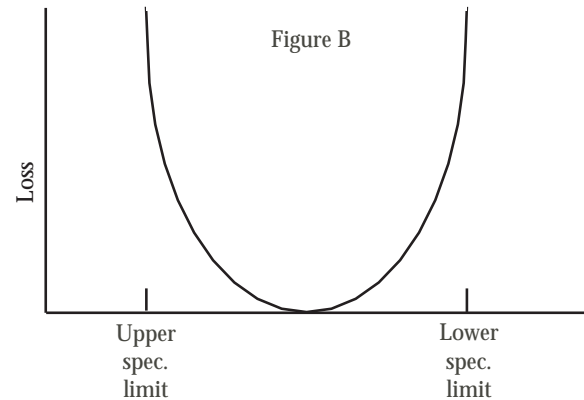
Is this really true? I recall the case of one particular car manufacturer who had plants in Japan and in the United States (US). The engine was manufactured in both Japan and the US - using the same set of drawings and to the same specifications; however, the units manufactured in the US had a higher incidence of failure (and associated repair costs) than those manufactured in Japan. The reason was discovered to be the way the two entities viewed specifications. While we in the US were content with manufacturing to the specification limits, in Japan the focus was on being as close to the nominal value (with lower variability) as possible.

All parts inside of the specification limits were not seen as equally conforming! Seeing in this light, the resulting loss to an organization could be represented as shown in Figure B.

The step approach, as shown in Figure A, indicates that there is no exposure of having any problems/loss when a part is barely within the specification limit and the loss is maximum whenever the part just crosses these limits. Most people would argue that this is not true.

This thinking was formalized as the 'loss function' and is a contribution of Genichi Taguchi. Understanding this concept can help bridge the language barrier between upper management and those involved in the technical details. While upper management best understands money, those involved within the technical arena better understand product variability.

The loss function describes the loss that occurs when a process does not produce a product that meets a target value. Loss is minimized when there is 'no variability,' and the 'best' response is achieved in all areas of the product design.



As indicated above, with the Taguchi approach it is not believed that loss relative to the specification limit is a step function.

Taguchi addresses variability within the process using a loss function. The loss function can take many forms and can be calculated mathematically; a common form is the quadratic loss function. When we apply this loss function to a situation, we give more emphasis toward achieving target as opposed to just meeting specification limits. Were we a television manufacturer, this type of philosophy would encourage us to continually strive to routinely manufacture products that have a very high quality picture (i.e., a nominal specification value), as opposed to accepting and distributing a quality level that is "good enough." It would encourage us to emphasize the reduction of process variability rather than focusing our efforts on weeding out defective parts before shipment to customers. It would encourage us to invest in new processes that can yield a tighter tolerance and lower defects, - economical considerations understood by all management.

To learn more about this and other six sigma methodologies, give us a call.

## Output Requirements? Service Requirements?

On a recent Asiana flight from Los Angeles to New Delhi, all the key output requirements were met: the flight was almost on time, we made our connections, we landed at the correct airport, and all our bags arrived safely. I even got my vegetarian meals, eventually! But I griped for days and called the airline to make sure that they had my meal requirements clearly noted - for my flight back, especially since my parents were returning with me. Although I got my vegetarian meals - the flight attendants did not have my needs listed and had to scramble to get me the special meals. All the time I kept on thinking of how well Singapore Airlines (my preferred airline) manages to meet customer output and service requirements - courteous attendants, efficient check-in, clean planes, correct meals on time, free drinks, enough movies, on time departure and arrival, efficient handling of baggage - the whole nine-yards! Although Asiana Airlines met my Output requirements, I was not totally

satisfied with the Service requirements.

Lets take an example with the reverse effect. My company messed up a customer's custom binder order. Due to an inadvertent error, we mis-printed a word on the binders. We delivered the product to the customer on time. The customer was impressed with the quality of the product - until they discovered the printing error over the next five minutes. I was on the way to the airport to head overseas for a few weeks and the customer had been waiting for the product. We had failed to meet the output requirements. What use is a solid product, with the correct shade of color, delivered on time, when the copy on it is incorrect? Especially knowing that our manufacturing cycle time is three weeks? However, we acknowledged our error, responded quickly, and were able to deliver the re-manufactured product to the customer. Even though I was overseas, I kept in contact with the customer

apprising them of the status on a regular basis. We had a customer who was quite happy overall and even provided us with referrals.

Lessons learned? Understanding customer requirements on both the Output and Service dimensions. Understanding that although they pose different challenges and may require different techniques to define and measure, both are equally important.

While we may have different departments to address the two dimensions, organizational 'silos' will tend to aggravate the problems by failing to see the links between the Service and Output requirements, and lead to sub-optimum efforts. To develop a better understanding of our customer requirements we need to look at both dimensions and ensure a seamless link between the two - Service and Output requirements.

### THE PIVOT PALETTE

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