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Now that you're sure you have good data going into the database, the next issue is putting that data to work for process improvement. Suppose, for example, that you would like to improve the daily yield of your process. You "mine" the database to get the daily yield for the last three months. This data can then be presented as a histogram and/or a trend chart to help assess the situation. Having computer SPC software, like Custom/QC, will make that task rather simple to perform. And, having the SPC software embedded in the database, as it is in the QMDS, makes the whole task even simpler.

Suppose, next, you would like to determine the process factors that seem to be driving the yield to its various levels. Here again, SPC analyses, like multiple regression or key variable identification can help with the improvement task.

"You can't expect to have quality improvement without a measurement and analysis system."

Proper use of SPC is one of the most important steps in a good process/quality improvement program. "You can't expect to have quality improvement without a measurement and analysis system", said Jim Poirier, CQE. "Many companies out there that are 'doing SPC' cannot identify any return on their SPC investment because they are simply drawing control charts. They are not hunting for 'assignable causes' and making improvements. Management and shop-floor personnel need to understand and utilize the tools of SPC."

What makes the Stochos system unique is that the QMDS puts the data, the necessary analysis tools and process information into the hands of both management and shop-floor operators. It is imperative that training in the use of the QMDS and the proper analysis procedures be accomplished. Otherwise, the collection of data is an exercise in futility. If you don't use it (the data), you might as well not collect it.

Dr. W. Edwards Deming insisted that the discovery of a special cause of variation and its removal should be the responsibility of someone connected directly with the operation that yields data for the control chart. This also points out the necessity for both management and shop-floor personnel to have

a solid understanding of the basic philosophy of SPC - of the essential nature of process variation.

Stochos has provided basic and advanced SPC training to leading U.S. and foreign companies for its entire 30 years of existence. This training in proper measurement techniques, data mining and analysis provides a very strong basis for process improvement.

**Important News  
for Stochos Customers**

**SUPPORT ON THE WEB**

Stochos customers can now visit our Web Page for support information.

[www.stochos.com](http://www.stochos.com)

## Data Precision - Do you have enough?

By Donald Holmes and Erhan Mergen

The control chart on page 4, gives a clear signal that the data has a problem with precision. There are only four or five "plateaus" in the data. This would occur, for example, if you were measuring thickness with a ruler calibrated in units of 1/16ths and there was little chance for variation in the data. The data is not being measured and/or recorded to a sufficient number of digits to be helpful for quality improvement efforts. It is almost like using "attribute" data with four classes rather than the usual two classes that occur in p charts.

The standard rule that one often hears is that the space between the "tick marks" on a gage should be small enough that the specification limits will be at least ten tick marks apart. We suspect that this rule is but another result of the fact that we have

Cont'd on Page 4

### FUTURE EVENTS

**Jan. 24 & 25, 2000**  
**Process Improvement Seminar**  
*Achieving Model-Free Process Optimization through On-line Experimentation*  
Hampton Inn - Airport  
Pittsburgh, PA  
8:30 - 4:30, Meeting Rm # 121  
(412) 264-0020

**February 7 & 8, 2000**  
**April 10 & 11, 2000**  
*Achieving Model-Free Process Optimization through On-line Experimentation*  
North Olmsted, Cleveland, OH  
8:30 - 4:30  
(440) 734-4477

**Stochos... Achieving Model-Free Process Optimization through On-line Experimentation**  
**Process Improvement Seminar description:** This seminar will deal with process improvements that may be accomplished by coupling integrated factory floor data collection (PCS and LIMS) with on-line, intelligent, model-free statistical experimentation and analysis. The concepts will first be explained in terms of a real plant example. The seminar will then address in more detail the required components of one such system.

**Stochos offers on-site Process Improvement classes.**  
**Contact:** Konnie Steele for details.  
**Phone:** (518)372-5426 or **Email:** Kesteele@Stochos.com

**Statistical Process Control Training**  
**Course Director: Donald S. Holmes**  
*Basic and Advanced Topics*  
3 - 5 Day Course  
Jan. 17 - 19 Basic, Jan. 19 - 21 Advanced  
**Registration Fee:** Basic \$800  
Advanced \$1600  
**Location: Stochos Inc.**  
14 N. College St.  
Schenectady, NY 12305  
(518) 372-5426

**July 17 - 19, 2000**  
**Unique SPC Workshop**  
*Statistical Analysis of Operations Data*  
Held at:  
The Center for Professional Advancement  
East Brunswick, NJ  
To Register Contact: CFPA (732) 238-1600

## Stochos Releases Advanced Process Improvement Software

Stochos Incorporated has developed a unique software system that has demonstrated the ability to reduce costs, improve plant performance and increase the quality of manufactured products. The technology advances in this system will bring manufacturing processes to the next level of quality and continuous improvement techniques.

The ProActive Process Improvement System (PPI) has already saved one company thousands of dollars. Donald Holmes, President and founder of Stochos Inc., said, "Results are good. We demonstrated a potential \$250,000 a year energy savings as well as determined that plant throughput can be increased with no additional capital investment." The plant referred to produces magnesite for Harbison Walker Refractories. They agreed to fund the first phase of the PPI project and test it in their plant in Ludington, Michigan. Tom Alway, Quality Assurance Supervisor for Harbison Walker Refractories said, "I think the power lies both in what PPI has done and in the historical data analysis and research that went into the project. We needed to follow research discipline."

Implementation of PPI requires a feasibility study, research and data collection before being installed and integrated to the plant process control system. "We learned that we were running our machines far too conservatively," said Dave Stepien, who was Manager of Statistical Management Systems for Harbison Walker. "PPI stretches those boundaries and takes a sustained look at running the machines more aggressively," said Stepien. "Running the machines more aggressively is where money can be saved."

The PPI system was developed using Informix SE and a SUN workstation with Solaris. Informix SE was chosen due to the dual-capability of SQL and high speed C-ISAM handling of data in combination with the SUN system whose stability makes it a natural choice for factory applications, where safety and predictability are paramount. PPI is the first software system to computerize techniques that have only been used manually in the past. "It is an on-line combination of designed experiments, exploratory data and time series analyses," said Holmes. Coupling this approach with high speed computing equipment and bi-directional communication with the plant control system provides you with an extremely powerful approach to continuous process improvement. "PPI reacts to changes in non-controlled variables to guide the process to better results in the face of the changes in the non-controllable variables," said Holmes. PPI benefits include: reducing energy costs, improving yield and quality and decreasing waste.

"The cost of the system (approximately \$200,000) is repaid many times over with the savings resulting from the use of the system," said Holmes.

### ProActive Process Improvement

ProActive Process Improvement is the ultimate Continuous Automated Process Improvement (CAPI) System. Real-time, automated, integration of experimentation and plant control system (PCS) guides processes to the best possible results. Implementation of the PPI system has produced annual operating cost reductions of hundreds of thousands of dollars. PPI is a dynamic combination of bi-directional communication with the process control system, an SQL database, and on-line statistical analysis.

*Please fill out the following information so that we can send you more on our exciting new software:*

Company : \_\_\_\_\_

Address : \_\_\_\_\_

Phone : \_\_\_\_\_ Fax : \_\_\_\_\_

Email : \_\_\_\_\_ Contact : \_\_\_\_\_

**Please answer the following questions:**

1. Do you currently have a PCS and/or SCADA system? (Yes/No)
  - a. If yes, do you link the results of your lab to the PCS system? (Yes/No)
  - b. If no, do you plan to install a PCS in the next 6 months? (Yes/No)
2. What type of process do you have? (Continuous/Discrete)
3. How often do you sample the output of your production run?  
\_\_\_\_\_
4. Are all your available Control Variables identified? (Yes/No)
5. Can you evaluate the effects of the Controlled Variables in your process? (Yes/No)  
Uncontrolled variables? (Yes/No)
6. Can you dynamically evaluate process data and recommend process adjustments in real-time based upon the data? (Yes/No)

**Please feel free to add comments or ask a specific question regarding your process:** \_\_\_\_\_

**Receive a FREE Demo disk when you submit this form**

Please submit your information to:  
**Stochos, Inc.**  
14 N. College St.  
Schenectady, NY 12305  
Attn: Konnie Steele or  
email: Kesteele@Stochos.com

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ten fingers. If we had 13 fingers, the rule would probably be at least 13 tick marks. So, in any event, we set out to see if there was some sort of rational basis for making this decision.

Our decision is based on an information theory argument. (You may refer to our Quality Engineering (QE 4(1), 1-7 (1991-1992)) article for a more detailed discussion of this matter.) We plotted the change in information available versus the number of tick marks available. From the plot, we selected the point at which the increase in information available as a result of using more tick marks seemed to be insignificant.

The result of this analysis was that the distance between the tick marks should be at about 0.3 times the standard deviation of the data or less. This would mean that if you had a Normal curve (approximately six standard deviations wide) that fit exactly inside the specification limits, then there should be about 18 tick marks within the



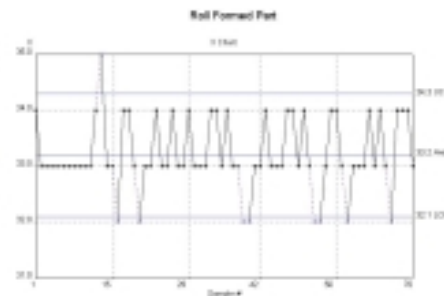
### SHOP-FLOOR POWER!

Stochos announces the release of **SPC Direct for Windows™** integrated with SQL Server™ 7.0 database.

*SPC Direct* is a real-time, on-line, 32-bit Statistical Process Control and analysis database for Windows™. Shop-floor interface can accept both manual and direct gage input as well as automatically poll larger process control data acquisition systems. Up to 32 SPC charts are automatically updated, providing instant feedback alarms for out-of-control and/or out-of-specification conditions. SPC Direct stores all information (data values, causes-of-failure, operator comments, environmental conditions, etc.) in a SQL Server™ 7.0 database to facilitate data retrieval for off-line analysis and reports.  
For more information call: (800)426-4014

specification limits. This is a large difference from the rule of 10.

Example: The data shown on the following Control Chart represents the width dimension of a roll formed part. The specifications were given as 35+/-3. The average and standard deviation for the data set of points were 33.2 and 0.6 respectively. This information indicates that the process is not properly centered but does have the ability to meet specs were it to be centered. Notice, however, the difficulty in trying to assess trends or unusual events early enough to be helpful.



The data used to make the chart is recorded to the nearest whole integer. The minimum value is 32. The maximum value is 35. The tolerance width for the product is (given 35+/-3 as specs) 6. Thus, the rule of ten tick marks inside the specs would indicate that the data should be measured and recorded to the nearest half unit (6/10 is approximately 0.5) rather than the nearest whole unit.

The rule we have developed would suggest that the data should be measured and recorded to the nearest quarter (0.3\*0.6 is approximately 0.25) of a unit. Or perhaps, if possible, the tick marks should be in 0.2 of a unit.

Note that the average and standard deviation of the data recorded to the nearest integer are recorded to the first decimal point. This is appropriate since the precision of averages and standard deviations is greater than the precision of the individual measurements. This statement is based on the following facts about sampling distributions:

- The standard deviation of sample averages is the standard deviation of the individual data points divided by the square root of the size of the sample used to calculate the average, and
- The standard deviation of the sample standard deviations is approximately the standard deviation of the individual data points divided by the square root of twice the size of the sample used to calculate the standard deviation.

Thus, for a reasonable sample size, the average and standard deviation should be recorded to at least one more digit than the original data. For control charts using small samples (4 or 5) it is standard practice to follow the procedure of one additional digit of precision.

### SPC Software Drawing

Stochos is interested in what you have to say. Send us your opinion on any of the three topics below and we will enter you in the drawing for a

**FREE Basic Version of Custom/QC**  
Stochos' off-line statistical package  
\$495 value

1. What do you find is the most difficult to understand regarding SPC?
2. Share a success story for SPC implementation within your company.
3. What is the most important factor in a quality improvement plan?

Submissions may be chosen for printing in future Stochos QC Reports.

**Submission Deadline: February 2nd**  
**Drawing will be held: February 15th**

Submit To:  
**Stochos Inc.**  
14 N. College Street  
Schenectady, NY 12305  
Fax: (518)372-4789 or  
Email: Matooley@Stochos.com

# QC REPORT

December 1999  
Volume 8, Issue 1

## For Quality Control and Process Improvement Professionals

### Cost Reductions Due To Utilizing Stochos QMDS System

Stochos has always been firmly committed to providing leading-edge products for manufacturing firms to help them achieve their targets in the areas of improved quality and customer satisfaction, reduced process costs and increased productivity.

The results below demonstrate annual cost reductions at a client's plant due to utilizing the **Stochos Quality Management Database System**. The average *decrease* in customer issues and process waste calculated at **24%**, while the productivity and quality average *increased 5%*.

### Manufacturing Operation Results Improved, with the Proper Use of Data in the QMDS System

In the last QC Report we discussed the importance of traceability in manufacturing and the Stochos QMDS system which is designed to perform this task in a very effective manner. In this issue we discuss the use of the data residing in the QMDS to improve the results of a manufacturing operation.

First we need to emphasize that the data collection process must provide data that is useful. To begin, the measurement or test device must produce Repeatable and Reproducible (R&R) results. Repeatability means that the variation of repeat measurements made on the same product by the same operator is small enough to lead to proper fact-based decisions. Reproducibility means that the same device used by different operators yields essentially the same results.

Given that the measurement or test device passed the "R&R" requirements, there are several issues that need to be addressed to ensure that the data in the database is useful. First, the data must be real - not made up to look like the specifications are being met. Stochos QMDS trainer, Karen Bailey, mentioned that operators sometimes view the process nominal (target) as what the result must be and enter it rather than the actual measurement result. This lack of understanding (or the fear of repercussions) must be overcome. "It's the old 'Garbage in, Garbage out' thing", said Bailey, "it defeats the purpose of analyzing your process for improvement, because the data is always entered as perfect and does not reflect the reality of the process."

Next, the data must be recorded to the proper number of significant digits or else potential process improvements may be overlooked. For example, a number entered as .11 may actually be 0.109, 0.114 or 0.107. Thus, the 0.11 does not accurately reflect the inherent variation in the process. (See page 2, Data Precision Article)

### QMDS Cost Reductions

Associated with Utilization of the Stochos Quality Management Database System  
Company Annual Gross (approximately \$75 million)

	1997	1998	Improvement	% Improvement
Number of Customer Complaints	62	45	17	down 27%
Cost of Quality for Customer Complaints	\$19,455	\$17,023	\$2,432	down 12.5%
Number of Internal Complaints	456	454	2	down .04%
Cost of Quality for Internal Complaints	\$326,794	\$100,407	\$226,387	down 69.3%
Number of Raw Material Complaints	380	372	8	down 2%
Cost of Quality for Raw Material Complaints	\$644,334	\$264,306	\$380,030	down 58.9%
Waste	11%	10.5%	.5%	down 4.5%
TPM Cost	\$901,000	\$778,500	\$122,500	down 13.6%
Perfect Order Rate (% Delivery/Service)	99.28%	99.82%	54%	up .5%
% Product Quality	96.75%	97.12%	.37%	up .4%
Productivity	93%	96%	3%	up 3%
Process Reliability	83%	87%	2.9%	up 17%

AVERAGE COST DECREASE 24%  
 AVERAGE QUALITY INCREASE 5%