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someone connected directly with some 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. When this training in proper measurement techniques, data mining and analysis provide a very strong basis for process improvement.

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 just as well not collect it.

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 in your company.
3. What is the most important factor in a quality improvement plan?

Submit To:

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

Quality Cost Reductions

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

	1996	1997	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	\$308,030	down 58.9%
Perfect Order Rate (%Delivery/Service)	99.28%	99.82%	54	down .5%
% Product Quality	96.75%	97.12%	.37	up .4%
Waste	11%	10.5	.5	down 4.5%
Productivity	93%	96%	3	up 3%
Process Reliability	83%	87%	2.9	up 17%
TPM Cost	\$901,000	\$778,500	\$122,500	down 13.6%

Cont'd

Shop Floor Data Collection, capturing production quantities, waste and downtime. Plus, lot traceability from finished goods to raw materials, generation of bar-code style labels and tags for real-time production and inventory tracking and order visibility through work-in-process and inventory tracking.

Gage Calibration, tracking calibrated gages for early warning of pending calibrations.

Warehouse Management, including the generation of bar-code labels at time of receipt, allocation of materials to production orders and validation of specified materials with visibility of alternatives.

Integrated is the operative word. Stochos software is downloaded with regular updates from the underlying legacy system. Changes to product specification, production orders, customers, vendors and materials are automatically reflected in the QMDS database in order to reduce duplicate entry. Additionally, as quality tests are conducted, test failures signal "cause of failure" and "corrective action" information to be captured by plant personnel. Certificate of Analysis documents are customer configured along with finished goods, pallet and core labels.

LM Shelbyville is serving as the pilot site, with rollout to other Food Flexible plants commencing in the fall of 1998.

Team Effort

Project Phoenix relies on total team effort, and each of the above software modules is managed by site module experts. The team configuration was selected in order to exploit staff skills and expertise necessary to adapt the software for the flexible packaging industry and to establish lead trainers for further system rollout to remaining sites.

Right now, the project team is faced with a number of challenges. Firstly, the high level of integration between modules and the underlying legacy requires a well thought out data cleansing initiative while ensuring that the interdependency of the primary software modules are well understood by team members. Secondly, the introduction of programmable logical controllers (PLCs) and interconnections with the Stochos software is uncharted territory. And finally, the human consideration of introducing personal computers to the plant floor to be backed by PC literacy programs as well as small group training sessions during the orientation process. Parallel testing is currently underway and results are promising indeed, so stay tuned for further updates from LM Shelbyville.

- Contributed by Stan Harwood, Project Manager LMP information system, Etobicoke Ont., Canada
Reprint from LMPACT, Algroup Lawson Mardon in-house Journal Vol. 3, No. 3, Autumn 1998

Data Precision

- Do you have enough?

By Donald Holmes

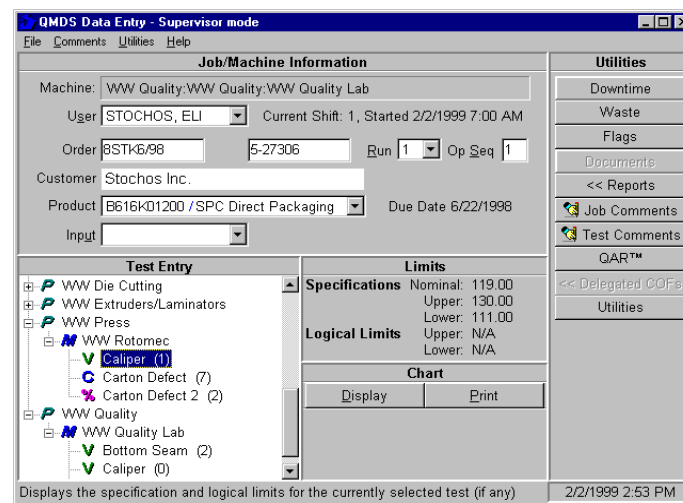
The control chart on the following page gives a clear signal that the data has a problem with precision. There are only four or five "plateaus" in the data. This would occur, for example, if you were measuring thickness with a ruler calibrated in units of 1/16ths and there was little chance for variation in the data. The data is not being 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 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 were 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 that 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 fitted exactly inside the specification limits, then there should be about 18 tick marks within the 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



QMDS Screen

You will find the Stochos' Longform - shop-floor operators screen at each station in the facility. Operators can directly enter and access data pertinent to the station's process, including Control Charts, Documents, Downtime & Waste information, Test Comments and Report Nonconformance related to the current job.

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.

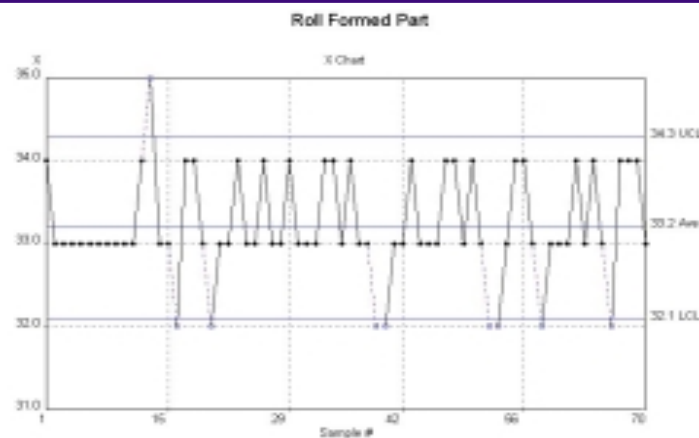
After being operational for only two months, the Proactive Process Improvement System (ProActive/PI) had already saved one company thousands. Donald Holmes, president and founder of Stochos Inc., said, "Results are good. We demonstrated a potential \$250,000 a year energy savings as well as determined 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 ProActive/PI 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 ProActive/PI has done and in the historical data analysis and research that went in to the project. We needed to follow research discipline."

Implementation of ProActive/PI 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. "ProActive/PI 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 ProActive/PI 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 which has the ability to run 24 hours a day, 7 days a week without system crashes.

ProActive/PI 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. "ProActive/PI 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. ProActive/PI 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.



average and standard deviation for the data set of points were 33.2 and 0.6 respectively. This information suggests 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 mark 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 re-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 deviation 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.

The practice of carrying more precision in the average and standard deviation is commonly used when constructing control charts.

Also, note that 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.

QC REPORT

July 1999
Volume 8, Issue 1

Using Traceability Databases to Improve Quality

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 results. By repeatability, we mean 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. By reproducibility, we mean that the same device used by different operators yields essentially the same results.

Given that the measurement or test device passes the "R&R" requirements, there are several issues that need to be addressed to insure 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 3 for a view of this topic.)

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 imbedded 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."

Dr. W. Edwards Deming insisted that the discovery of a special cause of variation and its removal should be the responsibility of

We thought you might like to see a report published in the corporate newsletter of a company that is installing the Stochos QMDS system...

Project Phoenix: North America Food Flexibles Embark on a Quality Systems Solution

Knowing the vital importance of quality in the Food Flexibles business, the Project Phoenix team members in LM Shelbyville (Kentucky) are applying an integrated quality system solution. They have been busy introducing Stochos QMDS™ to both the Food and Pharma plants since January 1998.

The Systems Software consists of eight modules:

Quality Management, translating to on-line, real-time statistical process control, quality test data entry, reporting, and charting, cause of failure and corrective action, positive release system and user configured certificate of analysis.

Document Control, or routing and sign-off process of controlled documentation.

Cylinder Tracking, for cylinder usage and early warning of pending maintenance.

Employee Training Log, involving the maintenance of employee training experience and employee schedules for necessary courses.

Quality Assurance Reporting to manage internal and external quality audit complaints. This closed-loop system requires action from appropriate personnel, while other features include QAR initiation, disposition of material, disposition sign-off, root cause analysis, corrective action, corrective action sign-off, tracking QAR progress and Pareto analysis.

Cont'd on Page 2

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