

Special 30th Anniversary Edition

QC REPORT

October 1998
Volume 7, Issue 3

Celebrating 30 Years of Quality Service

Stochos Incorporated



Since 1968

Quality Solution Experts

Stochos would like to extend thanks to our many valued customers over the last 30 years. We hope to continue providing you with the excellence and quality you deserve and have come to expect. This edition is dedicated to all of you.

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Y2K - Customer Note
**All current versions of
Stochos software are
Y2K compliant.**

*If you have questions regarding your
version of Stochos software please
contact: Konnie Steele
(800) 426-4014
Sales@Stochos.com*

**Stochos Accepts
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UPCOMING STOCHOS EVENTS

PROACTIVE PROCESS IMPROVEMENT COURSE

Achieve Continuous Process Improvement with Dynamic On-line Experimentation

Description: This course was designed specifically for continuous process personnel who are responsible for improving process yield and quality.

Topics covered include:

- Review of basic and advanced SPC tools pertinent to your type of industry.
- Critical control variable identification.
- On-line experimentation (EVOP) for process improvement.
- Case studies from real processes will be used throughout the discussion.

(See Page 4 for Seminar Outline)

Proactive Improvement through On-line Experimentation

Schenectady County Community College - ASQ Meeting

October 22, 1998 ...5:30-6:15 PM

International Manufacturing Software Expo

Orange County Convention Center - Orlando, Florida

April 26-29, 1999

Pittsburgh, PA

October 26-27, 1998

Hampton Inn
Beers School Road
(412)264-0020

Springfield, MA

November 4-5, 1998

Comfort Inn, Chicopee
Memorial Drive
(413)739-7311

Charlotte, NC

November 9-10, 1998

Comfort Inn Airport
South I-85 at Little Rock Rd.
(704)394-4111

Nashville, TN

November 23-24, 1998

Hampton Inn
Donelson Pike
(615)885-4242

Celebrating 30 Years

Since 1968, *Stochos, Inc.* of Schenectady, New York has provided a wide range of quality solutions to virtually all types and sizes of manufacturers. The following is a brief background on the growth of *Stochos* and our outlook for the next century.

Stochos' original mission, as it remains today, was to provide training and computerized solutions to manufacturers looking to improve both their process and product quality.

In the early years, in addition to quality improvement work, *Stochos'* technical staff provided a wide range of industrial solutions in many areas including CAD/CAM, numerical/inventory control, post processors, job shop scheduling, simulation and database applications.

As technological advances change manufacturers' requirements for quality systems, *Stochos* continues to change its product and service offerings to keep pace. Shortly after IBM launched its immensely successful personal computer in the early 1980's, *Stochos* became one of the first companies to introduce a powerful SPC program for the PC – **Custom/QC**. Nearly two decades later, **Custom/QC**, which now boasts a Windows version as well as DOS and UNIX, has become a corporate standard at several Fortune 1000 manufacturers, and continues to sell well in all industrial markets.

Stochos' dedication to meeting customer needs also gave rise to the development of **SPC Direct** – a real-time **Statistical Process Control** system for use on the manufacturing floor. Other manufacturer driven “Stand Alone Solutions” include the **QAR – Quality Action Report** which is a closed-loop corrective action tracking system to ensure timely resolution of Quality issues in both short term and reoccurring situations. **SLED – Sequence-Leveled Experimental Design** is a suite of coordinated programs which features Designs of Multi-Factorial Statistical Experiments with complete statistical analysis.

Integrated Quality Systems

Long before the advent of ISO 9000 standards, *Stochos* began supplying traceability databases which had complete SPC analysis. These **Quality Management Database Systems (QMDS)** provide manufacturers with “paperless ISO 9000” capability. Customer requests have led to further expansion of the **QMDS** to include an extensive factory floor data collection system. These integrated systems are currently installed in approximately seventy-five plants in the United States, Canada and the United Kingdom.

Stochos is now moving beyond the standard “reactive” role of SPC into a dynamic “proactive” process improvement system - **ProActive/PI**. This system integrates SPC research with established experimental design techniques and high speed computer capabilities to drive the manufacturing system to higher levels of quality and efficiency.

Stochos continues to research new techniques for SPC analysis and process improvement with many articles published in professional journals and presented at conferences. This research combined with the commitment to meet the needs of manufacturers will continue to drive the product developments of *Stochos* as we strive to meet the mission we have set for ourselves.

Encouraged to value opportunity during the depression, Don Holmes said, “It was upbringing and entrepreneurial spirit that led to the start of *Stochos*”. Prior to *Stochos*, Holmes participated in several consulting opportunities involved with solving business problems. As a quality engineer and business logician for an operations research group at the General Electric Company in upstate New York, he consulted internally as a statistician-mathematician, and pioneered factory simulation. He launched numerous training and problem analysis programs that were offered to hundreds of personnel each year.

Don credits his employees for *Stochos'*

success. “The major factor is the quality of the people on *Stochos'* staff” said Holmes. “Stars in terms of a professional rating, doing an outstanding job.”

Stochos is a family business that consists of highly intelligent, self-motivated employees. Employee empowerment encourages the creative thinking that has led *Stochos* to some of the most innovative superior products in the world. Years of consulting, problem solving and defining business needs helped *Stochos* achieve the leading edge in advanced process control technology and complete shop-floor and quality management databases.

Flexibility in the work place is an advantage to being a small business. *Stochos* employees, consisting of programmers, technicians, trainers, statisticians, administrators and sales people excel in their specialized area and are encouraged to organize and manage their own projects. Group meetings are utilized as a way of reporting work status, planning future needs, submitting ideas, and solving issues. This promotes communication and feedback between co-workers, creating team unity and pride. One employee mentioned, “Accomplishments are achieved as a team with all of us reaping the benefits”.

Stochos Mission:

We have made it our mission to be a leading supplier of high performance computerized systems which focus on improving the quality of manufacturing processes.

How did *Stochos* get its name?

The name **Stochos** was selected to emphasize that a high quality result of a process is one which achieves the target set by a customer. “**Stochos**” is the Greek word for target. And, “stochastic process” are those which vary in a more or less random fashion around their target values, much as manufacturing processes do.

ProActive/PI - The Whole Story

Note: Stochos has just begun to release information to the media regarding the new ProActive/PI system. Briefly mentioning ProActive/PI in past QC Reports, we feel it should be the privilege of our loyal customers to be given the opportunity to utilize this complete information first and gain the leading edge for your company.

Project Analysis:

This project was created to provide a tool which will help you as you strive for continuous process improvement.

ProActive Process Improvement (PPI) is a dynamic integration of concepts that separately have proved their place as tools for process improvement:

- **Experimental Design (DOE)**
- **Exploratory Data Analysis**
- **Statistical Process Control**

These concepts working together on-line in a highly computerized environment provide for process improvement beyond any means previously available.

ProActive/PI is NOT a control system. It provides bidirectional communication with the current control system, reacts to change in non-controlled variables, and guides the process to better results in the face of changes in the non-controlled variables.

To accomplish this task, data is collected from PLCs and laboratories, integrated, and analyzed on-line. PPI constantly searches for the critical control variables (CCVs) which are currently having the greatest impact on the quality variables. Once the CCVs are identified, an on-line experiment is set up and run to guide the process to better and better levels of quality and/or efficiency.

Application of PPI in one plant has already resulted in annual savings in the order of \$250,000 in operating costs. In addition, ProActive/PI has shown how the throughput of a plant can be increased with no loss in quality. Thus, expansion of a plant would not be required should the product demand increase - another sizable savings.

The manager of statistical systems at this plant said, "We learned that we were running our machines far too conservatively. PPI stretches those boundaries and takes a sustained look at running machines more aggressively. This is where money can be saved."

ProActive/PI Consulting:

In some plants the ProActive/PI system requires extensive consulting, research and data collection before being installed and integrated with the plant process control system. The objective of the consulting is to:

- 1) Identify the Quality Variables and the objective to be achieved, either as a single variable or a fuzzy logic type combination of multiple variables.
- 2) Determine CCVs from historical process data.

The plant manager said, "The power is both in what PPI has done and told us, and in the historical data analysis and research that went into the project. We needed to follow research discipline."

ProActive/PI Features

On-line

Exploratory Data Analysis
Analysis of Variance with Process Feedback
Multivariate Statistical Process Analysis
Univariate/Multivariate Statistical Process Control

Off-line

Process Specific Continuous Process Improvement
SQL Database Query Reporting
Univariate/Multivariate Statistical ProcessControl

If you have questions, are interested in the PPI Seminar or would like to discuss ProActive/PI, Contact Don Holmes
1-800-426-4014

For general information fax your request to PPI Info (518) 372-4789 or
Email: Sales@Stochos.com

ProActive Seminar Topics Include:

Day 1

- Review of histograms and Shewhart control charts
- Use of CuSum and EWMA control charts
- Multivariate Techniques (T² charts)
- Statistical Process Control (SPC) and Engineering Process Control (EPC)
- Effect of Autocorrelation on your SPC analysis
- ARIMA modeling and use in SPC

Day 2

- Review of standard off-line Design of Experiments (DOE)
- Critical Control Variable Identification (CCVI)
- A new DOE paradigm (SLED)
- On-line experimentation using Evolutionary Operation (EVOP)
- Standard EVOP
- Simplex EVOP
- Integrated CCVI, SPC and EVOP for Process Improvement

(See Page 2 - Upcoming Stochos Events for Dates and Locations)

The Importance of Traceability from Raw Materials to Finished Goods in Manufacturing.

There are many phases involved in the manufacturing process. When an item fails to meet quality standards, it is imperative to have the ability to trace back through each process phase to identify where the failure occurred and determine the root cause of the problem. A system that provides such information is invaluable.

Failures may occur during the production process (WIP) or may be the direct result of defective raw material. To resolve a manufacturing or quality problem, data regarding all phases must be collected and evaluated.

However, many manufacturers cannot trace back from finished goods to the raw material from which they were produced. This can result in unnecessary costs in waste, downtime, delay of orders and poor customer service.

For example, multiple orders may become waste due to poor materials of the same shipment/pallet, etc., but not revealed without a proper traceability system. In an environment that tracks materials, operators can review the properties of input materials to determine which is causing the problems. Action can be taken to assure prevention of future failure is accomplished.

Total traceability aids in the continuous effort for quality and process improvement. Utilizing raw material traceability promotes communication between manufacturers and their vendors, ensuring better quality materials - another key to good supply chain management.

Full product traceability benefits:

- Improves the Quality Process
- Required by ISO 9000
- Reduce Waste & Downtime
- Timely Orders
- Improved Customer Service
- Vendor Awareness

As mentioned earlier, a valuable system will provide you with the capability to collect all pertinent data regarding your materials and processes and then utilize it in every possible facet of your industry.

The Stochos system is unique in that it integrates shop-floor data collection with quality management and will interface with any front office business system. It incorporates traceability from raw materials to finished goods.

The strength of the Stochos solution is the seamless integration of Quality Management with Shop Floor Data Collection.

Material data can be entered manually or scanned via barcoding. This provides accurate inventory and identification of the material for other tasks.

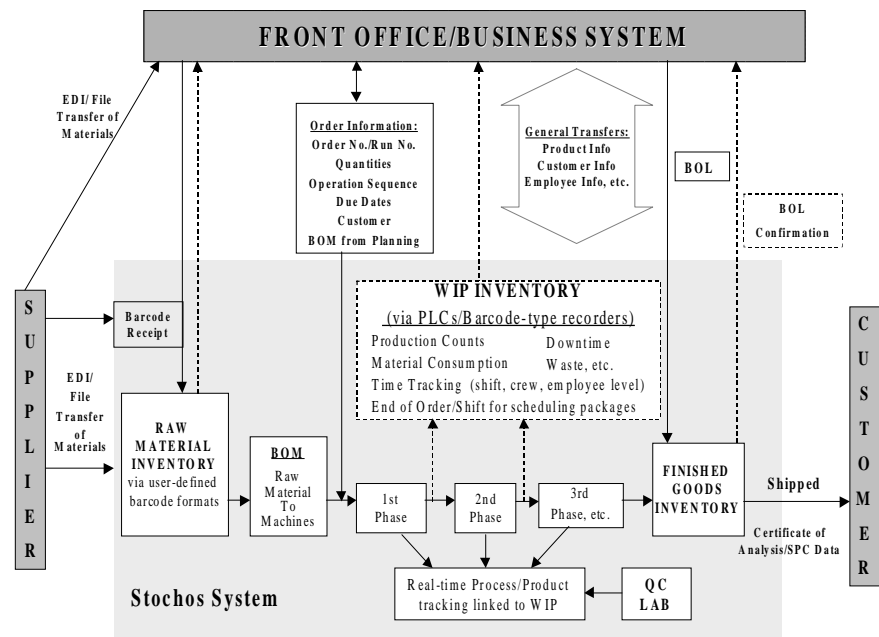
Once a material is in use, the Stochos system will attach the information through every phase of the process. Quality checks and process data

analysis being performed can signal an out-of-specification or out-of-control condition. At this point the problem can be fixed saving time, money and reducing waste.

Another valuable module of the Stochos system is the Quality Action Reporting (QAR) function. A QAR is initiated referencing a product or process problem. A message is then placed in the appropriate personnel work queue with instructions to resolve the issue. The QAR requires corrective action, verification and sign-off, helping to ensure quality improvement.

The Stochos system also utilizes collected information in its powerful reporting module. A Certificate of Analysis (COA) can be generated for customers, documenting your company's attention to quality control.

Contact Stochos for a complete listing of features in the Stochos Quality Management and Shop-Floor Data Collection System.



The above model represents the Stochos QMDS systems' traceability from supplier material, through the finished product, to the customer, and how it links to a front office business system.

Another Cpk Problem

By Don Holmes

We recently performed consulting services for Cpk with a chemical plant. In this plant, when a new batch of material is produced there is a natural, unavoidable transition that occurs as the reaction approaches steady state. The result is that the material produced during the whole cycle is segmented into three different products with three different prices. (In the discrete manufacturing world, this situation is similar to the production of resistors where the output is sorted and priced by nearness to the target value.) A time plot of the general change in the value of the property during a production run is shown below.

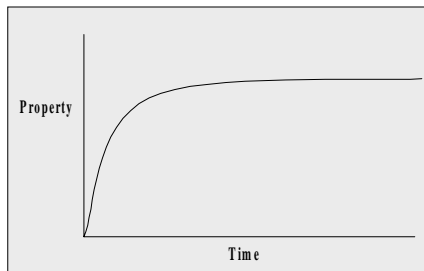


Figure 1

The customers for the plant's output are using the Cpk as a quality yardstick and wanted to be assured that the Cpk of the product they were buying exceeded 1.33.

The product segmentation procedure makes the Cpk an inappropriate measure.

A typical frequency distribution of the total process output with the specification limits for three segments superimposed is shown below. Segment A is recycle material. The material in segment B is lower value than that in segment C.

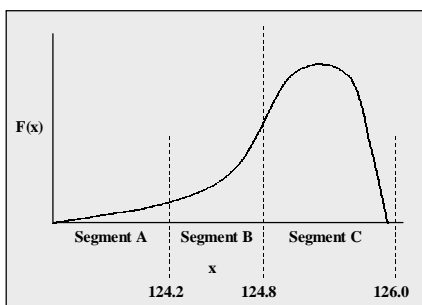


Figure 2

“When discussing Cpk, I feel the same frustration as the fish trying to migrate upstream over the Bonneville dam - before the fish ladders were in place”.

It can readily be seen from this diagram that the frequency distributions of the three segments are heavily truncated and certainly non-normal. This makes a Cpk analysis very questionable.

● The next issue that makes the Cpk inappropriate is that the process, during the generation of each segment, is NOT in statistical control: the process average is unavoidably undergoing change. The best one could hope for here is a process performance measure (Ppk) rather than a process capability measure (Cpk).

Thus one would be well advised to use the regular standard deviation of the segment data rather than the Rbar/d2 approach that is often seen.

● Another issue is that the material is essentially (but not completely) sorted by the value of the quality variable before being shipped to the customer. The “not completely” arises from:

Only a small sample is taken from a container to ascertain the quality of the container

AND

Not every container is sampled.

There is then a chance that one or more containers in a shipment have not been properly classified. Let's explore this aspect of the quality level analysis.

If lots sold as C's are really B's, the customer has paid extra money for a product which may be unfit for his/her use. The same is true for lots sold as B's that are really A's. (The plant also has a vested interest in misclassification: C's

sold as B's or B's sold as A's represent loss of profit.) So the real question for the customer has to do with the possible misclassification of material he/she receives - not, “Do we use Rbar/d2 or any other estimate of the process standard deviation?”.

The customer's focus should be on the % of containers he receives that are misclassified. The % can be transformed into an equivalent “Ppk” should the customer feel the need for such a measure.

Here is what seems to be a reasonable approach to the problem. Make an EWMA Acceptance Chart of the data to help make the decision as to when the material should be put into a particular segment.

Why an Acceptance Chart? The process is not “in control” during the transition, as was pointed out above. The process is also not in control when the reaction is more or less stable (segment C) due to variation of factors which are not controllable.

The question isn't whether or not the average value is some constant value (Xbar control chart) but rather, “Is the average value so close to one of the segment boundaries that misclassification of material (unacceptable material for the customer) will result?”.

Why an EWMA chart? There is about one container of material generated every hour and the samples are taken every four hours for analysis. So, you would like to have a chart with rapid response to changes in average value and one that is not too sensitive to non-Normality.

Please feel free to submit SPC and quality related questions to be answered by Don Holmes in future QC Reports to:

**Sales@Stochos.com
Fax: (518) 372-4789**

Another Cpk Problem (continued)

Here's an example of how to build such a chart.

| | |
|---|--|
| <p>Three segment boundaries</p> <p>A \leq 124.2 124.2 < B \leq 124.8 C > 124.8</p> | <p>Smoothing Constant</p> <p>0.20 so as to put emphasis on latest data ($0 < \text{Smoothing Constant} < 1.0$)</p> |
| <p>Std. Dev. of EWMA</p> <p>(with $\lambda = 0.2$)</p> $\sqrt{\frac{0.13}{2 - 0.2}} = 0.043$ | <p>Analysis of past data</p> <p>Capability Standard Deviation 0.13</p> |

The chart construction for segment C : (See figures 3 & 4 below)

Step #1 Find the smallest acceptable process means (SAM μ) by adding (4*Capability Standard Deviation) up to the lower spec limit to achieve a Ppk of 1.33.

Step #2 Find the largest acceptable process mean (LAM μ) by subtracting (4 * Capability Standard Deviation) from the USL.

Step #3 Find smallest acceptable EWMA by subtracting (3 * Standard Deviation) of EWMA from SAM μ (125.19 in this case).

Step #4 Find the largest acceptable EWMA by adding (3 * Capability Standard Deviation) to LAM μ . (125.61 in this case.)

Step #5 Plot EWMA's using a smoothing constant of 0.20 on this chart.

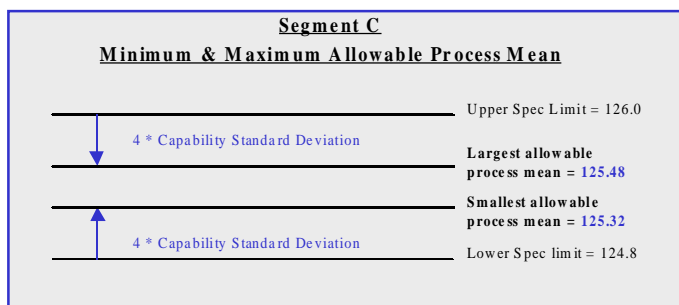


Figure 3

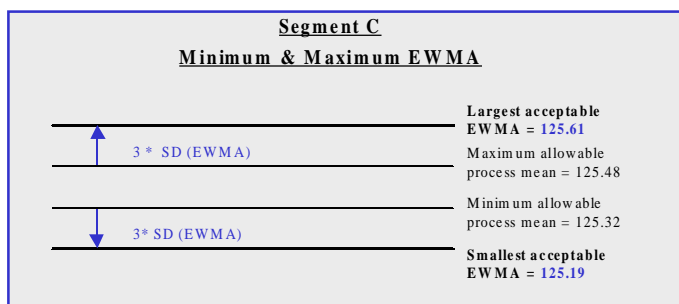


Figure 4

If the EWMA falls below 125.19, consider the material as being of segment B rather than segment C.

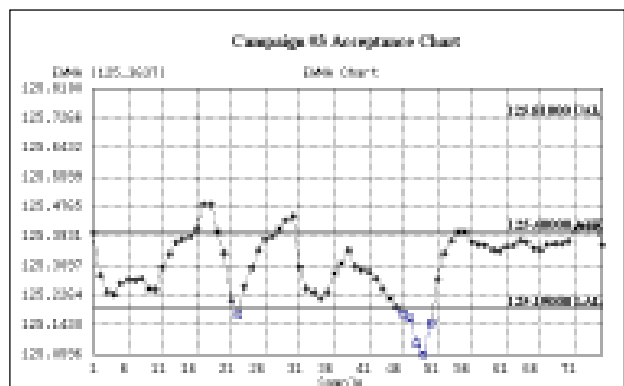
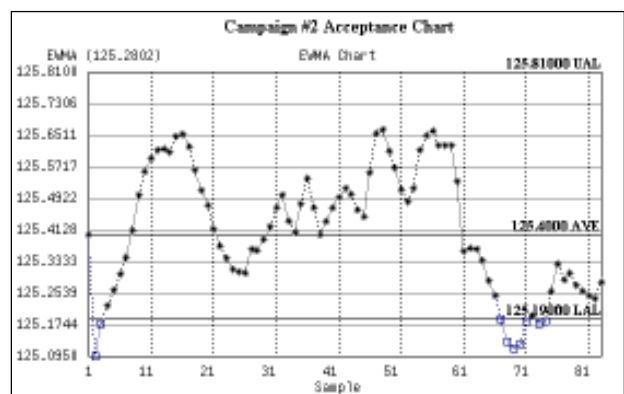
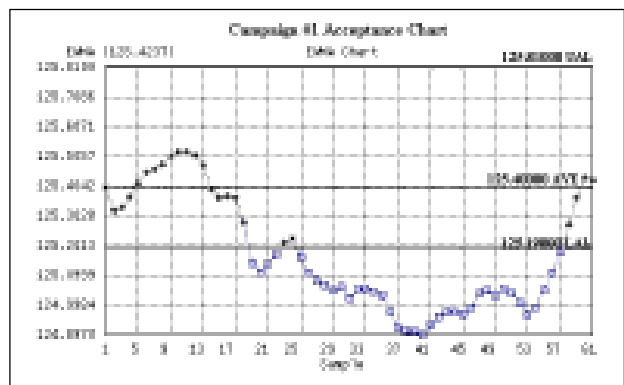
If the EWMA falls above 125.19, consider the material as being of segment C.

Notes: 1. This approach will result in shipments having an equivalent Ppk of about 1.33 or better.

2. The same approach can be used to check B's versus A's. The smallest acceptable EWMA for this example would be:

$$124.2 + 4 * 0.15 - 3 * 0.15 / \text{Sqr}(2 - 0.2) / 0.2 = 124.35.$$

The EWMA charts for several campaigns are shown below.



Note: The quality improvement indicated by the decreasing number of points in segment B.

Qualitex Expo 98, United Kingdom, Lawson Mardon Case Study



Meet Alan Davies Certified Stochos Partner

Stochos would like to welcome Alan Davies from the United Kingdom to our team. As a Quality Improvement Manager, Alan headed a quality software implementation project for Lawson Mardon Packaging. Prior to this project, Alan spent 16 years in technical development and quality management roles within the food and pharmaceutical industries. He is a member of the Institute of Quality Assurance and Management and currently is president of Lusion.



Don Holmes presents the Stochos QMDS system at the Qualitex Expo.

Business Solutions, a provider of consultation and training for quality and quality systems.

Alan and Don Holmes, president of Stochos, recently attended a Qualitex Expo in the United Kingdom. During the exposition Alan presented a case study regarding "Implementation of an Integrated Quality Management software system at Lawson Mardon Packaging". A condensation of the presentation is given below:

Background:

Lawson Mardon Packaging has 16 sites in the UK and 60 plus worldwide. It is part of the Aluisse Group. Lawson

Mardon Packaging at Bristol manufactures printed folding cartons for the tobacco industry and employs approximately 160 people. Over the past two years, significant changes to product portfolio and manning levels have occurred, aimed both at concentrating on a market sector and increasing efficiencies.

In June of 1995, a major business system was implemented. The business system did not satisfy the quality departments needs, thus the search for a suitable SPC and Quality Management system started in April 1996.

Initial Requirements:

Alan was on a Lawson Mardon team assigned to source and implement an integrated Quality Management and SPC system to assert some measurement and control of performance. This evolved into a vision of data collection and information generation across many departments (e.g. Production and Quality). This was a very important step forward in order that the output quality of the product can be viewed in the context of process conditions (e.g. run speed and process inputs, or raw material quality and employee training). Thus, achieving a holistic view of the process.

History:

A complete Shop Floor Data Collection and Quality Management Database System was discovered at a sister company in the U.S. The QMDS system integrated ISO 9000 considerations, shop-floor data, statistical needs and provided flexibility. In November, a team was formed and sent to view the software in action at the sister company. The team consisted of:

- IT** - hardware, networking, interfacing
- Finance** - SFDC, reporting
- Quality** - All quality aspects
- Logistics** - traceability, business system requirements

The software is designed by Stochos

Incorporated, based in Schenectady, NY. In January of 1997, a presentation was made, with the proposal for the purchase and implementation of the system on a Windows NT network. The proposal combined the need for a Quality System and for Shop Floor Data Collection, which captures, among other things, machine speed, downtime and waste information via PLC interfaces.

Implementation:

In October 1997, the system became active with the completion of PLC Interfacing for shopfloor data collection and subsequent modules were rolled out from this point.

The production and quality data collection has been the focus. Work still needs to be done on other areas (e.g. QAR process improvement teams). **It is very important to remember that continuous improvement has a beginning and no end.**

The implementation of the QMDS in the U.K. has led to stronger ties with quality oriented customers. The system generates certificates of analysis based on complete and up-to-date data. These certificates, along with complete product traceability, generate customer assurance of Lawson Mardon's ability to provide high quality product.

Stochos on the WEB

<http://www.stochos.com>



Lusion on the WEB

www.biternet.com/~lusion.solution

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