Using SPC Methods to Trigger Preventative Maintenance and Prevent CCP Violations

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Process Management & Predictive Maintenance

The frequency and timing of maintenance activities is an exercise in balancing cost and risk. Maintenance delayed too long can lead to catastrophic failure and high costs for repair or replacement. If maintenance is more frequent than needed, the cost, which includes downtime, opportunity costs, and the cost of consumables, parts, and labor, will be greater than needed to provide safe, dependable operation.

Conventional maintenance programs operate under fixed schedules. Since there is no way to directly monitor the state of the process, scheduled maintenance has to be excessively conservative to prevent failure. Is there any value-add to this large safety margin and the cost and overhead associated with this model?

Once we can monitor the state of the process and predict process degradation, it is feasible to balance cost and risk and be both more efficient and cost effective. Maintenance can become event-driven, triggered by SPC (Statistical Process Control) signals and managed in a lean just-in-time manner. Managing and triggering maintenance is part of the expansion of SPC methodology and incorporation of analytics to create information rich, intelligent manufacturing process management.

The SPC Contribution to Information Rich & Intelligent Manufacturing

SPC enables one to detect process destabilization and the capability of a process to meet specifications. Scheduled maintenance systems typically have no means to be aware of process disturbances. With continuous monitoring and process analysis we can move to an appropriate "just-in-time" event-driven maintenance response.

SPC is the appropriate method to drive event-driven maintenance:

- SPC is applicable to monitoring any parameter whether measuring pathogen levels, shaft load, bearing wear, etc.
- SPC differentiates signals from noise
- SPC is more sensitive to equipment and process deterioration than simple critical value based inspection systems.
- SPC enables dynamic, "intelligent" system response

The basic SPC tools used to monitor process and trigger maintenance activities

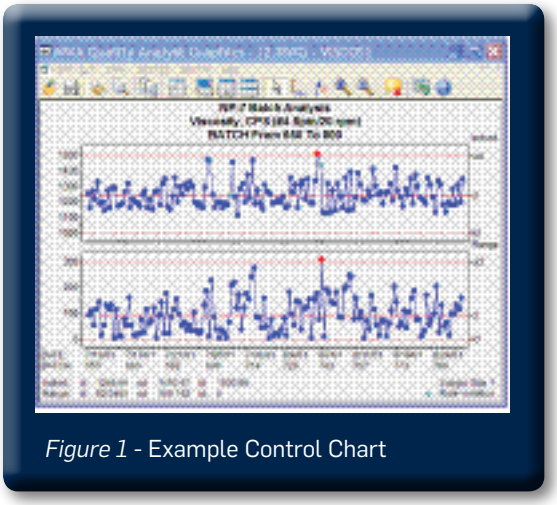


Figure 1 - Example Control Chart

The control chart (Figure 1) monitors process stability and give signals when the charted parameter shows unpredicted process drift. The ability to monitor pattern rule violations provides greater sensitivity to process degradation than simple violations of critical values.

Process capability analysis (Figure 2) examines and quantifies the ability of a particular process to perform to specification. Process capability gives a reading of process variation. With this information we can determine the likelihood of reaching a given value and set the risk level to trigger maintenance.

SPC Enables HACCP Success

- Integrating HACCP and SPC

The author participated in a study at Butterball Turkey which demon-

strated that process management using SPC methods was the effective way to make a critical value based HACCP inspection system work. In the Butterball case, aggressive use of SPC methodology enabled the staff to detect performance failure in the wash cabinet and to make timely process adjustments.

Because trained, focused people were paying attention to SPC signals, they were able to identify and to deal with inadequate wash cabinet performance and avoid shipping unwholesome food. The Butterball case illustrates how using SPC to monitor critical process variables enables process operators and management to sense process state and respond in timely fashion to prevent system failure.

While the study focused on how process management methods enable successful HACCP systems, it also demonstrates how SPC performs equally well triggering maintenance activities. By understanding underlying process behavior, we can perform the most cost-effective, least disruptive maintenance.

International SEMATECH e-Diagnostics

We can often learn from methods developed in other industries. Semiconductor manufacturing requires aggressive maintenance to maintain productivity and profitability. The industry can not afford the cost inefficiencies of scheduled maintenance and has spent considerable effort to develop predictive methods that will trigger just in time maintenance activities.

International SEMATECH (ISMT) is a global consortium focused on advancing semiconductor manufacturing technologies. The ISMT Manufacturing Methods and Productivity (MM&P) Division has defined e-Diagnostics as an advanced monitoring, analysis, and reporting model for predictive maintenance. While not all manufacturing systems will require such sophisticated maintenance management, it is an excellent reference model and source of good ideas.

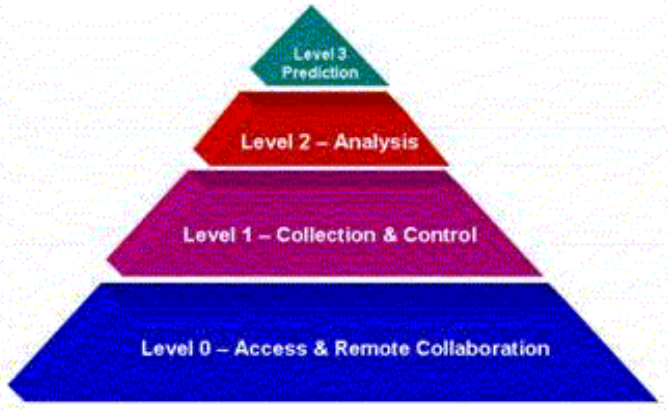
The ISMT e-Diagnostics program brings together IC makers, equipment suppliers, and software suppliers to define requirements to leverage mainstream computing technology, including the Internet, to drive down equipment support costs, reduce the mean time to repair, and consequently to increase output through higher availability.

e-Diagnostics operates in a process management context. As a result, SPC is an integral part of Level 2 - the analysis part of the system. The e-Diagnostic system provides both historical and real-time information, SPC charts, and other visualization tools to present data in a meaningful and user-accessible manner.

This analysis can produce productivity improvements throughout the system. It enables comparisons across production lines and across facilities. By drilling down on the data, the manufacturer can reduce consumption and increase output and quality.

e-Diagnostic proponents claim an impressive list of end user benefits:

- Increased Productivity
  Improved MTTR (Mean Time To Repair) from:
  - Auto-notification of problem to correct expert(s)
  - Resolution begins remotely, immediately
  - Increase in rate of first contact resolution
- Preventative Maintenance
  - Data showing Device wear and Time to Fail
  - Appropriate Scheduling of Downtime
- Data and Information to Decision Makers
  - Comparative Data across many sites
  - Reduction of Scrap/Increased Yield
  - Improvement in Quality
  - Greater Best Practice Sharing Between Facilities
- Greater Collaboration with Special Experts
  - Faster Commissioning of New Equipment/Facilities
  - Improved Utilization of Equipment



Several portions of the e-Diagnostics model can be applied to using preventative maintenance to help guarantee a successful HACCP program.

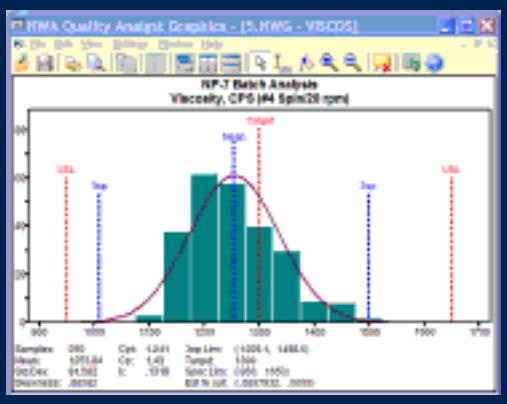


Figure 2 - Process Capability Report

- Operating in active problem prevention mode. Typical scheduled systems are passive and reactive. By taking an active approach, we can make maintenance part of the continuous improvement program and reduce the likelihood of a CCP violation.
- Active deployment of automated data collection systems to improve data quality and reduce operator overhead.
- Using process analysis to increase system knowledge and develop appropriate responses to prevent process failures.
- Monitoring process performance to drive optimized, event-driven maintenance frequency for greater cost-effectiveness and performance.

Summary - SPC & Predictive Maintenance Enable HACCP Success

Using SPC to actively monitor performance, trigger maintenance activity and improve the process results in a more productive system and a more successful HACCP program. Using analytics such as SPC enables event-driven maintenance which produces a safer product at lower cost with less downtime for maintenance.

About the Author

Jeffery L. Cawley is Vice President Market Development at Northwest Analytics, which develops analytics software for understanding and improving processes. NWA's suite of three software solutions for statistical process control and manufacturing intelligence is used in more than 4,500 corporations worldwide.

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