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## Batch Operations Benefit from Process Analytical Technology

A successful application of batch analytics for online operation, resulting in a solution validated for a specialty chemicals batch process. The discussion illustrates basics of batch analytics operation, including access via a Web interface. (Part 2)

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Fig. 7 — iPhone and iPod use for web-based analytics user interface



- Since the user interface is web-based it can be accessed from multiple sites over the intranet (or internet)
- Access is also available through an iPod Touch or iPhone.

Online analytics allows for the operator to monitor a batch operation simply by using a plot of the PCA statistics and the PLS estimated end of batch quality, as illustrated in Figure 7.

[Figure 7. Operator screens for fault detection (A), identification (B), and diagnosis (C).]

Once PCA and PLS models have been developed using data from normal batches, their performance in detecting faults and predicting variations in end-of-batch quality parameters may be tested by replaying data collected from abnormal batches.

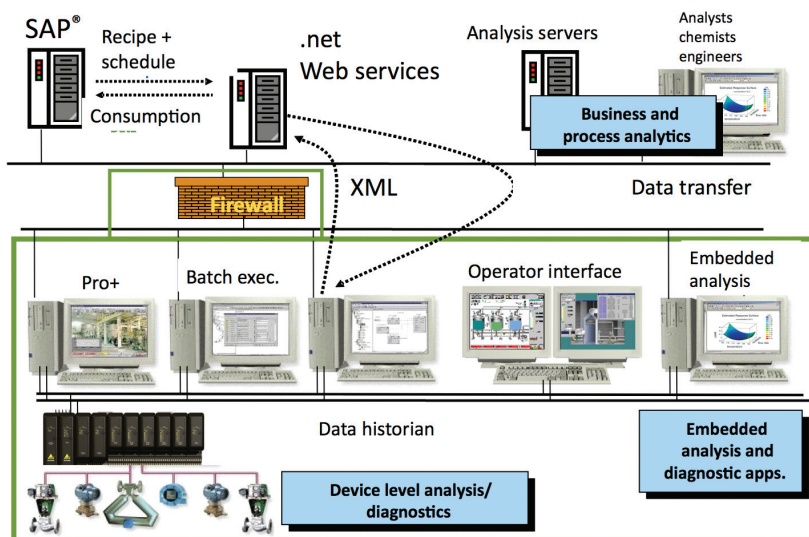
Analytics in specialty chemicals batch application

An architecture was developed to apply these advanced statistical analysis methods outlined in this paper for batch processing in such a way that it integrates with both an enterprise resource planning system as well as a process control system. (See Figure 8.) This application in the specialty chemical industry contains many of the batch components commonly found in many chemical processing companies. However, as with any engineering endeavor, the success of the project depends greatly on the steps taken in applying this analytic technology. To address this application, a multidiscipline team was formed that includes the toolset provider, as well as expertise from Lubrizol's plant operations, statistics, MIS/IT, and engineering staff.

The major steps of a successful project may be summarized as follows.

■ **Collecting process information:** When applying data analytics to a batch process, it is important to have a good understanding of the process, the products produced, and the

**Fig. 8 — DCS and ERP system integrated with process data analytics**



organization of the batch control. Thus, a multidiscipline team should be created for a project like this. A list of the process measurements, lab analysis, and truck data for raw material shipment should be created, forming what may be called an input-process-output data matrix.

■ **Instrumentation and control survey:** A basic assumption in the analytics application to a batch process is that the process operation is repeatable. An instrumentation and control survey, and good loop tuning are important factors in satisfying this requirement.

## References and additional reading:

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■ **Integration of lab data:** Key quality parameters associated with the batch operation at the plant should be obtained for lab analysis by obtaining grab samples. The lab analysis results should then be entered into the data system. The properties analysis for raw material shipments should also be entered into the data system. To allow this data to be used in online analytics, an interface is needed between the ERP system and the process control system.

■ **Historian collection:** Modeling and test data should be in an uncompressed format.

■ **Model development:** The tools for model development must allow for easy selection of data from the data historian and to organize a subset of the data associated with parameters used for the model development. The model must be validated on conformance with several model quality indexes and additionally by using fast playback of test data.

■ **Training:** Operator and plant engineering training is a vital part of commissioning any analytics application.

■ **Evaluation:** User feedback and data collected on improvements in process operation are valuable to evaluate the analytics application.

Basic findings from using this form of process analytics approach have been positive and include:

- The engagement of operators and engineers who provide positive feedback on the analytics used and accept this new tool for fault detection and quality prediction;
- The accumulation of learning as use of the installation continues after the preliminary field trials;
- The ability to exploit new functionality that can detect and diagnose process, instrumentation, and operational problems;
- The importance of using stages in analytic modeling;
- The advantages of Web-based online user interface; and
- The usefulness of Web-based process simulation for operator training.

## Conclusion

Using multivariate process analytics motivates people to think in entirely new ways and address process improvement and operations with a better understanding of the process. It allows operational personnel to identify and make better informed corrections before the end-of-batch, and plays a major role in ensuring that batches repeatedly hit predefined end-of-batch targets. Additionally, the engineers and other operations personnel gain further insight into the relationships between process variables and their importance on product quality. **ce**

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