Strategies for Upgrading your Paper Machine Automation System
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Introduction

In today’s paper industry economic climate, stretching the return on your capital dollar is more critical than ever before. Upgrading your existing automation system has proven to be an approach with one of the fastest, lowest risk returns on investment you can make. Upgrading does not mean replacing your existing investment. It means replacing only those components which:

- Present a risk to the reliable operation of the automation system, or
- Offer the greatest return for the smallest investment.

Good upgrade strategies generally involve minimizing the like-for-like components where no significant value can be achieved. This article focuses on some example and recommended upgrade strategies which do just that.

Distributed Control Upgrades

It is often difficult to justify the replacement of existing distributed control systems due the capital cost, cost of downtime, and risk to the operation. There are many benefits associated with the incorporation of HART, other fieldbus and wireless devices in to new automation projects. Field device management systems improve the reliability and maintenance procedures and the implementation of bus architectures and wireless architectures to reduce the wiring costs and broaden the scope of the variables that can be monitored.

However, on existing systems the most logical upgrade strategy involves maintaining the existing controllers, field wiring, and loop level configuration. The upgrade should focus on the higher level functions of the user interface to improve operator effectiveness, and implement advance control applications over the existing loop level configuration. This represents the lowest risk and highest reward strategy. With the tools which have been put in place today, the existing controllers and I/O can be integrated with modern server software and databases providing most of the benefits of the modern automation systems at a fraction of the cost and risk to the operation. The database integration enables the use of the latest alarm management and displays, integrated trends and process graphics. New 3D graphic displays can be integrated with existing graphic displays, allowing the mill a gradual transition which minimizes the potential upset to the process and simplifies the operator training effort.

Integration of Process Graphics with Modern Graphics

Existing process graphics can be integrated with new, more modern graphics to provide a gradual transition for the operators, and a lower overall implementation cost.

Perhaps one of the biggest benefits is the ability to integrate advanced multivariable control over the existing controllers and I/O. Honeywell’s Profit Suite combines a robust multivariable predictive controller with soft sensors and easy to use tools that enable the mill or local projects organization to easily configure and tune advanced control applications. This is where the real economic value of the upgrades are typically realized, when control strategies can be developed around multiple input / multiple output models of process, quality, and economic priorities and constraints.
In the future, as a new process area is added or reconfigured, the latest in I/O, field bus, and wireless technology can be added as part of the same system – appearing seamless to the operator as they share the same user interface, and real-time and historical databases. Honeywell utilizes this upgrade strategy extensively with its TPS/TDC installed base. Recently these same upgrade strategies and tools are being applied to other legacy Honeywell DCS systems including the Total Plant Alcont and the MXOpen DCS installed base, enabling the mills to plan a phased upgrade strategy that will reduce the overall capital cost, and reduce both the short-term and long-term risk to the operation.

**Quality Control System Upgrades**

A similar approach to upgrading the mill’s Quality Control System (QCS) is also being routinely implemented. Again replacement of the scanners, analog sensors, and CD actuators can be costly from a capital standpoint, and add downtime cost to the operation. But significant improvements to the performance of the measurement and control capabilities from this installed equipment can be easily achieved by simply upgrading the signal processing hardware and application software. The costly scanners, sensors, and CD actuators remain in place, but with a far more powerful and capable “front end.”

With an upgrade to the signal processing, the sensor analog signals can be processed at 2 KHz, which is many times faster that of the existing system. This enables the quality CD profiles to be read at faster scanning rates and higher CD resolution than with the existing signal processing. Often the existing wiring is reused and re-terminated in a wall-mounted cabinet that replaces the existing signal processing subsystem. The upgraded measurement signals are then passed on to the latest QCS server via Ethernet, providing improved CD alignment, improved edge measurement and control, and more responsive, scan-by-scan CD control with the existing actuators. This more responsive, more robust control ensures faster break recovery and fewer losses associated with grade changes and start-ups.

In addition to improved signal processing, the application software is upgraded to the latest release on modern server technology, offering more capability and greater reliability at lower life cycle costs.

This cost effective upgrade allows new sensors and applications to be added to the existing system. New sensors that measure porosity, camera-based formation sensors, and sensors for on-line strength measurement, can be mounted on the existing scanning heads. The capital which might otherwise be used for replacing like components might be better utilized for Honeywell’s latest non-scanning sensor arrays such a SpectraFoil MD drainage measurement technology to optimize forming and ExPress MD Moisture sensors following each press nip to optimize fabric usage and water removal. These sensing arrays, along with GelView for continuously monitoring the coating gelpoint inside the coating dryers, provide significant economic value by reducing energy usage and production losses. At the same time they provide visibility in to the process that was never before available.

Improved process visibility is one of the most significant advantages of upgrading your existing QCS. Even though the scanners and sensors remain unchanged, the improvements in signal processing and application software provide a whole new insight into the process. Applications such as Color Map and Topographic Maps provide a means of viewing consecutive profiles in a color graded scale or in a 3-D topographic map. Cursors enable viewing of any selected profile or the MD trend at any CD position. The Quality Optimizer provides the same high resolution scan-by-scan quality profiles, Web Imaging defect maps, and MIS production data for up to a year. Reel color maps can be recalled at anytime, logically cut into the actual rolls and sets off the winder, and used for complaint analysis, customer reporting, and process troubleshooting. Frequency Analysis displays provide high frequency power spectrum analysis for both CD profiles and MD variability logged from both scanning and high speed single point sensor measurements. These tools are invaluable in benchmarking the process and targeting the cause of variations that impact both product quality and process efficiency.
The Quality Optimizer stores scan-by-scan quality profile data, roll/set information, Web Imaging defect maps, and MIS quality and production data for a year for up to three machines.

The embedded Machine Sentinel is another cost effective upgrade. It utilizes the new high frequency quality measurements to automatically determine the source of higher frequency variations in the process caused by press vibration or pulsation in the stock approach system. By correlating high frequency sensor measurements with monitored rotating elements on the machine through synchronized time averaging, the system will automatically target the source of process variations from creping blade and doctor blade wear, felt and fabric health, nip crowns and roll covers. By monitoring the rotational frequency of fan pumps and screens, Machine Sentinel will automatically target the source of wet end pressure pulsations which impact quality and machine runnability. The key is that these new applications can be easily added to the upgraded system at a minimal cost, and they use inputs from the existing sensors with the enhanced signal processing.

Though there is great potential in the improved signal processing and measurement applications, how do you ensure that you get the best return from the QCS upgrade strategy we have outlined?

Certainly the best way is to integrate the improved measurements in to the latest multivariable MD and CD control applications. These applications are specifically designed to handle the complex interactions between quality parameters. Honeywell’s Performance Multivariable control provides optimal coordination of multiple sets of actuators controlling multiple sheet properties. For example, it allows you to bring the CD profiles of dry weight, reel moisture, wet press moisture, caliper, strength characteristics, porosity, etc. in to a single CD controller and coordinate the outputs to the headbox, press steambox, remoisturizing sprays, and calender actuators, to optimize the overall quality of the product. The operation of the powerful multivariable tuner is easy; using a simple slider on the display, the user can weight the most critical parameters as well as ensure that all of the quality measurements are optimized. This ensures the highest paper quality, maximizes production efficiency, and prevents the actuators from working against each other in complex control situations; saving energy and resources.

One machine producing white top linerboard is equipped with five CD actuators controlling three sheet properties: dry weight, moisture and caliper profile. Slice lip actuators are installed on the primary and secondary headboxes, a steam shower installed on the fourdrinier, a rewet shower installed in the beginning of the dryer section and an induction heating actuator on the calender stack. Utilizing Honeywell’s Performance Multivariable, the mill is now controlling the weight, moisture, and caliper to 0.5% of process in terms of steady state CD control performance, and has also reduced the recovery time due to grade changes, breaks and start-ups.
Substantial cost saving are also achieved due to reduced water usage by the rewet shower, therefore reducing drying requirements. It is important to emphasize that these improvements in CD control performance were accomplished with no changes to the existing scanners, sensors or CD actuators.

**Profit Controller-based multivariable control**

The Profit Controller-based multivariable control outlined in the DCS upgrade section is also being used today for machine direction control. Quality control on a paper machine is as good an example of multivariable interactions as you could define. By bringing multiple quality inputs and multiple process outputs in to a single controller the mill can define the most critical quality and economic based parameters, improving quality and reducing cost. The same approach is now being used for Grade Change control as multivariable control does a far better job of estimating and compensating for quality and process constraints. On a recent fine paper installation, the time required to complete a grade change was cut in half.

**Conclusion:**

As the availability of capital becomes more constrained, selectively upgrading components of the automation system on your machine may provide the best possible return on your capital investment. The quality and productivity gains have proven to be significant, and improvements in the system reliability improve both productivity and reduce the long term lifecycle costs of the system.
For More Information
To learn more about Honeywell’s Paper Machine Automation System Services, visit our website www.honeywell.com/ps or contact your Honeywell account manager.

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