Papermaker's experience with State-of-the-Art Automation

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Abstract:

Modern, State-of-the-Art Automation provides much more capability than the traditional DCS and/or QCS. Asset effectiveness solutions, Best Practice Implementations and Optimization Technologies provide papermakers with the ability to increase Overall Machine Efficiency, OME, by 1 to 3 %. This paper will provide some case history examples showing how these capabilities are used and the benefits received. The presentation will close with a challenge to the audience.

Introduction:

Automation fulfills a valuable and necessary function to be competitive in the papermaking market today. Distributed Control Systems, DCS, and Programable Logic Controls, PLC, are used to control the valves and motors required to run papermachines. Quality Control Systems, QCS, provide on-line measurement and control of many parameters that make up the grade specification for the paper such as the basis weight, moisture, thickness, color, opacity etc. The business case for automation investment is typically based on automation's ability to reduce variation resulting in the ability to operate close to allowable limits for economic gain. This is illustrated in figure 1.

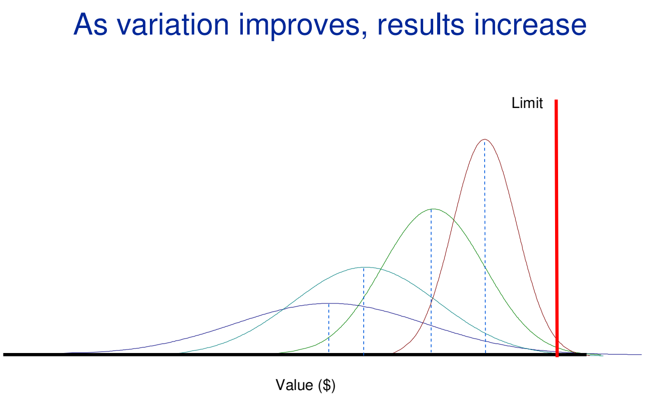

Figure 1: Economic value with automation

The objective of this paper is to demonstrate that modern automation systems provide the ability to achieve incremental efficiency improvements through best-practice implementations, asset effectiveness solutions, and optimization technologies.

Best practice implementation

Best practices are available for many different aspects of papermaking. For purpose of this paper, we will consider best practices as it applies to providing information to the user of the system. An automation system collects process information from the various flow, pressure, temperature, level, pH and other measurement devices on the process as well as the weight, moisture, color, thickness and related quality measurements provided by the QCS. A modern automation system uses commercially available technology for the computing and network infrastructure providing access to more of the information available in the mill computer systems.

In one case-study example illustrated in Figure 2, the information provided to the operator includes:

1. Control information so the operator can see the current process value, know where the valve is operating, understand his operating limits and enter setpoints
2. A trend showing how the variable has been running along with the setpoint changes and outputs to maintain desired control
3. Interlocks that will keep the control from operating normally and the status of those interlocks
4. Alarms that are associated with the variable
5. Diagnostic information provided by intelligent process measurement devices, valves and motor controls
6. Description of proper control operation
7. Maintenance history for the control

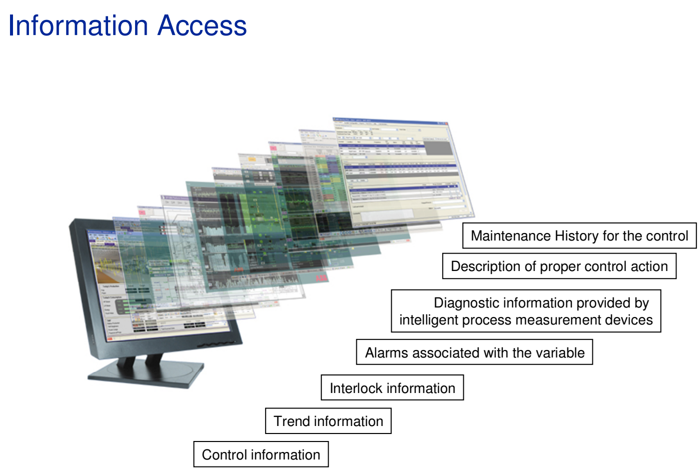

Figure 2: Information access

The first four items are resident in the automation system. The other items come from different sources. The diagnostic information, item 5, is resident in the intelligent measurement device, the description of proper control action, item 6, is maintained on a mill server as an engineering document and the maintenance history, item 7, is retrieved from a maintenance database.

The use of video cameras is becoming more and more common in the paper industry. Quite often there are TV monitors in a control room for on-line view to specific areas of the process or even the product in production. There is now a mill in Europe that has connected a system that manages video cameras in various parts of the mill so the operator has access to the video information from his display screen. For example, when an alarm message is presented to the operator, he can quickly view a video associated with part of the process that is generating the alarm.

With the modern automation system, connecting the people with this information is done cost effectively. The key to making this a best practice is to provide the information in context so when the operator wants to see the maintenance history for the fanpump, a right mouse click on the fanpump portion of his display will give him access to this information. Providing the right person with access to the right information at the right time enables better decision making and the opportunity to improve mill operations.

Asset effectiveness

Asset effectiveness is a term that has different meanings depending on the way it is used. For this paper, asset effectiveness means the way information from intelligent process transmitters and valves is used. Our case-study example involves a smart pressure transmitter. As shown in Figure 3, the following information is inherently available when the smart pressure transmitter is configured in the automation system:

1. Product documentation
2. Diagnostic information
3. Condition information
4. Configuration information
5. Operating information

When the transmitter reports an error message, the control loop will be automatically shifted to a safe operating condition and the operator is notified. At the same time, the instrument technician is notified that the transmitter is reporting an error message thus shortening the time it takes to diagnose and correct a problem.

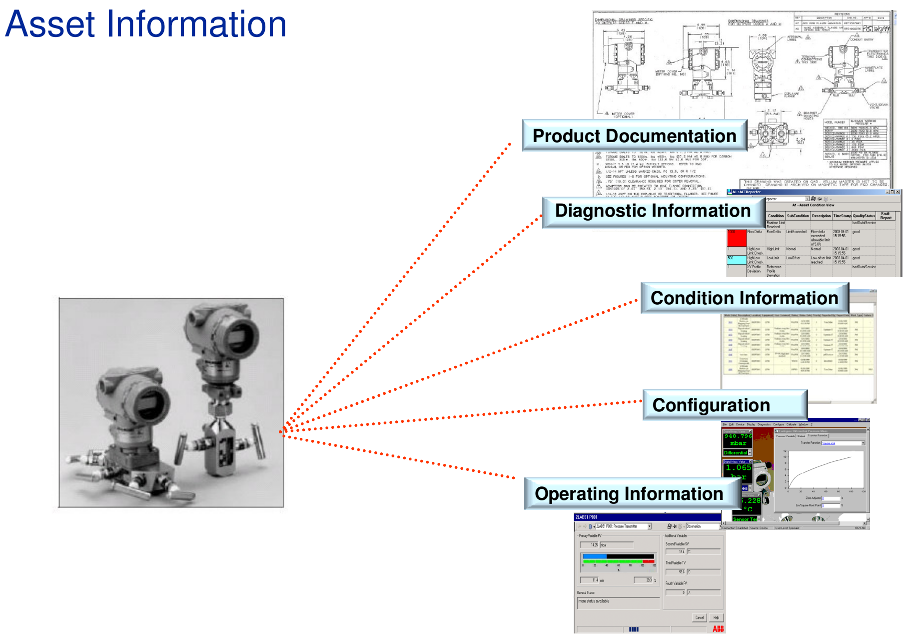

Figure 3: Pressure transmitter information inherently available

Optimization

The process information collected by the modern information system can be used to help improve the overall operation. Optimization is achieved with a three step process: diagnose, implement, and sustain.

The diagnostic portion of this optimization program is called a Process Fingerprint. This capability has been available for over 10 years and includes an experience database representing several hundred studies. Key performance indicators, KPI's, have been developed for the following areas: Product Variability, Stock Approach Stability, Machine Response, and Profile Capability. The KPI's are expressed as an index and compared to benchmark performance from the experience database. The ***Product Variability*** index is an indication of cyclic tendency in the process. This index is derived from adding together the individual weight and moisture indices. The ***Stock Approach Stability*** index is a number that represents the stability of dominant stock approach control loops. The ***Machine Response*** index is an indication of weight, moisture and headbox control performance and is the sum of the individual control indices. The ***Profile Capability*** index is an indication of Cross Direction weight and moisture control performance.

By evaluating the process information, the cyclic nature of the variation can be characterized as pulsations, surges, vibration, mechanical condition, etc. From the process response information, we can link the variation to its source. For instance, high frequency variation in basis weight is likely coming from the headbox and former. Figure 4 shows the typical sources for a stock delivery system.

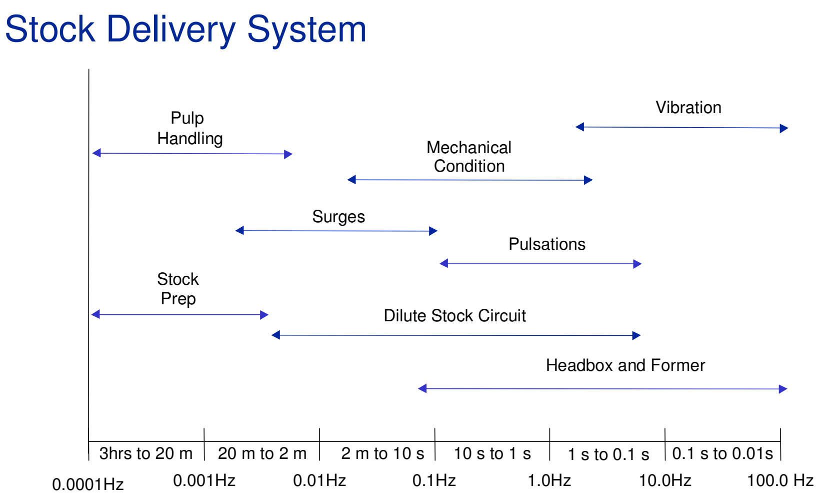

Figure 4: Variation in a stock delivery system

The improvement portion of this optimization program is an action plan. Information from the process fingerprint is used to identify and prioritize the recommended actions. In many cases, improvement can be achieved with some maintenance effort. In other cases, modifications to the controls will achieve the desired results. In some extreme cases, new capital equipment is required.

The sustain phase of this optimization program involves monitoring the KPI's and reporting when appropriate. This is shown in Figure 5

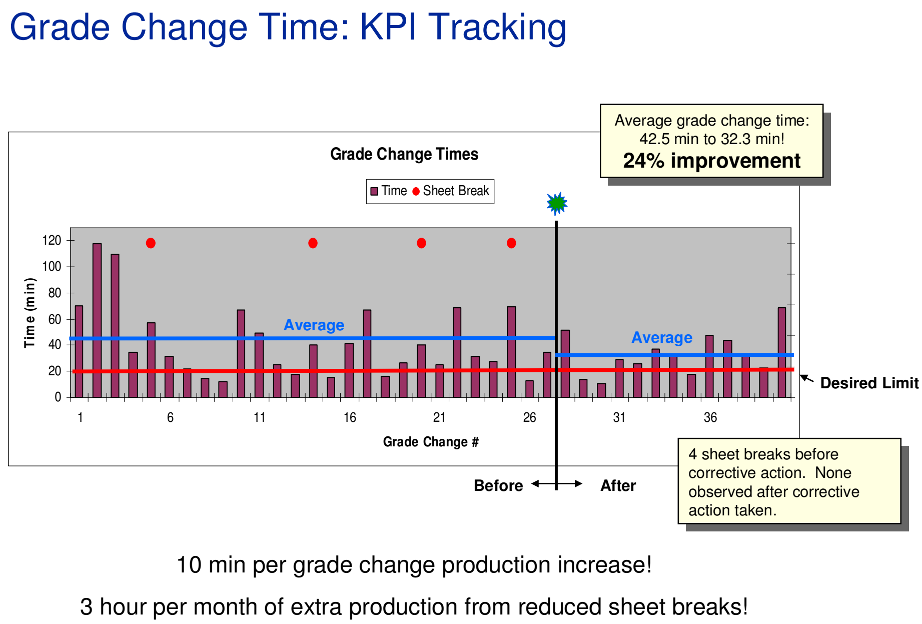

Figure 5: KPI reporting

US Corrugated in Cowpens, SC is our case-study example of the benefits achievable with this optimization program. The May/June 2010 issue of Solutions magazine featured an article on US Corrugated in Cowpens, SC. As mentioned in this article, "the mill has gone from producing 280 tpd to a recent record of more than 780 tpd. Much of the improvement is attributable to their strong relationship with ABB . . . " The program with US Corrugated has evolved over several years and now includes capability for experts to connect remotely. Through the remote connection, several problems have been fixed in minutes vs days by getting the right expert involved in the solution more quickly.

Results

Papermakers that are utilizing these capabilities are realizing efficiency improvements in the range of 1 to 3%. Except where noted, the papermills that are using these capabilities prefer to remain confidential at this time. Determining the improvement for a specific operation requires evaluation of the factors that are impacting efficiency. There are a number of methods to evaluate efficiency available from organizations like Zelchemming and TAPPI. For purposes of this paper, we will use a generalized model as shown in Figure 6. A gap analysis is performed to identify the issues that are impacting the availability of the operation, ability to produce at target production rates and desired quality.

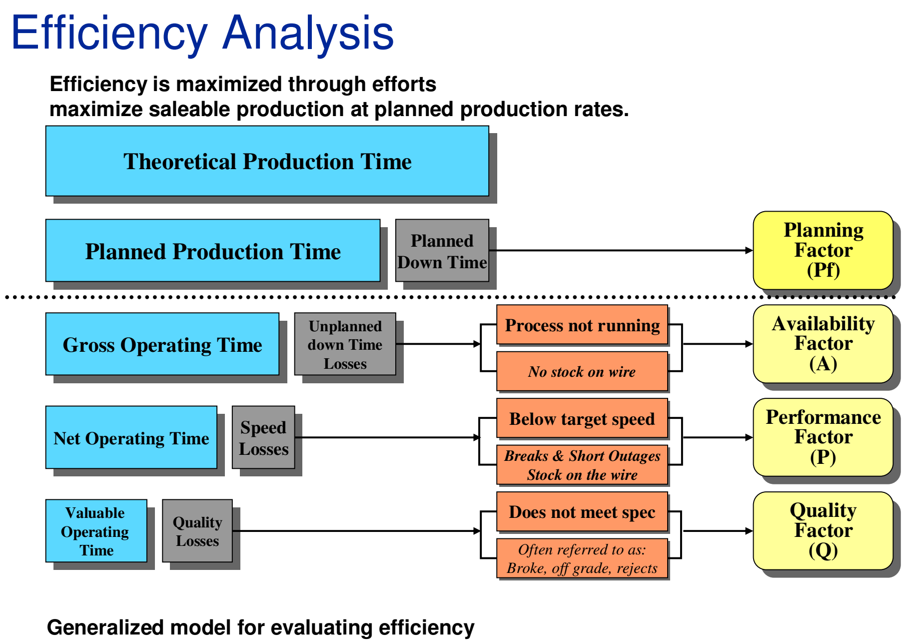

Figure 6: Factors that impact Efficiency

Another case history example shows a real-time calculation of the machine efficiency with some display and reporting capability to show overall performance and reasons for any gaps. An example display is shown in Figure 7.

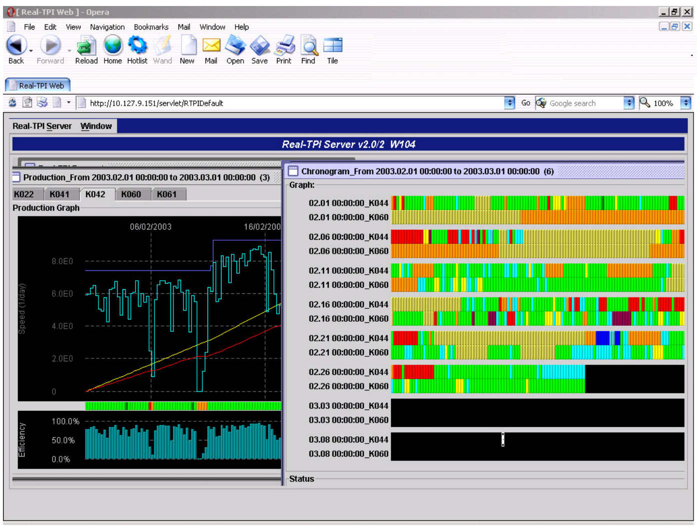

Figure 7: Real-Time efficiency reporting

Experience has shown that the efficiency gain is attributed to a combination of factors. The technology enables improvement by:

- bringing information from a number of sources together in a cohesive way
- structuring the information so it is relevant to the user's job function
- analysis and decision support tools

We find that as people use this capability downtime is reduced, production rates increase and product quality is achieved on a more consistent basis.

Challenge

The case history examples highlight some specific examples that are in use by papermakers today. As mentioned earlier, the commercially available technology used today for the mill computer network systems provides a foundation. What we choose to do with the information that is available is up to us. As we consider the various types of information in the mill computer systems, our challenge is to consider how we can better leverage this information to improve mill operations.

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