Executive Summary

In modern paper mills, the production of paper involves an extensive array of technology for automation of process operations. Mills seek effective control solutions to ensure stable production, compliance to quality control specifications and elimination of waste, which are essential to profitable papermaking.

Today’s operational demands require a quality control system (QCS) that stretches from stock preparation to the winder. Mills need a comprehensive approach to QCS that integrates process quality management, measurements and profile controls to help operating personnel understand and manage the process.

The following whitepaper describes Honeywell’s newest innovation in QCS, Experion® MX. This advanced system offers fast scanning and processing speeds with superior measurement technology, high-resolution cross-direction profile control employing a wide range of intelligent actuators, and a comprehensive suite of quality control applications.

Experion MX builds on Honeywell’s lengthy experience in the pulp and paper market. It is an integrated quality control and process knowledge system providing increased visibility into the papermaking process while simplifying operational efforts.

By modernizing their QCS platform to Experion MX, mill owners can improve paper quality, reduce service and maintenance costs, and increase production efficiency while achieving lower total lifecycle costs.
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Introduction

Profitable papermaking requires continuous production with minimal deviations from quality specifications. While steady-state control performance is essential, the elimination of waste during transitions such as grade changes and break recoveries is where significant economic gains can be achieved. As production rates rise — stretching the design capacity of the paper machine — Quality Control System (QCS) technology holds the key to improving production efficiency and quality.

A QCS is designed to continuously measure and control the material properties of a moving paper sheet in two dimensions: the machine direction (MD) and the cross-machine direction (CD). The ultimate goal is maintaining a good and homogenous quality, and meeting users’ economic requirements.

Recent years have seen a number of developments in quality measurement and control, which are targeted directly at areas of concern for all paper producers: optimizing productivity and minimizing losses, and improving quality while reducing energy usage and raw material cost per ton.

The application of a modern QCS provides greater insights into both product quality and the process. Mills can employ new on-line quality measurements for porosity, strength characteristics, formation, fiber orientation, etc. However, quality measurements are no longer restricted to the final product at dry end scanners. Upstream sensor arrays are now being installed in the former and press section, and inside the coating dryers themselves. These solutions provide a view of the process that was never before available.

Though expanded visibility alone provides a means to optimize the process and improve quality, when new sensors and upstream sensor arrays are coupled with developments in multivariable predictive control for both MD and CD applications, the quality and productivity benefits are significantly better.

Today’s Operational Demands

Pulp and paper companies face difficult challenges in today’s global marketplace. Fierce competition and an uncertain economic outlook have forced mill owners to seek new ways to expand production, reduce maintenance expenses, improve quality, and minimize the cost of lost production due to unplanned downtime. They’re also concerned with lowering the total cost of ownership for automation and production assets. Rising energy and environmental compliance costs put additional pressure on profit margins.

As paper manufacturers continue to “do more with less”, resources are stretched thinner than ever. In addition to aging mill assets, much of the skilled workforce for engineering and maintenance is approaching retirement. Increasingly, mill managers must focus on developing core competencies of the younger workforce, while squeezing as much as possible from existing capital and human resources. Competitiveness and profitability depend directly on the availability and reliability of production equipment.
Paper is a complex product and the business of manufacturing paper is a very demanding one. Starting from the natural raw material — trees — papermaking requires sophisticated controls from start to finish to ensure the final product meets end user specifications. This must be done in the most economical manner possible.

Each step of the papermaking process contributes in some way to the final properties of the paper sheet, and therefore all demand equal attention. Defects can be created just as easily in the first step as the last, so high quality finished products require stringent adherence to quality all through the process.

The paper machine is usually considered the last place to get conditions right for the final product. For example, a reliable consistency measurement at this location may prevent large runs of off-spec product. The QCS plays an important role by providing continuous measurement of the product in real-time. Data from the QCS scanning sensors is processed to support the following functions:

- Management and process information reporting
- On-line data analysis
- Supervisory control
- Machine-Direction (MD) control
- Cross-Direction (CD) control

Integration of the QCS in an overall system with the Distributed Control System (DCS) is important for enabling consistently superior quality combined with economical production. The QCS monitors and controls paper-specific quality parameters like basis weight, moisture, ash, and thickness at the machines by continuously recording the measured data via a communications link to the measurement frames. At the same time, the QCS is tasked with controlling both the machine-direction and cross-direction parameters to ensure the desired quality is achieved.

**Reasons for Modernization**

With investment budgets tight and demand for quality steep, paper mills need to deploy a QCS and DCS solution that delivers the latest technology and state-of-the-art control in one integrated system and at an acceptable price.

Generally speaking, the designers of legacy quality control systems did not envision these systems lasting for decades. However, due to shrinking capital budgets for new technology purchases, the lifespan of existing mill production assets is often being stretched over several decades.

Studies indicate more than 1,000 quality control systems 15 years or older are still in use around the world, and almost one-third of the total installed base is between 15 and 20 years old. While QCS platforms may be upgraded with new technology at various intervals, many systems continue to utilize their original 1980s-era scanners. As a result, the measurement and control capabilities of older paper machines frequently lag behind newer machines. The parts to keep them running also are becoming obsolete, while the cost of service continues to rise. And many existing machines are subject to failures resulting in costly production interruptions.

Over the last few years, QCS technology has made important strides to benefit the paper industry. The potential for ROI from this technology has increased thanks to faster and more precise measurements, better multi-variable model based controls, improved CD profilers, and extensive process diagnostic capabilities. Moreover, new measurements such as optical caliper, sheet structure and surface properties enable papermakers to improve existing paper grades and move forward to new ones (See Fig. 2).

Even with regular maintenance of a legacy QCS, it is often difficult to achieve the level of performance and reliability offered by a modern system. As such, many mill managers are now asking, "Is it time to make a commitment to new technology?"
Latest QCS Solutions

As previously stated, quality control systems and associated profile controls are a critical part of papermaking. QCS applications are no longer confined to the paper machine, but now stretch from stock preparation to the winder. That is why today’s mills seek a comprehensive approach to QCS that integrates process quality management, measurements, and profile controls to provide operating personnel with the insights they need to understand and manage the process.

Most paper producers have three key requirements for QCS technology:

- Greater visibility into the papermaking process in order to reduce costs while improving quality and uptime
- Equipment that is easy to operate, service and maintain
- Lowest total cost of ownership.

Honeywell Process Solutions, a leading supplier of process automation and quality control systems to the global pulp and paper industries, has addressed these needs with Experion MX, its next generation of paper machine automation. This new system was designed from the ground up to help papermakers easily improve their paper quality while reducing maintenance and service costs.

Experion MX is a comprehensive quality control and process knowledge solution providing increased visibility into papermaking processes while simplifying operational efforts and system support. Experion MX enables mills to improve paper quality, reduce service and maintenance costs, and boost production efficiency with a package of solutions delivering lower total lifecycle costs (See Fig. 3).

Unified with Honeywell’s Experion Process Knowledge System (PKS), Experion MX simplifies operations by allowing mill personnel to use a single software platform to control all critical functions, including process control, safety and security, business optimization, and reliability. This reduces training requirements and provides easier access to everything from mill-wide production planning to individual process control loops.

Experion MX provides an integrated user interface that makes it easier for operators to view and control the process. It also offers fast scanning and processing speeds with superior measurement technology, high resolution CD profile control, advanced multi-variable controls, and real-time process optimization. As such, the system enables production, quality and process control; machine logic; and drive control to work cooperatively to maximize performance. Experion enhances safety, environmental compliance, energy efficiency, cyber and physical security, as well as asset and lifecycle management. Integrating these systems ensures that better and more focused information gets to key decision makers. It also supports more efficient process design and execution, better system operation, and higher quality service.
Industry experience has shown that Experion MX allows mills to improve operational efficiency by up to five percent and increase production by up to 10 percent. At the same time, it helps reduce raw materials consumption by up to three percent.

Benefits of New Technology

Paper companies can achieve competitive advantages from a cost-effective, continuous evolution path from existing QCS solutions to the latest measurement and system technology, software and control applications. The key benefits include:

Improved process visibility and quality control

In the pulp and paper industry, business optimization starts with increased visibility of production operations. The Experion MX human machine interface (HMI) shows everything the operator needs to know about the process on a single display frame, no matter what the source of the data. The HMI has a consistent look and feel for all operator tasks, including process measurements, MD and CD controls, web monitoring and inspection, quality reporting, production reporting and field instrumentation. Its integrated display capability provides profile data, camera data, Programmable Logic Controller (PLC) logic state data, and DCS loop data on the same screen. All displays are easy and intuitive to operate. Intelligent alarm handling quickly directs the user to the source of problems (See Fig. 4).
Experion MX also takes quality control performance to a new level. It features a new O-Frame scanner with several innovative design points. Enhanced beam configurations have increased the scanner’s structural rigidity for improved reliability and accuracy on the widest of paper machines. With a scan speed of up to 1200 mm/second, a full scan takes 10 seconds or less on even the largest machines in the world. The scanner heads travel twice the speed of their predecessor and several times faster than previous generation systems. The improved speed of sensor signal processing even allows diagnostic data to be collected in normal scanning mode. Fewer interruptions mean more complete, consistent and statistically accurate data in the historian and Manufacturing Information System (MIS) — resulting in less time off control.

A number of unique new measurements are also provided with Experion MX. For instance, camera-based scanning sensors inspect paper formation; fiber orientation and anisotropy; surface topography, crepe and smoothness. Additional strength property measurements include direct ESS for MD and CD controls, with correlations for tensile energy absorption (TEA), compressive strength (STFI) and ring crush. Former drainage measurements are now based on an on-line water weight measurement technique called Spectra Foil. A new porosity measurement capability is available as well.

Experion MX’s multi-variable MD control with hard constraints optimizes grade change trajectories, resulting in a 50 percent reduction in grade change losses. In fine paper applications, the grade change time can be reduced from 20-25 minutes to 10-15 minutes. Honeywell has also made their model-based multi-variable MD control easier to tune and maintain. The system provides improved nonlinear first principles models, and automatic gain and delay retune capabilities. Integrated tools are offered for tuning and optimization.

Experion MX’s multi-variable CD control optimizes overall quality rather than just single quality parameters such as basis weight, moisture, caliper, porosity, fiber orientation, smoothness, gloss, etc. It includes a unique “scan-by-scan” control output allowing for faster grade changes and break recovery. The system even has the ability to understand constraints and improve control performance when CD actuators operate near limits.

**Easier operation, service and maintenance**

Experion MX was developed to be easier to operate and service than older QCSs. It offers a number of significant new features to improve reliability and simplify maintenance versus legacy platforms.

The QCS communication architecture is based on Ethernet Data Acquisition (EDAQ) nodes connected via standard Ethernet protocol and devices. EDAQ nodes in the sensor modules and scanner end-bell handle all data acquisition, I/O, and scanner control functions. This approach allows redundant, automatic switching of communication to the b-channel in the event of an a-channel failure. It also permits the use of Ethernet through the scanner and minimizes the need for analog and digital ribbons cabling around the moving head — a frequent point of failure with previous units. The Measurement Sub-System (MSS) receives time-stamped data from sensor modules as well as measuring head position from the frame controller. Data are then transferred to the Experion MX server for conversion to engineering units and inter-measurement calculations (See Fig. 5).

In addition, the use of an Ethernet-based solution removes limitations on power track capacity and the number signals that can be passed through data acquisition and sensors; the scanner network can now be sized to handle the maximum number of devices the system can support. This makes it very easy for production engineers to evaluate new sensors for different applications.

Experion MX provides advanced on-line diagnostics for logical and fast access to information that can enhance troubleshooting and repairs. Every system component is presented as a member of a logical tree structure, and alarms and alerts are escalated to higher levels for visibility. Relevant documentation can be accessed directly from the tree. Asset status is provided by means of detailed, color-coded information that easily identifies the source of the problem.

Integrated tools with the new QCS make it easy to plan and execute predictive maintenance. Periodic maintenance tasks automatically populate the schedule with parts and effort estimates associated with each task. Additionally, unfinished tasks automatically roll over to the next day. Component use data determine when specific maintenance activities are scheduled, and site support personnel can perform major repair work or equipment replacements to coincide with planned shutdowns.
The intuitive design of Experion MX also simplifies the work of service technicians on the mill floor. For example, all sensors are modular so they can easily install via mounting rails. The technician simply plugs in a replacement module with factory calibration data for the sensor already installed, and it connects to the network, self-identifies, downloads any operating parameters, and is ready to function. This approach enables fast removal and replacement of sensor modules — thus reducing downtime (See Fig. 6).

Finally, Experion MX has a built-in capability for remote system access — an increasingly important means of providing backup support as an alternative to having a team of experts on site. With secure data connection via a “Service Node”, the Honeywell global service team can view operating parameters and diagnostic results remotely to help solve almost any problem. All communication is outbound; an inbound connection can be opened only when the papermaker’s management requests the remote service center take control of a specific task. In short, the experts can look over the local service engineer’s shoulder without having to be there. The unprecedented visibility of system information also enables advanced tuning and optimization tasks to be completed by the most qualified system expert — regardless of where that expert is located.
Lowest cost of ownership

More and more, paper mills are looking for ways to reduce system support costs while dealing with an aging workforce, early retirement and the subsequent loss of experience and intellectual capital. The current situation requires automation and quality control systems that are easier to understand and maintain so ownership costs are as low as possible.

Take Experion MX’s new, compact sensor housing: it has been redesigned along with all sensor modules to achieve lower lifecycle cost objectives. The enclosure provides flexible mounting with self-identifying sensor modules within and around the measuring head, and allows easy access from the sides so sensors may be replaced with minimal effort. Measuring heads are provided in two versions: a six-pack measuring head housing six inboard sensor modules, and a four-pack measuring head housing four inboard sensor modules. Outboard sensors can be installed on either the MD or CD side of the head. Each sensor module has the same size and footprint, and can be installed in virtually any of the positions inside the head. Likewise, the sensors have their own EDAQ, which handles Ethernet communications, diagnostics, and storage of factory calibration data.

Honeywell has also given mill managers a real choice in terms of service and repair strategies with Experion MX. Thanks to the built-in remote service capability with the new QCS, self-serviced systems are easily supported. Honeywell’s QCS Support Program provides the right mix of expertise to leverage the right experts with right skills — no matter where they are in the world. This expertise can be combined with remote service and optimization technology to deliver 50-70 percent faster problem resolution, optimization savings in the form of reduced raw material costs, and energy reduction and production capacity increases. With proactive monitoring, mills can avoid hours of productivity losses by identifying potential problems and fixing them before they occur — all for as much as 50 percent less cost overall.

Should they choose, papermaking sites with local expertise, whether supplied by Honeywell under contract or by the mill, are able to continue performing service down to the component level, as in the past.

Choosing the Right Upgrades

Paper mills can’t afford to take chances with their production operations. Many older QCS platforms are becoming obsolete and losing the support of their suppliers. Spare parts availability is another growing concern. These problems can complicate equipment maintenance and pose unacceptable risks to continuous production.

At the same time, paper facilities worldwide are striving to improve their overall ROI. They need improved efficiency and performance out of fixed assets, as well as the ability to go faster on existing machines and make higher-value grades of paper. A mill producing corrugated board may be seeking higher moisture targets, flatter profiles and better coordination of multiple CD actuators, whereas a tissue manufacturer may require improved multi-variable MD controls, shorter break recovery times, and optimization for energy savings.

However, upgrading an existing paper machine QCS does not necessarily mean replacing existing investments — just those components that present a risk to the reliable operation of the system and offer the greatest return for the smallest investment. Improved process visibility is one of the most significant advantages of upgrading to newer technology; improvements in signal processing and application software provide a whole new insight into the process (See Fig. 7).
A typical QCS upgrade can encompass new measurement processing technology coupled with an existing scanner or a new scanner, CD actuators, and multi-variable control capabilities. These upgrades are intended to improve profile measurement response and resolution for better CD alignment, edge measurement and CD control. In addition, upgrade projects often improve system flexibility by adding new sensors and applications, such as porosity measurement, camera-based formation sensors, and moisture sensors and scanners.

Papermaking facilities migrating to the Experion MX solution may choose to: 1) maintain existing scanners and only upgrade the front-end and signal processing components of their QCS, or 2) upgrade both the scanners and the QCS platform to take advantage of all the Experion MX features. These upgrades are typically part of a two-step process that provides a secure, long-term path to the latest technology.

With the first approach, the primary motivation is avoidance of obsolescence. Due to a lack of capital funding for a complete system replacement, the mill may choose to perform a front-end upgrade first to address reliability concerns, and then replace its scanners at some point in the future. This strategy normally hinges on the physical health of the existing scanning equipment.

With the second approach, profit incentives from production optimization and reliability improvements justify the installation of an entirely new system. This enables the mill to benefit from improved measurement resolution, enhanced HMI, modern operating systems, and enhanced software and advanced controls included in the front-end upgrade, as well as a faster scanning platform, Ethernet-based data acquisition system, new sensor offerings, and advanced diagnostics.

For most papermakers, significant improvements to the performance of existing measurement and control capabilities can be achieved by simply upgrading the signal processing hardware and application software. The costly scanners, sensors and CD actuators remain in place, but the signals can be read many times faster, and in higher resolution. This improves CD alignment, edge measurement and control, ensuring faster break recovery and fewer losses during 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 lifecycle costs.

This cost-effective upgrade allows new sensors and applications, such as porosity measurement, camera-based sensors, and sensors for on-line strength measurement that can be mounted on the existing scanning heads, to be added to the existing system. The capital that might otherwise be used for replacing scanner components might be better utilized for implementing non-scanning sensor technology such as on-line drainage or wet-end ash and brightness measurements.

**Leveraging Existing Investments**

In today’s economic climate, it’s more important than ever to maximize the value of current mill assets — and make the right technology decisions to improve long-term operational performance. As older QCS platforms become more difficult and costly to support, Honeywell’s migration solutions enable a step-by-step upgrade of the most critical components.

The options for users planning to upgrade to Experion MX include:

- **Precision Measurement Upgrade** — allows scanners and sensors from previous generation QCS to work seamlessly with the latest measurement signal processing. This enables faster scanning at higher measurement resolution. The upgrade allows the users to take advantage of the latest measurement, control and system technology at a fraction of the cost of a new system.

- **Scanner Upgrade Kits** — offer improved measurement system reliability and performance by upgrading the current scanner. A series of cost-effective upgrade kits are available.

- **Performance CD Multi-variable Upgrade** — allows mills to realize the benefits of the latest CD multi-variable control technology while maintaining the existing CD actuators and CD interfaces.

- **Performance CD Open** — allows users to take advantage of the latest in CD multi-variable control technology while maintaining the existing QCS and CD actuators.

- **CD Actuator Upgrade Kits** — provide improved reliability and performance of the existing CD actuators and CD interface electronics, extending their useful life and improving the results achieved.
• **Performance MD Multi-variable Upgrade** – brings the performance of multi-variable control to advanced MD controls to improve quality control, grade change control, etc.

• **Support Choice for QCS** – offers the most cost-effective means of managing the obsolescence of a system’s commercial servers and workstations to continuously improve system performance and reliability while lowering the cost of ownership over the life of the QCS.

Mills should not overlook project execution when considering a QCS upgrade. Major suppliers like Honeywell have global project resources to help ensure upgrades are planned and completed with minimal disruption to normal operations. In many cases, their full-scope services allow mills to go down on one QCS platform and come back up on another, newer system as part of a normal maintenance outage (See Fig. 8).

![Figure 8: The right project resources enable QCS upgrades with minimal disruption to normal operations.](image)

**Conclusion**

As the availability of capital becomes more constrained in the pulp and paper industry, selective paper machine QCS upgrades may provide the best possible return on investment. The quality and productivity gains enabled through migration to a modern quality control solution like Experion MX have proven to be significant, and enhanced reliability improves both productivity and reduces the long-term lifecycle costs of a mill’s production assets.
For More Information
Learn more about how Honeywell's Experion MX can improve Papermaking with Lowest Total Cost of Ownership, visit our website www.honeywellprocess.com or contact your Honeywell account manager.

Honeywell Process Solutions
Honeywell
1250 West Sam Houston Parkway South
Houston, TX 77042

Honeywell House, Arlington Business Park
Bracknell, Berkshire, England RG12 1EB UK

Shanghai City Centre, 100 Junyi Road
Shanghai, China 20051

www.honeywellprocess.com