Mohawk Paper’s Beckett mill uses state-of-the-art manufacturing systems to get better control of processes, costs and quality

Bridging the Gap

By MONICA SHAW

Manufacturing systems function as a valuable bridge between floor-level control systems and corporate-level enterprise systems. For Mohawk Fine Papers’ Beckett mill in Hamilton, Ohio, a manufacturing execution system (MES) has been a key tool in streamlining processes, with measurable impact on productivity and production costs.

“Increasing competitive pressure necessitates that we continually enhance our visibility to the factory floor so we can more effectively manage production, sales, planning, purchasing and inventory,” explains Paul Stamas, Mohawk’s vice president of information technology.

Founded in 1848 as Beckett Paper, the Beckett mill has a long history as an operating mill in the US and currently produces 60,000 tons/yr of premium fine papers on three paper machines. It has changed ownership through the years, becoming Hammermill in 1959, International Paper (IP) in 1986 and Mohawk Fine Papers in 2005.
Since becoming Mohawk, the Beckett mill has tightly integrated its mill control systems, manufacturing systems and enterprise business systems (Figure 1). While the mill started integration work as far back as 1998, this activity has expanded since 2005 with support from Mohawk management. Much of the work has focused on the manufacturing systems, which sit in a unique position to influence both financial performance and process improvements, says David Krupp, Mohawk’s manager of enterprise manufacturing systems.

“Mill floor control systems like PLCs and the DCS focus on controlling loops, making good product and other process priorities, while business systems focus on standardizing best practices and business priorities related to the bottom line,” Krupp describes. “By bridging the gap between the two, manufacturing systems allow you to analyze and react to process level issues and trends in a way that adheres to business and financial goals.”

By focusing on integration of systems to better manage, control and optimize manufacturing processes, the Beckett mill has saved millions of dollars and helped improve productivity by 10% since 2005. The mill is using its manufacturing systems to go beyond monitoring downtime and efficiencies into controlling operating variability. Because of the success of this integrated manufacturing systems focus, Mohawk is now implementing the system architecture in a consistent, standardized format at its other operations.

Integration Fills Gaps
The Beckett mill is “heavily automated” at the mill floor level, says Krupp, with programmable logic controllers (PLCs), as well as an ABB online quality control system (QCS) and distributed control system (DCS), both of which were installed in 1992. By 1998, however, the mill determined it needed tools to fill gaps in process management.

In 1998, as part of IP, the Beckett mill installed an OSI PI data historian to collect process data, as well a manufacturing execution system (MES) with modules for efficiency and quality. The MES is Proficy Plant Applications from GE Fanuc Automation, but was formerly known as Mountain Systems GradeBook. In 2004, the Proficy production management module was added.

Interfaced with mill control systems, the PI historian and Proficy MES quickly helped the mill fill in process management gaps. Using the MES quality module, the mill no longer relied on log sheet entries to track quality but could instead depend on the MES to automatically monitor key parameters, providing quality reports and faster correction of problems. Likewise, log sheets were no longer needed for tracking raw materials use because the quality module monitored this as well, leading to less waste.

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Also, the mill began monitoring all aspects of manufacturing with the MES efficiency module, which provides reports on parameters like waste and efficiency while analyzing their root causes. And, the mill started using the production module to oversee operations, including product flow throughout the stock preparation and papermaking process.

With PI and the MES, the Beckett mill could better monitor process and equipment data, control loops and QCS system performance, while also using the systems to automate ABB sensor/lab correlations. The mill also began real-time environmental performance analysis and reporting using PI for tracking and the Proficy MES for contextualizing the data.

Interface Automates Order Execution
Integration of the MES and data historian with control systems went a long way in better managing mill processes, says Krupp, but there were even greater benefits to achieve by streamlining order execution through integrating the MES with the mill’s enterprise resource planning (ERP) systems.

As ERP systems, the Beckett mill uses Greycon’s SPLAN for scheduling and planning and XTrim for trim optimization. For financials and inventory, it uses AS400-based BPCS, or business planning and control system, from Infor. These enterprise systems were installed in 2005 as the mill transitioned from IP to Mohawk ownership.

Also in 2005, Mohawk upgraded to a new version of its MES, Proficy Plant Applications Version 4.0, which expanded
production management functionality. The upgraded MES was interfaced with the ERP systems to execute, track and report production status. The Greycon/Proficy/BPCS integration was accomplished in a three month transition period. The rapid integration of the Beckett mill’s factory floor systems with Mohawk’s enterprise systems “immediately generated significant synergies and manufacturing flexibility,” says Stamas.

Incoming orders are entered into the Greycon SPLAN master schedule, and scheduled orders, along with the trim pattern, are sent to Proficy, which is the only production information system visible on the mill floor. Operators then execute (activate) the orders and the trim patterns in a Proficy schedule, which is part of the production module. If problems are encountered and a retrim is needed, the MES adjusts the trim pattern and communicates this to the ERP system. The active order function then identifies the production (product, etc) and routes it to the next step of the work in progress (WIP) process.

While inventory is actually maintained in BPCS, WIP inventory processing is handled by the MES production module. After rolls are produced, they are labeled and routed into Proficy as WIP inventory. Greycon SPLAN then schedules the WIP for further processing, and the interface communicates the order to the MES, which operators use to process the WIP. The BPCS inventory is then updated through the interface to the MES with the consumed WIP roll and new processed item. In addition, genealogy links are established between the consumed WIP and processed item in Proficy for future quality or other analysis.

Interfaces between the MES and ERP translate into valuable cost information for business level users. For example, the quality module provides information on raw materials use by grade run to BPCS. This allows business users to better understand product costs for grade mix analysis.

The integration model between the ERP, manufacturing and control systems has been a huge success, as evidenced by its roll out to other Mohawk facilities this year. Stamas notes that Mohawk immediately recognized Beckett’s MES as a best-practice and is deploying this model company-wide to “drive higher levels of operational excellence.”

**Broke Reuse Brings Big Benefits**

The Beckett mill has taken further advantage of its interfaced systems with a variety of projects aimed at reducing operating variability (see sidebar), and one of the most beneficial has been broke reuse management. Because the Beckett mill purchases its pulp, optimizing the reuse of broke has had big implications for the bottom line, as well as for quality and adherence to FSC requirements.

Prior to implementing broke reuse management, the mill’s broke manager was tasked with managing large amounts of broke spread through multiple warehouses, manually tracking rolls grouped by characteristics like white and color. Because of the massive amount of broke and the inability to track individual rolls, there were paper machine upsets. For example, depending on what white roll was used for making a particular grade, there could be a huge difference in fluorescence, causing off-quality product, generation of more broke and paper machine shutdown.
Attacking Operating Variability with the MES

Since the successful integration of its business, manufacturing and control systems, Mohawk Fine Papers’ Beckett mill is now analyzing a variety of processes to see where information within the manufacturing execution system (MES) can reduce operating variability and contribute to the bottom line.

The data and trends exposed by the Proficy MES are important not just for real-time process management, but also because of the human element, says David Krupp, Mohawk’s manager of enterprise manufacturing systems, who says the MES has a “behavioral impact” on the mill floor.

“The better information you have, the more you can reinforce the right actions to take,” Krupp explains. “You may have the best control systems in existence, but they still rely on people to run them. With evidence of the right actions in front of operators, you also reduce the variability the human element can bring into the process.”

**Grade-based process management:** With 1,500 grades, the Beckett mill undergoes multiple daily grade changes. Grade-based process management was implemented to provide key operating parameters (KOPs) to operators on successful grade runs so they can use the best settings.

To better manage the process by grade, data from unsuccessful runs is filtered out to provide the KOPs used when the grade run was successful. This provides evidence and a level of comfort for the operators as to the correct parameters needed when embarking on future grade changes to that product.

**Control system target management:** Key control system targets are maintained in Proficy and sent through its interface with the PI data historian to the ABB DCS. For example, Krupp says speed targets in the DCS had been difficult to manage, but now when a grade change is signaled in the MES, the most efficient targets have been collected and analyzed within the MES and are sent to the DCS.

“‘We’ve done this for key parameters with the biggest financial impact on our cost per ton, like speed and ash content,’ Krupp describes. ‘We send those variables to the DCS to help prevent variability from operator-entered targets. Targets are also easier to track and maintain.’

**Activity and grade-based costing applications/optimization:** Krupp says using the MES to analyze this data at the manufacturing systems level has helped identify true costs of key items like ash content. Operators see “cost for running to a specific ash target in real-time, which helps them make better decisions.”

**Energy management:** Energy management is currently under development, and Mohawk sees great potential for managing this critical parameter within the MES. While the Beckett mill has always monitored kilowatts, steam use and costs of certain events like venting steam, it will soon use condition-based modeling to determine what is happening when energy use spikes within various manufacturing processes. This will be a customized solution that uses PI’s historical data within the MES quality and efficiency modules. The mill already tracks steam usage during breaks vs running well, as well as in stock preparation.

**Enterprise Asset Management:** Mohawk recently purchased the Infor Enterprise Asset Management (EAM) system, which will be integrated with its factory floor systems. Paul Stamas, Mohawk’s vice president of information technology, says that the Infor EAM solution will enable Mohawk to optimize the overall operating effectiveness of its manufacturing assets while consuming the lowest possible amount of energy and reducing carbon emissions.

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**Operator KOP display**
Capitalizing on Proficy’s support for building customized manufacturing models, the Beckett mill has created a SQL-based broke reuse management model that combines aspects of Proficy’s production and quality modules, including operator-entered data, with automated data from the PI historian. As rolls come off the reel, operators use lab quality data to flag them as good, broke, hold or rework within the MES.

If flagged as broke, the roll number and associated process and quality data are automatically routed to broke inventory (Figure 2), which is now consolidated at one large warehouse. Recently, efforts have been made to organize this warehouse by roll characteristics like fluorescence, color value and furnish content.

“We are now dealing with a massive broke warehouse with literally thousands of rolls,” Krupp describes. “This is why the Proficy broke management model is so valuable.”

As the paper machine, color control, stock prep and broke managers prepare for runs in the MES schedule, they view a broke report that combines data from the quality and production modules to determine which broke rolls fit the characteristics of the upcoming run (Figure 3). To better match broke to grade in real time, they can also use the PI historian to monitor DCS variables associated with contents of the broke pulpers (Figure 4) and then compare them with the broke report to make informed choices.

After broke rolls are chosen, stock prep operators click and drag the rolls to the appropriate pulper for consumption, which is accomplished using the production module’s genealogy model (Figure 5). By doing so, the roll is automatically removed from broke inventory, updating it in real time.

Proficy’s genealogy model allows managers to track broke rolls that may have caused an upset so that future quality and runnability issues are avoided. It also allows the mills to track and prove adherence to FSC standards, which has been a “huge benefit for FSC reporting,” says Krupp.

“Around 30% of our grades are now FSC, and with our old way of managing broke, we could not have tracked the broke resulting from an FSC run and would have had to use FSC virgin wood pulp,” Krupp describes. “Now, we can track the FSC broke, allowing us to save trees and lower production costs.”

In addition to further enhancing Mohawk’s environmental position by reducing the need for virgin wood pulp, the re-use efficiencies in the broke reuse application have resulted in substantial cost savings for raw materials. In 2006, the Beckett mill saved $750,000, based on 2005 pulp prices, and in 2007 it saved another $1.27 million.

“Our ongoing strategy to unify and standardize our manufacturing systems across the company will enable us to mitigate increasing energy and pulp costs while maintaining our flexibility to provide our customers with superior products and services,” says Stamas.

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FIGURE 4. To match broke to grade in real time, managers and operators use the PI historian to monitor DCS variables associated with broke pulper contents and then compare them with the broke report (Figure 3).

FIGURE 5. Within the MES, stock prep operators simply click and drag the rolls to the appropriate pulper to signal consumption.