Improved performance helps Eastman Kodak Co. stay competitive

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It takes more than a good product to succeed.

Kodak Park's first building, constructed in 1891, on a 16-acre site on the outskirts of Rochester. Today Kodak Park spans 1600 acres, includes more than 200 major manufacturing buildings, and employs approximately 20,000 people.

There's a certain irony to photographic paper: it's a substrate that can convey powerful images yet it gains its special qualities in almost total darkness.

Eastman Kodak Co. in Rochester, NY, has been the world's leading producer of color and black-and-white photo papers since the company began manufacturing there. Separate *flow* organizations are devoted to manufacturing the two distinct product lines. Mini photo labs and large-scale photofinishers comprise 80% of the market.

Gaining this position is no accident, but rather, an acknowledgement that change is inevitable to prosper amid growing competition.

"Back in the 1930s, '40s, and '50s, Kodak really didn't face any strong competition," says Martha H. Sewell, manager, Paper Support Division. "We had excellent technology, and we had most of the market share."

Competition began to emerge in the 1970s. "As the strong competition started, we really had a need to substantially reduce waste and the cost of our products," says Sewell.

In the early 1980s, Kodak began to implement a quality improvement program that would empower its employees by transforming the traditional hierarchical management structure to a flat organization that enabled operators to assume more responsibility and play a greater role in the company's activities.

"Waste reduction and improved machine performance yielded substantial manufacturing cost reductions," Sewell recalls. "This allowed Kodak to be price competitive. There continued to be strong price competition in the marketplace and a need to continue, probably forever on this path of cost reduction and further improvements."

Work systems

Realizing that its employees were critical to the company's competitiveness, Kodak's color and black-and-white paper manufacturing divisions began to flatten their traditional hierarchical organizational structures.

"Five years ago we started talking about high-performance teams and how we could better use our resources," recalls Ellen Warner, color papermaking department manager. "We had a very traditional papermill hierarchy: mill manager, day staff, assistant to the mill manager, shift foreman, machine tender, backtender.

"We followed a strategy that gradually eliminated the foreman positions as individuals retired," Warner says.

The mill is now operated by a machine tender, a chemical mix operator who is responsible for the people who supply the chemicals and the pulp to the machine, and a team leader at the dry end of the machine responsible for product quality and the team that runs both the winder and the testing services.

Since 1989, the mill's four shift teams have worked on 12-hour shifts on a schedule of two days on, 24 hours off, two nights on, four days off. "It's an ideal system for quality of work life," says Warner.

To improve the communication, Warner brought division management and operators closer together. Literally.

"This office used to be on the first floor, at the far end of the building," she says. "When we started to move through the team concept, we moved all of the process engineers who were directly involved with the process and the department manager directly up to the floor. That certainly made the team more cohesive. The manager wasn't a million miles away; the manager was here and able to interact with problems or see people and create a more sharing, two-way communication."

In addition, the division took significant steps to provide educational opportunities. "We've begun a skills enhancement program and started looking at where the base skills are of our workforce.

"We have a very flexible workforce: most people can work four different positions on the shift, so there's a lot of rotation and ownership for the entire process."

Warner notes that although the process has met some resistance at times, overall, "people feel a lot more...control over their own destiny.

"We've had a lot more involvement from the floor in anything from million-dollar capital projects to how we expedite documents to report to the managers.

"We've been able to involve our operators more in capital projects, and get their input up front instead of having to go back and change things later because the engineers didn't see all of the aspects that happen in a day-to-day mode.

"Rather than staff with technicians or entry-level engineers, we have taken people off the operations floor for a year or two years and said, 'these are the kind of training opportunities we will make available'.

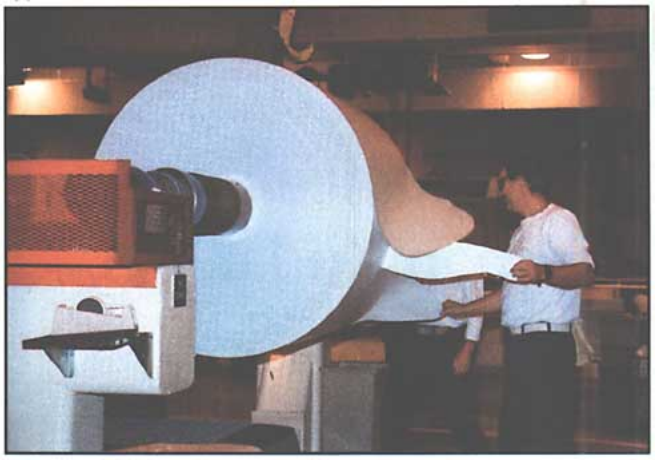
"Our backtender has a special assignment working on ISO 9002 and procedural variance. Ten years ago we would have had an engineer writing procedures for operators, and now we're getting operations people to write their own procedures and to facilitate and manage their peers in getting that work done.

"We also had a focus for the last several years on the relationship between the maintenance groups and the operator groups," says Sewell. "It used to be that they were quite separate, and so the operators would operate the machine and then, if the machine went down the maintenance people would come in and fix it, and the operators would wait and when the machine was ready, they would operate it again.

"Now we've become much more of a total team across those groups so if the machine goes down, it's not only the maintenance people, but also all of the operators now who have picked up some of the more straightforward maintenance capabilities; they can get in there and do a lot of those tasks and really let the maintenance guys focus on where their higher skills are important and where they can contribute value-added.

"We also went to integrated inspection and release of product where we used to have two separate groups: the operators and then the testing people. And we said everybody should be responsible for the quality of the products, so we integrated the testing and operational groups, and they can rotate jobs and really grow. The operators can grow their knowledge of the testing and quality operations and the testers can develop more knowledge about the actual operation.

In the paper coating area, rolls of raw stock are spliced onto the coating machine where the logo, polyethylene layers, and antistatic coating are applied.



"We then began to focus much more on the relationships between our operation and what we call the 'downstream operations' of sensitizing and finishing," says Sewell, "to ensure that the kinds of measures and quality systems that we had in place were really aligned through the whole system."

Sewell also implemented a formal planning and scheduling process, MRP-II, to obtain demand numbers from the customer, "to understand how much paper the customer is going to need in the next week or month or year and ensure that those numbers are consistently used throughout the business," she says. "It ensures that the whole business is integrated."

Setup time critical

Reducing setup time also became a major focus to improve efficiency, according to Sewell, particularly in the division's resin coating area.

Kodak operates on a just-in-time basis that is interdependent with a methodology known as Single Minute Exchange of Dies, or SMED.

"One of the big activities that we have is trying to reduce our setup time because we have so many different setups," says James J. Nelson, color paper coating department manager.

With different basis weights and widths, professional and commercial grades, color and black and white papers, and different logos, Kodak offers more than 130 different products. While product segmentation allows Kodak to penetrate niche markets, reducing setup time is a way to remain competitive.

"SMED activities are modeled after some teachings we learned from Honda," says Nelson.

Chill rolls, used in the coating operation to cool the polyethylene layer and give the paper its glossy, matte, or grain surface, are stored in these containers when they are not in use.

Coated rolls are sensitized in Kodak Park, the company's Colorado Division, or in Brazil or Australia. These rolls, shrink wrapped on pallets, will be sent by rail car to Colorado.

Through SMED, changeovers occur quickly between products so that Kodak can manufacture only as much of a particular product as its customers will need. "This prevents long product runs that tie product up in inventory as stock," says Nelson.

By employing the SMED methodology in the coating area, Nelson has seen some dramatic results. The time required to change the roll width on the coating machine used to take 12 hours; now it takes only four hours to accomplish the same task.

Black-and-white paper manufacturing

John D. Hill, manager of Kodak's black-and-white paper manufacturing unit, and James E. Parkman, manager of the organization, led a restructuring of their group that started in 1989 and nearly paralleled the efforts of Sewell and Warner.

That year, faced with a shrinking overall worldwide market and unacceptable manufacturing costs, Hill and Parkman began to look at the structure of their organization as a critical factor in Kodak's ability to compete in the black-and-white paper market.

By the end of 1990, they had transformed their vertical organization into three smaller sub-businesses: support, sensitizing, and finishing. A fourth group of technicians and engineers would support the three units. Seventy-five percent of the division's supervisors were removed, through retirements and transfers, from the management structure.

When black-and-white manufacturing began to reorganize, there was some resistance from employees. "It was a struggle as people adjusted to the changes," Hill admits. "But there was enough acceptance of the redesign to make it work."

As people began to understand the challenges of the business and realize that they were being given the opportunity to become more involved, acceptance grew rapidly. "People really began to accept the things that we needed to do to accomplish our objectives," Hill notes. "They realized the state of the business and understood that the new system could help us meet the challenges."

It's now frequent for employees to suggest and participate in implementing ideas to improve black-and-white paper manufacturing operations. For example, one team of employees championed the idea of converting an old *mothballed* paper machine to make high-quality pulp from recycled office wastepaper from Kodak's operations. Following the installation of detoning equipment, the operation has been successfully selling the pulp to outside mills that produce high-quality office paper. It has also been aggressively seeking additional office wastepaper sources from outside Kodak.

The coating services program is another employee-driven initiative offered by Kodak to outside companies. "Our increases in productivity and quality have helped make capacity available for high-quality contract manufacturing opportunities," Hill says. "Another employee-driven group has developed a business plan for us to proceed."

Manufacturing photographic paper

"Manufacturing photo base is not really that different from manufacturing other paper grades," says Warner. The process uses standard fourdrinier tables and a standard wet pressing arrangement.

The degree of cleanliness required to produce photographic paper is extremely high. Photographic contamination and dirt can shut the operation down. "Housekeeping has to have a high focus," says Warner.

"Photographic contamination can be anything from chemical radicals in the pulping process to inks used on bale wrappers to plastic materials," notes Warner. "Silicone sprays or oil residue that could be in the raw materials are of a high concern. There are hundreds of materials that are photographically active...and that's what makes the process special. The cleanliness of both our facility and of our raw materials is critical."

By using glass or metal beakers, paper cups, and no straws, the amount of plastic contamination at the mill has dropped significantly, says Warner. As an added measure to eliminate contamina-

tion, the mill's suppliers must comply with formal quality programs.

Raw stock

Kodak purchases all of its pulp. Kraft and sulfite bleached pulp are brought by rail car to a warehouse next to the mill. When needed, bales are brought to the mill, dewired, and mixed in a 2:1 blend of hardwood and softwood in a hydropulper. Some eucalyptus pulp is used. The pulp is pumped from the hydropulper into a blend chest for further mixing, then into a hydraulically controlled headbox. Diffuser tubes provide appropriate velocity control for the pulp as it is dispersed on the wire.

Built in 1962, the Beloit paper machine has undergone several rebuilds in its lifetime to keep it competitive with other mills making photographic grades. The 156 in. machine, which produces raw stock for color photographic products, can run in excess of 1100 ft./min. Kodak also has two other paper machines that produce raw stock for black-and-white products.

Computer process control systems monitor key parameters. "If there's an upset at the wet end, this system can catch it," says Mike Graham, paper machine backtender.

Dryers apply a maximum of 100-lb steam pressure to the sheet's surface. The dryer cans are stainless steel nickel coated.

A touch screen process control system controls all processes and can show hourly and historical trends.

The raw stock is calendered, wound onto rolls, and transported to the color paper coating building via automatic guided vehicles.

Paper coating

"Black-and-white paper and color paper coating processes are essentially the same," says James J. Nelson, color paper coating department manager (**Fig. 1**).

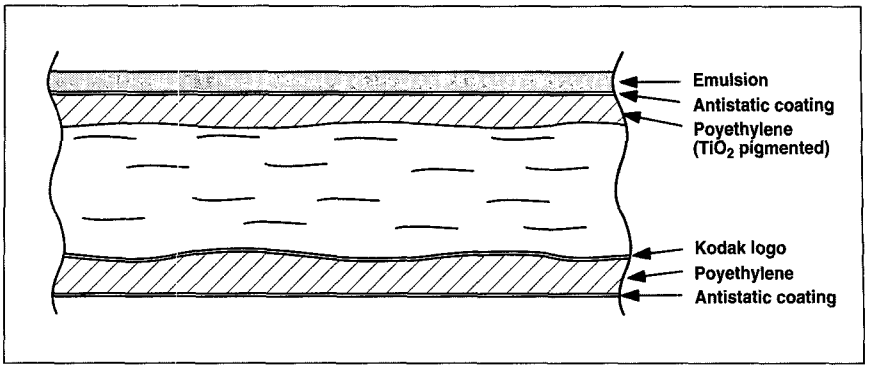
"The first thing we do is put the logo down on the raw stock," says Nelson. There are five photographic logos. The logos vary depending on the paper usage (professional or commercial), the finish, and its destination.

After the logo, a resin-coated polyethylene layer is applied to both sides of the sheet. The polyethylene comes in to the mill as a pellet. The pellet is melted at approximately 625°F and extruded through a thin slot die at high speed. "You need to run it that hot to get it to stick to the paper," says Nelson. It functions as a waterproofing layer. It also provides curl control through its thickness and density. Over the resin layer an antistatic coating is applied to provide static protection as paper passes through subsequent operations.

The emulsion coating and finishing areas operate at high speeds. "If they get any static discharges, that produces light, and light would fog the emulsion," Nelson points out.

The polyethylene on the front side of the sheet is pigmented with titanium dioxide to improve image sharpness and the whiteness of the final print.

1. During the coating process, several layers are applied to the raw stock.



Corona discharge treatment (CDT) units are high-voltage units that promote hydrogen-to-hydrogen bonding between the hydrogen from the polyethylene and the hydrogen from the cellulose by oxidizing the surface of the cellulose.

There are three CDT units on the coating machine: the first promotes adhesion of the polyethylene to one side the raw stock, the second promotes adhesion of polyethylene to the other side of the raw stock, and the third treats the resin-coated layer to promote the bonding of the antistatic coating. On-machine scanners check for defects in reflective and transmittance in the mill.

Four cameras are also positioned along the coating machine: two check the sheet through transmitted light for defects, the other two look for defects in reflectance. "Most defects see in transmittance are related to the mill; reflectance defects are related to coating operations," says Nelson. "You can discern the type of defects by the type of scanning that's done."

To put a finish on the paper, the sheet passes over a chill roll that casts the paper's surface as it cools the liquid polyethylene. The paper surface—glossy, matte, or grain—is determined by the type of impressions in the chill roll.

The extruders can accommodate sheets from 41 to 86 in. widths. After the paper is wound on a roll, it is sent to Color Paper Manufacturing in Kodak Park, Kodak Colorado, Kodak Brazil, and Kodak Australia. Each plant deals with specific widths.

Four crews of three teams each work in the coating area: two operate the two coating machines, the third handles and ships the rolls to be sensitized.

Sensitizing

Under safelights, silver salts are combined with a gelatin base in a batch process. The moment these elements are combined, the mixture becomes light sensitive. Every step after this point is performed under safelight conditions.

Emulsion is prepared in a kettle through a computer-controlled process shortly before it will be needed. After the emulsion is made, it is stored in containers in cold storage. When it is time to apply the emulsion to the paper, the mixture is liquified and pumped through a delivery system and deaeration devices to a hopper one floor below.

The mixture is applied to the paper in a coating process as the sheet passes underneath the hopper. The coated paper is pulled through dozens of rows of chilled rolls and dryers that run the length of both sides of a 100-ft room. The coated paper is then wound on rolls and shipped through a safelight-lit tunnel to the finishing and converting area.

Finishing and converting

In the finishing and converting area, the paper is packaged to customer specifications in many sizes and quantities. Self-directed work teams work in near darkness cutting, bagging, and boxing the paper. Team members work briskly, accustomed to an environment where their work is accomplished primarily through their tactile senses.

The boxed product is palletized and shipped to distribution centers or directly to customers. TJ

***Clites is associate editor of* Tappi Journal.**