INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Papermaking Process Control
Type of Industry	Kraft Paper Manufacturer
Name of User	Cellulose du Pin Facture, France
Equipment Used	IBM 1710 Computer Control System

Synopsis

Every day, the most powerful papermaking machine in the six European Common Market countries, a 400-foot long Beloit unit, turns out an average of 235 tons of kraft paper at the Facture, France, Cellulose du Pin plant, the Common Market's largest kraft mill. The whole of the machine's daily output is produced under constant closed loop control of an IBM 1710 computer control system, the first 1710 system to be used by a European paper maker. Its use, management reports, has substantially improved quality control and productivity for the plant which accounts for about 40 percent of French kraft production.

The 1710 system monitors the readings of 60 electronic and pneumatic input devices located along the paper machine's 400-foot length. These analog devices report such physical characteristics as cylinder surface temperature and pressure and paper stock flow rate and density. The 1710 compares the readings with previously established limits stored in the computer's memory. Whenever there are divergencies, the central computer, an IBM 1620 processor, issues corrective instructions to the Beloit unit through four analog output units.

Computer control has permitted greater operating speeds. A 12-1/2 percent increase in productivity has thus occurred since the rate of paper flow has been speeded up from 1,300 to 1,475 feet per minute (400 to 450 meters). Other savings are being achieved through a rational trimming program to minimize trimming waste incurred when master rolls are cut to meet customer specifications. Orders will be rescheduled to create a production job mix efficient enough to reduce trimming waste to one percent of production.

Most important, however, according to management, is the more scientific, methodical approach to papermaking the plant can take now that product standardization has been improved and differences in the quality of paper produced by different shifts have been eliminated.

Paper mills, like other continuous process plants, are characterized by large capital investments in processes in which relatively small increases in efficiency can yield great improvements in production and product quality.

At the Facture, France, kraft paper plant of Cellulose du Pin, an IBM 1710 control system has achieved substantial production efficiencies. Through a closed-loop operation, delicately instrumented sensors automatically report discrepancies occurring at any stage of production to the central computer. The 1710 processes this data and makes basic operating adjustments to the block long papermaking machine under its control.

Built as a fully integrated production facility, the Facture plant started production in 1928. It is the largest of the seven paper mills owned by Cellulose du Pin, an $80 million-a-year subsidiary of Compagnie de St. Gobain, one of Europe's largest and most highly diversified corporations.

The plant produces approximately 440 tons (400 metric tons) of kraft paper daily, 355 days a year. This represents about 40 percent of French production, making Facture the biggest kraft mill in the six Common Market countries.

Facture's raw materials requirements are supplied from the surrounding Landes de Gascogne. This region of Southwestern France is a dense pine forest covering 2.5 million acres of sandy dunes stretching for 150 miles down the Atlantic coast to the Spanish frontier. It has become a gigantic rationally exploited plantation, producing over eight million cubic feet (2.5 million cubic meters) of wood a year to supply many local saw mills and five pulp and paper mills. Of the latter, four are owned by Cellulose du Pin, three produce kraft and the fourth makes cellulose for writing paper and as a synthetic fabric base.

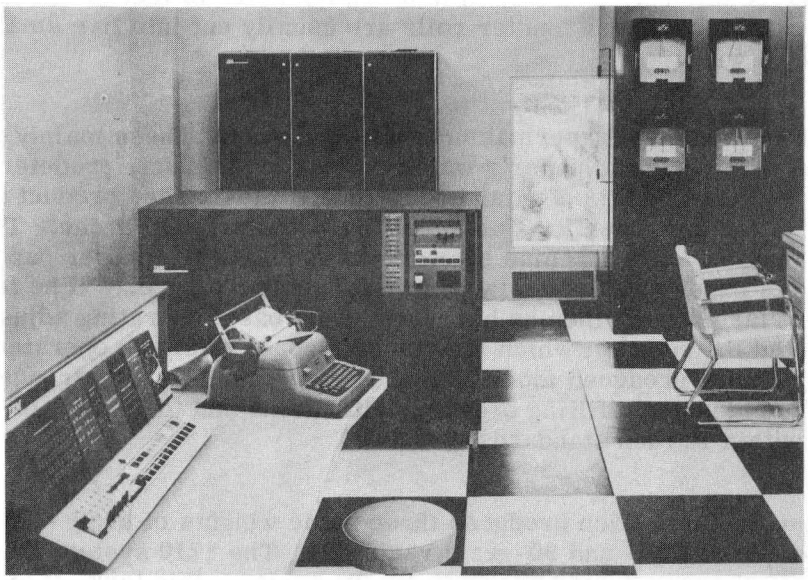
The Facture plant, located at the intersection of two railroad lines and two major highways, is the Landes' chief customer, receiving about one sixth of the yearly crop at the rate of 9,900 tons (9,000 metric) of pine logs and saw mill waste a week.

Equipment and Background

Facture's IBM 1710 system controls the largest of the mill's three papermaking machines, a 400-foot long Beloit unit built in Italy under U.S. license. It is the largest kraft papermaking machine in the Common Market countries. This computer application marked the first time that a 1710 system was used in Europe for control of a papermaking machine.

The 1710 system is built around a central IBM 1620 processor with a 20K memory. Its configuration includes an IBM 1711 analog-to-digital converter, a 1712 multiplex and terminal switching unit, a 1311 disc file, a card read-punch and a console typewriter for direct communications between the computer and the operator. The serial input-output channel is linked to two IBM 1717 typewriters on the plant floor.

Implementation of the closed-loop operation followed a gradual and carefully considered schedule requiring close cooperation between the manufacturer and Cellulose du Pin. Thus, as soon as the order had been placed for the 1710 system, IBM-France programers and analysts began a study of the tasks which the 1710 would perform, and they designed a series of suitable master programs. Among them is a master procedure, governing the operation of the subsystems which coordinate analog/digital measurements from 60 input points. IBM programers also helped train the plant's programing staff and assisted it in designing new procedures.



IBM 1710 PROCESS CONTROL SYSTEM which supervises papermaking at Cellulose du Pin's Facture plant, is centered around an IBM 1620 COMPUTER (console at left). Unit at right of window is a French-made analog signal indicator which continuously feeds the computer production line data.

Facture's staff of two operators/programers was chosen from among plant personnel and received its first training in an IBM school. It is supervised by Bernard Farbos, head of the instrumentation section of the Quality Control Div. This division has administrative control of the 1710 installation and its head, Andre Legrand, accounts for its operations to the chief engineer and through him to Jean Reymond, the plant manager.

For a year after it was installed, the 1710 was run on an open loop basis. Corrective instructions issuing from the computer were implemented on the plant floor by shift foremen who turned the actual valves and performed other required physical actions.

Today, there is an electronic hand at the valve wheel, actuated by signals from the 1710. Even if no action need be taken, the 1710 is still programed to report fully on its monitoring activities. Every five minutes, therefore, a summary of production parameters for that period is printed as one line of a summary report of daily production conditions. This report is available for management attention early the next morning. Another daily report indicates steam and kraft stock consumption for each of the 13-ton master rolls produced at average intervals of one hour and 20 minutes during the plant's 24-hour workday.

The Papermaking Control System

A fully integrated facility, the Facture plant is concerned with all stages of papermaking. These begin with cutting incoming pine logs and the chemical digestion of the resulting wood chips

to create kraft paper stock. The stock is made of small cellulose fibers which are ejected as a flat liquid sheet on the belt of the papermaking machine.

At this stage, where papermaking actually begins, so do its uncertainties. The Facture plant's Beloit machine is actually a block long drying unit. The 99 percent liquid kraft stock ejected from the head box is first conveyed over a bronze mesh belt for drainage. It is then processed through two series of presses and through a series of steam-heated cylinders. These operations down the machine's 400-foot length take place within a cycle time of less than one minute. Finished paper is automatically reeled into master rolls 18 feet (5-1/2 meters) wide and weighing 14.5 tons (13 metric). These master rolls are usually cut into five smaller rolls, each about 3-1/4 feet (1 meter) wide.

The 1710's task is to control papermaking's uncertainties. These mainly stem from the difficulties encountered in keeping the paper's water content to an exact, predetermined level at each stage of production. This task is of vital importance if the finished product is to have the same weight and possess the same qualities as specified in the original order. Traditionally, its success depended on the ability of a machine operator to establish the proper paper "freeness" as he watched the mixture of paper and fiber flow past him "along the wire." If he felt that the water travelled too far, or not far enough, then he hurriedly made basic operating adjustments. This method, however, limited the speed at which the machine could safely be operated. Also, manufacturers, particularly if they produced more than one basic paper weight, frequently used more stock than required to avoid underfulfilling order specifications and to be sure of keeping the paper's water content within French standards.

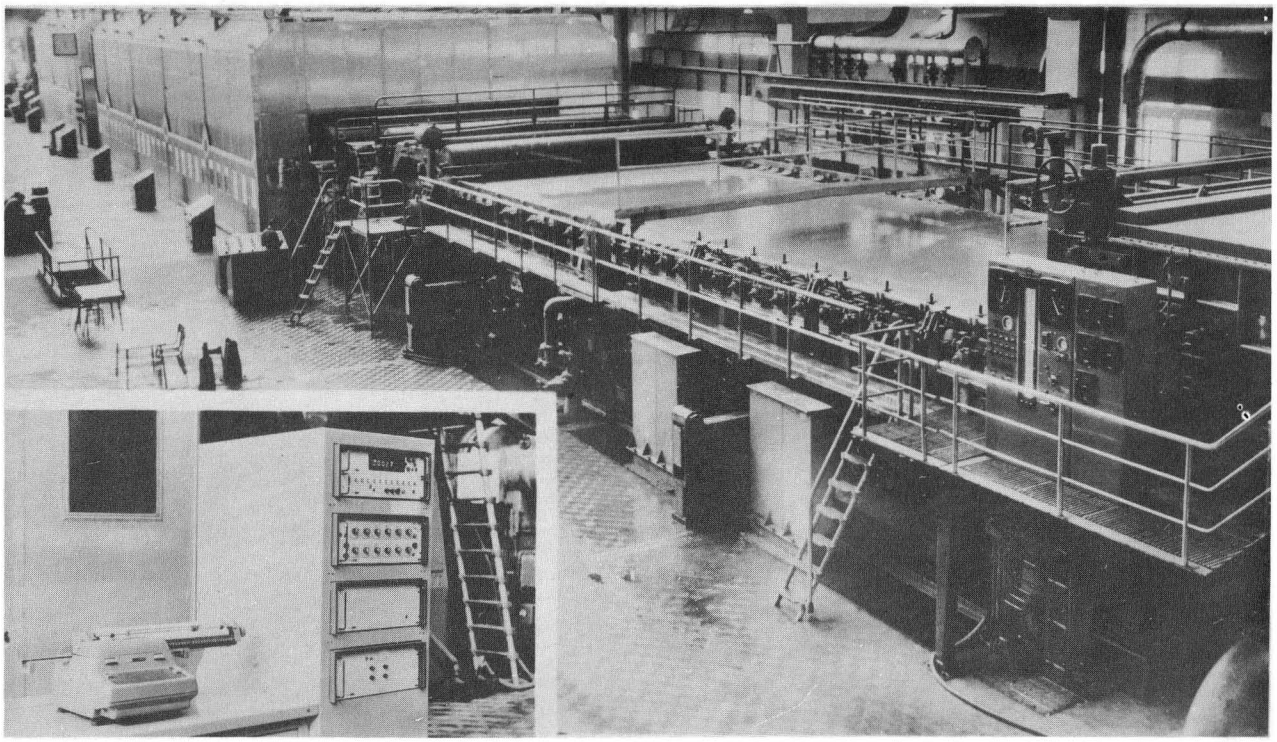
This held true at Facture which produces three basic weights of kraft -- the most commonly used 70-gram weight and 80- and 90-gram varieties. The 1710 system was installed to control the water content of paper during production. To perform this task, it monitors the readings of 60 electronic and pneumatic analog input devices located along the papermaking machine at every processing point between the head box and the reel winder. These analog devices read such physical parameters as cylinder surface temperature and pressure and paper stock flow rate and density. Whenever there are divergencies in the paper's water content, this information permits the central computer to issue corrective instructions to the Beloit machine through four analog output points. In addition, these instructions are reported to plant floor personnel through the two IBM 1717 output typewriters. Information can also be entered manually into the 1710 system from the plant floor by means of entry switches on the display consoles located beside the typewriters.

Results and Future Plans

The benefits of continuous process control have been swiftly apparent, reports Reymond. Most important, he says, is the more scientific, methodical approach to papermaking which the plant can now take. Cellulose du Pin salesmen can always count on marketing highly standardized products, making for greatly improved customer relations. Its impact on manufacturing operation has also been substantial. There, computer control has erased the difference in paper quality that sometimes occurred as one of the three eight-hour shifts that operates the papermaking machine around the clock was replaced by another.

Similarly, the centralized information handled by the 1710 and its prompt reaction to this data have facilitated greater operating speeds. Facture engineers have made successful use of the IBM equipment to raise the rate of paper stock flow from 1,300 to 1,475 feet (500 to 450 meters) a minute, a 12-1/2 percent increase in productivity.

This greater productivity is accompanied by increased economy. Great savings in paper stock have been realized as the need for excessive consumption to overfulfill specifications no longer exists. These savings for the first six months of the system's operations exceeded rental cost for that period.



SIXTY ELECTRONIC AND PNEUMATIC COMPUTER INPUT DEVICES are located down the Beloit papermaking machine's 400-foot length. IBM 1717 OUTPUT TYPEWRITERS (see inset) report all 1710 corrective actions to plant floor personnel. Information can be entered manually from plant floor through switch-controlled console, beside typewriter.

Other savings are being achieved through a recently designed rational trimming program. Its purpose is to sort production orders so as to minimize trimming waste incurred when master rolls are cut to meet customer specifications. Under the program, orders are rescheduled to create a production job mix sufficiently harmonious that trimming waste is expected to be reduced by more than one percent production. Thanks to the 1710's simultaneity features, this auxiliary program is run while master routines are also being handled.

These programs may later be applied to one of the two other papermaking machines (one of French, the other of Canadian manufacture) which are not now included in the process control system. Another application may include control of the continuous wood digestion process. There, however, the parameters to be measured must still be established and standardized by Facture's testing laboratory. Its technicians have actively sought to meet the plant's needs for more accurate technical standards, even designing new instruments for that purpose when they were unavailable from commercial sources. These devices include one to measure paper viscosity in relation to its organic content and the length of its cellulose fibers. Also being sought is a means of measuring the water content of paper and the drainage rate through the whole cycle of paper production.

For the more distant future, as the plant's needs continue to expand, consideration is being given to the eventual use of a larger or an additional EDP system to handle payroll, inventory and sales control and other office functions. Connection of data transmission equipment to this system would also permit centralized production of technical summary reports for all Cellulose du Pin plants throughout France. In addition, new orders could be processed and allocated for execution at the most efficient production locations for each job.