

# INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

**Applications** Job Order Scheduling  
Production Data Collection

**Type of Industry** Manufacturer of Textile Machinery

**Name of User** Textile Machine Works Co.  
Reading, Pa.

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**Equipment Used** IBM 1401 Data Processing System  
IBM 1405 Disc Storage Unit  
IBM 1030 Data Collection System

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## Synopsis

Textile Machine Works of Reading, Pa. utilizes an IBM system consisting of a 1401 computer, a 1405 Disc Storage Unit and a 1030 Data Collection System to schedule and control approximately 16,000 different jobs that may be in production in the company's plant at any one time. Nineteen input terminals located throughout the factory are equipped to read prepunched cards which acknowledge the location and status of each job. The computer processes the output of the collection units, updates the shop order file maintained in a disc storage unit, and prints out a daily shop schedule for all departments involved.

Scheduling begins with the initiation of a shop order on which is listed the "wanted" date. Using this date as a target, individual operation start dates are scheduled backwards. Production data collected by the 1030 units are processed through the computer several times daily to update the shop order file so that inquiries regarding the location and/or status of any order may be answered quickly. In addition, the computer determines priorities for each job based on its "on-schedule" status and produces daily shop schedules on the basis of these priorities.

Scheduling and controlling the production of a broad product mix, including complex components for proprietary machines as well as equipment manufactured for contract customers, holds great potential for confusion. Keeping track of approximately 16,000 jobs of widely varying lot sizes, which are in production at any one time, can complicate the problem even further. These problems are being solved at Textile Machine Works Co. in Reading, Pa., through the use of an IBM 1030 data collection system linked to an IBM 1401 data processing system.

Textile Machine Works Co. manufactures a wide range of knitting and braiding machinery and auxiliary equipment for the textile industry. Many of these are so intricate that they are practically custom made. In addition, the company does contract manufacturing of various components and devices for civilian and military use, including weaponry, machine tools and business machines.

The company's main facility in Reading has well over a million square feet of manufacturing space and employs nearly 4,000, of which about half are direct, productive labor. Inventory consists of some 70,000 items, 35 percent of which are purchased. There are about 40,000 routines and an equal number of bills of material, averaging seven assembly levels.

Implementing the scheduling system has enabled Textile Machine Works Co. to maintain close control over all work in progress, to provide foremen with daily shop schedules which indicate up-to-date priorities and to reschedule shop orders within 24 hours. In addition, the system eliminates the need for scheduling information on outstanding shop orders on paper, keeps down dispatching/expediting expense and minimizes work-in-process inventory investment. Reports emanating from the system aid management in both capacity planning and control over the shop's performance compared to the schedule.

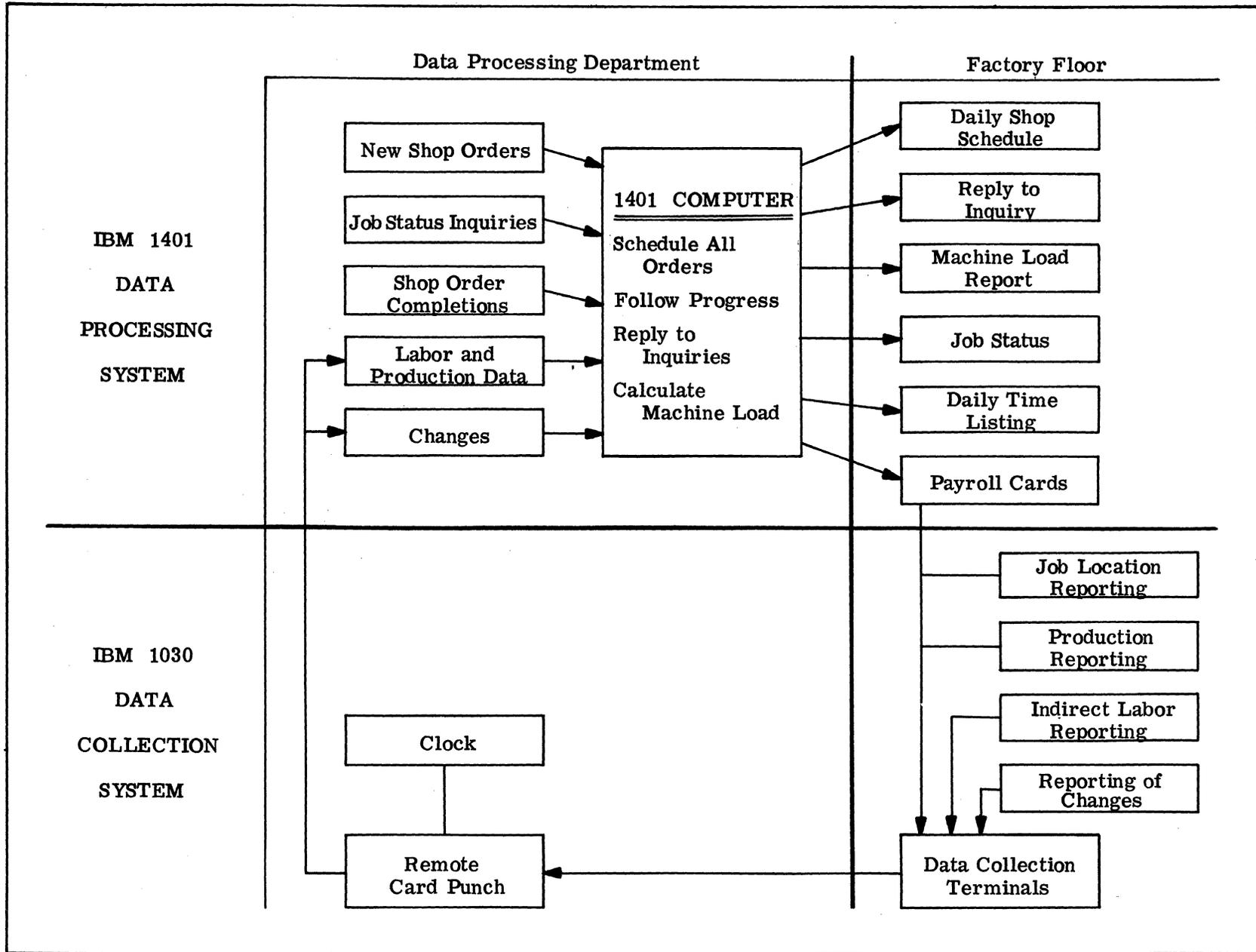
#### Job Scheduling System

Textile Machine Works' shop order file is maintained on IBM 1405 disc storage unit which is updated several times each day by processing the production feedback collected by the 1030 data collection system. This file constitutes the basis for the shop scheduling system.

The scheduling, based on realistic machine shift capacity, begins with the initiation of a shop order. For a given order, individual operation start dates are scheduled backwards from the assigned order completion date. Standard hours of setup and production time, adjusted by a historical efficiency factor, add up to net fabrication time. Added to this are transit allowances of two days between departments and one day between different machines within a department.

As production progresses, priority designations are computed daily so that any job which is behind can be brought up to schedule. The individual jobs listed on the schedule show only these relative priority designations.

A shop order is initiated by a planner in the inventory control department. The planner requests a specific quantity of a part number, assigns the shop order number and indicates the "wanted"



1401 COMPUTER SYSTEM AT TEXTILE MACHINE WORKS CO.

date. Through a traveling manual record, the request is conveyed to the manufacturing engineering department which releases an up-to-date operation record, or route sheet. The operation record which lists operation descriptions, is routed to the data processing department. There a single cost card showing part number and the variable shop order information is keypunched.

These cost cards are processed on the computer against the master labor tape which contains a file of abbreviated operation records, including setup and production standards. The computer calculates the scheduled start date, sets up a shop order record on the disc file, and prints out a job status record. This record is forwarded to the timekeeping section where it serves as a shop order control.

The original cost card, with scheduled start date entered, is then used to produce a material transfer card. This card is forwarded to the department that will perform the last operation, and will accompany the finished part to the stockroom where it will serve to report receipt and to close out the order. This is accomplished by removing the record from the disc file.

The cost card, along with two copies of the operation record, are returned to the inventory control area to await receipt of raw material. When the material is received, the order is released to the shop. One copy of the operation record will be used for shop routing; the other, for dispatcher's control.

#### Job Location and Production Reporting

Ten days before a job is expected to reach a particular department, the 1401 automatically prepares a payroll card, or labor ticket. Forwarded to the department dispatcher, this card is used to report back to the computer the current location and status of work in process. When the job physically arrives in the department, the information contained on the card is transmitted through one of the input terminals to acknowledge receipt.

The same cards are later used to report production status through the IBM 1030 data collection system. Production is reported by transmitting two cards: the payroll card which identifies the job; and the operator's badge card, which has the operator's clock number, name and department punched in it. The badge card also contains a perforated portion in which the operator records the number of pieces completed by punching out the quantity with a pencil, pen or similar pointed object.

A clock attachment on the remote output punch of the data collection system enables it to punch the time of day into all output cards. The operator reports production at the end of a job or shift. Elapsed time for each job is later computed by the data processing system based on shift start time or the time of completion of the previous job. A supply of prepunched badge cards is available for each worker. A new card is used for each transaction transmitted. The used cards stay in the department to serve as operator receipts as well as for an audit trail. The payroll card can be retransmitted as many times as required, as in the case of partial job completion at the end of a shift.

Down time and indirect labor activities are reported by the employe through the transmission of perforated account number cards in which the account number has been prepunched. The foreman punches in the sub-account or variance code plus hours allowed. The worker punches his clock number. The computer subtracts the allowed indirect time from the computed elapsed job time.

Since the shop order records in the disc file are updated several times a day, the system can be interrogated about the current location and status of any outstanding order. Several periods during

the day, following the processing of each batch of data collection cards, are set aside for inquiry from the various locations on the plant floor. The reply to the inquiry is a printout of the respective shop order record, showing progress to date.

Data processing maintains a record of transactions reported each day by operator clock number and prints out a daily report listing this information for auditing by the respective department foreman.

### Determining Priority; Rescheduling

After the close of the second shift and following the processing of all outstanding transactions, a report of open shop orders is prepared by the computer for examination and rescheduling.

For each order, the computer program recognizes the "first uncompleted" operation and starting with it, will perform two scheduling functions on operations that remain to be performed:

1. Compute a relative priority factor for each operation;
2. Determine projected start dates, by day, for these operations based on the net fabrication time plus transit allowances.

The priority factor is computed by dividing hours of work remaining on the shop order (including transit allowances) into hours left (at 16 hours per day) until the wanted date. For example, if the time remaining amounts to 152 hours and the work plus allowances add up to 160 hours,

$$\frac{152}{160} = 0.95$$

To simplify the interpretation of these ratios, the decimal point is moved two positions to the right. An arbitrary figure of 500 is added to preclude negative values, which would otherwise result whenever a shop order is not completed by the wanted date.

$$\begin{array}{r} 95 \\ + 500 \\ \hline 595 \end{array}$$

A job carrying a 595 rating would have priority over one with 600 because it is slightly behind schedule whereas the latter is exactly on schedule. As all of the priority factors are recalculated every day, the value for a given job keeps dropping, and its relative priority keeps increasing as long as no work is reported against it. The converse is true where work is performed ahead of schedule.

Rescheduling of any shop order is accomplished by merely changing the "wanted" date. The next day the job will have a different priority factor and will automatically take its proper place in the ranking of all jobs.

Based on the priority factors and the projected completion dates, the computer generates, in the form of a printed report, a new shop schedule every day. The schedule shows, by department and work center, all of the jobs with priority ratings of 625 or lower that are either available in the department or are projected to become available through the next two days.

### Weekly Reports

Each week, a load report of all shop orders, whether released to the shop or not, is prepared by the computer. Work load in actual hours is shown by machine center within each department. The capacity for every machine group is included for comparison.

Load hours are given in weekly totals for the next four weeks, in monthly totals for the two months following and in quarterly totals for the remaining quarters of the year.

The system compares load-to-capacity for each period, indicating cumulative over/underload by an ampersand or minus sign, respectively. This indicates to shop managements which capacity requirements must be provided.

### Results and Future Plans

Implementing the scheduling system has enabled Textile Machine Works Co. to cut work-in-process inventory by more than 25 per cent. At the same time, outgoing shipments have nearly doubled, without increasing the number of production control personnel.

In addition, the company is able to maintain close control over all work in progress, so that changes can be implemented quickly and easily. In case of a machine breakdown, for example, jobs can be shifted without jeopardizing later operations or other jobs in process. The company also can budget manpower and machine-loading requirements within the shop to a greater extent, so that low priority jobs can be set aside for slack periods.

Although the computer system is primarily concerned with production control, it also serves in quality control. Information on the amount and type of defects is included on the shop order file and transmitted from an input terminal in the inspection department. Rework orders immediately become part of the daily rescheduling operation.

In the future, Textile Machine Works Co. plans to include purchasing and receiving in the production control system.