

# INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

**Applications:** On-line Order Entry

**Type of Industry:** Finished Goods production, Distribution

**Name of User:** Lamp Division, Westinghouse Electric Corp.  
Bloomfield, New Jersey

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**Equipment Used:** IBM System/360 Model 30, 64K  
35 remote terminals

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## Synopsis

The on-line order entry and processing system that the Lamp Div. of Westinghouse Electric operates via a teleprocessing network of 23 sales/distribution and 12 factory locations. It combines on-line order entry and processing with automated allocation and scheduling of finished-goods inventory and fully automated production planning on a limited scale. Additionally, it provides a message-switching service for the users of the teleprocessing network. The system has eliminated "almost completely," punched card input, according to the division. The group modified the system's available computer memory by eliminating certain instructions not necessary to the operation. Core memory is also partitioned to serve the disc operating system, the message traffic requirements and the regular processing chores. The division has calculated that the system is saving some \$50,000 in order processing costs and \$12,000 in communications costs per year.

### Background to the system

The Lamp Division of Westinghouse Electric Corp. designed its computer system to automatically allocate and schedule the movement of finished goods inventory from manufacturing locations to distribution warehouses in the field. The Lamp Div. has combined on-line order entry and processing along with the automated allocation and scheduling functions. In addition, the system provides a message-switching service for the users of the teleprocessing network.

### How the system works

System input consists mostly of messages received from the 35 remote Teletype terminals, plus some data entered on-site in punched card form. Terminals are in 23 sales/distribution and 12 factory locations. Messages received include orders, inquiries, unscheduled inventory changes, production reports, shipment receipts, and miscellaneous data pertinent to maintaining the basic files on customers, shipping points and manufacturing locations. Inputs entered on site consist of such items as invoice corrections and changes for the files defining products and shipping practices.

The procedure for orders consists of editing the order, deciding whether to ship the goods or backorder, assigning the order to the appropriate shipping point, working out the pricing, generating and transmitting detailed shipping instructions and bills of lading (except routing information to the assigned shipping point).

System operation, from an observer's point of view, is fairly straight forward. Orders arrive at one of the Westinghouse customer sales offices. There, the order is edited by a clerk and typed on a Friden Flex-o-writer, which produces a punched paper tape. This punched paper tape is transmitted, several times a day, to headquarters in Bloomfield, N.J., by a Teletype 83B3 Model 28 unit, over leased lines.

It is received by an IBM 2702 terminal, part of the IBM System/360 Model 30. The order enters and is processed in core, and inventory is automatically updated in one of the seven associated disc files, which contain product, customer and shipping information. The customer and shipping information is extracted, and via the same path, a bill of lading and shipping papers are transmitted back to either the field or factory warehouse, whichever is involved. The turnaround time is from 3 to 5 seconds through 10 to 15 minutes, depending on the system load. A customer invoice is generated simultaneously with the other processing functions, printed out at the Bloomfield headquarters, and mailed to customers from there.

All the terminals in the system are Teletype 83B3 Model 28 send-receive sets. In out-of-stock situations, Bloomfield advises the sending office that the merchandise is not available, and the order is held for a certain time, and then retransmitted.

The originating sales office must be notified of any complications (backorder or shipment from a warehouse other than the local one associated with the sales office), and writing a full description of the order and its status on a tape file that is used later to generate invoices and a master-order file.

The procedure is varied accordingly for special situations. For example, the customer-service people may be authorized to specify the shipping point on a particular order. Another special situation is an order for a product that is not stocked and must be delivered by a specific date. This type of order will be scheduled through the production and shipping cycles and stored in a special-order file for periodic follow-up.

The 360/30 handling the on-line order entry system is totally dedicated; that is, the system does virtually nothing else. "We don't even have an operator for it," explains Frank H. Muns, manager, business systems. "An operator for another machine (another Model 30) which processes payrolls, cost accounting, production scheduling and other similar jobs, looks at it periodically, but that's all."

#### File Maintenance

The complementary function to order processing is file maintenance. Files on inventory, customers, and shipments in transit are updated as orders are processed and as messages concerning unscheduled stock transactions, orders shipped, shipments received, and new production available for shipment are received by the system. The file-maintenance function also includes the computation and recording of costs.

The on-line functions of the system are rounded out with inquiry response and a number of housekeeping tasks. The system responds to inquiries about stock availability, order status, and the status of shipments scheduled between factory and distribution warehouses. Customer-service people can use this facility to check stock availability not only in their local warehouse but also in two other warehouses that have been designated as alternative shipping points for their particular distribution areas.

The housekeeping functions consist of monitoring the progress of special orders, processing invoice corrections and processing changes to basic customer, product and shipping-practices data.

#### Off-Line Functions

The system also performs a number of important functions that do not involve the on-line teleprocessing network. The two most advanced are allocation of finished-goods inventory among distribution centers and production planning.

The allocation of finished-goods inventory integrates the order processing and inventory control operations. It is done with a mathematical model designed to minimize the division's shipping and inventory costs within the constraint imposed by customer service standards. The model first works out monthly forecasts of the shipping rate per item per warehouse, and then makes the necessary allocations within the context of the lead time between placing an order on a factory and having stock available in the warehouse for shipment, optimum shipping weights, optimum production levels per factory and optimum materials-handling rates per factory and warehouse.

Production planning is done by another model that closes the loop on the production-inventory-sales cycle by generating a detailed 12-month inventory and production plan. This model is being used to plan production for the 400 items in the division's line that account for 50 percent of the dollar sales volume. It will eventually take over the entire production planning job.

The other off-line functions are the generation of invoices and reports. The data base accumulated through the on-line operations of the system also makes possible the generation of a large variety of daily, weekly and monthly reports and analyses. These include sales reports, accounts-receivable reports and weekly inventory and shipping reports. Most of the stock and inventory reports are compiled on an exception basis. Management receives a short critical supply listing; customer service, a lengthy list to be used as a reference tool.

### Tailoring a system

The key to the economic performance of the Lamp Div., according to Business Systems Manager Frank Muns, is keeping central processing unit costs down. The previous system, with off-line order entry, was run on an IBM System/360, Model 30 with a 32K core. The company is still using the 360/30, but with core upgraded to 64K, for the on-line system.

This maneuver was accomplished by reducing core requirements to a minimum for both the communications and the order-processing functions. The CPU operates in a multi-programming mode under the control of the disc operating system (DOS) 360. Core is divided into three partitions: a 10K partition for the DOS supervisor, a 24K foreground partition for a QTAM (Queued Telecommunications Access Method) control program that handles all the message traffic (both that requiring switching and that traffic requiring processing), and a 30K background partition that handles all the processing chores. QTAM provides a high-level, macro-oriented language which controls movement of a single or multiple address message traffic between computer and terminals and between one remote terminal and another, holding messages and queueing them till lines are free. It also directs the flow of messages from terminals to update, inquiry and message processing programs.

While a QTAM message-control program capable of handling both switch and process traffic for a 35-station, 20-line network normally requires a minimum of 30K of core, the division fit it into 24K by eliminating all the macro-instructions that were not considered essential to the application. The group eliminated items such as "time stamp" and "date stamp." Also eliminated were all macro modules that applied to terminals other than the ones the division is using, the Teletype units. And the standard priority system was eliminated and replaced by three separate process queues of different priority for system message, priority orders and regular orders.

The QTAM shutdown procedure was dropped, and it was replaced by a simple routine to reformat and write the contents of the process queues, station queue, and the transmitted-messages log to a storage disc. Thus, data processing can close down the foreground partitions simply by pushing a button.

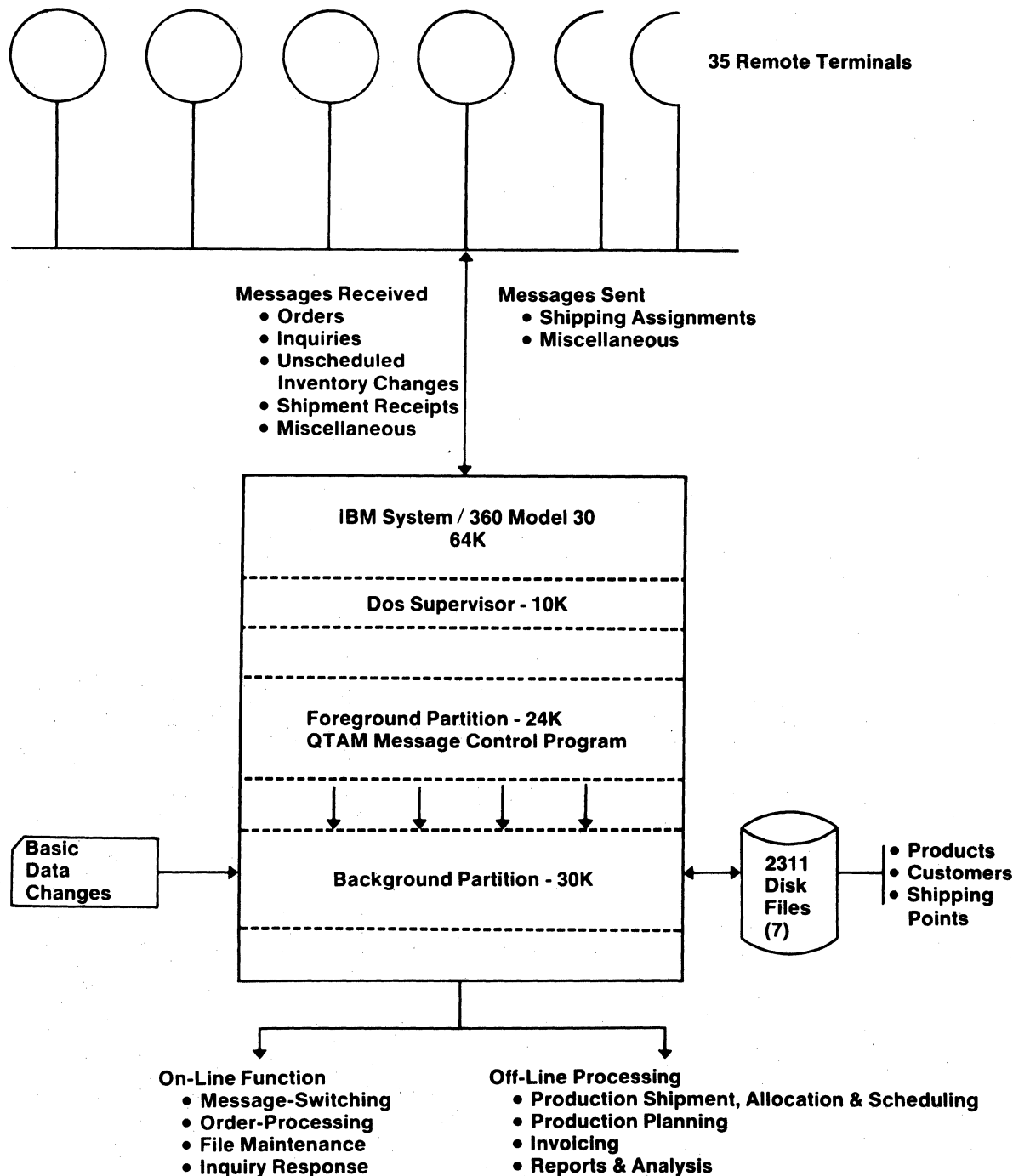
The core requirements for handling the processing functions in the background partition have been reduced to a minimum by organizing all of the job functions as subroutines of the message-processing program. This program analyses each message, determines what processing is required, and overlays, in sequential order, the subroutines that are needed. This approach is a legacy from the 1401 days when the division was processing orders in 16K of core. To keep supervisory overhead to a minimum, each subroutine is treated as a data record rather than a load module; this eliminates the need for a FETCH call for each overlay and reduces I/O times to the 75 milliseconds required to access the disc.

### Results

The most extensive payoff from the system is a shortened control cycle on inventory. "We used to work on a monthly cycle," says Manager Muns, "and even then management didn't really know our position at the end of the month until about three weeks after closing. Now they get a detailed report on our inventory position every Monday morning, and that report accurately reflects the situation as of the close of the business on Friday."

In addition, inventory costs and shipping costs as well, have been reduced by the model that allocates and schedules production shipment to the field warehouses. Payoffs have come in two other more intangible areas. One is pricing, which has been made more accurate. The other is customer service. With the off-line system, it took several hours to get the order into the system and processed. Now, the same function is accomplished in 15 minutes. The

improvement in response time has been particularly important on orders shipped from warehouses other than the primary local one established to serve a distribution area. Orders that couldn't be filled from the local warehouse used to take at least a week to reach the customer. Now they are shipped within 24 hours and reach the customer within two days.



**Figure 1: On-Line Order Entry & Processing System At Westinghouse Lamp Division**

According to the division, the reduction in clerical operations and almost complete elimination of punched card input is saving the division some \$50,000 per year. "We have managed to reduce even our communications costs by \$12,000 per year," adds Muns, though the on-line network contains four more lines than the off-line network. This is because lines have been better planned and some communications equipment at the computer facility has been eliminated

Future plans

The system will next be expanded to cover production. Admittedly, the amount of information that may be loaded into 64K of core is "uncertain." However, the division's limited use of a production-planning model has indicated that there is still potential for savings in both production and inventory. "And we plan to realize this potential as soon as possible," Muns concludes.