A MERCHANDISE CONTROL SYSTEM

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Introduction

Merchandise control operations promise to be benefited by the application of electronic data processing equipment. Such equipment offers a new concept of speed and accuracy in reporting. It makes possible data summaries and analyses which to date have not been economically justifiable.

Inventory control represents one of the most rewarding and interesting problems for which electronic equipment is feasible. Such equipment will reduce the costs of preparing and maintaining inventory records, and will also make it possible to maintain reduced inventory because of the inherent speed of reporting.

Business organizations, in general, operate by purchasing according to predicted needs, performing some operation on the purchased goods (if only sorting and storing) and then distributing it to purchasers. Purchasing is conducted by means of management reports which aid in predicting future needs. This information is usually obtained from the past history of sales records, the current inventory status, or both. In general rapid reporting permits reduced inventory with associated savings by giving a more immediate picture of current status.

Reports on current operations give management the opportunity to monitor the efficiency of their organization. Unfortunately such reports are often voluminous, and the time of high-salaried talent is required to extract the attention-requiring items. The selection of these items can be made by the decision apparatus available in electronic computers. For example, inventory reporting can be reduced to those items which do not fall within an established stock tolerance. Reports on receipts and shortages can be reduced to the data on those vendors which are overdue. Reports on sales can be reduced to those items not meeting the sales rate tolerances set by management, etc. Special treatment can be given certain items as is required.

One of the major items in large scale business operations is the filling of a customer order. In large retail businesses the paperwork for individual customer orders may be processed under one roof at rates around ten orders per second. In chain store operations paperwork resulting from sales may be processed at a central operations location at near the same speed. In one application the central location is a warehouse which uses the sales information coming from the stores to effect restocking of the stores. In such a case the warehouse is filling an order for the individual store.

The number of people required by large organizations for their order-filling operations may vary from under one hundred to many thousands. A good share of these people are entirely concerned with the routine processing of
paperwork. Often the business has grown up in such a manner that stock clerks and sales people are partially occupied with paperwork. By automating the clerical functions the effectiveness and productivity of the personnel can often be increased or, if the volume of work does not warrant, the staff diminished.

Another important inventory application is keeping track of in-process inventory in manufacturing plants. It is important to know the number of acceptable subassemblies and parts in process at each stage of production. Such records can be maintained by electronic equipment.

In actual case studies it is apparent that the application of appropriate electronic equipment will result in large savings in indirect labor in addition to the advantages manifest in faster operations. Through savings in indirect labor such equipment often promises to amortize itself within two years.

To meet the requirements of business organizations several basic functions must be performed. Equipment must be provided to encode the business information into machine language. Means must be provided to enter the encoded information into the system in proper order using it to fill orders, update records, or perform other required functions. Means must be provided to process this summarized data into management reports for purchasing, financial records, and other purposes. Printing facilities are required to prepare the reports. In many cases facility for interrogating the equipment memory for particular information is important.

So-called general purpose electronic computing equipment does not fulfill many of the needs encountered in the operation of large scale business. In particular the instantaneous selection of data regarding any one of a large number of items is beyond the current capabilities of these equipments. To perform this function either the capabilities of the general purpose units must be greatly extended or special purpose equipment must be developed.

Companies designing special purpose equipment to fill these needs are confronted with a serious problem. The many advantages and unique character of electronic data processing equipment indicate that its adoption will cause improvements in the information flow procedures in many businesses. These improvements will suggest changes in business procedures which, in turn, in the course of time may obsolete the special purpose equipment. In order to avoid such obsolescence, the electronic equipment manufacturer is faced with the problem of designing his equipment to accommodate optimum management data processing procedures. Unfortunately, today no one knows these optimum procedures. An expedient solution might be for the equipment manufacturer to utilize operations research methods to design optimum data processing procedures for his prospective client. He must then sell the client on converting his business methods over to these procedures which the equipment can accommodate.

The client, on the other hand, who has presumably operated at a profit in the past, is faced with evaluating this proposed operating method and deciding whether it will effect a savings or, indeed, still permit him to operate at a profit. A mistake on the part of the operations research team could put quite a dent in the promised savings of the new system and apparatus.
A more acceptable and reliable approach to this problem would be to supply equipment that would permit the operating business to utilize electronic data processing techniques in its current data processing system. If the equipment were suitably flexible, an operations research team within the organization, or working in conjunction with the equipment manufacturer, could modify the client's procedures a step at a time, monitoring the effects on the business operation. Thus by an evolutionary rather than a revolutionary approach a more efficient operation could be achieved. The equipment thus grows with the client's procedures. As in general purpose scientific computers, the use of an internally stored modifiable program, together with a set of well-chosen operational commands, should permit this approach to be used. This programming or, in other words, procedural flexibility also permits many types of organizations to use similar equipment.

With this design philosophy in mind hardware is under development. Two computers form the nucleus of a system that will fit many applications. One, called an Inventory Computer, serves the function of entering the input information making preliminary calculations, preliminary summarizing, sorting, and making elementary decisions. The other, the Management Computer, serves the function of updating seasonal records according to the information supplied by the Inventory Computer, performing business-type calculations on the categories being processed and controlling the operation of an associated high-speed printer.

Application of this equipment can best be illustrated by an example of a large scale operation. Although systems have been designed for warehousing and distribution organizations, retail businesses, manufacturing concerns, and others, the case illustrated will be that of a mail order house.

Mail Order Operation

A block diagram of the flow of information in a mail order house operation is shown in Figure 1.

Incoming orders are processed through cash analyzing or credit as appropriate, and then proceed to a ticket-pulling operation. Here paperwork in the form of tickets, preprinted with the appropriate information such as price, weight, and description, is available in racks by catalog number. A clerk processes a given customer order, selecting the appropriate ticket for each catalog number on the order. The tickets are then manually marked for color, size, catalog by which purchased, and quantity. Mailing labels are prepared and the orders are scheduled and stamped with a packer number so that the people who will wrap the orders for mailing are uniformly scheduled. The tickets are then separated from the customer orders, sorted by the various merchandise departments, and dispatched thereto. At each department they are tallied by size, color, and catalog number, flagged if out of stock, and released for stock pulling. Each merchandise item is placed, together with its pull ticket, on a conveyor belt system for transportation to the wrappers. Customer orders are separately routed to the packer. The packer number determines the time and the packer station which is to receive the merchandise and order. The complete order is merged and packed at a packing station. It is then weighed, stamped, the customer billed, and the merchandise shipped. Data gathered at the tally stations serve to prepare management reports on stock condition, sales by item, sales by catalog, etc.
Receiving and transfer information is routed to the tally stations to correct their inventory figure. The same data is also used to prepare reports on purchases, receivals, and shortages.

The tally operation often proves troublesome because of seasonal rushes and the resultant human errors they induce into the system. The speed-tally equipment described in a previous paper ideally suits a situation where it is necessary to replace a tally operation. A logical extension of tally equipment is a system which automates many of the clerical operations concerned with utilizing data such as produced by tally in the control of merchandising. The equipment to be described in the following material is directed toward a large operation requiring high entry rates, complex entry operations, detailed management reports, and preliminary accounting data.

Electronic Control of a Mail Order Operation

The application of electronic equipment to the mail order operation is illustrated in Figure 2. The ticket-pulling and preadjusting functions are replaced with electrical typewriters directly connected through buffer storage facilities to the Inventory Computer. A typewritten form as shown in Figure 3 is prepared at this station, this form replacing the preadjusted pull ticket. The form also provides for an indication as to whether the sale can be made or must be canceled. The top portion of the ticket is manually typed directly from the customer order. The data is accepted by the Inventory Computer which then refers to its memory, looking up description, weight, price, available inventory, and tallies. If stock is available the machine indicates that the item can be sold and corrects inventory and tallies accordingly. Tallies on both sales and cancels are maintained. If the item is out of stock the machine corrects only the cancel tally. The updated tallies and inventory data are replaced in the Inventory Computer memory and the results of the decision, the price extension, and the data looked up are routed back to the buffer and thence to the typewriter. One entire operation of the Inventory Computer is completed in approximately 1/10 of a second. Data on bulk operations involving vendors is entered through typewriter-prepared perforated tape. A complete record of vendor information, including purchase orders, due dates, quantities, and financial data is maintained in the memory. The typewriter-created tickets are now routed through the same operation as the old form of tickets except that no manual tally function is required. A special station at billing serves to correct the computer inventory for those cases where a sell decision is made and no merchandise was found on the shelf. Such a condition can be caused by the usual factors creating shrinkage.

Periodically the contents of the memory are read off onto magnetic tape in ordered form. This tape is fed into the Management Computer, together with a master record tape containing detailed data on every item sold. The master record tape is ordered in the same manner as the updating information on the tape prepared by the Inventory Computer. The updating data, together with the master record tape, is processed by the Management Computer, using a fixed program to create an updated master record tape. No sorting problem is encountered because the data is processed by a preset fixed sort. During the updating operation report data is placed on magnetic tapes controlled by the Management Computer, each report on a separate tape. All output tapes, updated master record, and reports are prepared simultaneously. The report
tapes, which contain information in the correct format sequence for the report, are applied to the printer controller which, via the high-speed printer, prepares the reports.

The Inventory Computer can be interrogated at will for current inventory on any item.

**Equipment**

Merchandise control systems of the type described above fit a wide variety of applications. The chief difference in the equipment to fill these various applications is in the input apparatus. For many types of retail operations perforated tape prepared by a cash register or label reader is more appropriate. Punch card equipment, direct-connected numeric keyboards, or direct-connected label reading devices may be appropriate in other applications. The Inventory and Management Computers, which form the nucleus of the system, should fit any of these systems when suitably programmed.

Medium access large scale memory facilities are a key part of the Inventory Computer. Facilities for handling variable word lengths with no particular requirements on stock number arrangements are fundamental to flexible operation. In one application a memory having an average access time of 25 milliseconds and having storage facilities for $16 \cdot 10^6$ bits is required. Drum equipment currently available could supply this need. Flexible memory addressing requirements are achieved by storing the respective customer number along with each group of data in the memory and selecting the right group of data by achieving comparison with the address number and the number stored in the memory location.

The Management Computer utilizes rapid access memory of a more modest capacity to store its instructions and data. It stores the data on one particular group of information and processes it according to a fixed instruction sequence. In one application 10,000 binary digits of magnetic core memory are required to hold the data, along with an additional 50,000 bits of drum memory to hold instructions. Data is processed on a continuous basis from magnetic tape input to magnetic tape output. Both input and output tapes operate at a maximum rate of approximately 1,000 decimal digits per second. The Management Computer is capable of controlling ten output tapes simultaneously. By means of these auxiliary output tapes the data for different management reports can be separately organized. These tapes can then be detached from the computer and introduced to the printer controller where memory facilities for one complete line of information are provided to operate the printer. The printer controls the operation of the tape, transferring in a line of data at a time. Tape motion is intermittent.

For those applications requiring larger memory capacity with more modest access speed requirements a device is in development capable of storing $50 \cdot 10^6$ bits each with an access time of less than one second. Such a device when coupled with a modest drum memory greatly extends the flexibility of the Inventory Computer.

All of the equipment and techniques used in achieving the computers and systems components described above have been developed and put into use by laboratories throughout the country. The development of the Inventory and Management Computers involve the organization of these components and techniques in a manner which has direct application to inventory type problems.
Fig. 1. A mail order operation
Fig. 2. A merchandising control system
<table>
<thead>
<tr>
<th>SALE</th>
<th>CATALOG #</th>
<th>COLOR</th>
<th>SIZE</th>
<th>EFFORT</th>
<th>QUANTITY</th>
</tr>
</thead>
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<tr>
<td>m</td>
<td>114120</td>
<td>blue-w 97</td>
<td>20</td>
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</table>

<table>
<thead>
<tr>
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<th>DESCRIP.</th>
<th>LOT #1</th>
<th>LOT #2</th>
<th>PRICE</th>
<th>EXTENSION</th>
<th>SALE</th>
<th>BO</th>
<th>CANCEL</th>
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</thead>
<tbody>
<tr>
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<td>dress</td>
<td>00295</td>
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<td>000870</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**COMPANY NAME**

Important: Save this sale slip. Send it to us if you write about this item or return it.

**Fig. 3. Sample input form**

From the collection of the Computer History Museum (www.computerhistory.org)