INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Materials Management
Type of Industry	Telephone Equipment Manufacturer
Name of User	Western Electric Co. North Andover, Mass.

Equipment Used	IBM 7074 Computer System
	IBM System/360 Model 30
	IBM System/360 Model 50

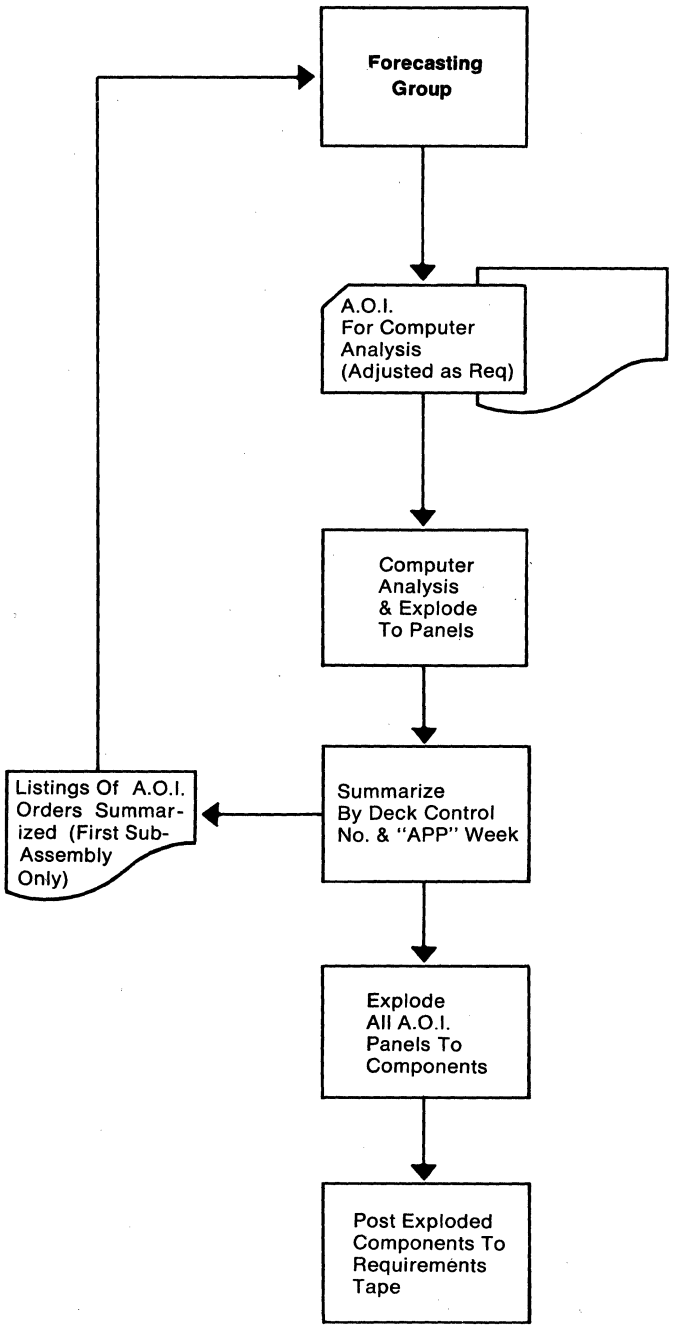
Synopsis

A materials management system at the Merrimack Valley Works of Western Electric Company in North Andover, Mass., dynamically balances an inventory of 82,000 parts against requirements for the assembly of a product line which may have as many as 22,000 variations. Components from inventory supply changeable production schedules for telephone transmission equipment.

The system, which uses an IBM 7074 computer with three IBM System/360 computers serving as input-output devices and for preparing reports, has maintained a 95 percent customer service record while minimizing the need for protective stock margins.

The Merrimack Valley plant of Western Electric produces 12 classes of transmission equipment for the Bell System, each of which is composed of one or more bays of complex panels. The production of components is scheduled within lead time of 26 weeks; equipment is assembled in six levels within a lead time of 15 weeks. In order to minimize inventory levels, materials management requires that schedules be determined at a point which will satisfy the longest lead time. In addition, the scheduling system must have the ability to respond to changing product demand.

PROCESSING ADVANCED ORDER REQUIREMENTS



To accomplish this, the system explodes a 52-week forecast each week, reflecting changing product demand, into a new schedule of component requirements. These requirements are phased, level by level, from delivery data to stockroom due date, at which time it must be available for the next level of production. Hard orders are also reprocessed and rescheduled.

Processing is performed on an IBM 7074 computer. Two System/360 Model 30s and a System/360 Model 50 act as input-output devices and prepare reports.

The system also keeps track of stockroom transactions and open replenishment orders on a daily basis.

Five fundamental rules were established in designing the system.

First, the system employs the management by exception concept. Only out-of-balance stock situations are identified for the stock-maintenance personnel. They do not receive data on normal situations which require no action.

Second, only one man has the responsibility for maintaining the stock of a given item. This means the system has to produce only one copy of requirements and that orders for a given item can come only from one source.

Third, all production is supplied from a centrally located storeroom, and there is no duplication of stock records.

Fourth, all transaction documents to be entered into the system are keypunched in the originating department to eliminate the complex, centralized card punching operation. The responsibility for accuracy is placed on the originating department.

Fifth, the system's recommendations for stock action must be closely followed by production control. This rule is necessary to maintain the system's ability to accurately project requirements from level to level.

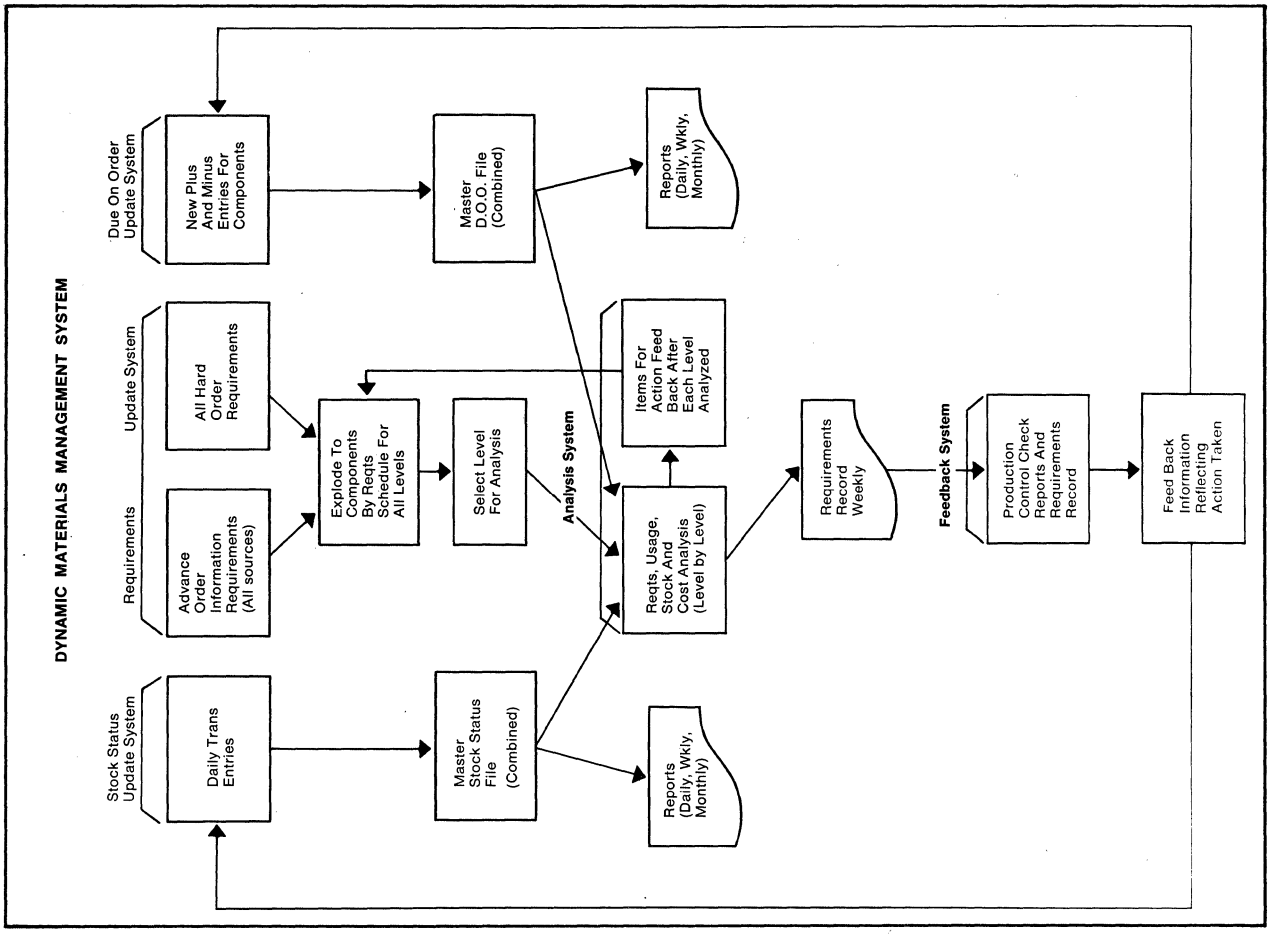
Provisions have been developed, however, to allow production control to handle exception situations.

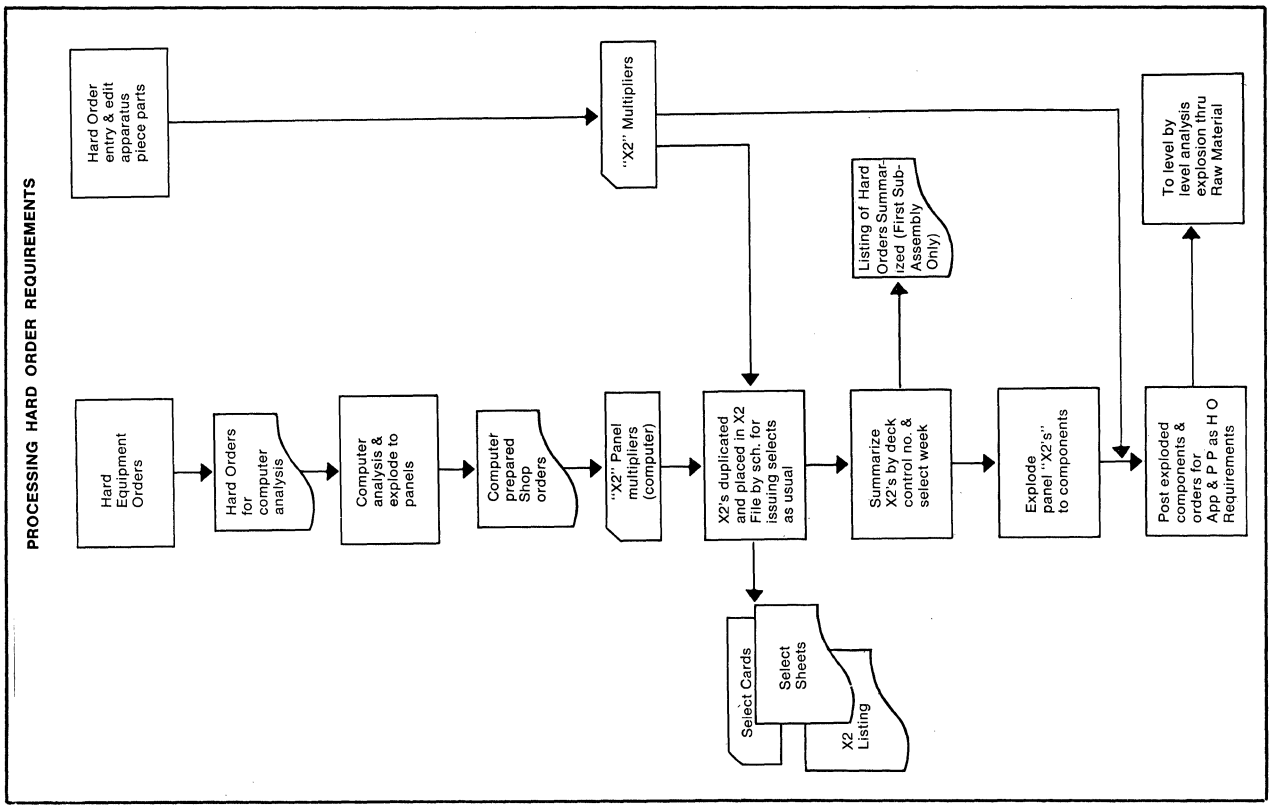
THE SYSTEM

At the end of each week, the system reviews both forecasted and actual requirements at each level of manufacture. Requirements are extracted and exploded from a monthly 52-week forecast of equipment orders. The explosion is to raw-material levels in two stages with the first stage exploding requirements through six levels to the panel assemblies. These assemblies are scheduled by phasing through levels from delivery date to "storeroom-select week." Summarized listings of items in the first subassembly level are prepared which give the forecasting group the requirements implied in the forecasts.

The second-stage explodes panels, down through all component levels to raw materials. These requirements are also scheduled by storeroom-select week. Each component is then entered into a file of advanced order requirements by part number, quantity required, and select week.

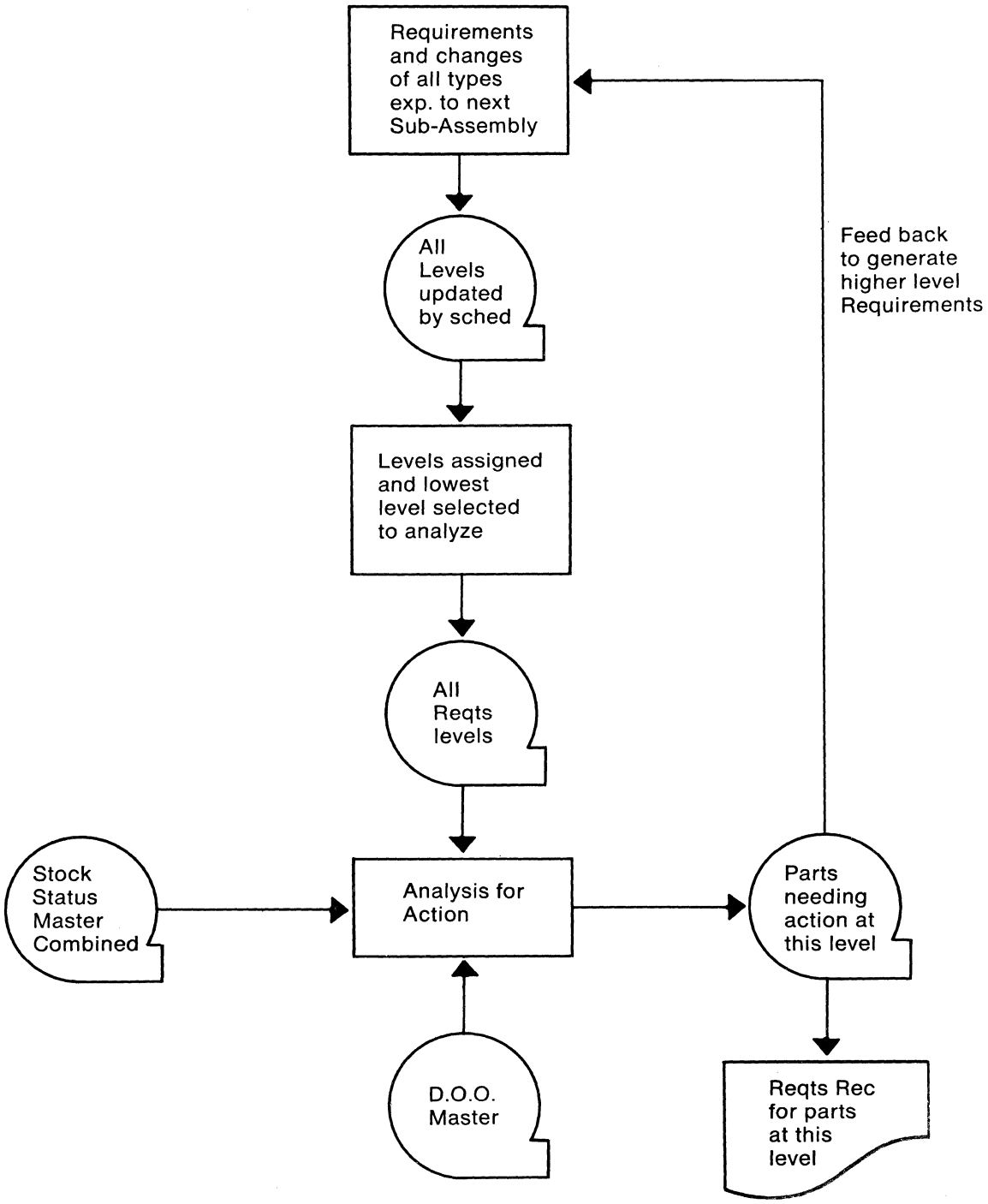
Hard orders which consist of both completed equipment and loose parts are similarly processed each week. Equipment orders are exploded as far as panel requirements to produce listings for the forecasting group. In addition, shop orders are generated and punched cards are prepared indicating the panel requirements. The panel cards are used for processing against the select file, which, in turn, generates storeroom orders for the panel components. Orders for loose panels and parts are also taken into consideration.





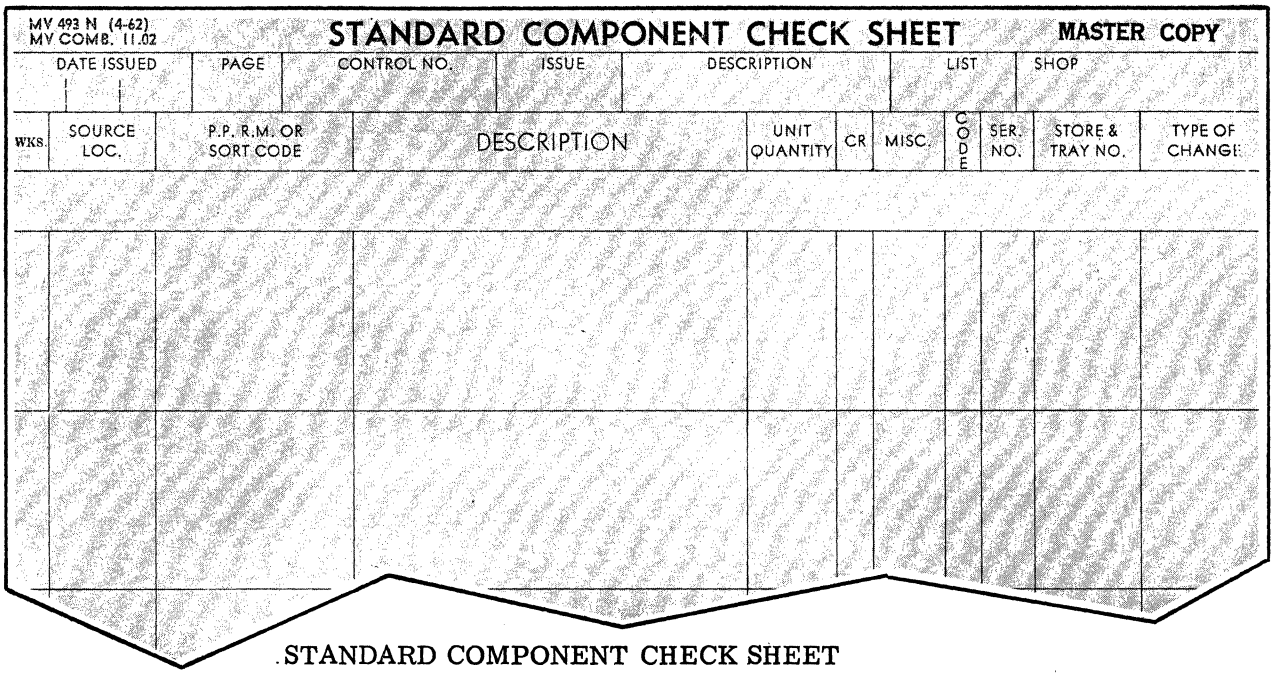
Loose order and equipment order requirements are combined to produce total requirements and are posted by "select week" to a hard order requirements file. This file and another containing forecasted requirements form the requirements input to the weekly analysis.

ANALYSIS PROCESSING



Stock Status Records

Storeroom inventory is updated daily by storeroom transaction cards which are created by the computer during the explosion of requirements. The data in these records enables the computer to generate reports with information such as quantity on hand, transactions, variances between manual and computer inventories, stock-activity levels, piecework hours recovered by the storeroom, rejects, and investment.



MV 493 N (4-62)
MY COMB. 11.02

STANDARD COMPONENT CHECK SHEET

MASTER COPY

DATE ISSUED	PAGE	CONTROL NO.	ISSUE	DESCRIPTION	LIST	SHOP

WKS.	SOURCE LOC.	P.P. R.M. OR SORT CODE	DESCRIPTION	UNIT QUANTITY	CR	MISC.	CODE	SER. NO.	STORE & TRAY NO.	TYPE OF CHANGE

STANDARD COMPONENT CHECK SHEET

Detailed in accounting reports are billings to customers for storeroom supplied items and charges for shop expenses and materials. Data in this master stock status file enables Western Electric to review descriptive and cost information, on-hand quantity, actual usage, and excess usage due to shop breakage or losses. Production orders are maintained on three separate files: one file contains in-house orders; another, orders with outside suppliers; the third, orders with other plants in the company. Order records are created as new orders are processed. These are then updated as work-in-process, reflecting daily production reports. When the storeroom indicates receipt of an order or when outgoing orders pass through inspection, the records are relieved. Records on orders from outside vendors as well as from other plants are updated from original order cards, change cards, closeout cards, and receipt cards.

Reports

A master Due on Order report is created for weekly analysis in addition to reports showing status and replenishment order costs. The key report produced by the system is a weekly requirements record. This is an exception report, listing only those items requiring action. In addition to identifying the exception condition, the report contains the status information which permits production control to evaluate the situation.

Historical summaries of actual usage, excess usage, and forecasted requirements are provided for the past three months and to date in the current month. Forecasted and actual requirements, replenishment orders due, and the amount of stock available are shown by the week for three months into the future and by the quarter for an additional nine months. In addition, a historical variance figure is shown to indicate the number of dropouts to be expected. On the basis of this data, production control personnel can issue orders to correct the out-of-balance situation. These orders are then used to update the system files accordingly.

The requirements report is the product of a weekly level-by-level analysis of current data managed by the system. Recommended action indicated in this report is based on the application of decision rules which check on component requirements, due date, lead time, and the cost of ordering and storing.

MV 493-L (10-61)
MV COMB. 11.03-B

MATERIAL SELECT SHEET

STOCK SELECT A

DELIVER TO	FROM	DATE ISSUED	SEL. SCHD. MO. / WK.	SHIP SCHD. MO. / WK.	EQUIPMENT CONTROL NUMBER	PAGE NO

	SERVICED BY		DESCRIPTION	WEEK NO.

QUANTITY	EQUIP. DRAW. NO. / TEN DIGIT NO.	LIST	EQUIP. ORDER NO. / DESCRIPTION	CARD SEQ.	ITEM NO. WKS.	ITEM NO. LOC.	MISC.	TRAY & STORE	RECEIVED

MATERIAL SELECT SHEET

MV 119-G (5-62)

REQUIREMENT RECORD

PART NO.	TRAY	DESCRIPTION	COST/C	DEN.	CLASS	EXP.	LEV.	CURRENT DATE M.	CURRENT DATE CALENDAR	LAST NOTICE M.	LAST NOTICE CALENDAR	LAST TRANS. M.	LAST TRANS. CALENDAR	LAST INV. M.	LAST INV. CALENDAR	RECEIVALS - USAGE ± MISC. = ON HAND

	ACTUAL USAGE 3RD MO.	2ND MO.	1ST MO.	M.T.D.	AVERAGE	EXCESS USAGE 3RD MO.	2ND MO.	1ST MO.	M.T.D.	AVERAGE	PROGRAM REQUIREMENTS 3RD MO.	2ND MO.	1ST MO.	M.T.D.	AVERAGE	REASONS FOR NOTICE
DATE																
PROGRAM REQUIREMENTS																
ORDER DUE																
HARD ORDER OTHER WORKS																
HARD ORDER PRODUCTION																
BAL. TO BE SEL.																
EXPECTED VAR.																
AVAILABLE																
ACTION																

PROTE STO
STOCK LAST Y.
EXP.

PART NO.	TRAY	DESCRIPTION	COST/C	DEN.	CLASS	EXP.	LEV.	CURRENT DATE M.	CURRENT DATE CALENDAR	LAST NOTICE M.	LAST NOTICE CALENDAR	LAST TRANS. M.	LAST TRANS. CALENDAR	LAST INV. M.	LAST INV. CALENDAR	RECEIVALS - USAGE ± MISC. = ON HAND

	ACTUAL USAGE 3RD MO.	2ND MO.	1ST MO.	M.T.D.	AVERAGE	EXCESS USAGE 3RD MO.	2ND MO.	1ST MO.	M.T.D.	AVERAGE	PROGRAM REQUIREMENTS 3RD MO.	2ND MO.	1ST MO.	M.T.D.	AVERAGE	REASONS FOR NOTICE
DATE																
PROGRAM REQUIREMENTS																
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REQUIREMENT RECORD

Analysis Procedure

A weekly analysis of stock status and production requirements is made one level at a time. On-hand and on-order quantities of each part are reduced by weekly requirements throughout its lead-time. If the quantity available becomes negative, it is listed on the requirements report with a recommendation to place a new order or reschedule on open order.

In order to project all requirements as far into the future as available data permits, the analysis is carried beyond the lead time of each item. All items, including those not listed on the requirements report, are analyzed far enough into the future to cover the total

lead time for the item and all of its component parts. Artificial orders are generated by the system as required to project requirements from level to level in the proper time frame, without actually placing real orders.

Lot sizes of both real and artificial orders are determined by an economic-lot-size formula. Both ordering and inventory-carrying costs are included in the formula. Carrying costs are made up of factors such as rent, depreciation, interest, stock-keeping, taxes and insurance, depreciation and obsolescence, and clerical services. The elements in the ordering costs vary according to the supplier. The costs of placing orders for in-house production include setup, clerical, storeroom, and handling time. The costs of placing orders with outside suppliers and other company plants include purchasing, stock-maintenance, receiving, and storeroom-handling time.

RESULTS AND FUTURE PLANS

The development of the dynamic materials management system at the Merrimack Valley Works has been an evolutionary one. The first stage covered the explosion of equipment orders into panel requirements. Phase II of system development expanded this capability to include requirements at all levels down to raw materials. A number of years was required to bring the system to this stage of development and, during this time, storeroom investments were reduced from six-and-a-half weeks of stock to four weeks of stock. Current plans call for continued expansion into the areas of dynamic scheduling and automated dispatching systems for each shop to control all work in process.