INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications   Integrated Information System, Inventory Control,
                            Procurement Control, Production Control

Type of Industry   Data Processing Equipment Manufacturer

Name of User   Burroughs Corp.
                            Pasadena Plant
                            Pasadena, Cal.

Equipment Used   Burroughs B283 Data Processing System
                            Burroughs B300 Data Processing System
                            Burroughs B5500 Data Processing System
                            Friden Collectadata Data Collection System

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Synopsis

The more technical the product a company makes, and the more subject to constant design change and improvement, the more the company needs to control its parts inventory as carefully as possible. To meet the joint problems of product complexity and constant design change, Burroughs Corp. has developed and installed its ACT!ON system for inventory control at its Pasadena, Cal., plant where most Burroughs EDP products are made.

The ACT!ON system is implemented by the use of three Burroughs computers, a B283, a B300 and a B5500. In addition, a Friden Collectadata data collection system permits prompt entry of data from all departments concerned into computer memory in order to update magnetic tape and disc files. The system depends heavily on "turn around" media, computer-produced documents which call for action on someone's part. As each of these actions is completed, it is recorded in the computer file via data transmission units. The data processor then automatically produces the action document needed to inaugurate the next step in the production process.

All action messages are in simple business English and use a uniform terminology. They can thus be understood by all who must use the documents. All possible exception conditions produce delinquency reports automatically, and the delinquency, if not corrected automatically, produces a follow-up notice which goes directly to the person responsible. The report also goes to his superior in the form of weekly management summaries covering each buyer and each production planner.

As ACT!ON is primarily an inventory program, its basic initial input comes from the parts list file and the inventory file. The first lists each of the component parts needed in all Burroughs computer assemblies. Since the listing entered on tape is the only record of the parts needed, it is the single controlling record for the Manufacturing Div. The Inventory file lists quantity of parts on hand; quantity on order, whether to be acquired outside or produced internally; reserved quantity, the portion of on hand and on order supplies already designated for a scheduled use; and available balance, the quantity remaining when reserved quantity is deducted from on hand and on order totals.

This information provides the basis for strict control of all inventory, purchasing and production activities. The control thus achieved also makes possible the preparation of detailed and sensitive management reports whose value, Burroughs executives claim, outweighs the substantial savings achieved through use of the system.

Over 4,000 computer systems a year are now being produced by U.S. EDP manufacturers. Yet, even though computers have long since passed from the one-of-a-kind, handbuilt stage to something very close to assembly line production, each new system delivered represents a near miracle of manufacturing control and planning.

Upwards of 10,000 parts and sub-assemblies go into every EDP system, and harried procurement and production personnel must see to it that all of these items are available in-plant at exactly the right time for a production order to be fulfilled. This task, in itself, is a large one, but it is hugely complicated by the constant design changes and improvements to which the parts are subjected and which can obsolete existing inventories at a moment's notice. Plant managements are, therefore, not merely concerned with the efficient, economical assembly of complex, highly technical products. They must also strive to exert, the control over inventories required to keep stocks at minimum levels needed for current production requirements, while assuring prompt and timely replenishment.

To meet these complex inventory and production control problems, management of the Pasadena plant of Burroughs Corp. has developed and installed a wholly computerized control system. This system, the ACT!ON system is implemented by the use of Burroughs on-line, real-time EDP systems processing information from "turn-around" documents, entered through Friden Collectadata data transmission devices to automatically update computer files. It is built around three basic concepts:

● Control can be exercised only over future events.

● To control is to manage.

● Manufacturing management is almost entirely devoted to inventory control, production control, and scheduling, all three of which are interrelated functions.

The ACT!ON System at Pasadena

The Pasadena plant is the principal manufacturing location of Burroughs EDP products. These include: central processors, disc files, tape drives, card readers and punches, teletype and universal terminals, data communications controls and other peripherals. The plant, headed by DuRay Strombach, general manager, has approximately 2,500 employes, and makes the components for Burroughs computer systems ranging from the medium-scale B200 family, the upgraded B-300 series to the large-scale B5500 model. They are also incorporated into the B8500 system whose design features extremely powerful EDP capabilities.

The ACT!ON system at Pasadena is the first computerized inventory and production control to be developed and installed in any Burroughs plant. It is backed up by three Burroughs computer systems: a Burroughs B283 with four magnetic tape drives, a B300 with magnetic disc file storage, and a B5500 installation. In addition, a Friden Collectadata data transmission system permits entry of punched card data into computer memory from any of 20 input stations and various teletype stations. This equipment permits the transmission of significant manufacturing transactions to a set of data processing records maintained in computer files. The processors are programed to continually review these files and, following the exception principle, immediately signal any variation from the standards established by manufacturing management.

The system thus evolved has three main characteristics:

1. No manual files are kept independently outside the magnetic tape and disc files.

2. The system relies largely on "turn around" computer-produced documents which call for action to be taken. After the action is performed, the document provides a means

of entering constant information through an input station into computer memory for file updating, with variable data being keyboarded in.

3. All computer input and output are in simple English, understandable by both men and machines.

In addition to providing an efficient method of recording production, procurement, and material planning data, the ACT!ON system monitors all inventory and production transactions as they are fed to the computer. Plant management and operating personnel have specified points at which they want an opportunity to take corrective action. The computers is therefore programed to continually test parts records and order status to inform the proper person when such a relevant action condition has been detected as a delivery not being made by the specified date; a reorder level being reached for a part or assembly; a decision not being promptly made regarding rejected material; or a future inventory shortage being forecast. Some 60 action messages exist today, with more being added as the need for them is revealed. They provide the exception information needed by manufacturing, purchasing, quality control, accounting and higher levels of management personnel to exert effective control.

The system's built-in ability to absorb the impact of change is of prime importance to Burroughs, considering the high engineering change rate and constant rescheduling required of computer manufacturing planners. Orders for obsoleted parts are immediately identified for cancellation. When internal jobs are cancelled all of the orders for components related to that job are also automatically cancelled. Orders for newly-designed assemblies are automatically exploded into their material requirements. A change in the production schedule automatically updates the corresponding material requirements schedule. Surplus material is cut to a minimum by ordering parts and assemblies in not only the exact quantities required, but also with each order schedule for delivery at the exact time that it will be required.

The "turn around" document principle has proved effective in permitting the information processing accuracy and simplicity required for the system. Computer-produced punched cards and printed reports are thus directed to the appropriate persons for action. They record variable data on the output form and return the document to data processing as input information. Whenever possible, the turn around documents are preinscribed with part numbers, job numbers, purchase order numbers and so forth to avoid potential errors through manual recording.

Under the ACT!ON system, the computer installation is the master control for all interrelated systems functions. An input from one source can thus be made to trigger all of the integrated actions. Accounting, as well as various manufacturing transactions are automatically coordinated by the single input as it affects the three interrelated control functions that underlie the system: inventory control; procurement control; and production control.

Inventory Control

There are considerably more than 200 computer applications incorporated in the ACT!ON system, calling for several different inventory information magnetic tapes or disc files. The two most important files within the system, however, are the parts list file and the inventory file.

Parts List File lists every component part needed in each computer assembly. It is used to:
- Print parts lists for engineering and manufacturing
- Maintain control over specification changes
- Print "where-used" listings
- Compute forecasts and other special analysis reports
- Explode production reservations for the inventory file

MANUFACTURING

PARTS LIST is checked

for every upcoming

order by the Area

Engineer who lines out

parts to be deleted and

enters new specifica-

tions.

PLANNER G				AREA ENG. P			MANUFACTURING			PARTS LIST				DATE 10/15/63			

ADD	ENG. ITEM	MFG. ITEM	PR	IND	PL	DWG SIZE	PART NUMBER PRIME	DASH	SUB	DESCRIPTION	QUANTITY	U/M	CODE	MFG. LEAD	ZN	LN	S	BN	REMARKS
		10		0	PL	ND	11092277	000	AOZ	FRAME ASSY 21 CONN	1	EA	MKE		40				
		15		1		D	11998259	000		FRAME 21 CONN BLOCK	1	EA	BY		40	F	B		
		20		1		C	11096179	000		STRIP 35 PIN GND	6	EA	BY		40	F	B		
		25		1		C	11942117	000		GND PLANE ASSY CONN	21	EA	BY		40	F	B		
		30		1		B	11944451	000		INS GND PLANE	18	EA	BY		40	F	B		
		35		1		B	11971231	000		CLIP CONN BLOCK	6	EA	BY		40	F	B		
		40		1		B	11971744	000		GROMMET-INSULATOR	12	EA	BY		40	F	B	10	
		45		1		S	11025996	000		SCR 6-20X5/8 HEX	24	EA	BY		40	F	A	12	
		50		1		S	11025947	000		SCR 4-24X5/8 HEX	24/12	EA	BY		40	F	A	11	
		~~55~~		~~1~~		~~ST~~	~~12561122~~	~~000~~		~~SCR PAN HD 8-32X1/2~~	~~6~~	~~EA~~	~~BY~~		~~40~~	~~F~~	~~A~~	~~13~~	
		60		1		ST	12565263	000		NUT 8-32 HEX	6	EA	BY		40	F	A	14	
		65		1		ST	12568036	000		WASHER PLAIN #8	6	EA	BY		40	F	A	15	
		70		1		ST	12567731	000		WASHER IT LOCK #8	6	EA	BY		40	F	A	16	
		75		1		B	11096161	000		BAR GND 6 HOLES	1	EA	BY		40	F	A		
		55		1		ST	12561130	000		SCR PAN HD 8-32X5/8	6	EA	BY		40	F	A	13	

Burroughs Corporation ELECTRODATA DIVISION		PAGE 1	ISSUE NO.	UNIT NUMBER PRIME	DASH	SUB	ASSEMBLY NUMBER PRIME 11092277	DASH 000	SUB AOZ	D/L

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A common parts list documentation system is used by both the Manufacturing and the Engineering divisions. Although separate computer parts list files are established for each division, a common program is used to achieve as much uniformity as possible. A common parts list print-out format is utilized and a common coding system has been established.

The Engineering Parts List is the framework for compiling a logical arrangement of documents required for communication to the Manufacturing Division. The Manufacturing Parts List is structured to conform with the methods employed in the assembly operations. The component parts are listed in the sequence in which they are assembled. Copies of the computer-printed parts lists are enclosed with each job order released to production operations. The Manufacturing Parts List is thus the controlling document within the Manufacturing Division. It is the sole controlling one as the listing entered on magnetic tape is the only records of parts needed for each and every assembly -- the master file.

The original printout of parts list is held in Document Control. Copies are sent to the planner responsible for producing the assembly and the area engineer responsible for maintenance of the parts list records. The area engineer checks the parts list for every upcoming order and makes any changes or deletions caused by engineering or design changes. These changes are noted on the engineer's copy of the list -- the old component is lined out and its replacement written in at the bottom of the listing. The document is then returned to the computer center where changed information is keypunched for nightly updating of the parts list file.

The computer is programed to test changes for certain criteria that must be met by parts list input. If a change is rejected, the reasons are printed on fallout reports and returned to the originator. Duplicate additions or deletions are rejected automatically. Similarly, the part number addition or substitute called for by the area engineer is checked by the data processor to ensure that a valid part number has been used. When these tests have been passed, change information is accepted and an entire new record is automatically prepared for the revised assembly. By coding this input, the assembly parts list on the file may be either corrected only, revised and the old level deleted, revised with the old level retained, or deleted only.

Every day, a new parts list is printed for every assembly in which there has been a change of components, with the change information flagged. Corrected information is shown with the letter "C" printed in the first or ADD column. On revised parts lists, the items added are asterisked in the first column and items deleted are printed at the bottom of the list under the heading "DELETED THIS ISSUE." The parts list printout illustrating the changes performs as the change notice to all concerned. When additional copies of the parts list are required, they are requested by filling out a special parts list request tab card.

The updated list is supplied to the Manufacturing Div. which then has a current parts list always on hand. When Manufacturing receives a production authorization for an assembly, the units and assemblies scheduled to be produced are exploded through the parts list file to establish "reservations" for the parts and assemblies required to fill a given job order (parts list quantity is multiplied by job quantity to determine reservation quantity). The reservations are dated and recorded in the inventory file in date sequence. The parts lists file thus serves as a reference file which links production and inventory control and establishes their interrelationship within the ACTION system.

Inventory File forms the basis of the ACTION system. It is designed as a four-balance inventory record. Each reservation of material is dated. Both purchase orders and internal job orders are dated. With this complete record of material requirement in time sequence, the plant's supply and demand situation can be constantly tested for all periods of time covered by planning. Potential surplus as well as potential shortages are flagged far enough in advance to remedy an incipient situation.

The four balances which make up the inventory file are:

1. On Hand quantity of usable parts in Material Stores and available for immediate use.

2. On Order quantity of parts to be acquired from outside suppliers or through internal production.

ACTION REQUISITION

CARD computer-pro-

duced upon determination

of parts shortages pro-

vide input for automatic

preparation of PUR-

CHASE ORDER RE-

LEASE and RECEIVING

REPORT card.

3. <u>Reserved Quantity</u> - the pledged or committed portion of the inventory which has been flagged for a scheduled use.

4. <u>Available Balance</u> - the plus or minus inventory amount which remains after Reserved Quantity has been subtracted from combined On Hand and On Order quantities.

The inventory file is controlled through one major record for each part or assembly and as many as 300 sub-records can be added to the major records. The latter contains the part identity number and all significant information or codes peculiar to that part or assembly. 220 characters are allocated to each major records.

Each sub-record, 110 characters in length, describes either an order, reservation, stack issue, stock receipt, or adjustment transaction to the past record. All of the sub-records are arranged in date sequence for printout so that a complete part record illustrates the supply and demand schedule for the part or assembly.

The complete part record printout, with beginning and ending balances plus each of the sub-records, may be computer-produced according to the existence of an inquiry request or certain exception conditions. The part record is identified by the prime and dash portions of the part number. The sub-portion of the part number records the engineering change level at which the part was last ordered.

Part record columns bear the following headings:

- <u>Description or Message</u> contains part description from major record and, on lines below, action messages pertinent to the sub-record on that line.

- <u>Transaction Area</u> contains vendor code for BUY (outside supplier) items, or production zone for MAKE (internal production) items, or field for sub-records pertaining to field service records.

- <u>Transaction Phase, Type and Number</u> columns describe the sub-record printed on each line and the purchase requisition, order, or job orders number. The number column also contains a code letter for the production planner or purchasing buyer responsible.

- <u>Data Released or Issued</u> is the date when the transaction was recorded in the file, save for open jobs when it indicates when each job is scheduled to be released to production.

- <u>On Hand Balance</u> shows beginning and ending quantities, plus each of the stock issue and receipt entries occurring on the date of the printout.

- <u>On Order</u> column's first line bears the MAKE or BUY coding. Each succeeding line shows the individual order quantity specified for a given date required.

- <u>Date Required</u> column specifies the due in plant or completion date for each order and the date the material is required for each reservation record.

- <u>Reservation Balance</u> shows the quantity required or committed for a scheduled use.

- <u>Available Balance</u> is calculated for every date for which there is an order or reservation scheduled.

Available balance is the first of the action signals in the system. If it is a positive number, it indicates that supply is greater than scheduled demand. The planner responsible is then automatically flagged so that he may cut back on orders. Similarly, action is taken if the available balance is a minus quantity. This shows that needs already anticipated will require more components than are

available. In this case an Action Requisition Notice or reorder is automatically printed to initiate procurement procedures.

Procurement Control

Under the ACTION system, procurement activities are initiated when a potential shortage is spotted; whereupon, the computer automatically prepares a Requisition card and a complete printout of the part record to signal the need for action to the appropriate planner. Each part record contains information indicating whether the part or assembly currently has a MAKE or BUY status. The requisition cards are so identified and the printed record is similarly labeled to show whether the item is to be purchased outside or produced in-plant. The printed record also shows in date sequence the quantity required for each schedule use so that the planner may see when and where the materials will be needed.

The program contains several built-in safeguards. When reorder quantity -- the negative reorder figure -- is very small in comparison to the quantity reserved for future production, the requisition card is held up until a general reorder switch is triggered. Also, if the manufacturing date sequence shows that the reorder quantity will not be necessary until some time after the next scheduled general reorder, the signal to the planner is held up. Small items, such as production supplies, use an economic order figure rather than the exact figure required to allow the most efficient ordering of relatively inexpensive items.

On internally manufactured items, the requisition card is used by the planner to open a job order in the computer record. For BUY items, the planner checks the quantities of supplies required and delivery dates desired interpreted on the requisition card. He then sends a signal to the computer, via the Friden Collectadata data collection system, that the requisition has been converted to a purchase requisition. The card, together with such support documents as are needed to describe the parts to be purchased is turned over to the buyer who makes arrangement with the supplier.

When the buyer's arrangements are completed, the requisition card becomes a "turnaround" document which is returned to the computer center. There, the information that both the planner and buyer have entered -- order number, quantities and dates desired, vendor code, and unit price -- are keypunched for computer entry. This fresh information updates the inventory file to reflect the new purchase order status.

REJECT INSPECTION CARD accompanies parts rejected to quality control engineer who determines if they are to be returned to vendor or salvaged in which case a SALVAGE card is automatically produced.

If either planner or buyer fails to return the completed requisition card within seven working days of receipt, the computer prints out a second action message as a reminder. Thus, the requisition card functions as a "turnaround" document, a traveling paper that stimulates human action from planner and buyer and generates an automatic computer reaction if the desired response is not made within definite time limits. In this closed loop, feedback to the computer is essential and action is taken if there is no feedback.

The great majority of items bought from outside suppliers are covered by annual or blanket purchase agreements with vendors at set prices. In all such cases, the requisition card is stamped "p o release" and inputted to the computer which produces a Purchase Order Release card. This card serves as the actual purchase order to the vendor specifying the quantities and the delivery dates.

The computer also produces a Receiving Report card bearing the same information carried on the purchase order. This is sent to Receiving to prepare that department for receipt of the order on the scheduled delivery date.

Burroughs Corporation
ELECTRODATA DIVISION

ACTION SYSTEM REQUISITION MANUFACTURE CYCLE

INVENTORY ACTION SYSTEM

DATA COLLECTION TRANSMISSION
CRITICAL PATH
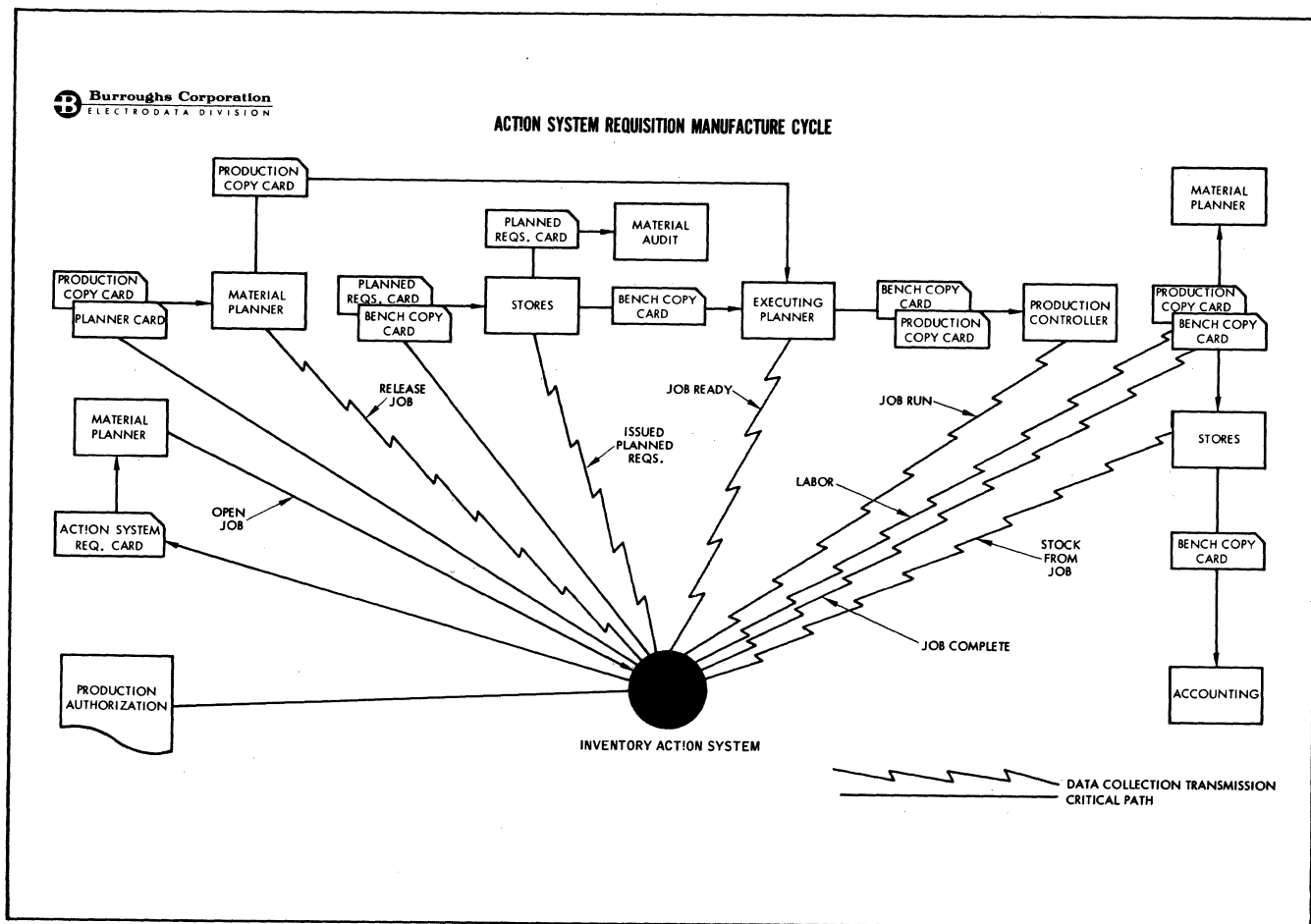
When the parts are received from the vendor, the Receiving report card is used to signal through a Collectadata input station, notice of the quantity receiving to update the inventory file. The card then moves with the parts into inspection where it is used again to signal any quantity rejected. If only a partial delivery was made, another receiving card is automatically produced for the balance

remaining on order. For rejects, a Reject Inspection card is produced and forwarded to be used by the quality control engineer who determines if the parts rejected are to be returned to the vendor or forwarded to salvage. When the quality control decision is "SALVAGE," a disposition card is provided to the salvage engineer for his decision -- "SCRAP" or "REWORK." This quality control decision is recorded in the inventory file and printed in the message column as "VENDOR REPLACE" or "VENDOR CREDIT" when the parts are returned.

After inspection, the Receiving Report Card travels along with the good parts into the Stores Dept. where the parts are again counted. The quantity accepted to stock is then transmitted to the computer center and the card moves on to Accounts Payable. Simultaneously, the part record is updated and the printed record for that date subsequently shows the transaction and an increase to the on-hand quantity.

If purchased parts are not inspected within four days from the date of receipt, an action message "NOT INSPECTED," is printed in the "RECEIVED P O" sub-record. An exception report listing such items is forwarded to Inspection supervisors.

Production Control

Production control procedures are similar to those used for inventory and procurement control in that as each part of a cycle is completed and recorded in computer files, the data processor automatically produces the action documents needed to initiate the next step in the production process.

There are seven phases assigned to production job orders to indicate job order status:

OPEN	Prior to release to production
RELEASED	Released to production and for "pull" of component materials from stores
READY	Accepted by the production zone where work is to be started
RUN	Labor applied to job, and job started
COMPLETE	Quantity of goods, completed assemblies
SALVAGE	Quantity of rejected assemblies
STOCK	Quantity accepted to stores

Open phase begins when the production planner uses the requisition card to submit the input job-opening transaction. The job order numbers, quantities ordered, release dates, and scheduled completion dates are entered. The open job is exploded through the parts file to determine material requirements, and reservation records are automatically established in the inventory file for each of the component materials required.

While the job is in open status, the computer reviews the parts requirements for the job daily and generates action messages when the planner should be notified of an exception condition. Thus, when a sufficient number of parts are on order to meet the reservation requirements, but the scheduled delivery date is later than the demand date, a RESCHEDULE message is generated. Similarly, 14 days before each reservation due date, the parts record is tested to determine if sufficient material is on hand to meet requirements. When on hand inventory proves insufficient for immediate demand, a POTENTIAL SHORTAGE message is created.

A Planner Job card is automatically created for each new job to be opened. This card becomes the master record controlling the entire job until all necessary materials have been assembled and sent to Production and the actual manufacturing process is about to begin. If there is an engineering change or a change in release and/or completion date, the old dates and specifications are lined out and new ones written on the card in their place. The card is then keyed into the computer and all computer files affected are automatically updated.
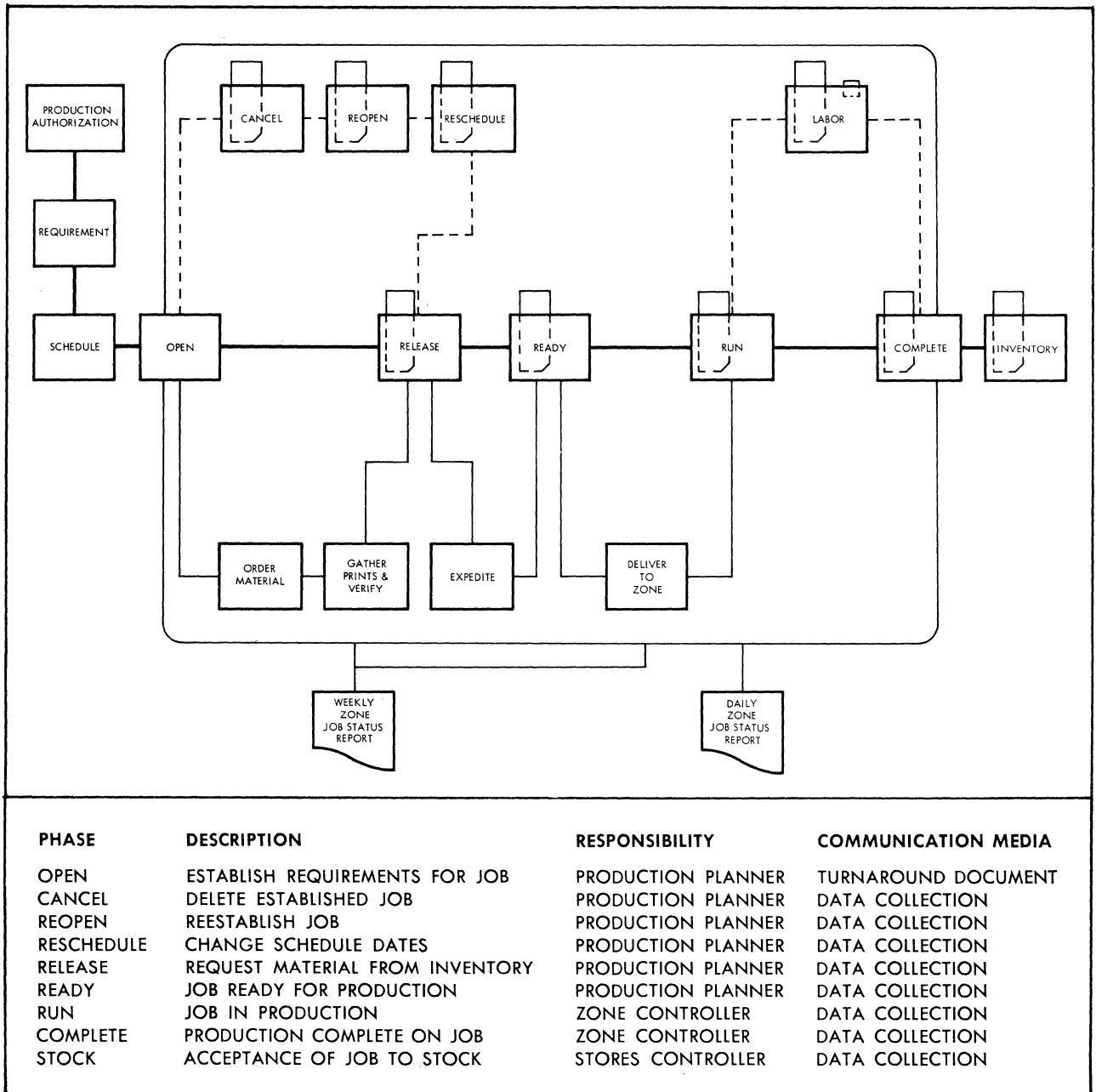

PLANNER JOB CARD is automatically created for each open job as a master record for pre-production assembly of all necessary materials.

Released status is reached when the production planner releases a job order to production operations, using the Planner Job card to trigger the following computer responses and file updatings:

1. Conversion of the inventory record from "open" to "released" job.

2. Conversion of the inventory records from "reservation" to "planned reservation" for each of the component parts reserved for the job.

3. Provide two copies of the Job Order card to control the job through production operations. One is sent to the Production Zone controller as his record of the jobs in process in his zone. The other, the Bench copy accompanies the work as it moves through Production and serves as the master document throughout the production process.

4. Provide a deck of planned requisition cards, one for each of the component parts to be pulled from stock for the job. As it is pulled, the card is returned to the computer center to bring Stock Issue Transaction records up-to-date.

5. Printing of an extended bill of materials -- the Parts Order -- to be used as a packing list for the delivery of the parts to the production zone.

6. Open a job record in the Master Job Order File used to test labor and material charges before they are posted to the Work-In-Process ledgers and the labor efficiency programs.

7. Open a Work-In-Process ledger in which to accumulate charges for the job.

8. Notify Manufacturing - Engineering when standards have not been properly established for the assemblies being built.

9. Notify Cost Estimating when the standard cost for the assemblies has not previously been established.

When material is pulled from stores and insufficient parts are on hand to fill the entire requisition for the job, the quantity issued is signalled through a Collectadata input station to the computer center. The planned requisition card for that part is held in store for the subsequent issue of

PHASE	DESCRIPTION	RESPONSIBILITY	COMMUNICATION MEDIA
OPEN	ESTABLISH REQUIREMENTS FOR JOB	PRODUCTION PLANNER	TURNAROUND DOCUMENT
CANCEL	DELETE ESTABLISHED JOB	PRODUCTION PLANNER	DATA COLLECTION
REOPEN	REESTABLISH JOB	PRODUCTION PLANNER	DATA COLLECTION
RESCHEDULE	CHANGE SCHEDULE DATES	PRODUCTION PLANNER	DATA COLLECTION
RELEASE	REQUEST MATERIAL FROM INVENTORY	PRODUCTION PLANNER	DATA COLLECTION
READY	JOB READY FOR PRODUCTION	PRODUCTION PLANNER	DATA COLLECTION
RUN	JOB IN PRODUCTION	ZONE CONTROLLER	DATA COLLECTION
COMPLETE	PRODUCTION COMPLETE ON JOB	ZONE CONTROLLER	DATA COLLECTION
STOCK	ACCEPTANCE OF JOB TO STOCK	STORES CONTROLLER	DATA COLLECTION

BURROUGHS ACTION SYSTEM -- Job Phase Control Flow

Burroughs Corporation
ELECTRODATA DIVISION

PARTS ORDER

	ISSUE DATE	PAGE
JOB NO. 23218 PLANNER F	9 27 63	1

CUSTOMER NO.   CUSTOMER NAME

ORDER NO.	PART NUMBER			DESCRIPTION	QTY. ORDERED	QTY SHIPPED	UNIT PRICE
ASSEMBLY	11856358	000	B01	CONTROL PANEL	300		
ITEM							
40 60	12669255	000		RESISTOR			
40 90	11828175	060		SCREW-8-32X1/			
40 70	11853017	000	A01	DISPLAY PANEL			
40 230	11828175	062		SCREW-8-32X3/			
40 210	11858800	129		SCREW-10-32X3			
40 120	11909660	001		WIRE #12GA HV			

PLANNED REQUISITION

PLANNED REQUISITION card deck and a printed PARTS ORDER are prepared when an open job is released to production.

the back-ordered quantity. When the release date of the job comes due and their is still not enough material on hand to meet the reservation, a STOCK OUT message is provided.

Ready status is reached for the job order as soon as it is accepted by the production zone and a data collection signal is sent to the computer center to shift the job status from Released. When labor operations begin and the job is actually started, its status is advanced from Ready to Run.

As the job is Completed, the production zone reports, via data collection, the quantity of assemblies accepted or rejected at the final inspection station. The bench copy of the job order functions as a material transfer document, moving with finished products to stores where it provides input for signalling the number of acceptable finished assemblies. The production control copy is forwarded to the production planner upon completion of the order.

If it is necessary to move a portion of the completed order to its destination before the entire job is complete, a duplicate set of "split" job order cards is prepared to account for the quantity split off from the original order.

Many of the assemblies rejected at the final inspection station are reported as SALVAGE JOB transactions. A salvage card permits the salvage engineer to input his SCRAP or REWORK decision in the same manner as for rejected purchased items. As for the latter, turnaround documents and constant revision of computer records give the company close and continuous supervision on the progress of every job and every order.

The system generates some 30 punched card action documents. Each is prepunched with the job order number or the purchase order number and the part number to minimize chances of human error in transcription.

Exception reporting provides on-line control of all transactions. This control is supplemented by periodic reports providing meaningful job status information from the inventory file

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for both planning and production control purposes. Four status and load reports are produced daily and weekly:

Weekly Zone Load Report is produced through extension of scheduled jobs by their standard hours and summarization of the totals by production zone. The scheduled work for each zone includes all jobs in open, released and ready status. For jobs in the run status, the scheduled standard hours plus the actual applied hours are shown. The calculated or estimated balance of work is printed, showing the hours that need to be applied to complete those jobs which have been started.

Weekly Planner Status Report is sorted first (major) on planner code, second (intermediate) on assembly number, and then (minor) on the scheduled completion date. This report provides each planner with a schedule of production planned for each assembly.

Weekly Zone Status Report shows·a complete schedule of all work planned for each zone in scheduled completion date sequence.

Daily Zone Status Report provides instructions to the production zone, giving the priority of each job which has been accepted by the zone. Each job order, in both the ready and the run status, is listed in priority sequence. Jobs in the run status carry the actual hours applied to date plus an estimated completion percentage. This daily zone status report also provides an audit of work in process as the zone controller must check every day that all jobs reported in his zone are in fact under his control.

Other Control Procedures

The ACTION system was primarily designed to support Burroughs' production activities. However, since it was installed, the system has been extended to cover such diverse areas as storage of engineering information, cost accounting and shipments from the factory.

Engineering Information for all Burroughs electronic circuitry is recorded in computer files by the design engineers. Through the relatively sophisticated file maintenance program used, the computer will print out a complete set of logic schematics for all units in any system produced at the Pasadena plant. Engineering changes are red-lined on the schematic printouts and submitted for updating of files.

PRODUCTION CONTROL and BENCH copies of the JOB ORDER CARD control the job through production operations, the bench copy acting as a traveller.

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Burroughs Corporation                          MANAGEMENT ACTION SYSTEM
ELECTRODATA  DIVISION              REPORT NUMBER - M2-F      OCTOBER 11, 1963

      PLANNER F ACTIVITY REPORT   . FARBER-MAGNETIC TAPE TRANSPORT

      ACTION TYPE         NO. OF    EXTENDED   PERCENT   LATE    EXTENDED    PRCNT
                          ITEMS      VALUE     OF TYPE   ITEMS  LATE VALUE   LATE

BUY ORDERS               1 781     1 504 672     24       125     198 836      7
   ACTION REQUISITIONS     124       151 931     19         3       9 534      2
      DELAYED-NO ACTION     94       132 537     21
   PURCHASE REQUISITIONS   372       516 808     36        30      37 316      8
   PURCHASE ORDERS       1 285       835 933     20        92      41 987      7
      ON ORDER           1 238       803 756     21        77      44 265      6
      RECEIVED              35        20 882     11        21      11 944     63
      REJECTED              10        10 385     28         7       9 868     70
      SALVAGE                2           910     14         2         910    100

MAKE ORDERS              1 830     6 428 182     30        33     353 456      3
   ACTION REQUISITIONS     109       391 346     18
      DELAYED-NO ACTION     29        13 382      5
   OPEN JOBS             1 159     4 631 355     36
      LATE JOBS             78       216 794     19
   RELEASED JOBS          562     1 404 480     24        33     353 456      6
   SALVAGE JOBS

RESERVATIONS            12 708     7 932 854     15       428      60 480      3
   FACTORY ORDERS         174     4 030 053
   PRODUCT. RESERVATIONS 12 534    3 872 623     35       396      30 302      3
   PLANNED REQUISITIONS    32        30 178     35        32      30 178    100
   SUMMARY RESERVATIONS
   FIELD RESERVATIONS
   FIELD PART ORDERS

ON HAND BALANCE          1 038       677 993     12
   MAKE ON HAND BALANCE    473       165 909     22
   BUY ON HAND BALANCE     565       512 084     15

AVAILABLE BALANCE        1 038       143 596     24
   PLUS AVAIL BALANCE      975       156 406     24
      MAKE PLUS AVAIL      452        64 810     23
      BUY PLUS AVAIL       523        91 596     24

   MINUS AVAIL BALANCE      63        12 810-    20
      MAKE MINUS AVAIL      21         6 954     19
      BUY MINUS AVAIL       42         5 856-    26

NO STANDARD COST PARTS     71                            10
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PLANNER ACTIVITY REPORT for each individual is summarized for management information in weekly reports derived from the inventory file.

With each major change in circuitry, a new magnetic tape record reflecting the changes is transmitted to Manufacturing. Manufacturing programs are designed to read the circuitry tapes and produce the following:

● A deck of punched cards which is used in production to operate automatic wire wrapping machines; as many as 10,000 wires for a back plane panel are automatically wired by machine from the instructions punched in these cards.

● Printed circuit lists for both production and inspection purposes.

● Punched paper tapes to operate automatic verifying or testing machines which check the completed back plane panels.

Work-in-Process Accounting and Labor Efficiency are similarly integrated through computer control. As each material receipt or issue is transacted in the inventory file, a priced mate-

rial transaction file is generated. As the payroll and labor distribution are also automated, the labor detail is available in machine language to combine with the material charges for job cost accounting. The labor costs, burden charges (a percentage of actual labor), and material charges, are automatically accumulated for each job order. When the job is completed, the quantity of assemblies approved on final inspection is priced and the variance from the standard is computed.

The labor detail is also used to run a variety of labor efficiency reports -- by job, by operation, and by zone -- in order that production management may spot and correct problem areas.

A complete Departmental Expense system showing current and cumulative budgets, expenses, and variances is integrated into this total system. When labor or material charges are incurred in an indirect department, rather than a production job, the costs are automatically accounted for. In addition to the Work-in-Process ledgers, the sub-ledgers and journal vouchers are also printed by the computer.

Shipments from Factory are also integrated within the system. All orders calling for the shipment of end items, computer units, subassemblies, inter-plant shipments, and so forth, other than Field parts, are established as factory orders and a reservation record for each such requirement is set up in the inventory record.

A complete schedule of the factory order demands on the manufacturing operations is maintained in the inventory file and printed on request. At a predetermined date, the factory order reservations are automatically converted to shipping requisitions. The shipping requisition cards perform in "turnaround" manner to update the inventory records when the shipment is completed.

Results and Future Plans

A more informed person is not necessarily one who receives more information but one who receives more information that is geared to current needs and easy to understand. Burroughs' ACT!ON system follows this concept. Thus, all action messages are in English and a minimum number of codes is used in the printed output. Naturally, uniform terminology is also used in every area of the system.

The coding of the computer files and the nature of the action documents permit highly selective reporting. All possible exception conditions produce delinquency reports automatically. The delinquency, if not corrected, will automatically trigger a follow-up notice which goes directly to the person responsible and to his superior in the form of weekly management summaries covering each planner and buyer.

The system's benefits have been tangible according to Burroughs executives. Buying has increased five times, but the clerical staff is smaller than it was before the system was developed.

Similarly, production has jumped 500 percent since the system's inauguration, but inventory levels are 25 percent lower.

Nearly $2 million a year is being saved on BUY items since the majority of them are now purchased under blanket contracts.

There are, however, other benefits which, if less tangible, are perhaps even more substantial. They are derived from the immediate access which anyone concerned now enjoys, to information about the status of any part, product, or order by direct communication with computer memory which, itself, is constantly updated.

All accounting records are integrated with the management control system to provide a total management information system. Management has constantly updated records of vital information

with which to more effectively control operations. The following are some of the many facts which
are now always available to top Burroughs executives:

- Total inventory value

- Total purchase commitments (by scheduled dates)

- Total production schedule

- Total demand on factory (by scheduled dates)

- Total exception conditions

    a. Stock-outs by production planner

    b. Production delays by production planner

    c. Late deliveries on purchase items by buyer

    d. All expense variations beyond an allowable limit

    e. All delinquent actions by individual and by department.

This management information is described by Burroughs executives as having even greater
value than the savings achieved through the system. Its future benefits will increase further as Bur-
roughs analysts continue to develop and refine the ACT!ON system. Thus, they are considering ad-
ditions to the 60 action messages which now trigger computer responses. Additional applications
are also under analysis for the system's about 30 punched card documents. In almost every case,
these preprinted punched cards have replaced far more expensive, cumbersome and time-consuming
multiple copy forms. Through their use, data collection speed is increased, the cost of collection is
reduced, and a large amount of keypunching is eliminated or minimized. Yet, increased accuracy
far outweighs all other advantages.