INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Order processing, requirements scheduling, production control
Type of Industry	Automotive parts manufacturer
Name of User	Mechanics Universal Joint Div. Borg-Warner Corp., Rockford, Illinois

Equipment Used IBM 1440 computer system

Synopsis

Borg-Warner's Mechanics Universal Joint Div. moved from a manual order entry, requirements scheduling system to a computerized version of these activities on an IBM 1440 with three disc files. The plant, which handles 7,000 part numbers and 700 customers, was struggling with the increased business activity and the ensuing paper generated. The computer system was designed to provide an even flow of information needed to implement better shop floor controls.

BACKGROUND

One key to the fast, smooth conversion effort at the Universal Joint Division was the bill of materials processor package, according to Richard Parrott, data processing manager. This was an essential element in setting up the parts inventory and product structure master files. It established the logic for the various data processing routines. When the equipment was delivered in July 1966, input data and control programs were ready to go. The initial conversion was made by keypunching the open orders, the customer master files and the bill of materials. The bill of materials was somewhat difficult, as all the information had to be made uniform.

A gradual cut-over schedule was established, putting order entry and billing onto the system first, then the bill of material routines and finally the management reporting functions.

According to dp manager Parrott, the big job was the verification of the accuracy of the data available from the previous manual system. This information would be used as input in building the computer system data base and to prepare the necessary computer programing.

Borg-Warner Mechanics Universal Joint Div. was one of the first established by the industrial corporation. There are over 50 other divisions, subsidiaries and affiliates in 13 of the United States and in 21 foreign countries. Management at Mechanics Universal decided to convert to computer processing when it became apparent the manual system could not handle increased activity. Sales volume with the computer has subsequently increased 15 percent over the previous non-computerized year.

Actual cut-over was virtually trouble-free, according to the firm, and the system has been operative since July 1966. The system's design eliminated the need for any parallel operations relying on the previous manual control system. The 1440 computer setup includes three 1311 magnetic disc drives for maintenance and ready access to master data files, a card reader-punch, a printer, and a console typewriter.

MASTER PARTS INVENTORY

The heart of the system, insofar as the integration of order entry, requirements planning, production scheduling and control functions is concerned, is the master inventory parts file and its associated product structure record. The parts master maintains the updated situation status on all 7000 part numbers -- raw materials, purchased item, a component, sub-assembly or finished assembly. Data for the parts master comes from the shop, is collected manually and keypunched. The file record contains the requirements slotted by monthly time periods for each part number, the standard costs (materials, labor and overhead) associated with the part and complete on-hand, on-order and in-process inventory balances. This includes a breakdown on issued balances (parts which have been moved from in-process to final assembly or shipping) and service crib (storeroom replacement parts) balances.

A bill of materials processor code is also associated with each of the part numbers. This is the link to the product structure portion of the file record and the key to the bill-of-material explosion to break the given part number down into its components. The B/M (bill of material) cod and the B/M processor program will also produce an implosion -- building up from a raw material to component part to sub-assembly to assembly. All needed programing for the explosion/implosion routine is provided in the B/M processor package.

There are, of course, other master files essential to the integrated processing routines. The most important includes the open-order master record which tracks every order from the time it is received until the full order quantity is shipped, including promised shipping dates and performance against requirements by shipping date. Closely associated with this file is the customer master to accumulate sales by product for each of some 700 customers.

The master routing file was recently completed. It contains the description, sequence and timing for every production and assembly operation. It was compiled in a series of steps. Each part number has a separate route sheet. Each has assigned operations capabilities, standard time values and standard pay values. The information was collected and fed into the computer via cards. This will be used in automatically routing orders through the plant, maintaining work-load situation status at the various work stations and for actual plant loading. The payroll employe master file is important because it not only automates payroll and employe record-keeping, but has enabled the firm to convert from the former group incentive pay plan to an individual incentive program.

ORDER INPUT

The computer system is currently processing some 90 to 95 new customer orders a day and about the same average number of change orders. The incoming orders move first through an edit and coding routine, which is still a manual operation. The sales department goes through each customer order, verifies the number, the price, and checks for information which must go into the system. The orders then go to production planning for analysis and assignment of a promised delivery date. In making delivery date assignments, the production planning department relies heavily on the computer-produced requirements analysis report. It shows the current on-order totals by part description and the time-slottings for delivery of current requirements. This report, together with the up-to-date inventory status report, makes it easy for the production planner to assign a realistic promise date for each customer order. Eventually, the computer will be programed to assign shipping dates, with no manual intervention in the order entry process.

Incoming orders are processed through the system twice a day, late morning and late afternoon. Only the customer order number, the part number and quantity and the promised date are keypunched, then the batch of order cards is run against the master file records. The computer first generates all needed order documents -- the complete order set, shipping set, customer acknowledgement and internal control data -- and updates the master open-order file record. Next, the system explodes the order data to break out the materials, components and assemblies required and to relate the data on a time-slot basis geared to the promised delivery date. The planning department sends orders to the shop at that point.

Daily production data comes back to the data processing department from the plant floor via documents manually collected at work stations. The open-order master file is updated as a result of shipping notices from the shipping department. This triggers the customer billing routine in the computer. The data is captured to update inventory status records and to accumulate sales statistics by part and product, by customer and by sales territory, including pin-pointing cost and profit analyses.

DAILY REPORTS

A flow of daily reports from the system are invaluable in control of costs and in providing tight management control over previously poorly controlled areas, such as the shop floor, and in inventory. A production summary, for example, now provides the planning department with accurate data for control of parts on the shop floor. The schedule of order requirements by parts and the past-due schedule report enable planners to head off potential production bottlenecks and concentrate on current problem areas.

PART NUMBER	REL	OPR#	MACH	OSR	OSPA	QTY-SH 1	QTY-SH 2	QTY-SH 3	TOTAL
						244	230	220	694
-03630J- - -	941	27	4183	210	7452	113			
-03630J- - -	941	27	4183	210	7452			111	
-03630J- - -	941	27	4183	210	7452		130		
						113	130	111	354
-03630J- - -	1254	11	3881	210	7462	679			
-03630J- - -	1254	11	3881	210	7462	679			
						1,358			1,358
-03669J- - -		13	3182			350			
-03669J- - -		13	3182			350			
						700			700
-03669J- - -		311	5022	411		400			
						400			400
-03669J- - -	942	63003	5277			352			
-03669J- - -	942	63003	5277				312		
						352	312		664

THE DAILY PRODUCTION REPORT SHOWS WHAT WAS RUN IN THE SHOP EACH DAY BY PART NUMBER. COLUMNS FIVE AND SIX INDICATE IF THE WORK TO BE DONE IS OFF THE STANDARD PAY RATE AND THE SUBSEQUENT AUTHORIZATION NUMBER. QTY-SH 1, 2, 3, INDICATES THE QUANTITY PRODUCED ON EACH OF BORG-WARNER'S THREE SHIFTS.

The computer assembles and prints out labor information from the shop floor to show parts run, the number of jobs on-standard, the number off-standard -- and the reasons why (machine repairs, etc.). When the production routing program under computer control is fully implemented, the company will be able to keep tabs on total shop load by operation and measure performance against standards at every step in production and assembly.

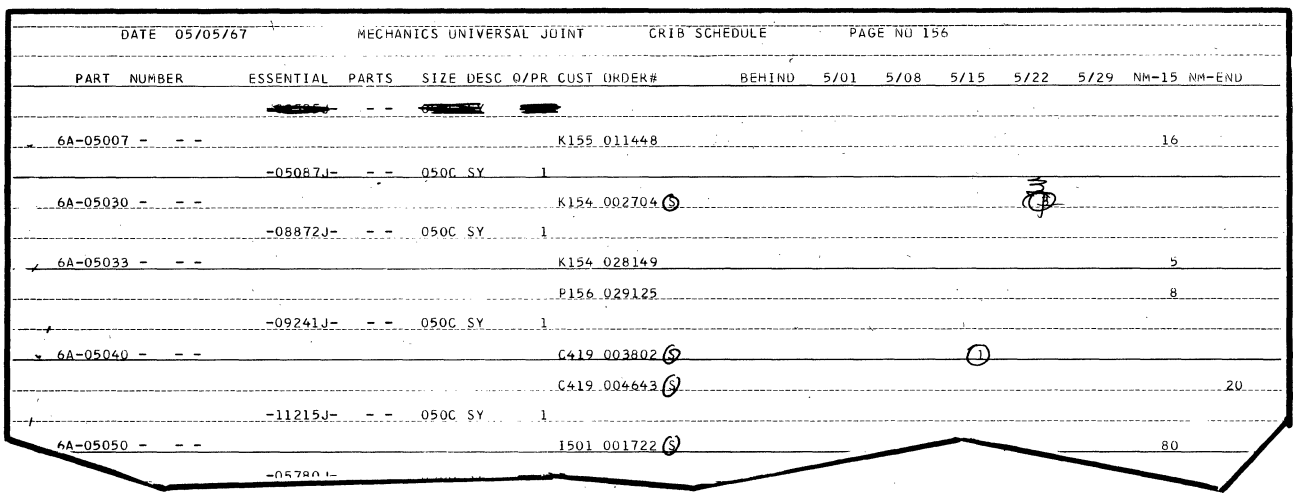
Reports which were never before available on a complete and current basis have already made a tremendous contribution to overall operating efficiency. The master shipping schedule, for example, provides a concise picture of the up-to-date situation for every order in the house. The schedule projects needed requirements by weeks into the future, by individual part number and by customer. This is, perhaps, the key reference document coming out of the computer system.

MASTER SERVICE SCHEDULE 02/16/68

PART NUMBER	SIZ	DESC.	M/ORD#	C/ORD#	O/QTY	S/QTY	PAST DUE	FEB	MAR	APR	MAY	JUN	JUL	FUTURE
A419 ALLIS-CHALMERS MFG CO			CEDAR RAPIDS IA 52406											
-10688J- - -		YOKE	050378	CR 91058	10						10/13			
114 -08105A- - -	08	SPD & B	007020	CR 85124	100	65	35 01/01							
114 -08105A- - -	08	SPD & B	Q09597	CR 89191	150					60/08	30/06	30/03	30/01	
114 -08506A- - -	085	SPD & B	007441	CR 86096	50		25 01/15	25/12						
114 -08506A- - -	085	SPD & B	009813	CR 89880	50							25/03	25/01	
A420 ALLIS-CHALMERS MFG CO			HARVEY IL 60426											
2A-10764 -001- -	02	U JOINT	006703	MS 18483	24	17	7 12/11							
A421 ALLIS-CHALMERS MFG CO			NORWOOD OH 45212											
114 -03124 - - -	03	UNIV JN	009814	RN 41707 S	30						30/16			
114 -05101 - - -	05	SP & BR	050024	RN N 42203 S	24					24/17				
114 -09014 - - -	09	JRNL CR	050288	N 115781	1						1/13			
A430 ALLIS CHALMERS			WHEATON IL 60187											
-04569J- - -	02	CAPSCRE	009599	PC 4981610103	2500				2500/11					
-05492J- - -	05	CAPSCRE	009169	PC 0076460508	320				320/11					
-05586J- - -	07	COUPLIN	008407	PC 0629946505	8				8/11					
-06601J- - -	02	PLATE	050038	PC 4981606905	20						20/13			
-06626J- - -	09	WASHER	009312	PC 0069965203	1400				1400/11					
-08485J- - -	085	E V			14									

THE MASTER SHIPPING SCHEDULE PROJECTS REQUIREMENTS INTO THE FUTURE BY INDIVIDUAL PART NUMBER AND BY CUSTOMER. ORDERED QUANTITY AND SHIPPED QUANTITY ARE LISTED; PAST DUE ORDERS ARE LISTED AS THEY OCCUR.

Supplementing the master shipping schedule is the crib schedule. This is a report of open orders sequenced by part number. It shows the total requirements against the part for each week of the current month and bi-weekly for the following month. This enables production crib personnel to control the distribution of plant production output and direct it to assembly operations or directly to shipping by part number.



DATE 05/05/67 MECHANICS UNIVERSAL JOINT CRIB SCHEDULE PAGE NO 156

PART NUMBER	ESSENTIAL	PARTS	SIZE DESC	O/PR	CUST ORDER#	BEHIND	5/01	5/08	5/15	5/22	5/29	NM-15	NM-END
	[redacted]	- -	[redacted]										
6A-05007 - -					K155 011448							16	
	-05087J-	- -	050C SY	1									
6A-05030 - -					K154 002704 (S)								
	-08872J-	- -	050C SY	1									
6A-05033 - -					K154 028149							5	
					P156 029125							8	
	-09241J-	- -	050C SY	1									
6A-05040 - -					C419 003802 (S)				(1)				
					C419 004643 (S)								20
	-11215J-	- -	050C SY	1									
6A-05050 - -					I501 001722 (S)							80	
	-05780 J-												

THIS CRIB, OR STOCKROOM SCHEDULE, SHOWS REQUIREMENTS BY PART. IT IS TIME-SLOTTED BY WEEK TO SHOW CUSTOMER ORDERS OUTSTANDING BY ORDER NUMBER AND INDICATES WHEN PARTS ARE REQUIRED. THE LAST TWO COLUMNS SHOW THE NUMBER OF PARTS REQUIRED NEXT MONTH BI-WEEKLY (NM-15, NM-END).

The schedule of requirements by parts description also enables production planners to group similar releases to send to the shop. This cuts down on line conversion and down times. The schedule is also helpful to industrial engineering in adjusting routings, a formidable task. Mechanics Universal Division works with some 2,000 two-way assembly bills, with some 15 or 20 components for each bill.

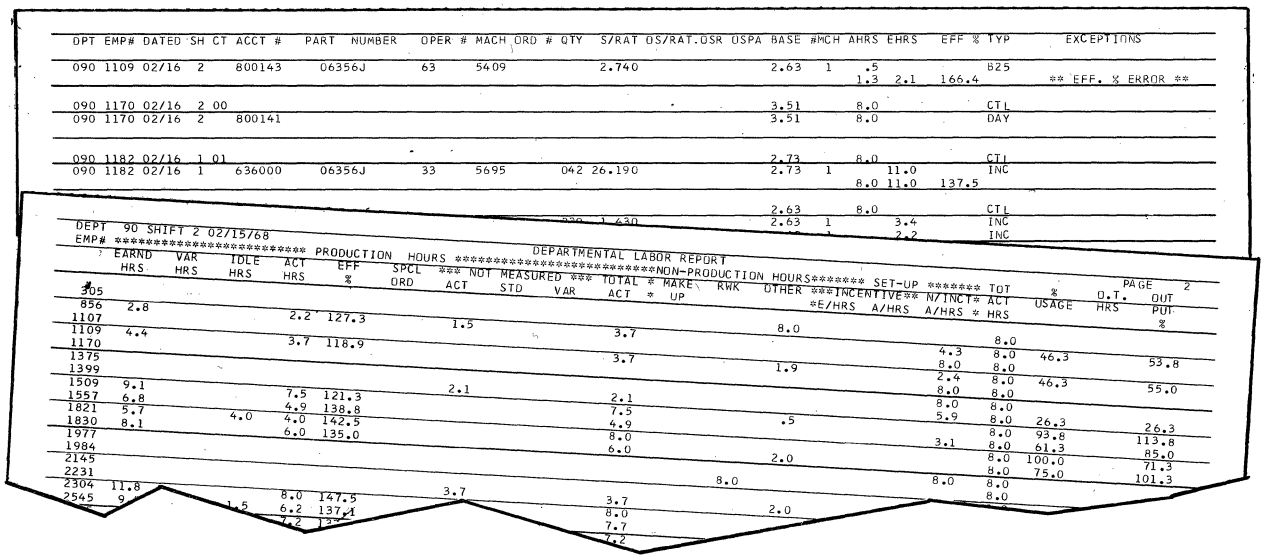
An important top management report furnished by the system is a back-log order summary. This shows total current order dollars by product class and by time period. The report includes a summary of the dollar value of shipments to date and of new business booked for each time period. The data is broken down by some 50 individual product groups in automotive, non-automotive and industrial classifications. In effect, it gives management an at-a-glance situation report on important orders and dollars.

Using this back-log summary and past due schedule reports, bottlenecks in customer service and cash flow can be easily spotted. Using the back-log summary and the master schedule report, performance against requirements can be measured and problems can be traced to the individual part or raw material source. Using the back-log summary with detailed sales analysis reports by customer and by salesman, particular marketing and sales problems can be considered.

RESULTS AND FUTURE PLANS

Conversion to the computer control system has already paid off. Most obvious are production and inventory cost savings, together with improved service to Borg-Warner customers. Among the immediate benefits:

In production control: The system spells out operations and assembly routings by sequence and standard times. It keeps track of production order requirements by customer and part number. A series of daily reports pin-points employe performance by individual job and summarizes labor utilization by employe, department, and plant. Employes are now paid on an individual incentive basis by a group incentive plan as before.



DPT	EMP#	DATED	SH	CT	ACCT #	PART NUMBER	OPER #	MACH	ORD #	QTY	S/RAT	OS/RAT.	OSR	OSPA	BASE	#MCH	AHRS	EHRS	EFF %	TYP	EXCEPTIONS
090	1109	02/16	2		800143	06356J	63	5409			2.740				2.63	1	.5			B25	
																	1.3	2.1	166.4		** EFF. % ERROR **
090	1170	02/16	2	00											3.51		8.0			CTL	
090	1170	02/16	2		800141										3.51		8.0			DAY	
090	1182	02/16	1	01											2.73		8.0			CTL	
090	1182	02/16	1		636000	06356J	33	5695		042	26.190				2.73	1		11.0		INC	
																	8.0	11.0	137.5		
															2.63		8.0			CTL	
															2.63	1		3.4		INC	
																		2.2		INC	

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EMP#	EARND HRS	VAR HRS	IDLE HRS	ACT HRS	EFF %	PRODUCTION HOURS SPCL ORD	NOT MEASURED ACT	NOT MEASURED STD	NOT MEASURED VAR	TOTAL ACT	TOTAL * MAKE UP	NON-PRODUCTION HOURS RWK	NON-PRODUCTION HOURS OTHER	SET-UP INCENTIVE E/HRS	SET-UP INCENTIVE A/HRS	SET-UP N/INCT A/HRS	TOT * ACT HRS	% USAGE	O.T. HRS	OUT PUT %
305																				
856	2.8			2.2	127.3		1.5			3.7			8.0				8.0			
1107																4.3	8.0	46.3		53.8
1109	4.4			3.7	118.9					3.7			1.9			8.0	8.0			
1170							2.1			2.1						2.4	8.0	46.3		55.0
1375																8.0	8.0			
1399																8.0	8.0			
1509	9.1			7.5	121.3					7.5			.5			5.9	8.0	26.3		26.3
1557	6.8			4.9	138.8					4.9							8.0	93.8		113.8
1821	5.7		4.0	4.0	142.5					8.0			2.0			3.1	8.0	61.3		85.0
1830	8.1			6.0	135.0					6.0							8.0	100.0		71.3
1977																	8.0	75.0		101.3
1984												8.0				8.0	8.0			
2145																	8.0			
2231																				
2304	11.8			8.0	147.5		3.7			3.7			2.0							
2545	9		1.5	6.2	137.1					8.0										
				7.2	1					7.7										
										7.2										

THE DAILY PAYROLL PRE-EDIT (TOP) NOTES EMPLOYE PERFORMANCE BY JOB. IT ALSO SERVES AS A COMPLETE AUDIT TO VALIDATE ALL INPUT FOR EACH MAN AND EACH DEPARTMENT FOR A DAY. S/RATE IS THE STANDARD RATE OF PAYMENT FOR A JOB: O/S IS OFF STANDARD AND INDICATES A JOB PECULIARITY REQUIRING A PAYMENT VARIATION: OSR IS A COLUMN PROVIDED FOR AN OFF STANDARD REASON AND OSPA REPRESENTS AN OFF STANDARD PAYMENT AUTHORIZATION NUMBER.

THE DEPARTMENTAL LABOR REPORT (BOTTOM) MEASURES AN EMPLOYE'S PRODUCTION HOURS, NON-PRODUCTION HOURS AND JOB SET-UP TIME. IT EVALUATES HIS OVER-ALL EFFECTIVENESS FOR THAT DAY.

For inventory control: The bill of materials processor which is an integral part of the system breaks down the single level bill for every assembly by component structure and it provides a where-used list of all active component parts and the assemblies they go into. The computer furnishes daily reports to show current status of inventory -- on-hand, in-process or on-order from vendors, issued to assembly or to a service crib.

In requirements planning and scheduling: A master shipping schedule prepared by the computer lists all current open-orders sequenced by customer and part number and time-slotted by promised delivery date. A plant crib (stockroom) schedule shows requirements by part, again time-slotted. The system also issues past-due schedule notices, shop release status and lead-time reports and daily production summaries.

Time savings: Availability of the computer-produced reports has eased the heavy clerical workload of production planners. For example, the master schedule saves 21 hours a week, and the crib schedule saves 24 hours a week of production planning time. The requirements analysis saves schedulers some 60 hours of tedious paperwork a week. In addition, the master schedule saves the sales department more than 30 hours a week in tracing customer order status and handling order inquiries.

Plans are now underway to install a shop-floor data collection system and then move to a third-generation computer.