

# INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

**Applications** Production Scheduling, Production Control,  
Inventory Control

**Type of Industry** Power Transmission Mechanisms Manufacturer

**Name of User** Twin Disc, Inc.  
Racine, Wisc.

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**Equipment Used** IBM System/360 Model 30

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## Synopsis

Twin Disc's system is a group of computer programs built around the bill of material processor program. This program group explodes customer orders to each successive lower level of production to determine inventory availability of component part requirements on the basis of time. Thus, a scheduled shipping date can be predicted. The object of the system is to provide better control over complex production routines and lengthy material lead times which had become complicated by a rapidly increasing volume of business.

Twin Disc is about 50 years old and has a \$49 million per year volume. Subsidiary plants are in Neuville, Belgium; Stroud, England; Sao Paulo, Brazil; Vaduz, Liechtenstein and Sydney, Australia. A Japanese affiliate has offices in Tokyo, Camo and Omiya, Japan. The company manufactures torque converters, clutches, power-shift transmissions, universal joints, equipment for auxiliary drives and a variety of controls plus marine gears.

## Background to EDP

Before computerization, Twin Disc used unit record equipment with office calculators. The production scheduling and control system was designed in 1963 and in 1964. In late 1964, the first programs were put on an IBM 1401 disc system. By October 1966, the System/360 Model 30 had arrived and operated compatibly with the 1401 for a year. The smaller system was finally returned and all the work was put onto the System/360. This system has a 65K memory, six disc drives; the company is planning to replace the disc drives with a 2314 multi-disc storage unit. Nine keypunch operators and verifiers work two shifts as do many other of the EDP personnel.

## The Program

The System/360's bill of material processor program is the key to the system. It uses two basic master record files maintained on direct access magnetic disc storage files. They are the bills of material master record and the inventory master record. The bills of material master record file, contains the level-by-level bill (piece parts, subassemblies and components) for most Twin Disc products. The average product bill has 100 piece parts. Some bills include as many as 500 piece parts. The inventory master record contains on-hand and on-order balances, incoming receipt schedules, time-phased requirements and planned production utilization. Lead times are included for each level of inventory.

A satellite file on disc operates as a master open-order record. This is also referred to as "master pegged requirements" and contains the bill of material number, part number, shipping order number and quantity data for each customer order in progress. The shipping order number is assigned to each original customer order number and eventually becomes his invoice number.

## The System

About 250 customer orders each week come to Twin Disc's Racine headquarters from the six district sales offices and from some 150 authorized dealers. An additional 150 orders come from the plant's own service department and from customers themselves. Orders arrive by mail, primarily.

After editing, pricing and conversion from a customer order number to the company's bill of material number (done by the sales department on the order), the order goes to production control. There, a preliminary check is made to be certain that the required bill of material is maintained on the computer system (over 90 percent are), and then the bill of material number, order number and requested shipping date are keypunched onto an order card. If a shipping date was not requested by the customer, the production control department sets up the order on a standard six-week lead time. Otherwise, it enters the system with the shipping date as requested by the customer. One order card is punched for each order delivery requested.

Each night, the order cards resulting from this procedure are batch processed by the System/360. The computer program compares each order card against the master file record and checks for availability of inventory called for within the time period of the requested shipping date by considering established material lead times at each production level.

If the computer system finds that a part at a particular level is not available or cannot be manufactured in time to meet the requested date, the program calculates a revised shipping date for the order, closest to the requested date, based on the established lead times--the times necessary to manufacture or buy the required part. As the system establishes the new shipping date, it also reallocates inventory necessary to manufacture the missing parts, level-by-level, within the proper time sequences. Then, the computer program updates all related inventory records, also level-by-level, on a time sequence basis.

To complete this processing cycle, the computer records all orders in process associated with the inventory available, lead times and shipping dates in the inventory disc file. It also prints out, at this point, the order acknowledgement which is a promised delivery date for the customer. This acknowledgement goes back to product planning and sales where it is incorporated into the sales order. A sales order with the acknowledged delivery date returns to data processing and a sales order copy goes out to the customer indicating that the merchandise can be delivered as requested. The customer order sets up a file requirement which shows up on the action report. A line on the action report triggers activity on the shop floor.

The order acknowledgement, one line on the printout, triggers activity on the shop floor. It is reviewed by a clerk for the first decision: parts must be purchased, or parts must be made. For parts to be made, a shop supervisor transfers the information to a "work order-routing" schedule. (If raw material is not available, the supervisor does not see the action report. Instead, another action report is sent to purchasing, and triggers a manual purchasing function in that department.) The multipart work order in hand, the supervisor sends a copy back to data processing for payroll purposes. A card for each operation required to make that part number is punched and assembled with copies of the original sales order into a package which will go out onto the shop floor to the machines and then travel with the part. (The "make" order from the action report is not released to the floor until this package is assembled.) Another copy of the work order is released to the store area where raw materials are pulled out and sent to the first operation on the work order/routing. A man has been assigned to a machine where the piece part is then fabricated. The item moves to the "finished stores" area, and then the punched card marking this part returns to data processing where computer records are updated to show that the part has moved from "in process" to "on hand."

FORM 1349 WORK ORDER - ROUTING												
C O D E		PART NO.	DESCRIPTION					WORK ORD NO.				
1		206165	GEAR					215 A 35				
2		ROUTING DATE	MADE FROM					QUANTITY				
		11/30/67	M-203174 FORGING					105				
		SPECIAL INS.						DATE ISSUED				
								2095				
								VENDOR NO.				
								HEAT NO.				
OPER NO.	DEP NO.	WRK CTR	EST	HRS/C	PCS/HR	INS	OPERATION DESCRIPTION	FIN. DATE	RESCHEDULED FIN. DATE			
5	010	1	BD			X	TURN O.D., SEMI FACE, SEMI BORE & CHAM	208				
5	020	1	BD			X	TURN, CTBR, FACE, BORE, U.C. & CHAM	208				
5	030	8	FC		8.95	11.	GRIND FACE	209				
5	040	16	NB				INSPECT FOR RUNOUT	209				
5	050	8	CJ		4.44	7.5	RGH HOB TEETH	209				
5	060	8	CV		2.49	13.	SEMI HOB TEETH	210				
5	070		RW				WASH	210				
5	080	8	NH		4.78	21.	CHAM TEETH	210				
5	090	8	CN		3.76	27.	SHAVE TEETH	211				
5	100		RW				WASH	211				
5	110	8	TA		3.12	32.	BALANCE	211				
5	120	1	Z		.390	257.	NUMBER X-206165	212				
5	130	16	NB				INSPECT	212				
5	140		SB				CARB & HARDEN DEL TO 21ST	213				
5		16	ND				INSPECT HARDNESS	214				

THE WORK ORDER IS A RESULT OF THE ACTION REPORT AND LISTS ACTIVITIES NECESSARY TO MANUFACTURE A PART. THE OPERATOR NUMBER, WORK CENTER NUMBER AND A SPACE FOR PRODUCTION ESTIMATES ARE INCLUDED.

FORM 129 REV. 2/67

**TWIN DISC, INCORPORATED** **MATERIAL STATUS - PRODUCTION SCHEDULE**

PART NUMBER	NAME	FORECAST QUANTITY	USED LAST YEAR	USED TO DATE	USED THIS PERIOD	YEAR TO DATE SCRAP	SAFETY STOCK	LEAD TIME	S.O.Q.	SM. CONS.	REQ. FREQ.	SPECIAL INSTRUCTIONS	MODEL USED ON	LOWER LEVEL OR CRITICAL PART NUMBER		PRINT DATE
														PART NUMBER	QUANTITY	
A 6512	FLPLATE	87	5367	91	91			4		15	1	A-R.O.-	SP14	A 6512		06/12/68

  

UNREL. W. O.	ALOC. NOT IN PROCESS	ORDER	CANCEL	ISSUED	INVOICED	TYPE	DUE	QUANTITY	AUTHORITY

  

* ROWSPAN #	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	
REQUIREMENTS	170	178	33	23	204	66	217	5	37	48	220	25	102	45	110	75	5	211
SCHED. RECEIPTS				472														
AVAILABLE	286	62	95	354	150	63	241	241	328	413	635	722	824	911	1021	1108	1195	1406
PLANNED ORDERS		154	87	87	87	220	87	102	87	110	87	87	211	87	194	126	87	87
		133	5	37	48	220	25	102	45	110	75	5	211	65	194	126	40	
REQUIREMENTS	224	225	224	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241
SCHED. RECEIPTS	65	194	126		40	85	23	19	42	84	8	10			34	10		
AVAILABLE	1493	1687	1813	1900	1987	2074	2161	2248	2335	2422	2509	2596	2683	2770	2857	2944	3031	3118
PLANNED ORDERS	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87
	85	23	19	42	84	8	10			34	10				10			
REQUIREMENTS	242	243	244	243	246	247	248	249	250	251	252	253	254	255	256	257	258	TOTALS
SCHED. RECEIPTS	10																	2524
AVAILABLE	3205	3292	3379	3466	3553	3640	3727	3814	3901	3988	4075	4162	4249	4336	4423	4510	4597	4597
PLANNED ORDERS	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87
																		1766

THE MATERIAL STATUS-PRODUCTION SCHEDULE IS AN EXCEPTION REPORT. THE FORECAST QUANTITY IS EXPONENTIALLY SMOOTHED. SPECIAL INSTRUCTIONS INDICATE WHERE THE PART IS FILED IN INVENTORY. MINUS SIGNS INDICATE WHEN PIECES WILL GO OUT OF STOCK THROUGHOUT THE 52 WEEKS' REPORTING CYCLES.

For the final assembly, the customer order copy of the work order and a preprinted bill of material is sent to the stockroom. There the foreman pulls the material and sends it to another area to be assembled, tested and shipped. A copy of the sales order goes with the material as a packing slip, and another copy goes to data processing to trigger invoicing and to relieve inventory. Though invoicing is computerized, accounts receivable is a manual operation.

The promised delivery date is as accurate as the established lead times or in-plant or vendor performance permit. There is no lag in inventory updating, so there is no allocation of the same inventory to two different order requirements.

206165 <small>PART NUMBER</small>	215A35 <small>WORK ORDER NO.</small>	010 <small>OP'N NO.</small>	208 <small>FIN. WEEK</small>
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Do Not Fold, Soil Or Tear This Card

INSERT THIS END FIRST AND THIS SIDE UP FOR DATA COLLECTION REPORTING

Do Not Fold, Soil Or Tear This Card

OEI M71480

A WORK ORDER CARD TRAVELS WITH A PART AND IS USED TO ENTER WORK CENTER LOAD PROGRAMS. ANOTHER CARD UPDATES THE PART'S PROGRESS THROUGH THE SHOP

### Status Production Report, An Exception Report

One of the most valuable reports put out by the system for production control is the material status-production schedule printed out twice weekly. The report, which is really an exception report, spells out each item required and when that item is needed to support the predicted shipping date. It lists forecast quantity (or a set reorder point), cumulative and current period usage, lead time in weeks, the economic order quantity, where used data and average frequency of requirements for each part. Total requirements against the part to date, scheduled receipt, on-hand availability and planned order quantities are totaled and the action required is indicated--such as "initiate shop order," "initiate vendor purchase order," "reschedule," or "expedite."

### Usage and Availabilities Forecast

The forecast used in calculating usage and availabilities is the product of current usage data for inventory parts accumulated in the daily updating program, plus an exponential smoothing factor. In the forecast updating program, the system compares what has actually been sold for the period with the sales forecast for the period and accepts the larger figure to compute possible order availability. The system creates protection stock to match the larger figure which it has chosen.

### Emergencies

In the case of an emergency order, production control personnel can manually override regular computer scheduling by pre-assigning a date, once they have decided that standard materials lead times can be improved by such action. When such a rush order is forced into the system, the computer immediately flags all part numbers which are required to meet the emergency shipment date. These required parts are marked on the action report.

### Results and Future Plans

More than 90 percent of all product bills are processed on Twin Disc's materials planning system. Even in the face of a rapidly expanding production volume, the materials planning system has assisted the firm to predict and in most instances meet delivery dates established by the sales department. The information needed for action is available in a matter of days in either the manufacturing or purchasing operations. In the past, it required five to six weeks before this information was available. Better customer service is provided, as a delivery date is acknowledged to the customer within several days of receipt of the order. Previously the acknowledgement took 10 days to two weeks.

All component parts and assemblies are analyzed for lead time, not just the few which are considered critical. This is important, for example, for other equipment manufacturers who use the firm's power transmission equipment. Their need for reliable availability information is a key element in their production planning.

With the system, production control, by checking the daily action report, knows what parts and materials are needed to meet the order delivery schedule and when they are needed. The report saves the production control manager as much as fifteen hours of tedious paperwork each week.

Order turnaround time has been reduced and service improved with fewer production bottlenecks, and the buildup of inventory investment--the bane of manufacturers and shippers--has been minimized.