Production Management/3000 overview

The efficient management of production resources is made possible using the techniques of Capacity Requirements Planning (CRP) and Shop Floor Control. These techniques build upon a manufacturer's production schedule, an accurate description of the facility, and the steps necessary to fabricate or assemble each part; as well as information about the status and location of each work order. An effective method of dealing with these fundamental issues can provide a manufacturer with a sound foundation for success.

Production planning and control system

Production Management/3000 is a standard application product which helps manage the planning and control functions of a discrete manufacturing company. The objectives of the product are to minimize inventory investment while maximizing asset utilization, shipment performance, and customer satisfaction.

Production Management/3000 is a fully integrated system and addresses the following areas:

Routings and Workcenters—Maintains descriptive, cost, and planning information about each workcenter in a manufacturer's production facility and the routing sequence necessary to build each assembled or fabricated part.

Work-In-Process Control—Provides a variety of tools to analyze the progress of the manufacturing plan and allows production managers to fine-tune the shop floor control process.

Work Order Scheduling—Calculates start and completion dates for each sequence of every production work order under the control of Production Management/3000.

Shop Floor Dispatching—Maintains production priorities to ensure that manufacturing resources are devoted to the right tasks at all times.

Work Order Tracking—Records the progress of each work order as well as related labor charges and exception information.

Capacity Requirements Planning—Anticipates labor and other manufacturing resource requirements on the basis of in-process production work orders and/or planned work orders from a Material Requirements Planning system.
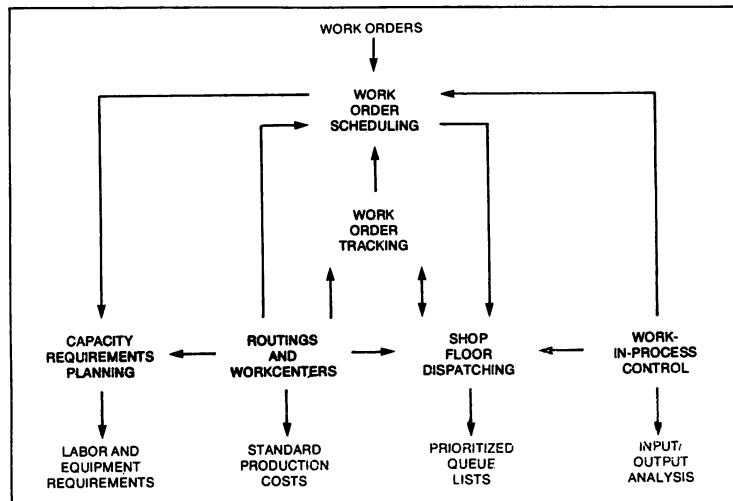
Production Management/3000

PRODUCTION MANAGEMENT / 3000

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The shop calendar

An important factor in the creation of a detailed production plan is a definition of the work schedule for each production area. Production Management/3000 maintains a *shop calendar* which describes the work-day and shift schedules for each workcenter in the manufacturing facility. This calendar can be maintained on-line by shop management and can be modified at any time to reflect changes to the work schedule as soon as they are planned. The Production Management/3000 shop calendar describes schedules for up to three shifts per day, for as many months as necessary.

In addition to a master shop calendar, a separate calendar can be created for any individual workcenter. All Production Management/3000 scheduling and planning functions refer to the same set of shop calendars, providing a consistent basis for detailed production planning and a simple means of indicating holidays and planned work schedules.

Describing the manufacturing process

Part number definition

Each manufactured part, subassembly, and product is assigned a unique *part number*. This number is used throughout Production Management/3000 to access, update, and retrieve information about each item. Part information maintained in Production Management/3000 includes: standard yield percentage, standard run quantity, and part description. If desired, additional data items can be added through the use of the Production Management/3000 customization feature.

Defining production operations

Each basic manufacturing process can be described separately within Production Management/3000 and is assigned a unique *operation* number. Information such as average queue, setup, and unit run times as well as standard manufacturing yield is maintained for each operation along with a brief description of the procedure (i.e., drill, paint, test, etc.).

These operations form the basis for describing the individual steps involved in the manufacturing process for each manufactured part number under the control of Production Management/3000.

Defining workstations

Basis of CRP exception reporting

Defines standard waiting time at this workstation

Routings and Workcenters

Features

- On-line data base update.
- On-line review of routing and workcenter information.
- Standard, common, and alternate routings.
- Capacity specifications of workcenters.
- Cost specifications of workcenters.
- Shop calendars.
- Standard labor and overhead cost calculation.

Description

An accurate model of the manufacturing facility and the procedures used to manufacture each product is essential to all production planning and control functions. The ROUTINGS AND WORKCENTERS module provides for on-line entry, validation, and maintenance of the information which forms the foundation for the operation of Production Management/3000.

The capability to define and maintain standard part routings and manufacturing workcenter descriptions is provided both in Materials Management/3000 and in Production Management/3000. In situations where both Materials Management/3000 and Production Management/3000 are employed together, all facility and routing specifications will be defined and maintained through Production Management/3000. In such cases, the ROUTINGS AND WORKCENTERS module of Materials Management/3000 will be disabled. Standard labor and overhead cost information will be provided to the STANDARD PRODUCT COSTING module of Materials Management/3000 from Production Management/3000.

For customers who choose to install Production Management/3000 *after* Materials Management/3000 is already in operation, information defined in the ROUTINGS AND WORKCENTERS module of Materials Management/3000 can be transferred to the ROUTINGS AND WORKCENTERS module of Production Management/3000 as a part of the normal system installation procedure.

Describing the manufacturing facility

Production Management/3000 views the manufacturing facility as a collection of *workcenters*, each of which shares common personnel, supervision, and/or floor space. Workcenters, in turn, are comprised of one or more *workstations* which represent labor or equipment used to perform each type of production activity. Depending upon the nature of each manufacturing facility,

individual people and/or pieces of equipment can be represented by separate workstations, or those which are more or less interchangable with one another can be grouped together.

A workstation may be thought of as a location at which people and/or machines perform a particular type of activity needed to produce each part, assembly, or product. Information maintained for each workstation includes descriptive and control information such as labor and equipment capacity, average queue delay time, and the percentage of the normal queue which can be compressed for high priority work.

Additional information including average wage rates, production capacity, and the names of responsible managers can be maintained at the workcenter level.

The information maintained for each workstation and workcenter is essential for realistic work order scheduling and tracking, as well as for the calculation of accurate standard labor and overhead cost information.

Alternate workstations

In situations where a routing sequence for a part can be performed equally well at more than one workstation, the various alternatives can be specified by creating multiple entries having the same route-sequence number. On the shop floor, when each work order arrives at a production sequence for which multiple alternatives exist, Production Management/3000 examines the workload in queue at each alternate workstation and then recommends sending the order to the one with the least hours of work waiting to be done.
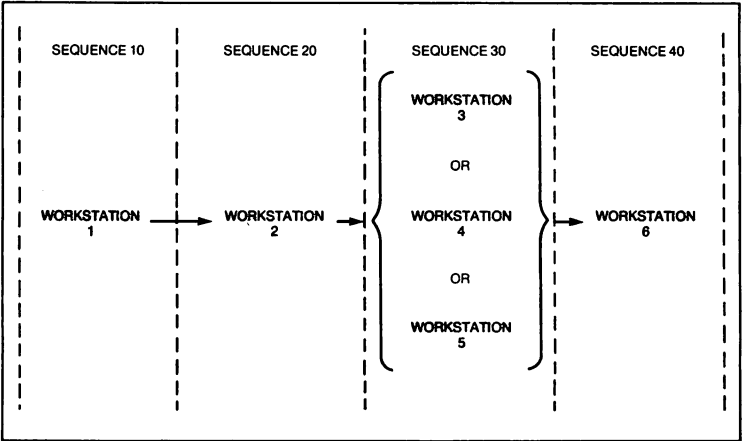
Alternate workstations

Defining standard routings
(Bills of labor)

The sequence of operations required to produce or assemble an item constitutes the *standard routing* (or bill of labor) for that part.

Each sequence in a part's routing must be associated with both a valid workstation and a valid operation. The order of each operation within a part routing is controlled by the user-supplied *route-sequence number*. Any amount of descriptive text may be associated with each route-sequence. In addition, the user may enter the following information for each sequence in the routing:

- Descriptive and control information.
- Machine, tool, and drawing references.
- Setup and unit run times.
- Transit time from the previous operation.

This information provides the basis for all work order scheduling, capacity planning, and shop floor control functions.
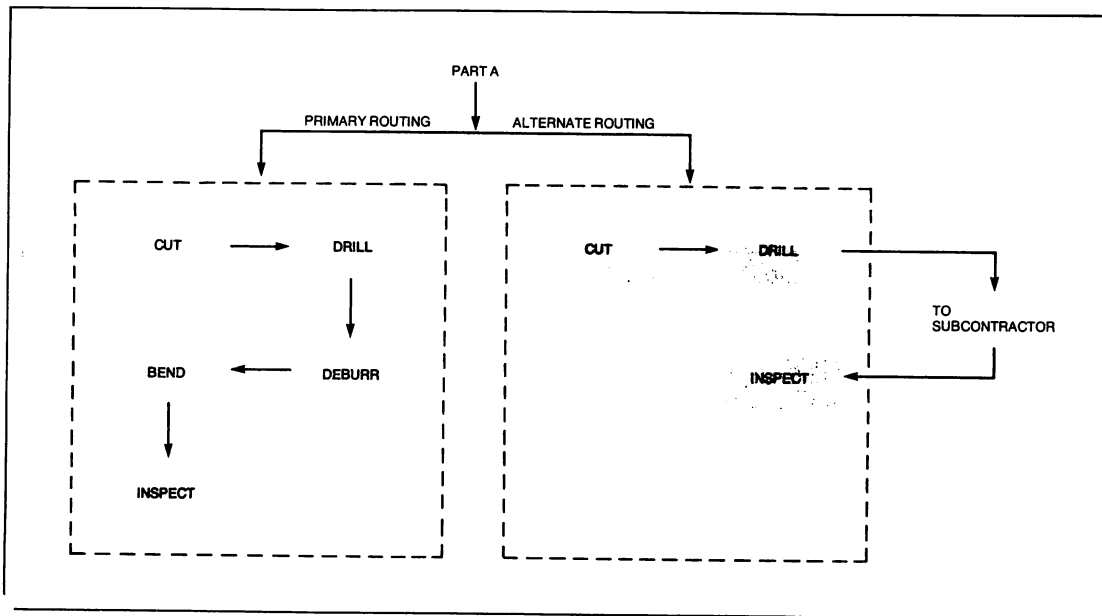

Defining standard routings

Alternate part routings

Alternate routings designed to take advantage of various equipment configurations or subcontractors can be defined in advance. Each alternate routing specified for a part must be complete and is independent of all other routings. When work orders are actually created, any of the specified routings can be selected.

PART A

PRIMARY ROUTING   ALTERNATE ROUTING

CUT → DRILL

DRILL

BEND ← DEBURR

INSPECT

CUT → DRILL

TO SUBCONTRACTOR

INSPECT

Alternate routings

Parallel routing sequences

Production Management/3000 provides the capability to schedule and control multiple *parallel production paths* for each individual part number. This allows related subassemblies to be manufactured on a single production work order and then to be combined without using intermediate inventory levels. Any number of parallel paths can be specified for each part, and each can include as many production sequences as necessary. Each production path is identified by a user-defined *parallel code* attached to each routing sequence, and by a specification of the sequence at which paths "join" for assembly.

Production Management/3000 provides for the scheduling and control of parallel production paths to minimize overall manufacturing lead time, and to keep work-in-process inventory levels to a minimum. In certain types of manufacturing environments, the use of parallel production paths can result in significant reductions in inventory carrying costs.

SEQUENCE 10 PATH 1 → SEQUENCE 20 PATH 1 → SEQUENCE 30 PATH 1

PATH 1 LEAD TIME

SEQUENCE 40 PATH 2 → SEQUENCE 50 PATH 2 → SEQUENCE 90 → SEQUENCE 100

PATH 2 LEAD TIME

SEQUENCE 60 PATH 3 → SEQUENCE 70 PATH 3 → SEQUENCE 80 PATH 3

PATH 3 LEAD TIME

TOTAL PART LEAD TIME
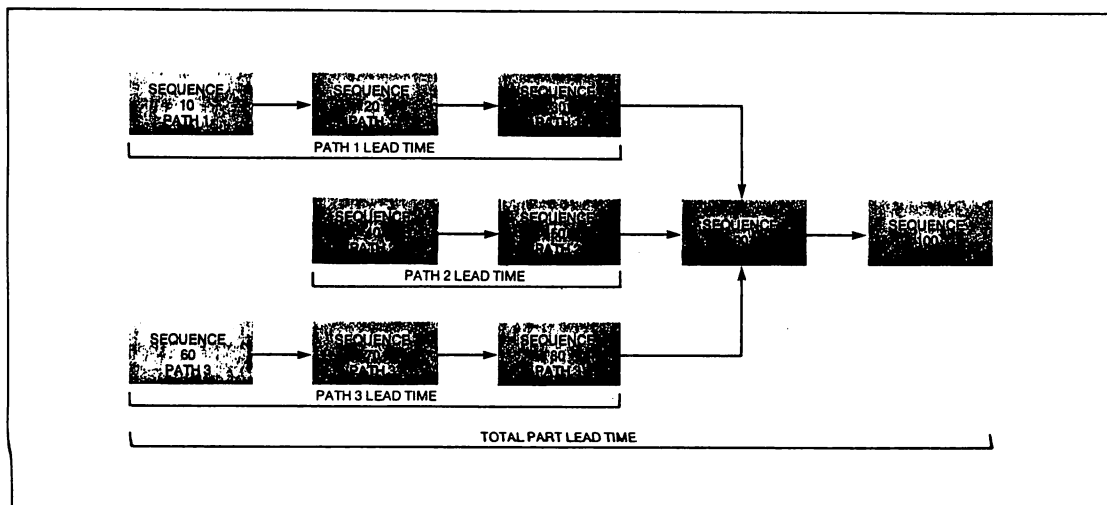
Parallel routing paths

Employee information

Employee information in Production Management/3000 is used primarily for the validation of direct labor charges. An *employee identification code* must be assigned to each employee who will be charging labor time to work orders. As labor is reported, Production Management/3000 verifies that a valid ID code is entered with each transaction. Additional information such as location code and overhead account can be maintained for each employee, for use as reference information.

Standard Product Costing

Production Management/3000 calculates standard labor and overhead costs for each part under its control. These costs are calculated using the run quantity for each part, labor setup and run times from the standard

routing, and overhead and average wage rates from each workcenter. If more than one routing exists for any part, the primary routing is used (i.e., any alternate routings are ignored). This information is available to the STANDARD PRODUCT COSTING module of Materials Management/3000 for use in the standard cost roll-up. For a detailed discussion of STANDARD PRODUCT COSTING, please refer to the chapter describing Materials Management/3000 earlier in this document.

Common part routings

Production Management/3000 allows any part to use the routing defined for any other part as if it were its own. All Production Management/3000 functions can automatically refer to the *common* routings for such a part. This feature eliminates the need to define identical routings for each of a number of similar parts which utilize the same basic manufacturing process.

An additional advantage of this approach is that when the common routing changes in any way, only one *master* routing needs to be modified in order to effect the change for all parts which refer to it. This can represent a substantial reduction in effort and can help to ensure the consistency of manufacturing specifications.
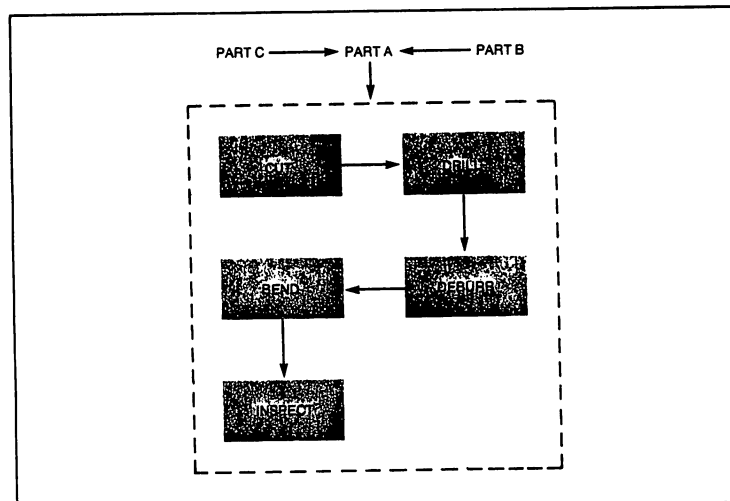
Common routings

Input/Output analysis

The Input/Output analysis report provides a means of evaluating recent performance both in absolute terms, and in the light of previously planned production requirements. *Planned* input and output are presented alongside actual or *observed* input and output for each recent time period, and cumulative changes in backlog are calculated for easy analysis. Early identification of production bottlenecks through the use of Input/Output analysis allows corrective action to be taken before the overall manufacturing plan can be seriously effected.

```
O| PRINT DATE   04/02/81  15:17              HAPPY PEDALER BICYCLE WORKS           |O
O|  RUN    DATE   04/02/81  15:00                  EXCEPTION I/O REPORT              |O
O|                                                    WORK STATION                   |O
O|                                                                                   |O
O|  WKCTR   METAL           TOLERANCES   LOWER   UPPER    CAPACITY = 16 HRS          |O
O|  WKSTN   DRILL             INPUT        80     120     PERIOD   =  2 DAYS          |O
O|  MANAGER-J. FERGUSON       OUTPUT        0     100     AVG OVER  4 PERIODS         |O
O|                                                                                   |O
O|  -PERIOD- -----------INPUT------------- ------------OUTPUT------------ ----BACKLOG----|O
O|   DATE    PLAN  OBSD   DEV  CUM.DEV   PLAN  OBSD   DEV  CUM.DEV   OBSD   PLAN       |O
O|  03/24/81 16.0  14.0  -2.0   -2.0     16.0  15.5  -1.5  -1.5<    42.6              |O
O|  03/26/81 13.5  13.5    .0   -2.0     16.0  15.5   -.5  -2.0<    40.6              |O
O|  03/28/81 17.0  20.0   3.0    1.0     16.0  17.0   1.0  -1.0<    43.6              |O
O|  03/30/81 16.0  12.5  -3.5   -2.5     17.0  12.5  -4.5  -5.5<    43.6              |O
O|  04/01/81 16.0  11.5  -4.5   -7.0     17.0  13.5  -3.5  -9.0<    41.6              |O
O|  04/03/81 16.0                        17.0                              40.6       |O
O|  04/05/81 16.0                        17.0                              39.6       |O
O|  04/07/81 14.0                        17.0                              36.6       |O
O|                                                                                   |O
O|  Standard labor hours      Standard labor hours           Cumulative deviation    |O
O|  scheduled to arrive       actually arriving at           from the production     |O
O|  at this workstation       this workstation               plan at this workstation|O
O|                                                                                   |O
O|       LEGEND:  '<' = Out of Tolerance                                             |O
```

Input/Output report

Work-In-Process Control

Features

- Input/Output analysis.
- On-line work order status and history reporting.
- Work order priority control.
- Work order partialling.
- Work order routing modification.
- Data archiving and retrieval.

Description

WORK-IN-PROCESS CONTROL provides a set of reports and functions which allow production managers to monitor the progress of the manufacturing plan and to override the automatic scheduling and control functions of Production Management/3000 in order to accommodate special situations.

When factors beyond the scope of automatic planning and control arise, Production Management/3000 allows priority and routing decisions to be included directly into the manufacturing plan. This capability removes the need to "work around the system" in special situations; thus integrating the best of automatic scheduling and control with management discretion.
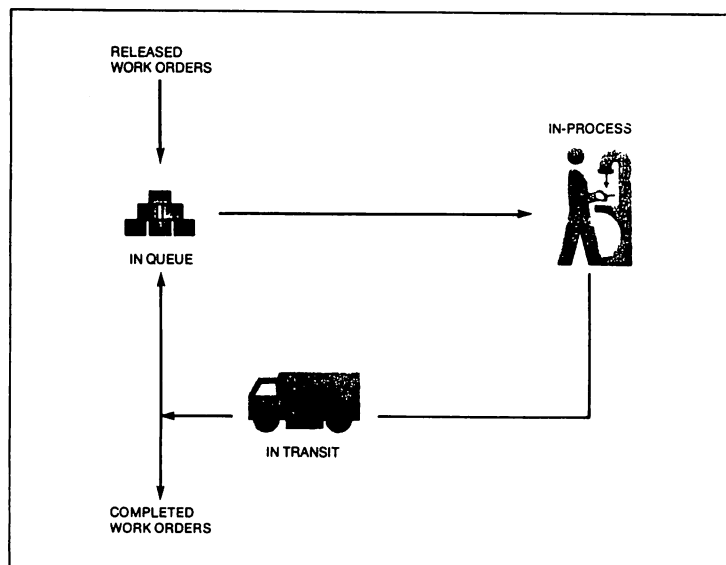
Life cycle of a work order

All planning and control functions of Production Management/3000 revolve around individual production *work orders*. Taken together, all planned and open work orders constitute the current *production schedule*. In order to ensure that the detailed production schedule supports the due dates of all known requirements, Production Management/3000 assumes that infinite production capacity is available at all times. CAPACITY REQUIREMENTS PLANNING evaluates all such requirements over time in order to identify schedules which call for more capacity than is actually available. By evaluating the resource requirements stemming from each work order, *capacity requirements* and *production priorities* can be determined so that specific actions can be recommended by Production Management/3000.

Each Production Management/3000 function uses the current production schedule in a coordinated way as individual work orders proceed through the following life cycle:

Production life cycle

Creating partial work orders

Production Management/3000 provides for the separation of work orders into multiple *partial work orders* at any time. Partial work orders are created by specifying the number of units from the *parent* work order which are to be separated, and the production sequence from which they are to be taken. A separate copy of the work order is then automatically created which has a routing identical to that of the parent.

Once created, partial work orders become independent of their parent work orders and can be assigned separate due dates and/or priorities. For accounting and material planning purposes, all *related* work orders carry the same order number and are distinguished from one another on the basis of the *partial number* assigned to each. Any number of partials can be associated with a single work order number, and partial work orders can be further sub-divided if necessary.

Creating a partial order

Labor reporting and maintenance

Direct labor hours reported on the shop floor can be reviewed by employee, work order, or workcenter. Modifications can be applied to any individual charge, if necessary, prior to the utilization of these records for job costing or other reporting purposes.

Work order status reporting

The current location and status of each work order in process is available at all times for on-line analysis and review. Work-in-process status can be reported either on CRT screens or printed reports by:

■ Individual work order.
■ Workstation or workcenter.
■ Operation number.
■ Part number.

Order routing modification

Production Management/3000 provides the capability to modify the *order routing* for any single work order to accommodate special situations (such as subcontracting) without changing the *standard routing* for the associated part. Such changes are applied to the copy of the routing which is made at the time each work order is *scheduled* (see the section on WORK ORDER SCHEDULING later in this chapter).

Existing *production sequences* can be modified or deleted and new production sequences can be added at any point in the routing. Work orders which are modified in this manner are immediately rescheduled in order to ensure that all changes are accurately reflected in the detailed production schedule.

Reporting work order status

Infinite capacity assumption

For purposes of work order scheduling, Production Management/3000 assumes that infinite production capacity is available at all times. Each work order is scheduled independently and requirements in excess of available capacity are then identified by the CAPACITY REQUIREMENTS PLANNING module (see the discussion of CRP later in this chapter). This procedure ensures that detailed production schedules will support the overall master schedule, and that modifications to the plan based on capacity constraints will be made in a coordinated manner through the materials management function.

The scheduling calculation

Lead time requirements for each work order are calculated by accumulating the specified transit, queue, setup and run times for each production sequence.

Backward and forward scheduling

Once sequence lead times have been calculated, *should-be* start dates can be assigned to each production sequence either by "backward scheduling" from a user-supplied order due date, or by "forward scheduling" from a user-supplied order start date. The dates are established by calculating actual elapsed time required to perform any production sequence and by examining the shop calendar for each workcenter to determine the number of working hours scheduled for any given date and shift.

Parallel production paths

When parallel production paths are defined in the routing for a part (see the ROUTINGS AND WORKCENTERS section earlier in this chapter), each path is scheduled independently so that all will be ready for the joining sequence at the same time. In this way, inventory levels at all points in the manufacturing cycle can be maintained at the lowest possible levels.
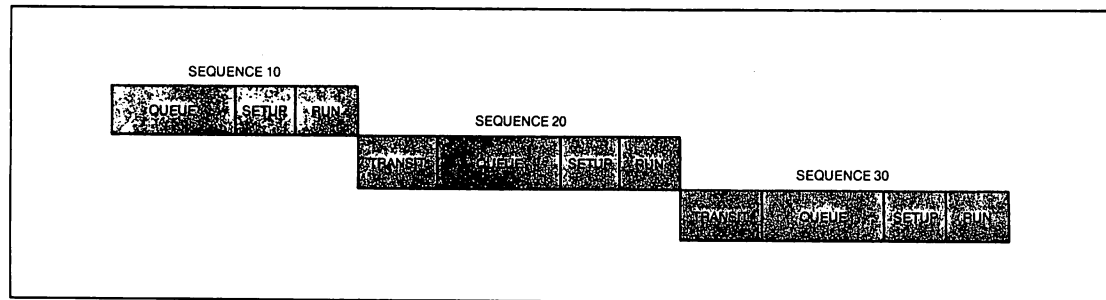
Components of lead time

Work Order Scheduling

Features

- Backward or forward scheduling.
- Infinite capacity scheduling.
- Work order specific routings.
- Overlapped, compressed, and split sequence scheduling.
- Partial work order scheduling.
- Parallel path scheduling.

Description

Work orders can be created as a result of transactions from Materials Management/3000, and/or directly within Production Management/3000. As each work order is created, a unique copy of the standard part routing for that part is made and is associated with the order. This order routing can then

be modified as necessary to indicate unique deviations from the standard routing (refer to the discussion of "Order routing modification" in the WORK-IN-PROCESS CONTROL section earlier in this chapter).

Using the due date of the work order as a basis, scheduled start and completion dates/times are calculated for each production sequence. Work orders are automatically rescheduled whenever their due dates or other specifications are modified. These schedules form the basis for the evaluation of production priorities as well as other planning and control functions.

PART A			WORK ORDER #1234 FOR 100 PART A DUE DEC. 1			
SEQUENCE	OPERATION		SEQUENCE	OPERATION	START DATE	COMPLETE DATE
10	CUT		10	CUT	NOV. 10	NOV. 13
20	DRILL		20	DRILL	NOV. 15	NOV. 24
30	BEND		30	BEND	NOV. 25	NOV. 27
40	DEBURR		40	DEBURR	NOV. 28	NOV. 30
50	INSPECT		50	INSPECT	NOV. 30	DEC. 1
STANDARD ROUTING			ORDER ROUTING			

Standard Routing and Order Routing

Shop Floor Dispatching

Features
- Routing Lists.
- On-line review of workcenter status.
- Dispatch lists by workstation or workcenter.
- On-line priority calculation.
- Multiple dispatching rules.
- Manual priority override.

Description
The SHOP FLOOR DISPATCHING module provides the tools to ensure that manufacturing resources are devoted to the right work orders at all times. The SHOP FLOOR DISPATCHING module evaluates production priorities dynamically on the basis of up-to-date status information and makes these priorities visible when needed on the shop floor.

Overlapping, splitting, and queue compression

Production Management 3000 provides for three methods of reducing the manufacturing lead time for a part below that which results from the scheduling calculation described above:
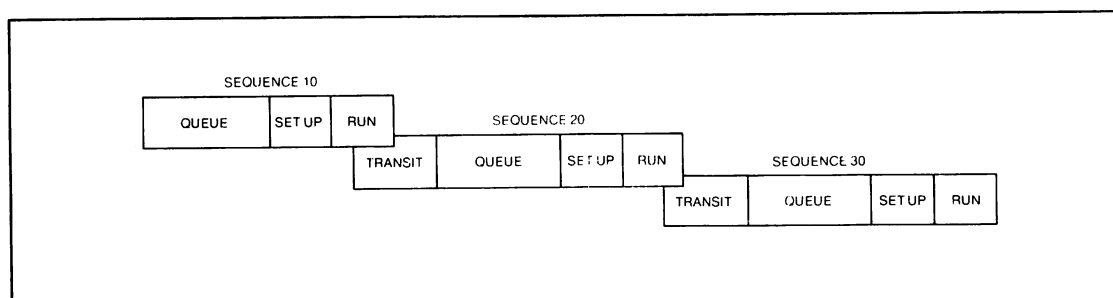
Overlapped sequences—Are those where some part of a work order is moved on to begin the next production sequence before all units on the work order have been completed. The effect is to "overlap" process times at two sequences and to reduce the overall elapsed time required for completion of a work order. Overlap can be specified either for individual routing sequences or for all sequences in a standard part routing.

Split sequences—Are those where more than one person or machine performs work concurrently at a single production sequence. The number of such people or machines can be specified for any sequence of a part's routing, which has the effect of reducing the *processing* portion of elapsed lead time.

Queue compression—Is a means of pre-expediting a work order by assuming less than standard queue times when calculating scheduled start dates for each production sequence. Since these dates form the basis for the assignment of relative priorities among work orders in queue, this has the effect of assigning the *compressed* work order a higher priority at each sequence than it would normally have. This is accomplished by specifying a "queue compression factor" for a work order which indicates the percentage of the standard queue which is to be removed for scheduling purposes.

	SEQUENCE 10										
QUEUE	SET UP	RUN									
	TRANSIT		SEQUENCE 20								
		QUEUE	SET UP	RUN							
			TRANSIT		SEQUENCE 30						
				QUEUE	SET UP	RUN					

Overlapped scheduling

Work order priority calculation

The relative priority of each work order in the queue of each workstation is evaluated on the basis of a user-specified system value which defines the *facility dispatching rule*. Two such dispatching rules are provided by Production Management/3000:

Scheduled start dates—The scheduled start dates assigned to each production step by the WORK ORDER SCHEDULING module are compared with one another, and higher priorities are assigned to work orders with earlier dates.

Critical ratio—Priorities are based upon the ratio between the remaining lead time for each work order, and the elapsed time remaining until the due date for that work order. Work orders with *lower* critical ratios have higher priorities.

In either case, these priorities can be overridden, as necessary, by user-specified priority assignments.

When personnel or machines become available, a dispatcher can obtain a list of jobs currently waiting at any workstation or workcenter in priority order. This list can be produced either on-line or in printed form.

Selecting work from queue

Releasing work orders

Once shop management has determined that all materials and documentation necessary to begin production activity on a given work order have been assembled, the order is *released* to the queue of the first production sequence. At that time a *Routing List* is printed which describes the routing for that order in detail. This Routing List is added to the shop packet and travels with the work order through the production process.

As work order movement or schedule changes take place, the Production Management/3000 data base is modified immediately to reflect the current status of work-in-process at all times. This dynamic model of the shop environment provides the basis for *dispatching* work according to the latest priorities whenever manufacturing resources become available.

Work order Routing List

Work Order Tracking

Features

- On-line work order status review.
- Interactive step completion reporting.
- Factory Data Capture terminals.
- Partial work order tracking.
- Rework and scrap reporting.
- Exception reporting.
- Automatic load balancing.
- Labor collection.

Description

In order to effectively establish production priorities and provide shop managers with the information necessary to properly manage the manufacturing environment, Production Management/3000 must maintain an accurate picture of the status and location of each work order (or partial work order) at all times. Work order status information is collected *on the shop floor* at the time production activity actually takes place. Either simplified HP Factory Data Capture terminals or full-screen CRTs can be used for this purpose.

Work order status can be modified in either of two ways:

1) As a result of completing an operation. When a production *step completion* is reported, the status of the associated work order is automatically changed from *in process* at the current sequence to *in transit* to the next sequence.

2) Through the use of a specific transaction which modifies the status of a work order sequence to indicate that it has changed from one status to another (e.g., *in transit* to *in queue*, or *in queue* to *in process*).

Work order status reporting

The current location and status of each work order in process is available at all times for on-line analysis and review. Work-in-process status can be reported either on CRT screens or printed reports by:

- Individual work order.
- Workstation or workcenter.
- Operation number.
- Part number.

Selecting work orders from available queue

As each work order is selected from queue for processing, its status is changed from *in queue* to *in process* using the WORK ORDER TRACKING function to indicate that it is being worked on.

Dynamic shop floor dispatching ensures that priorities are up to date at all times, reflects changes to the overall production plan quickly, and can reduce or remove the need for manual expediting of hot jobs.

Changing the status of a lot

Production exceptions

Information describing material failures, scrap losses, rework activity, or other exceptional conditions associated with each work order sequence can be collected and stored for analysis and review. This information can be entered at the time work orders are being tracked from one production sequence to another, or separately when exceptions are actually detected.

Exceptions can be recorded either as *free-form comments*, or in terms of predefined codes which can be analyzed on a statistical basis. *Exception codes* and their definitions can be described at any time and can be either *global* or *local* in scope. *Global exception codes* can be used to describe unusual events regardless of where in the manufacturing facility they occur, while *local exception codes* apply only to those workcenters with which they have been specifically associated.

Recording exception information

Pre-defined exception code

Free-form comment

Production sequence completions

As soon as each production sequence has been completed, the results can be reported to Production Management/3000 *by the people who actually perform the work.* The number of units completed, scrapped (lost), bonused (found), and reworked at each sequence can be entered via an HP Factory Data Capture terminal or a full-screen CRT. Related information such as direct labor charges, material failures, or other exceptions can be collected either all at one time as a part of the *step completion* transaction, or separately through individual transactions designed specifically for each type of information.

Completing a production sequence

Labor collection

Production Management/3000 provides the means to capture and record direct labor hours applied to each work order sequence. Labor hours are reported directly by shop personnel *on the shop floor* where work is actually being performed. As each entry is made, Production Management/3000 ensures that a valid employee ID and work order number have been provided.

Labor hours can be entered at the time work orders are being tracked from one production sequence to another, or through separate transactions as work is actually performed. Labor charges can be modified at any time and accumulated hours can be reported by employee ID, work order number, or workcenter.

Charging time to a work order

Capacity Requirements Planning

Features

- Load projection by workstation.
- Exception reporting.
- Summary workcenter reporting.
- Alternate load measures.
- User-defined reporting periods.
- Load detail reporting.

Description

CAPACITY REQUIREMENTS PLANNING can be used to plan labor and other manufacturing resource requirements over time at the workstation and workcenter level. It can use both existing work orders and production requirements suggested by Materials Management/3000 or another similar system. It provides a tool to highlight potential capacity constraints and provides information that can be used to help ensure that appropriate resources are available when needed and to smooth the workload for a manufacturing facility.

Capacity Requirements Planning

Balancing load among alternate workstations

When successful completion of a production sequence is reported, the status of the work order is modified to indicate that it is in transit to the next production sequence. In cases where more than one alternate workstation has been specified for the next production sequence, Production Management/3000 will examine the amount of work in the queue of each alternate workstation. The work order will then automatically be made available in the queue of the workstation with the least hours of work waiting to be done and the user will be notified which workstation has been selected.

This technique for *load balancing* provides for the even distribution of work among alternate workstations, and consequently for the reduction of lead times and inventory levels.

Load balancing

Workcenter summary reporting

In situations where direct labor personnel are trained to move among several different workstations in response to changing workloads, the true labor capacity of a workcenter may be less than the sum of the capacities of all workstations within it. In addition to work*station* load reports, Production Management/3000 provides summary load reports for each work*center* which can help to identify resource constraints which might not be visible at the workstation level.

EQUIPMENT
AVAILABLE
8 HOURS/DAY—
TOTAL = 32 HOURS

LABOR
AVAILABLE
8 HOURS/DAY—
TOTAL = 16 HOURS

Workcenter labor capacity

Calculation of requirements

The calculation of manufacturing resource requirements is accomplished by *scheduling* each work order in the *production schedule* using *part and order routings* and the *shop calendar* to determine *detailed load requirements* for each work order. Each work order is scheduled independently of all others as if infinite capacity were available at all times. These detailed load requirements are then accumulated *by workstation* for each user-defined time period (days, weeks, months or quarters), forming a *load profile* for each workstation.

Alternate load measures

Although labor is often the capacity constraint in manufacturing operations, this is not always the case. CAPACITY REQUIRE-MENTS PLANNING can calculate resource requirements both in terms of labor hours *and* one alternate unit of measure (e.g., machine hours, cm2, etc.) which can be specified for each workstation. Both load measures are accumulated and reported separately for each workstation, so that they can be analyzed

independently of one another or together. This capability provides the flexibility to evaluate resource requirements in terms most appropriate to each individual workstation.

Load profile reporting

After all time-phased *load profiles* have been calculated, the resulting resource requirements are compared with the *standard production capacity* specified for each workstation. In cases where requirements differ from standard capacity by more than a user-specified percentage, a *workstation load report* is printed which describes the load profile of that workstation and indicates the time periods in which *overload* or *underload* conditions are anticipated.

```
PRINT DATE    04/02/81   15:52                    HAPPY PEDALER BICYCLE WORKS                              PAGE    1
RUN    DATE   04/02/81   15:00              EXCEPTION CAPACITY PROJECTION REPORT
                                                     WORK STATION


WKCTR   METAL                                      D   W   BW   M    Q   SA   A
WKSTN   DRILL                    UPPER TOLERANCE  115 120 120 125  1 8 150 150
MANAGER-J. FERGUSON              LOWER TOLERANCE   90  85  85  80   60  60  50


---PERIOD---  -MACHINE--  ---------LABOR LOAD---------  LABOR --DEVIATION-  --------UTILIZATION OF SCHEDULED CAPACITY---------
  DATE   LEN  LOAD   CAP  RLSD  OPEN  PLAN  SUGG  TOTAL  CAP  CUR   CUM   %  OUT .       50.       100.      150.      200.
04/02/81   1    0     0     6     4    0     0     10<    8   2     2  125   10 XXXXXXXXXXXXXXXXXXXXXXXXX
04/03/81   1    0     0     5     3    0     0      8<    8   0     2  125   10 XXXXXXXXXXXXXXXXXXXXXXXXX
04/04/81   1    0     0     7     3    0     0     10<    8   2     4  150   35 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
04/05/81   1    0     0    12     0    0     3     15<    8   5     9  213   98 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX+
04/08/81   1    0     0     2     6    0     0      8<    8   0     9  213   98 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX+
04/09/81   1    0     0     0     7    0     0      7<    8  - 1     8  200   85 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
04/10/81   1    0     0     0     4    2     2      8<    8   0     8  200   85 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
04/11/81   1    0     0     0     0    6     0      6<    8  - 2     6  175   60 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
04/12/81   1    0     0     0     0   10     4     14<    8   6    12  250  135 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX+
04/13/81   7    0     0     0    12   46     0     58<   40  18    30  175   60 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
04/20/81   7    0     0     0     0   48    10     58<   40  18    48  220  105 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX+
04/27/81   7    0     0     0     0   36     0     36<   40  -4    44  210  105 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX+
05/04/81   7    0     0     0     0   38     2     40<   40   0    44  210  105 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX+


LEGEND:            '<' = Out of Tolerance
        Length:  'D' = Daily   'W' = Weekly   'BW' = Biweekly   'M' = Monthly   'Q' = Quarterly   'SA' = Semiannual   'A' = Annual
```

Workstation load profile

Calendar days in reporting period

Total labor hours planned for each period

Percent by which planned load is outside of stated tolerances

Load detail reporting

In situations where examination of the load profile report identifies overload conditions which need to be corrected, a *load detail report* can be requested for any individual workstation. The load detail report indicates the specific work orders which contribute to the accumulated load profile during each time period, and the amount of workload which each represents.

On the basis of this information, individual work orders can be rescheduled into earlier or later time periods to arrive at a load profile which better fits the available manufacturing resources.

```
PRINT DATE   04/02/81  15:52              HAPPY PEDALER BICYCLE WORKS                              PAGE    1
RUN  DATE    04/02/81  13:49           DETAIL CAPACITY PROJECTION REPORT
                                                WORK STATION


 WKCTR   METAL                         D    W   BW    M    Q   SA    A
 WKSTN   DEBURR             UPPER TOLERANCE 115 120 120 125 140 150 150
 MANAGER-J. FERGUSON        LOWER TOLERANCE  90  85  85  80  60  60  50

 ---PERIOD--- ---PART NUMBER---- PL --------ORDER------- --SCHEDULED DATE- OPER MACHINE- -LABOR-- ----SCHEDULED---- ---WORKSTATION--
   DATE  LEN                        NUMBER  PRTL TP QTY  IN   START  OUT  NDR  LOAD CAP LOAD CAP DEV   CUM LD% OUT PREV    NEXT
 4/02     1 3940-0498               WO200168      OP  32 04/02 04/02 04/02 DB03    .0    1.5                      DRILL   PAINT
           8498-0498               WO200527      OP  50 04/02 04/02 04/02 DB01    .0    2.2                      DRILL   PAINT
           9487-1152               WO200886      OP 100 04/02 04/02 04/02 DB01    .0    2.5                      DRILL   PAINT
           8376-8274               WO201245      OP 110 04/02 04/02 04/02 DB01    .0    3.0                      DRILL   PAINT
           0938-1784               WO201604      OP  75 04/02 04/02 04/02 DB01    .0    1.5                      DRILL   PAINT
           7467-6662               WO201963      OP  90 04/02 04/02 04/02 DB01    .0    4.5                      DRILL   PAINT
           8578-8391               WO202322      OP 100 04/02 04/02 04/03 DB01    .0    2.2                      DRILL   PAINT
           6473-0395               WO202681      OP 100 04/02 04/02 04/02 DB07    .0    3.4                      DRILL   PAINT
           8495-1722               WO203040      OP 225 04/02 04/02 04/02 DB11    .0    1.0                      DRILL   PAINT
           4095-2883               WO203399      OP 400 04/02 04/02 04/02 DB01    .0    2.5                      DRILL   PAINT
           7459-0384               WO203758      OP 430 04/02 04/02 04/02 DB01    .0    3.0                      DRILL   PAINT
           9847-7844               WO204117      OP 100 04/02 04/02 04/03 DB01    .0    2.2                      DRILL   PAINT
           1872-1846               WO204476      OP  48 04/02 04/02 04/02 DB01    .0    3.0                      DRILL   PAINT
           8732-3784               WO204835      OP  48 04/02 04/02 04/02 DB01    .0    2.5                      DRILL   PAINT
                                        TOTAL                                     .0   35.0 40.0 5.0


 LEGEND:              '<' = Out of Tolerance
          Length:   'D' = Daily   'W' = Weekly    'BW' = Biweekly    'M' = Monthly    'Q' = Quarterly    'SA' = Semiannual   'A' = Annual
```

Starting date of reporting period

Planned labor requirements for each work order

Load detail report