Part 1: System Management.

Ch.6 Manufacturing Planning & Control System.

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Manufacturing Planning & Control Systems.
Manufacturing Planning System.

Manufacturing Planning & Control Systems.

- Strategic Planning
- Business Planning
- Financial Planning

Sales & Operations Planning

- Master Planning of Resources
- Detailed Scheduling and Planning
- Execution and Control of Operations

Resource Management

- Material Planning & Scheduling
- Resource Management
- Financial/Accounting Mgmt.

Measurements and Results

- Intermittent Production
- Continuous Production

- Capacity Planning & Scheduling
- MRP (Order or Rate Based)

- Simulations
- Capacity Planning
- Documentation

- Lean Manufacturing
- Outside Source Planning
- Quality

- Advance Planning and Scheduling
- Rough-Cut Capacity Planning
- Procurement

- Master Production Scheduling
- Constraint Management
- Shop Orders

- Bridge
- Bridge
- Bridge
Manufacturing Planning System.

Production Planning System.

- **Master Planning.**
  - It covers that part of the continuum that takes the business plan and converts it into a matching sales and operation plan.
  - The plan broadly defines what products groups and volumes are required to match up with the business revenue plans and planning sales levels, taking into account any required adjustments to aggregate inventory across a longer distant time frame.
  
  - Major functions of mater planning.
    - Forecasting and demand management.
    - Production planning (Sales and operations planning).
    - Resource planning.
    - Master production scheduling
Manufacturing Planning System.

Production Planning System.

- Detailed Scheduling & Planning.
  - The activities required to convert the broad plans coming out of master planning of resources into more precise, shorter detailed schedules and plans.

  - Major functions.
    - End-item master production scheduling.
    - Material requirement planning.
    - Capacity requirement planning.
    - Testing for feasibility.
    - Order(job) releasing to execution and control.
Production Planning System.

- **Execution & Control of Operation.**
  - The activities required to covert the intermediate schedules and plans coming out of detailed scheduling and planning into more precise, very short time frame priorities and control mechanisms.

  - To perform this function, two pieces of data must be made available to the controller managing the operational area. The pieces of information are the priority of all jobs in the queue and the identification of jobs that have material on hand versus those that do not.

  - Major functions.
    - Shop(operations) floor management systems.
    - Supplier management system.
Sales & Operation Planning.

- Introduction.
Sales & Operation Planning.

■ Characteristics of S&OP
  • It is a business process.
  • It is designed to keep demand and supply in balance.
  • It is performance at the aggregate level of product families or groups.
  • It occurs on a monthly cycle. It displays information in both product units and financial numbers.

■ Process of S&OP.
  • The sales and marketing departments assess the market potential, and forecast demand.
  • The updated marketing plan is communicated to manufacturing, engineering, and finance.
  • If these departments find they cannot accommodate the new marketing plan, then the marketing plan must be adjusted.
## S&OP Inputs & Outputs.

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
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<tbody>
<tr>
<td>• Business Plan (Top Management)</td>
<td>• Sales plan (Marketing and sales)</td>
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<td>• Projected demand (Marketing)</td>
<td>• Production plan (Manufacturing)</td>
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<td>• Market intelligence (Marketing)</td>
<td>• Inventory plan (Management)</td>
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<tr>
<td>• Actual sales (Sales)</td>
<td>• Backlog projection (Management)</td>
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<td>• Capacity information (Manufacturing)</td>
<td>• Purchasing plan (Purchasing)</td>
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<td>• Financial requirement (Finance)</td>
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<td>• New product information (R&amp;D)</td>
<td>• Engineering plan (Engineering)</td>
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<td>• New process information (Process engineering)</td>
<td>• Workforce plan (Human resource)</td>
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<tr>
<td>• Workforce availability (Human resource)</td>
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## Sales & Operation Planning.

- **S&OP Example: Make-to-Stock**

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</table>

※ Current period = March
Sales & Operation Planning.

- Production Planning: Basic Strategy.
  - Chase (Demand Matching) Strategy: The goal of the chasing strategy is to produce the amounts demanded at any time. Because inventory does not build up, the cost of inventory is kept at minimum.

  - Level Production Strategy: The goal of this strategy is to continuously produce an amount equal to the average demand.
Master Production Scheduling.

- Definition.
  - The anticipated build (or buy) schedule for those items assigned to the master scheduler. The master scheduler maintains this schedule, and in turn, it becomes a set of planning numbers that drives materials requirement planning.

  - The master schedule must take into account the forecast, the S&OP, and other important considerations such as backlog, availability of material, availability of capacity, and management policies and goals.
### Master Production Scheduling.

#### Master Schedule Formats.

- **Lot Size**: 50
- **On Hand**: 50
- **Lead Time**: 2 Periods.

Demand Time Fence: 3
Planning Time Fence: 8

<table>
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<tr>
<th>Item: 78100</th>
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<td>Orders</td>
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<td>Projected Available Balance</td>
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<tr>
<td>Available-to-Promise</td>
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<tr>
<td>MPS</td>
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</table>
Master Production Scheduling.

- **Inputs of Master Schedule.**
  - Forecast: The anticipated demand for a period within a certain time period.
  - Customer order: The backlog of planned shipment for the product.
  - Projected available balance (PAB): An inventory balance projected into the future.
  - Available-to-Promise (ATP): The uncommitted portion of a company's inventory and planned production, maintained in the master schedule to support customer order promising.
  - Master production scheduled quantity: When the PAB becomes negative or has reduced the safety stock, an MPS quantity must be scheduled.
Master Production Scheduling.

- **Planning Horizon.**
  
  - The planning horizon is the time span for which plans are made. It must cover a period at least equal to the time required to accomplish the plan.
  
  - The master production scheduling, the minimum planning horizon is the longest cumulative or end-to-end item lead time.
Master Scheduling.

Master Production Scheduling.

■ Time Fence.
  • A policy or guideline established to note where various restrictions or changes in operating procedures take place.

  • Demand Time Fence (DTF)
    A future master schedule period inside of which changes to the MPS are typically not accepted due to the excessive cost caused by schedule disruption.

  • Planning Time Fence (PTF).
    A future master schedule period inside of which changes to the MPS are evaluated to prevent costly schedule disruption. The MPS is typically stated as firm planned orders inside the PTF.
Master Production Scheduling.

- Calculating MPS.

Lot Size : 50  
On Hand : 50  
Lead Time : 2 Periods.

Demand Time Fence : 3  
Planning Time Fence : 8

<table>
<thead>
<tr>
<th>Item</th>
<th>Forecast</th>
<th>Orders</th>
<th>PAB</th>
<th>Available-to-Promise</th>
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<td>50 50 50</td>
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Material Requirement Planning.

- MRP Concepts.
  - A set of techniques that uses bill of material data, inventory data, and the master production schedule to calculate requirements to materials. It makes recommendations to release requirements orders for material.

  - Time-phased MRP determines:
    1. The quantity of all components and materials required to fabricate those items.
    2. The date that the components and materials are required.

  - Time-phased MRP is accomplished by:
    1. Netting. (or adjusting for inventory quantities on hand or on order).
    2. Lead time offsetting.
    3. Exploding the bill of material.
Material Requirement Planning.

- **MRP Inputs.**
  - Master Production Schedule.
    The anticipated build schedule for those items assigned to the master scheduler. It is a statement of which end items are to be produced, the quantity of each, and the date they are to be completed.

  - Inventory Record.
    - Planning factors: Order quantity, Lead times, Safety stock, Scrap.

  - Bills of Materials.
    The bill of material shows all the parts required to make ONE of the item.
Material Requirement Planning.

- MRP Grid & Bills of Materials.

- Order Quantity: 50 units
- On-hand Balance: 10
- Safety Stock: 0
- Allocated Qty: 0
- Lead-Time: 1 weeks
- Low Level Code: 0

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<tr>
<td>Projected Available</td>
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</tr>
</tbody>
</table>

A

- LT: 1 week
- Qty: 2 units

B

- LT: 1 week
- Qty: 2 units

C

- LT: 1 week
- Qty: 3 units

D

- LT: 1 week
- Qty: 1 unit
### Material Requirement Planning.

#### MRP Explosion

- **Order Quantity**: 50 units
- **On-hand Balance**: 10
- **Safety Stock**: 0
- **Allocated Qty**: 0
- **Lead-Time**: 1 weeks
- **Low Level Code**: 0

<table>
<thead>
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<td>Planned Order Release</td>
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- **Order Quantity**: 50 units
- **On-hand Balance**: 50
- **Safety Stock**: 10
- **Allocated Qty**: 0
- **Lead-Time**: 1 weeks
- **Low Level Code**: 1

<table>
<thead>
<tr>
<th>Periods</th>
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50×2 = 100
Material Requirement Planning.

■ MRP Explosion

- Gross Requirement.
  The total of independent and dependent demand for a component before the netting of on-hand inventory and schedule receipt. In level 0, gross requirement is determined by MPS, but in other levels, it is determined by multiplying the needed unit by the upper level planned order release thought BOM structure.

- Scheduled Receipts (Open order).
  A released manufacturing order or purchase order, or unfilled customer order.
Material Requirement Planning.

**MRP Explosion**

- **Net Requirement.** The net requirement for a part or an assembly are derived as a result of applying gross requirements and allocations against inventory on hand, scheduled receipts, and safety stock. Net requirements, lot-sized and off-set for lead time, become planned orders.

- **Netting** - The process of calculating net requirements.

- **Lead Time Offsetting (Offsetting).** This is the process of placing the exploded requirements in their proper periods based on lead time.

- **Level by Level Explosion.** Higher level planned orders become lower level gross requirement in MRP process.
Material Requirement Planning.

- **MRP Outputs.**
  - Planned Production Orders. (Quantity, Timing).
  - Planned Purchase Orders. (Quantity, Timing).
  - MRP Exception Message. (Releasing, Expediting, Order Cancelation)
  - Pegging Report.
    The pegging report shows the parents creating the demand for the components, the quantity needed, and when they are needed. Pegging keeps track of the origin of the demand.
Production Activity Control Systems.

Definition.

- Production Activity Control.
  - Production activity control (PAC) represent the implementation and control phase of the production planning and control system. PAC is composed of shop scheduling and control, typically referred to as shop floor control (SFC), and supplier management systems.
  
  - Supplier management system is responsible for establishing and controlling the flow of raw materials into the factory, and shop flow control is responsible for planning and controlling the flow of work through the factory.
Main Activities.

- The Major Subfunctions of SFC.
  - Assigning priority of each shop order.
  - Maintaining work-in-process quantity information.
  - Conveying shop order status information to the office.
  - Providing actual output data for capacity control purpose.
  - Providing quantity by location by shop order for work-in-process inventory and accounting purpose.
  - Providing measurement of efficiency, utilization, and productivity of the workforce and machines.
**Main Activities.**

- **Backward & Forward Scheduling.**
  - Backward Scheduling.
    
    The last operation on the routing is scheduled first and is scheduled for completion at the due date. This schedules items to be available as needed and is the same logic as used in the MRP system.
Main Activities.

- Backward & Forward Scheduling.
  - Forward Scheduling.
    Material procurement and operation scheduling for a component start when the order is received. Whatever the due date, and operations are scheduled forward from order received date.
Main Activities.

- Bottleneck Management.
  
  - A bottleneck is defined as "a facility, function, department, or resource whose capacity is equal to or less than the demand placed upon it." Bottlenecks control the throughput of all products processed by them.
  
  - Some Principles of Bottleneck Management.
    1. Identify the bottlenecks
    2. Apply greatest efforts to improve capacity and adjust load
    3. Reduce queues at non-bottleneck work center.
    4. Allow queues at bottlenecks: do not let them run out of work.
    5. Feed quality parts to bottlenecks: do not waste their time on bad parts.
      
      If necessary, inspect parts before the critical operations.
    6. Continue improvements until bottlenecks are relieved.
Main Activities.

- **Operation Sequencing.**
  
  - Dispatching is a function of selecting and sequencing available jobs to be run at individual workcenters.

  - The information of dispatching list.
    1. Plant, department, and workcenter.
    2. Part number, shop order number, operation number, and operation description of jobs at the workcenter.
    3. Standard hours.
    4. Priority information.
    5. Jobs coming to the work center.
Main Activities.

- **Operation Sequencing.**
  - First come, first served (FCFS).
  - Earliest job due date (EDD).
  - Earliest operation due date (ODD).
  - Shortest process time (SPT).
  - Critical ratio (CR).

\[
CR = \frac{\text{Due date} - \text{Present date}}{\text{Lead Time Remaining}} = \frac{\text{Actual Time Remaining}}{\text{Lead Time Remaining}}
\]

<table>
<thead>
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<th>Operation Due Date</th>
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Performance Check.

1. Production and resource planning considers
   I. Process and schedule definition.
   II. Capacity evaluation and adjustment.
   III. Work center scheduling and expediting.


2. Which of the following correctly represents functional goal in the organization?
   I. Sales wants no missed deliveries and a narrow product line.
   II. Finance wants to minimize investments in equipment and inventory.
   III. Manufacturing wants low per-unit product costs.
   IV. Engineering wants long product-development times.

   A. I, IV   B. II, IV   C. I, III, IV   D. II, III, IV
3. The chase strategy would be likely to
   I. Have relatively high inventories.
   II. Stabilize employment and subcontracting.
   III. Have periodic capacity-change costs.
   IV. Use extensive overtime during peak periods.

   A. I, III  B. I, II, IV  C. II, IV  D. III, IV

4. Production planning may be used for
   A. Make-to-stock, but not make-to-order, environments.
   B. Level and seasonal production environments.
   C. Make-to-order, but not make-to-stock, environments.
   D. Level, but not seasonal, production environments.
5. A time fence policy does work of the following?
   A. Controls the amount of change that can occur during predefined areas of the planning horizon.
   B. Controls supply planning information for production.
   C. Avoids excess inventory through a dynamic process.
   D. Monitors changes in supply and demand conditions.

6. Which of the following are data required for the development of a realistic master schedule?
   I. New product introduction schedule
   II. Sales forecasts.
   III. Shipment history.
   IV. Workforce constraint.

   A. I, II, III.  
   B. I, II, IV.  
   C. I, III, IV.  
   D. I, II, III, IV.
7. Which of the following is defined as the process of converting the master schedule into the load for critical resource?
   A. Available-to-promise.                  B. Resource capacity planning.

8. Which of the following is the process of creating a detailed statement of independent demand that is used to develop detailed material and capacity plans?
   A. Master scheduling.                  B. Master planning of resources.
9. What is the portion of inventory or production that is NOT committed to customer orders called?
   A. Free stock.  
   B. Available-to-promise.  
   C. Excess production.  
   D. Waste.

10. Lead-time offsetting can be described as
   A. Positioning the planned order release in advance of the date of need by the length of the lead time.
   B. Adding some safety time to lead time to offset unforeseen manufacturing problems.
   C. Scheduling material to be delivered earlier than called for by the requirements plan.
   D. Compensating for the difference between actual and planned lead times.
11. The main reason for level-by-level processing is to
   A. Provide time-phased schedules.
   B. Accumulate higher-level requirements before netting.
   C. Allow pegging.
   D. Avoid exploding product by product.

12. MRP explosion is the process of
   A. Extending requirements from parent to component.
   B. Detailing the timing of requirements.
   C. Calculating net requirements from gross requirements and on hand.
   D. Expanding requirements to cover in-process losses.
13. The three primary inputs to an MRP system are
   A. Bills of material, inventory status, and master production schedule.
   B. Bills of material, product structure trees, and inventory status.
   C. Bills of material, customer orders, and master production schedule.
   D. Product structure trees, master production schedule, and lot sizes.

14. Which of the following problems could result from inaccurate bills of material?
   A. Inaccurate on-hand inventory balances.
   B. An overstated master production schedule.
   C. Inaccurate raw material requirements.
   D. Invalid operation due dates.
15. Which of the following questions should be included in a checklist used to measure the success of a newly implemented MRP system?
   A. Is the fabrication workload more level than before?
   B. Have lead times been reduced?
   C. Has the cost per order placed been reduced?
   D. Has the number of purchase orders being expedited been reduced?

16. What is the name given to a scheduling system in which the last operation on a routing is scheduled first and for completion on the due date?
   A. Forward scheduling.  
   B. Backward scheduling.
   C. Infinite scheduling.  
   D. Finite scheduling
Performance Check.

Solutions.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
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