# 6

# MASTER PRODUCTION SCHEDULE

MGT2405, University of Toronto, Denny Hong-Mo Yeh

So far, in discussing material requirement planning (MRP), we have assumed that master production schedule (MPS) is ready to be fed into MRP. In fact, human users involve in MPS procedure much more than in MRP. MPS drives all kinds of planning including MRP of an enterprise. MPS is so important that users involve intensively, while MRP is normally an automatic computer procedure.

## MPS Objectives and Data Sources

In this section, we discuss the importance of MPS and its input data. MPS itself is a major input to the MRP.

- *Importance of MPS*

  A production plan is an aggregate plan that schedules product families in relatively long time intervals. Master production schedule is used for individual end products and in shorter time intervals. MPS is important in the following aspects:

  1. It is the link between what is expected (production planning) and what is actually to be built, i.e., material requirement planning and final assembly schedule (FAS, to be discussed).
  2. It develops data to drive the detailed planning, MRP. MPS is a priority plan for manufacturing. It keeps priorities valid.
  3. It is the basis for calculating the resources available (capacity) and the resources needed (load). It provides devices to reconcile the customers' demand and the plant's capability.

4. It makes possible reliable delivery promises. It provides salespeople information on available-to-promise (ATP) indicating when end products are available. ATP will be discussed later.
5. It is a tool that can be used to evaluate the effects of schedule changes. It is a device for communication and a basis to make changes consistent with the demands of the marketplace and manufacturing capacity.
6. It is a contract between marketing and manufacturing departments. It is an agreed-upon plan. It coordinates plans and actions of all organizational functions and is a basis to measure the functions' performance.
7. It provides management with the means to authorize and control all resources needed to support integrated plans.
8. In the short horizon, MPS serve as the basis for planning material requirement, production of components, order priorities, and short-term capacity requirements.
9. In the long horizon, MPS serves as the basis for estimating long-term demands on the company resources such as people, equipment, warehousing, and capital.

- *MPS as a primary Input to MRP*

MRP input data include MPS, external demand for components, forecasts of independent demand for components, BOM, and fundamental data in item master such as lead times, safety stocks, scrap allowances and lot-sizing rules. Among the above data, MPS is the primary input to MRP. It enables MRP to translate the end item schedules into individual component requirements. Therefore, MRP depends on the validity and realism of the MPS for its effectiveness.

Suppose that there are 30 end products made from 5,000 components, parts, and raw materials. MPS helps people to concentrate on the planning of the 30 independent end items, and leave the other 5,000 dependent items to be processed automatically by MRP.

External demands for components include service-part orders, interplant orders, OEM orders, components needed for sales promotion, R&D, destructive testing, etc. Forecasts of independent demand for components include service parts no longer used in regular production which are better planned by time phased order point (TPOP). After reviewing forecasts, the planners input the quantities they decide are reasonable for such items as added gross requirements. External demands and forecasts for

independent components normally are not incorporated in the MPS but are instead fed directly into MRP as separate inputs.

- *Data sources for MPS*

The data needed to develop an MPS include:

1. Customer orders.
2. Dealer orders.
3. Inventory replenishment orders.
4. Forecast for individual end products.
5. Interplant requirements.
6. Distribution center requirements.
7. Inventory levels for end products.
8. Safety stock.
9. Released production orders for end products.
10. Capacity constraints.

**Time-Phased Order Point**

Time phased order point (TPOP) is a technique similar to MRP logic. It is used to conduct planning for independent demand items, where gross requirements come from a forecast, not via explosion of the planned order releases of the parent items. TPOP can be used in planning service part requirements. This technique can also be used to plan distribution center inventories as well as plans for service parts. TPOP is an approach that uses time intervals thus allowing for time-phased lumpy demands instead of average demand as in ROP.

TPOP is a preferred alternative to reorder point replenishment techniques (ROP) for the following reasons:

1. TPOP allows planning for known lumps in future demand; ROP accepts average demand only.
2. TPOP provides information on future planned orders, which is the data required in planning the needed resources. ROP only provides information for overall resources requirement.
3. TPOP permits re-planning for requirements; this keeps relative priorities valid for

all shop orders. ROP does not consider future requirements.

4. TPOP links planning for independent and dependent demands for items with both types. Service part demand planning is an example.

ROP is to be discussed in chapter seven. TPOP differs from MRP in that TPOP covers each individual item while MRP covers all the items in a product structure. The gross requirements in TPOP are drawn from independent sources while the gross requirements in MRP come from the explosion of higher level data. The planned order releases in TPOP are not further exploded, but the POR in MRP are exploded to next level items.

**From Production Plan to Master Production Schedule**

Production plans and master production schedules differ in their precision. Production plans are "macro" plans, while MPS are "micro" plans. Production planning is for preparing resources to accomplish business objectives. Resource requirement planning is used to reconcile business objectives with the resources available. MPS is the schedule of end item production. It is a decision of manufacturing actions subject to the constraints of capacity.

It is a set of decisions that determines manufacturing actions subject to capacity constraints.

Rough-cut capacity planning is used to obtain a realistic MPS and therefore a realistic MRP. Suppose the following production plan is for a product family X of three end products A, B, and C: (The initial on-hand inventory for X is 500.)

Table 1: Production Plan for Product Family X

| Month | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Forecast | | 620 | 800 | 660 | 760 |
| Production Plan | | 720 | 720 | 720 | 720 |
| PAB | 500 | 600 | 520 | 580 | 540 |

The on-hand inventory for X consists of the inventories of its end items shown in Table 2:

Table 2: On-hand Inventory

| Item | On-hand Inventory |
|---|---|
| Product A | 250 |
| Product B | 150 |
| Product C | 100 |
| Product Family X | 500 |

The master scheduler must devise an MPS to fit the constraints of the PP. MPS is derived from the customer orders and the forecasts, but must not exceed the production plan quantities. Table 3 is a valid MPS for the first two months.

Table 3: MPS for End Items

| Item | Week | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| A | GR | | 78 | 85 | 86 | 90 | 96 | 100 | 120 | 100 |
| | MPS | | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | PAB | 250 | 262 | 267 | 271 | 271 | 265 | 255 | 225 | 215 |
| B | GR | | 48 | 50 | 46 | 52 | 58 | 60 | 70 | 55 |
| | MPS | | 54 | 54 | 54 | 54 | 54 | 54 | 54 | 54 |
| | PAB | 150 | 156 | 160 | 168 | 170 | 166 | 160 | 144 | 143 |
| C | GR | | 28 | 30 | 32 | 32 | 38 | 44 | 40 | 36 |
| | MPS | | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| | PAB | 100 | 108 | 114 | 118 | 122 | 120 | 112 | 108 | 108 |

**MPS Techniques**

Master production scheduling is a time-phased order point (TPOP) procedure. The planned order releases (POR) in the TPOP are the master schedules fed into the MRP system. MPS are done for the MPS items (end products). In assemble-to-order (ATO) cases, a module is defined as an MPS item, and all its ancestors must also be MPS items. Two-level master production schedules are used in assemble-to-order cases. Related topics are discussed as follows.

- *Demand Time Fence (DTF)*

  DTF is a point of time in MPS. The DTF is set between the current date and the planning time fence (PTF). The region between the current date and the demand time fence contains actual orders that are frozen. Change of orders within DTF may cause unstable production problems. No unanalyzed and unapproved changes are allowed

for the MPS in this region. DTF is the earliest due date for taking a customer order. Promising a customer order with a due date prior to DTF may cause late delivery. But it does not mean that it is impossible to take an order with a due date earlier than DTF. As long as there is enough available-to-promise (ATP) within the DTF, we can still promise a customer order delivering before DTF.

- *Planning Time Fence (PTF)*

PTF is set between DTF and the end of planning horizon. The region between DTF and PTF contains actual orders and forecast orders. The region beyond PTF contains only forecast customer orders. Between DTF and PTF, actual customer orders replace the forecast quantities.

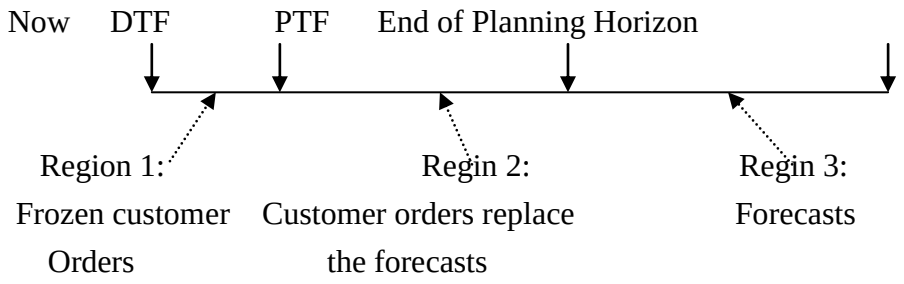


Figure 1: DTF and PTF

PTF is the accumulated lead-time for the end products. Related purchase orders or manufacturing orders may have been released. Change of customer orders within PTF may bring the necessity of rescheduling purchase orders or manufacturing orders. A customer order with due date later than PTF can easily be changed for related activities have not started yet.

MPS considers only the customer orders within DTF for it is not likely that any new orders will fall in this region. MPS considers the larger of the customer orders and the forecasts from DTF to PTF for new orders keep replacing the forecasts in this region. If customer orders exceed forecasts, it means that the demand is underestimated, and MPS considers customer orders. MPS considers only the forecasts for it is not likely that many customer orders are received that early.

- *Projected Available Balance (PAB)*

  Projected available balance is the projected inventory of the end items if the MPS quantities are completed. MPS quantity is the quantity of end items that we planned to manufacture. It includes the scheduled receipts and the firm planned orders (FPO). Firm planned order is a common approach to describe MPS. Master schedulers are required to firm all the planned order receipts (PORC) before PTF. That is, master schedulers have to make a decision of what to produce from now to PTF. As shown in Figure 1, MPS system considers as independent demand only the customer orders in region 1, the larger of forecast and customer orders in region 2, and the forecast orders only in region 3.

- *Available-To-Promise (ATP)*

  Available-to-Promise is the uncommitted portion of a company's inventory and planned production, maintained in the master schedule to support customer order promising. The ATP quantity is the uncommitted inventory balance in the first period and is normally calculated for each period in which an MPS receipt is scheduled. In the first period, ATP equals on-hand inventory plus MPS (if it is positive) less customer orders that are due and overdue. In any period containing MPS schedule receipts, ATP equals the MPS less customer orders in this period and all subsequent periods before the next MPS schedule receipt. A negative ATP takes over prior periods' ATP until it turns from negative to zero or the prior periods' ATP becomes zero.

- *Two-Level Master Production Schedule*

  It is a master scheduling approach where a planning bill of material is used to master schedule end items or product families. Key features such as options and accessories are frequently used in the two-level MPS procedure. For forecast demand, product families are master scheduled and the usage ratio in the "quantity-per" of planning BOM is used to calculate the gross requirement of the modules. For customer orders, options and accessories are defined before the master production scheduling. In this case, end items instead of families are master scheduled.

- *Multilevel Master Production Schedule*

A master scheduling approach that allows any level in an end item's BOM to be master scheduled. To accomplish this, MPS items must receive requirements from independent and dependent demand sources. Higher level MPS items are scheduled before lower level MPS items.

**Case Study: MPS and ATP**

Suppose there are two MPS items X and Y with BOM shown in Table 4. Please notice that the parent part number in Table 4 should be BOM code; we assume all items have default values for the BOM codes. The sources of independent demand are customer orders and forecast. The demand time fence (DTF) is period 4, and planning time fence (PTF) is period 10. The gross requirement from period 1 to period 4 includes actual customer orders. From period 5 to period 10, the gross requirement in each period is the maximal of customer order and forecast. The gross requirements include only forecasts beyond period 11. The projected on-hand (POH) and projected available balance (PAB) are identical to those defined in MRP reports. We assume all the planned order receipts (PORC) are firm planned orders thus the MPS is equal to the PORC. The calculation of POH, PAB, MPS, and ATP are done in a TPOP procedure, as shown in Table 5 and Table 6.

Table 4: BOM

| Parent Part No. | Component Part No. | Qty-Per |
|---|---|---|
| X | C | 0.25 |
| X | D | 1 |
| Y | D | 1 |
| Y | E | 1 |
| E | F | 2 |

Table 5: MPS and ATP for X

| **Part No.=X** | OH= 55 | | LT= 1 | | SS= 0 | | LS= 40 | | DTF= 4 | | PTF= 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Forecast** | 18 | 21 | 17 | 17 | 15 | 15 | 29 | 28 | 25 | 25 | 20 | 20 |
| **Cust. Order** | 19 | 20 | 15 | 25 | 12 | 18 | 14 | 16 | 20 | 20 | 15 | 15 |
| **POH** | 36 | 16 | 1 | -24 | 1 | -17 | -6 | 6 | -19 | -4 | 16 | -4 |
| **PAB** | 36 | 16 | 1 | 16 | 1 | 23 | 34 | 6 | 21 | 36 | 16 | 36 |
| **MPS(PORC)** | 0 | 0 | 0 | 40 | 0 | 40 | 40 | 0 | 40 | 40 | 0 | 40 |
| **ATP** | 1 | | | 3 | | 22 | 10 | | 20 | 5 | | 25 |

Table 6: MPS and ATP for Y

| **Part No.=Y** | OH= 10 | | LT= 1 | | SS= 5 | | LS= 20 | | DTF= 4 | | PTF= 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Forecast** | 20 | 20 | 20 | 20 | 15 | 15 | 15 | 15 | 20 | 25 | 15 | 30 |
| **Cust. Order** | 30 | 20 | 20 | 15 | 11 | 8 | 0 | 20 | 5 | 5 | 20 | 0 |
| **POH** | -20 | -15 | -15 | -10 | -5 | 0 | 5 | -15 | -15 | -20 | -10 | -20 |
| **PAB** | 5 | 5 | 5 | 10 | 15 | 20 | 5 | 5 | 5 | 5 | 10 | 5 |
| **MPS(PORC)** | 25 | 20 | 20 | 20 | 20 | 20 | 0 | 20 | 20 | 25 | 20 | 25 |
| **ATP** | 5 | 0 | 0 | 5 | 9 | 12 | | 0 | 15 | 20 | 0 | 25 |

Available-to-promise (ATP) appears in the first period and those periods with positive MPS quantities. The amount of ATP means the quantity that sales can promise the customers during the period from current period to the period before the next positive MPS period. The first period ATP (5) of Y in Table 6 is the on-hand inventory (10) plus MPS (25) minus the accumulated customers in period 1 (30). The accumulated customer orders should include the second period if the MPS in period 2 is zero. In calculating MPS (or PORC), safety stock has to be considered to make PAB always above the safety stock. In calculating ATP, we do not consider the safety stock; any stock can be promised to customers.

Suppose we receive a customer order for 30 X's to be delivered in period 7. The total customer order in period 7 becomes 44. The result of MPS is shown in Table 7.

In Table 6, since there is no MPS in period 8, the MPS in period 7 must cover the demands in period 7 and 8, and the ATP is 10 (40-14-16). In Table 7, the customer order quantity in period 7 increases to 44, which makes the master scheduler to schedule a new MPS (40) in period 8, and the MPS (40) in period 7 needs only cover the demand in period 7. Even so, the customer order still exceeds the MPS by 4. To prevent ATP in period 7 from going negative (-4), 4 units of ATP are moved from period 6 to period 7. The ATP in period 6

should be 22 (40-18) if the next MPS is enough for the demand of customer orders. Since the customer order exceeds MPS by 4 units in period 7, the ATP in period 6 decreases by 4 and only 18 remains.

Table 7: MPS Calculation with Insufficient ATP

**Part No.=X** OH= 55 LT= 1 SS= 0 LS= 40 DTF= 4 PTF= 10

| **Period** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Forecast** | 18 | 21 | 17 | 17 | 15 | 15 | 29 | 28 | 25 | 25 | 20 | 20 |
| **Cust. Order** | 19 | 20 | 15 | 25 | 12 | 18 | 44 | 16 | 20 | 20 | 15 | 15 |
| **POH** | 36 | 16 | 1 | -24 | 1 | -17 | -21 | -9 | 6 | -19 | 1 | -19 |
| **PAB** | 36 | 16 | 1 | 16 | 1 | 23 | 19 | 31 | 6 | 21 | 1 | 21 |
| **MPS(PORC)** | 0 | 0 | 0 | 40 | 0 | 40 | 40 | 40 | 0 | 40 | 0 | 40 |
| **ATP** | 1 | | | 3 | | 18 | 0 | 4 | | 5 | | 25 |

**Distribution Requirement Planning**

- *Distribution Inventory*

  Distribution inventory includes all finished goods held anywhere in the distribution system. It consists of finished goods in warehouses and also in transit. There are various types of distribution systems. Generally, a distribution has a central supply warehouse that is supported by a factory, a number of distribution centers, and customers. An example of distribution system is shown in Figure 2.

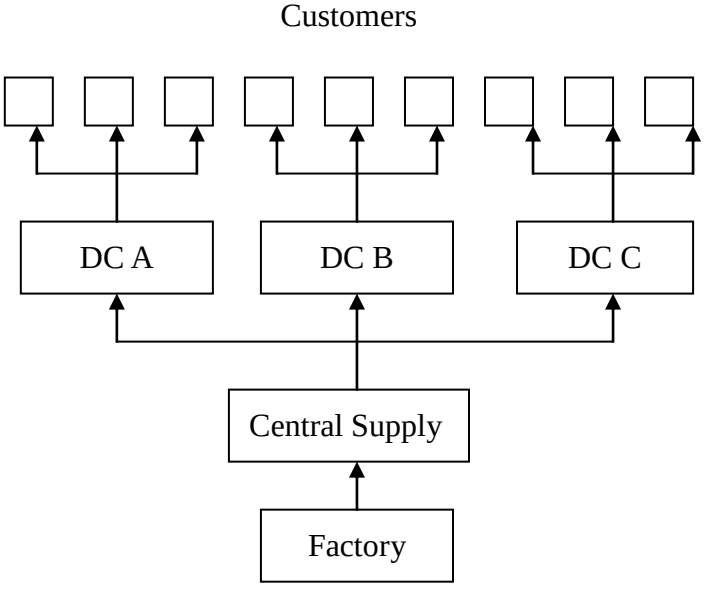

Figure 2: A Distribution System

The purpose of holding inventory in distribution centers is to improve customer service by locating stock near the customers and to reduce the transportation cost by allowing the manufacturer to ship in full loads rather than in partial loads over long distances.

- *Distribution Requirement Planning (DRP)*

  Distribution requirement planning is a system that forecasts what, how many, and when demand will be required by the distribution centers. This gives the central supply and the factory an opportunity to plan for the production of finished goods that will be needed in the near future. In addition to responding to customer demands, it can also coordinate planning and control of manufacturing and distribution: The DRP for each distribution center is executed by TPOP, then using MRP logic to explode the planned order releases for the central supply and factory.

**Case Study: Distribution Requirement Planning**

The finished product X is stocked in distribution centers A, B and a central supply S. In order to calculate the planned order releases of the central supply by using the requirements of the distribution centers, a BOM is created, as shown in Table 8. Since the item numbers of the products are identical in distribution centers and central supply, phantom items are defined to represent the products in various sites. These phantom items are used in the BOM file in Table 8.

Table 8: BOM for Distribution System

| Parent | Component | Qty-Per |
|---|---|---|
| X-DCA | X-CS | 1 |
| X-DCB | X-CS | 1 |
| X-CS | X | 1 |

The lead-time in traditional MRP calculation now means the transportation time. Other data such as on-hand, safety stock, allocation, lot-sizing rule, etc. are the same as in MRP.

Distribution inventory in transit is equivalent to the schedule receipt (SR) in MRP. The explosion, netting, and lead-time offsetting logic are exactly the same as in MRP procedure. DRP reports are illustrated in Table 9 to Table 11.

Table 9: DRP for Product X in Distribution Center A

**Distribution Center A**

| **P#:X-DCA** | **Past** | OH= | 50 | TT= | 2 | SS= | 0 | AL= | 0 | LS= | 100 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **Due** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Fcs Sale** | | 25 | 30 | 55 | 50 | 30 | 40 | 50 | 40 | 30 | 40 | 50 | 30 |
| **In Transit** | | | 100 | | | | | | | | | | |
| **POH** | | 25 | 95 | 40 | -10 | 60 | 20 | -30 | 30 | 0 | -40 | 10 | -20 |
| **PAB** | | 25 | 95 | 40 | 90 | 60 | 20 | 70 | 30 | 0 | 60 | 10 | 80 |
| **NR** | | 0 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 100 |
| **PORC** | | 0 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 100 |
| **POR** | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 100 | 0 | 0 |

Table 10: DRP for Product X in Distribution Center B

**Distribution Center B**

| **P#:X-DCB** | **Past** | OH= | 100 | TT= | 1 | SS= | 0 | AL= | 0 | LS= | 200 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **Due** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Fcs Sale** | | 95 | 85 | 100 | 70 | 50 | 60 | 70 | 75 | 85 | 100 | 90 | 75 |
| **In Transit** | | | 0 | | | | | | | | | | |
| **POH** | | 5 | -80 | 20 | -50 | 100 | 40 | -30 | 95 | 10 | -90 | 20 | -55 |
| **PAB** | | 5 | 120 | 20 | 150 | 100 | 40 | 170 | 95 | 10 | 110 | 20 | 145 |
| **NR** | | 0 | 200 | 0 | 200 | 0 | 0 | 200 | 0 | 0 | 200 | 0 | 200 |
| **PORC** | | 0 | 200 | 0 | 200 | 0 | 0 | 200 | 0 | 0 | 200 | 0 | 200 |
| **POR** | 0 | 200 | 0 | 200 | 0 | 0 | 200 | 0 | 0 | 200 | 0 | 200 | 0 |

Table 11: DRP for Central Supply

**Central Supply**

| **P#:X-CS** | **Past** | OH= | 400 | LT= | 2 | SS= | 0 | AL= | 0 | LS= | 500 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **Due** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GR** | | 200 | 100 | 200 | 0 | 100 | 200 | 0 | 100 | 200 | 100 | 200 | 0 |
| **SR** | | | 0 | | | | | | | | | | |
| **POH** | | 200 | 100 | -100 | 400 | 300 | 100 | 100 | 0 | -200 | 200 | 0 | 0 |
| **PAB** | | 200 | 100 | 400 | 400 | 300 | 100 | 100 | 0 | 300 | 200 | 0 | 0 |
| **NR** | | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 500 | 0 | 0 | 0 |
| **PORC** | | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 500 | 0 | 0 | 0 |
| **POR** | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 0 |

In this case, the distribution centers, central supply, and factory belong to the same enterprise, and all the DRP are processed within an ERP system. If the distribution centers

belong to other companies, their planned order releases (POR) are transmitted via Internet into the ERP system of the factory as independent demands.

## Manufacturing Environment

In different manufacturing environments, which are determined by the characteristics of products, the competition, and the business strategy, a company may respond differently to the marketplace.

- *Make-to-Order (MTO)*
  Products are finished after receipt of customer orders. The final product is usually a combination of standard items and items custom designed to meet the special needs of the customer.

- *Engineer-to-Order (ETO)*
  Includes MTO products whose customer specifications require unique engineering design or significant customization. Each customer order results in a unique set of part numbers, bills of material, and routings. Both end items and components have no standard specifications.

- *Assemble-to-Order (ATO)*
  Includes MTO products for which key components (bulk, semi-finished, intermediate, subassembly, fabricated, purchased, packaging, etc.) used in the assembly or finishing process are planned and stocked in anticipation of a customer order. The ATO products are highly modular. Though the finished goods have no standard specifications, the modules are standardized components.

- *Make-to-Stock (MTS)*
  Products that are shipped from finished goods and therefore are finished prior to the arrival of customer orders. The specifications of the MTS products are standard. No customization is required.

## Final Assembly Schedule (FAS)

The FAS is prepared after receipt of a customer order and is constrained by the availability

of material and capacity. It schedules the operations required to complete the product from the level where it is stocked to the end-item level. In ATO environments, MPS are made for the components of end products and FAS are for shippable end products. The planning horizon of MPS usually covers several months while FAS cover only a few days or weeks.

Most second level MPS items, e.g., modules, are available at the moment FAS is released. Exceptions occur on a few selected items, which may be put into manufacturing bills of material (M-bills) and are manufactured or procured during execution of the FAS. These items are characterized by:

1. High unit cost,
2. Short procurement or manufacturing lead time,
3. Short assembly lead time of their parent, if any,
4. Absence of long setups or quantity discounts.

In ETO environments, no components can be prepared before receiving the customer orders. MPS is used to forecast the requirements of common raw materials. Wafers in an integrated circuit design house or iron ingot in an investment casting plant are examples of low-level MPS items. In these industries, raw materials are few but end products are numerous. Most process manufacturing industries have this characteristic. For discrete manufacturing, products are assembled from different parts. The number of end products is limited while the number of materials is huge. The items planned in MPS and FAS are identical. MPS and FAS differ in precision. In MTS and ATO environments, MPS often are based on forecast customer demand; FAS usually contain actual customer orders and may be constrained by shortages of components.

MPS, FAS, and BOM in various manufacturing environments are compared in Figure 3. For MTS environment, there are few finished goods made from many raw materials, this kind of products are called A-type products. Many assembled products in the discrete part manufacturing are A-type products. The demands are forecasted and the inventory of the end products is built before customer orders are received. MPS and FAS are prepared for the finished goods and MRP for semi-finished goods and raw materials. For MTO environment, since there are enormous possible finished goods and very limited number of raw materials, we call this category of products V-type products. Many products in process manufacturing pertain to V-type products. MPS schedules the product families and obtains the requirement plans for the raw materials. The FAS is scheduled when customer orders

are received. MRP is not required for V-type products. In the ATO environment, the finished goods are assembled from optional modules, the number of products is much larger than the number of modules, and the modules are made from a lot of raw materials. These products are called X-type products. Forecast of the demand of product families is used to in the MPS to obtain the requirement of the modules. MRP calculates the requirement of the raw materials building up the modules. The inventory of the modules is established according to MRP. The FAS is scheduled when the customer orders are received, and the ordered finished goods are made from the modules.

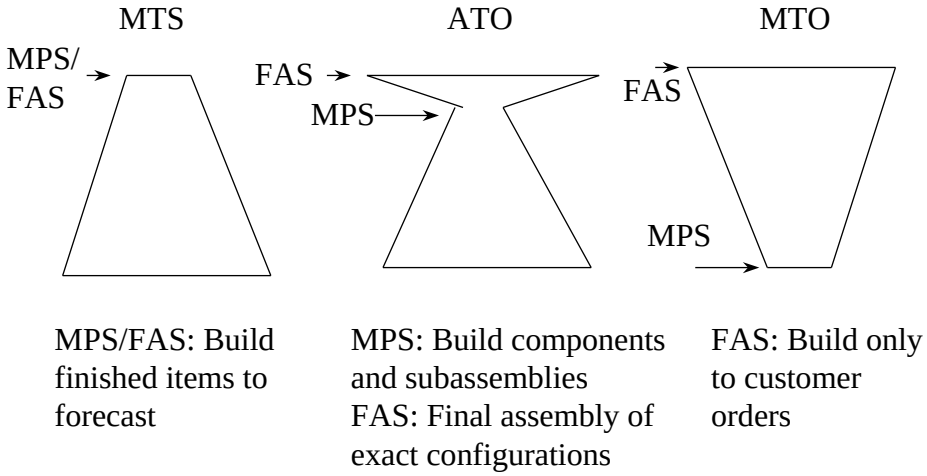


Figure 3: Comparison of MPS, BOM, and FAS

**Other topics on MPS**

- *Master Scheduler*

The master scheduler is the person charged with the responsibility of managing, establishing, receiving, and maintaining a master schedule for selected items. The person should have substantial product, plant, process, and market knowledge because his/her actions will often result in a great impact on customer service, material, and capacity planning. The duties of a master scheduler include:

1. Comparing actual and forecast demand, and suggesting revisions to forecasts and MPS.

2. Converting forecasts and order-entry data into MPS.
3. Correlating MPS with shipping and inventory budgets, marketing programs, and management policies.
4. Maintaining MPS data by tracking the use of safety stock provided at the MPS level, accounting for differences between quantities of end items produced and those consumed by the FAS, and entering and editing all changes to MPS files.
5. Participating in MPS meeting, preparing agendas, anticipating problems, providing data for possible solutions, and bringing conflicts to the surface.
6. Evaluating suggested MPS revisions.
7. Developing and monitoring customer delivery promises.

- *Responsibilities in MPS*

Responsibilities in MPS fall under every division of a business enterprise: manufacturing, marketing, engineering and finance:

1. Forecasting demand is a marketing responsibility whereas scheduling production falls under manufacturing.
2. Manufacturing takes responsibility for inventories of raw material, WIP and finished components; marketing controls and accounts for finished product inventories.
3. Marketing takes responsibility for optional components if the usage is above some percentage of the total costs; manufacturing handles the balance, using statistical analysis of the past demand as forecasts.
4. Engineering designs not only for product function but also for manufacturability, and should work cooperatively with users of BOM to meet their needs for information and to reduce engineering changes.
5. Finance takes the responsibility for financing and budgeting the inventories and providing cost data for decision making.

- *Making MPS Realistic*

The following concepts make MPS realistic:

1. Master production schedules are planning devices not execution tools. They provide means for coordinating the activities of all functions.

2. MPS is best when done by teams of people from marketing, manufacturing, engineering and finance, and when revised by top management.
3. Rough-cut capacity planning (RCCP) assists the master scheduler in establishing a realistic MPS.