

# Master Production Scheduling

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## How does Master Scheduling Work?

### What is being planned?

Anything requiring frequent human involvement in the scheduling process:

- Make-to-stock: End items
- Assemble-to-order: Component items (refer to Multi-level Master Scheduling below)
- Make-to-order: Job completion due dates
- Engineer-to-order: Job completions and/or project phase completions (e.g. engineering deliverables)
- Plant maintenance is also frequently integrated with the Master Schedule

Separate (but integrated) Master Schedules might be maintained for somewhat independently-controlled portions of your production process. Examples:

- Final Assembly
- Shipping
- The gating operation (first operation of the entire process)
- The gating operation for a sub-process (that might be made somewhat independent due to a time or inventory buffer)

### Frequency of planning

The Master Scheduler is always revising the schedule, but might attempt to “freeze” the near-term horizon.

### Typical planning horizon

Must span the longest lead time.

### How much latitude does the Master Scheduler have?

The Master Scheduler has a lot of latitude for making day-to-day scheduling decisions, but must receive executive-level authorization to stray from the parameters established by the Sales & Operations Plan.

# Sample Master Schedule

Item: 12345

Run date: 01/01/97

Description: Master Scheduled Item Plant: San Diego Plant #1

Lead time: 2 periods

Lot size method: Fixed qty

Demand Time Fence: 4 periods

Beginning on-hand qty: 100

Lot size: 50

Planning Time Fence: 10 periods

Safety stock: 11

Period (e.g. days, weeks...)	Demand Time Fence				Planning Time Fence							
	Now	1	2	3	4	5	6	7	8	9	10	11
Production Plan		20	20	20	20	20	40	40	20	20	20	20
Actual Demand		10	20	0	40	20	70	0	40	10	0	0
Master Production Schedule expected receipts (arrive 2 periods after release)						50	100			50		50
Projected Available Balance	100	90	70	70	30	60	90	50	10	40	20	50
Available to Promise – Per Period		30				30	-10			40		50
or ATP – Cumulative		30				60	50			90		140
or ATP – Cumulative w/look-ahead		30				50	50			90		140
Master Production Schedule work order releases				50	100			50		50		

Example of demand pegging:

Period 1 demand comes from sales orders #1234 and #1237

Example of supply pegging:

Period 3 MPS is reflected in work order #4321

## Definitions (APICS standard definitions. Everything may vary by software package.)

**Production Plan:** The Production Plan is the amount planned manufacturing receipts for this item – which is determined as a result of your Sales & Operations Planning process. (If you always quickly manufacture to immediate demands, your Production Plan might be equal to your Forecasted Shipments. Or your Production Plan might call for strategic stockpiling or backlog management.)

**Projected Available Balance:** The amount of inventory that you expect to physically find on-hand during that time period. Normally, PAB is calculated as the prior period’s PAB minus the greater of forecast or actual customer orders plus expected Master Production Schedule receipts. Within the **demand time fence**, PAB considers only actual customer orders, not Production Plan.

**Available to Promise:** The amount of inventory available to promise before the next Master Production Schedule Expected Receipt. Your software will have ONE of the following calculation methods:

1. “Per period” ATP is calculated as the MPS expected receipt minus the sum of the customer orders scheduled to ship before the next MPS receipt. The first period also considers beginning balance.
2. “Cumulative” ATP adds any leftover ATP from prior production periods.
3. “Cumulative ATP With Look-ahead” looks ahead to consider negative ATP in future production periods.

**Master Production Schedule:** The amount of inventory per period that that Master Scheduler decides to make. Orders are presumed to be released or received on the first day of a planning period. Pegging will clarify whether each order is a released order, a planned order, or a firm planned order. Within the **planning time fence**, the Master Scheduler is responsible for maintaining **planned orders**, and the computer will not suggest planned orders, but outside of the planning time fence it will. **Firm planned orders** are used to prevent the computer from suggesting changes to planned orders outside of the planning time fence.

# Case Study Exercise

Here's your chance to test your understanding of the calculations beneath what you see on the Master Production Schedule screen of your ERP system.

When you think you're ready – you can request the MPS Answer Sheet from your Project Manager – who can also answer your questions if anything is still confusing. (or he or she can request help from Systems2win)

## Case Scenario

The MPS below is identical to the Sample MPS, except for the following changes:

1. As a result of the last Sales & Operations Planning meeting, our executives decided to reduce the Production Plan in Periods 6 and 7.
2. Due to shop floor conflicts with other orders, the Master Scheduler recently moved the planned production of 100 units from Period 4 to Period 5.
3. Early this morning, we booked one big surprise new sales order for 80 more units of Actual Demand in Period 5.

## Your assignment

1. Calculate the new Master Production Schedule for PAB and all 3 ATP calculation methods. (We've calculated the first period for you.)
2. Give recommendations for how the Master Scheduler might react to the unexpected demand spike. (Hint: Like most real-life challenges, most potential correct responses involve more than just math.)

Description: Master Scheduled Item Plant: San Diego Plant #1

Lead time: 2 periods

Lot size method: Fixed qty

Demand Time Fence: 4 periods

Beginning on-hand qty: 100

Lot size: 50

Planning Time Fence: 10 periods

Safety stock: 11

Period (e.g. days, weeks...)	Demand Time Fence					Planning Time Fence						
	Now	1	2	3	4	5	6	7	8	9	10	11
Production Plan		20	20	20	20	20	20	20	20	20	20	20
Actual Demand		10	20	0	40	100	70	0	40	10	0	0
Master Production Schedule expected receipts (arrive 2 periods after release)						50		100		50		50
Projected Available Balance	100	90	.	.	.	.	.	.	.	.	.	.
Available to Promise – Per Period		30	.	.	.	.	.	.	.	.	.	.
or ATP – Cumulative		30	.	.	.	.	.	.	.	.	.	.
or ATP – Cumulative w/look-ahead		30	.	.	.	.	.	.	.	.	.	.
Master Production Schedule work order releases				50		100		50		50		

# Multi-Level Master Scheduling

## What is being planned with multi-level Master Schedules?

Items lower than the top planning level.

Examples:

- ✿ Component or sub-assembly items – one or more BOM levels below the finished good end item
- ✿ End item configurations – one or more planning BOM levels below the product family

The relationship between the parent and lower-level master schedules is usually expressed as:

- ✿ The percent of the parent items that are forecasted to generate demand for the lower-level item.

Examples:

- ✿ 30% of all finished goods bicycles are forecasted to want chrome wheels, and 70% will want alloy wheels
- ✿ 40% of sales for a product family are forecasted to be Product A, and 60% Product B

# Example of Multi-level Master Scheduling

In addition to the definitions already defined within the Sample Master Schedule (above), there is one definition that is unique to Multi-level Master Schedules for lower-level items.

**Production Forecast:** Anticipated demand beyond actual demand for a lower-level master-scheduled item.

Production Forecast serves only to advise the Master Scheduler. The Master Production Schedule for the lower-level item is maintained by the Master Scheduler, and does not need to exactly match the sum of the Production Forecast and Actual Demand – although the schedule usually won't stray too far from it.

## Formula to calculate Production Forecast

There are many different calculation mechanics that might be used by any given software package to calculate the Production Forecast for a lower-level Master Scheduled item – and it is not uncommon to customize your software to use your own calculation method. It is VERY IMPORTANT to understand the calculation method used by your software – which might differ (radically) from the calculation method used in this example.

## For this example (and many standard software packages)

Production Forecast for lower-level items is calculated as a percent of the parent-level ATP.

The first period is based on the difference between parent-level Production Plan - Actual Demand, rather than ATP.

Production Forecast is never negative. (It is zero if it would otherwise be negative.)

## Parent-level Master Scheduled Item or Product Family

Period	Demand Time Fence			Planning Time Fence			6
	Now	1	2	3	4	5	
Production Plan		100	100	100	100	100	100
Actual Demand		110	110	60	60	20	0
Projected Available Balance	11	11	1	1	-21	-21	-21
<b>Available To Promise – Per Period</b>		<b>11</b>	<b>-10</b>	<b>40</b>	<b>20</b>	<b>80</b>	<b>100</b>
Master Production Schedule (Both release and receipt – because lead time happens to be zero)		110	100	100	80	100	100

## Lower-level Master Scheduled Item – with 50% forecast of Parent ATP

Period	Demand Time Fence				Planning Fence		6
	Now	1	2	3	4	5	
<b>Production Forecast</b>		<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>40</b>	<b>50</b>
Actual Demand		40	70	30	40	0	0
Projected Available Balance	12	22	2	22	22	32	32
Available To Promise – Per Period		22	-20	20	10	50	50
Master Production Schedule (Both release and receipt – because lead time happens to be zero)		50	50	50	50	50	50

Notice – the Master Production Schedule does not need to exactly match the sum of the Production Forecast and Actual Demand – although the Master Scheduler usually won't stray too far from it.