



IENG/MANE112 Introduction to Industrial and Management Engineering

# Production Planning: Aggregate Planning

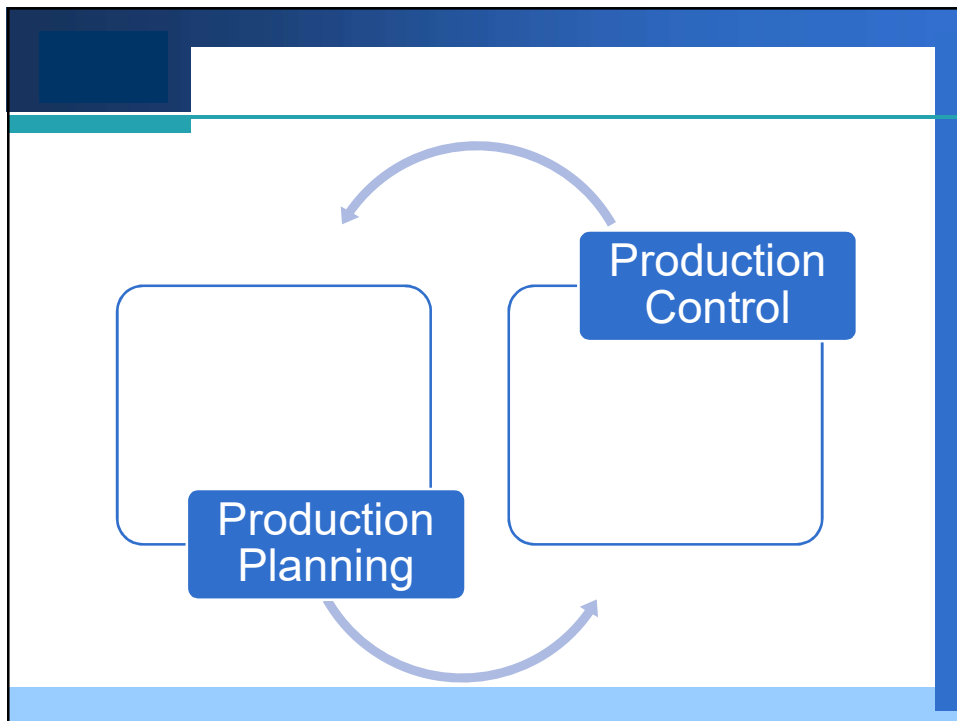
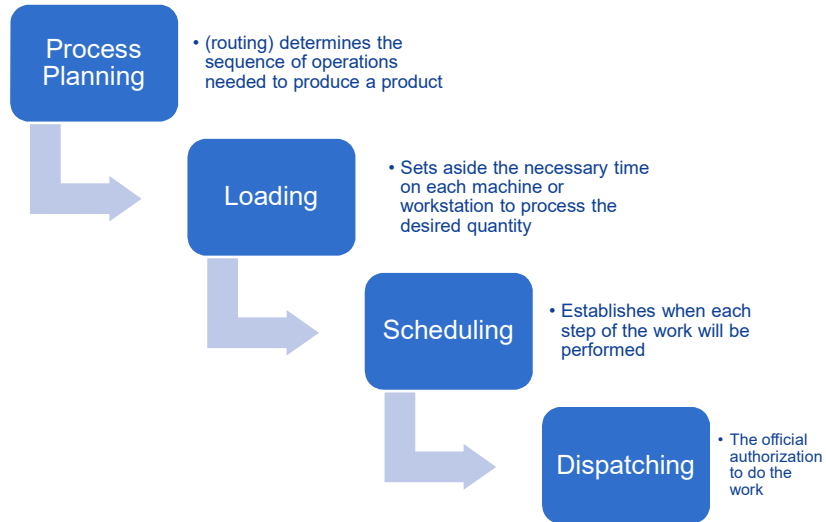
Instructor

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## Introduction

- A number of industries and public services have to deal with seasonal variations in demand.
- Such organizations face difficulties in predicting the exact quantity and timing of demand for specific products or services months in advance.
- Yet, they typically must assess their labor and inventory requirements in advance in order to handle demand.
- How do they do it?

## Steps in Production Planning



## Overview of Planning Levels

### Long-Range Plans

- Long-term capacity
- Location & layout
- Product Design
- Work system design

### Intermediate Plans

- General levels of:
  - employment
  - Output
  - Finished-goods inventories
  - Subcontracting
  - Back orders

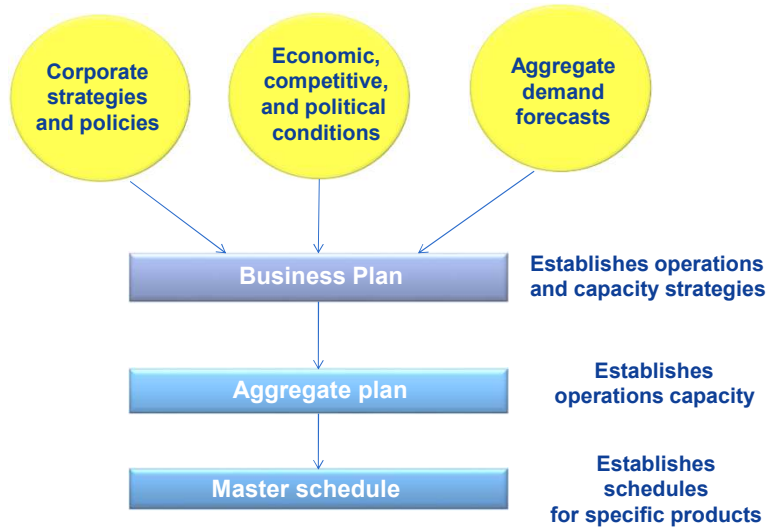
### Short-Range Plans

- Detailed Plans:
  - Production lot size
  - Order quantities
  - Machine loading
  - Job assignments
  - Job sequencing

## Aggregate Planning

- An intermediate-range capacity planning, usually covering **2 to 12 months**.
- The goal of aggregate planning is to achieve a production plan that will **effectively utilize the organization's resources to match expected demand**.

## Planning Sequence



## The Concept of Aggregation

- Aggregate planning is essentially a 'big-picture' approach to planning.
- Organizations don't focus on a single product but on a group of similar products or services. Hence, the term *aggregate* planning.

## Why do organizations need to do aggregate planning?

- Implementing a plan is time consuming.
- Aggregation is necessary because of the difficulty in estimating the volume and timing of individual items with accuracy.
- It is related to budgeting process.
- Helps synchronizing flow throughout the supply chain.

## Overview of Aggregate Planning

Forecast of aggregate demand for intermediate range

General plan to meet demand requirements

Production Plan

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graph LR; A[Forecast of aggregate demand for intermediate range] --> B[General plan to meet demand requirements]; B --> C[Production Plan];
```

## Mathematical Techniques

Technique	Solution Approach	Characteristics
Linear programming	Optimizing	Computerized; linear assumptions not always valid
Simulation	Heuristic (trial and error)	Computerized models can be examined under a variety of conditions

## Disaggregate the Aggregate Plan

For the production plan to be translated into meaningful terms for production, it is necessary to disaggregate the aggregate plan, i.e. breaking down the aggregate plan to specific product requirements.



Shows quantity and timing of specific end items for a scheduled horizon (6-8 weeks).

## Disaggregation Example

### Aggregate plan

Month planned output

Jan.	Feb.	Mar.
200	300	400

### Master Schedule

Month planned output

	Jan.	Feb.	Mar.
Ipad	100	100	100
Ipad Mini	75	150	200
Ipad Pro	25	50	100
<b>Total</b>	<b>200</b>	<b>300</b>	<b>400</b>

## Master Scheduling

- The master schedule is the heart of production planning and control.
- It determines the quantities needed to meet demand from all sources, and that governs key decisions and activities throughout the organization.

## Master Scheduling

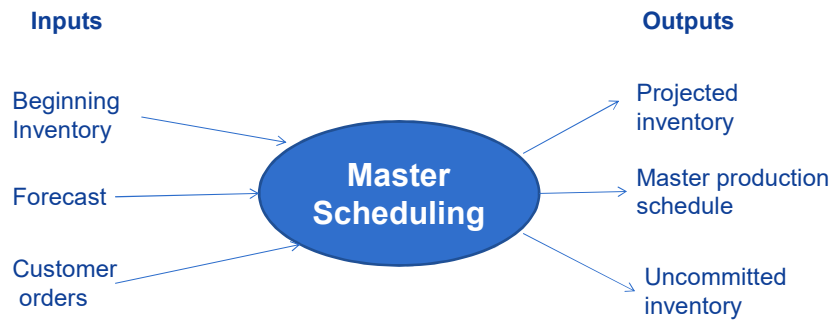
- The heart of production planning and control
  - It determines the quantity needed to meet demand from all sources
  - It interfaces with
    - Marketing
    - Capacity planning
    - Production planning
    - Distribution planning
  - Provides senior management with the ability to determine whether the business plan and its strategic objectives will be achieved

## The Master Scheduling Process

- The master schedule indicates the quantity and timing for a product, or group of products, but it does not show planned *production*.
- The **master production schedule (MPS)** indicates the quantity and timing of planned production, taking into account desired delivery quantity and timing as well as on-hand inventory.



## The Master Scheduling Process



## The Master Scheduling Process

- **Rough-cut capacity planning (RCCP)** is the validation of the developed master schedule.
- It involves testing the feasibility of a proposed master schedule relative to available capacities.

## The Master Scheduling Process

- The master schedule covers a period of few weeks up to 2 or 3 months.
- The master schedule may be updated monthly.
- A key component of effective scheduling is the use of **time fences** to facilitate order promising and the entry of orders into the system.
- **Time fences** divide the scheduling time horizon into 3 phases: *frozen*, *slushy*, and *liquid*.

## Time fences in an MPS

Period	1	2	3	4	5	6	7	8	9
	Yellow	Yellow	Yellow	Green	Green	Red	Red	Red	Red
	Frozen (firm or fixed)			Slushy (somewhat firm)		Liquid (open)			

## Output of the MPS

- The MPS uses the information on a period-by-period basis to determine the projected inventory, production requirements, and the resulting uncommitted inventory which is referred to as **available-to-promise (ATP) inventory**.

## Example 3:

- A company that makes industrial pumps wants to prepare a master production schedule for June and July.
- Marketing has forecasted demand of 120 pumps for June and 160 pumps for July. These have been evenly distributed over the four weeks in each month: 30 per week in June and 40 per week in July.
- Suppose that there are currently **64** pumps in inventory, and there are customer orders that have been committed and must be filled.

## MPS – Forecasts and Customer Orders

Given data:

	June				July			
	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	40	40	40	40

**FIGURE 13.8A**  
Weekly forecast requirements  
for industrial pumps.

Beginning inventory 64	June				July			
	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	40	40	40	40
Customer orders (committed)	33	20	10	4	2			

**FIGURE 13.8B**  
Eight-week schedule showing  
forecasts, customer orders, and  
beginning inventory

## MPS-Calculation

- The given data are used to calculate:
  - The projected on-hand inventory
  - The master production schedule
  - The uncommitted (ATP) inventory

# MPS – Projected On Hand

Projected on-hand =

inventory from previous week -

current week's requirement

The **larger of forecast and customer orders**

**FIGURE 13.9**

Projected on-hand inventory is computed week by week until it becomes negative

	Beginning inventory 64	June				July			
		1	2	3	4	5	6	7	8
Forecast		30	30	30	30	40	40	40	40
Customer orders (committed)		33	20	10	4	2			
Projected on-hand inventory		31	1	-29					

Customer orders are larger than forecast in week 1; projected on-hand inventory is  $64 - 33 = 31$

Forecast is larger than customer orders in week 2; projected on-hand inventory is  $31 - 30 = 1$

Forecast is larger than customer orders in week 3; projected on-hand inventory is  $1 - 30 = -29$

## Determining MPS and Projected On Hand, and ATP

	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	40	40	40	40
Customer orders	33	20	10	4	2			
Projected on hand inventory	31	1	41	11	41	1	31	61
Net inventory before MPS	31	1	-29	11	-29	1	-39	-9
MPS	-	-	70	-	70	-	70	70
ATP	11		56		68		70	70
	$64 - (33 + 20)$		$70 - (10 + 4)$		$70 - (2 + 0)$		$70 - 0$	$70 - 0$

## Adding MPS and Projected On Hand to the MPS

64	June				July			
	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	40	40	40	40
Customer orders (committed)	33	20	10	4	2			
Projected on-hand inventory	31	1	41	11	41	1	31	61
MPS			70		70		70	70

**FIGURE 13.11**  
Projected on-hand inventory and MPS are added to the master schedule

## Available to Promise

64	June				July			
	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	40	40	40	40
Customer orders (committed)	33	20	10	4	2			
Projected on-hand inventory	31	1	41	11	41	1	31	61
MPS			70		70		70	70
Available-to-promise inventory (uncommitted)	11		56		68		70	70

**FIGURE 13.12**  
The available-to-promise inventory quantities have been added to the master schedule