Sales and operations planning

CHAPTER 8

Learning Objectives

1. Understand what sales and operations planning is and how it coordinates manufacturing, logistics, service, and marketing plans.

2. Construct aggregate plans that employ different strategies for meeting demand.

3. Explain yield management and why it is an important strategy.
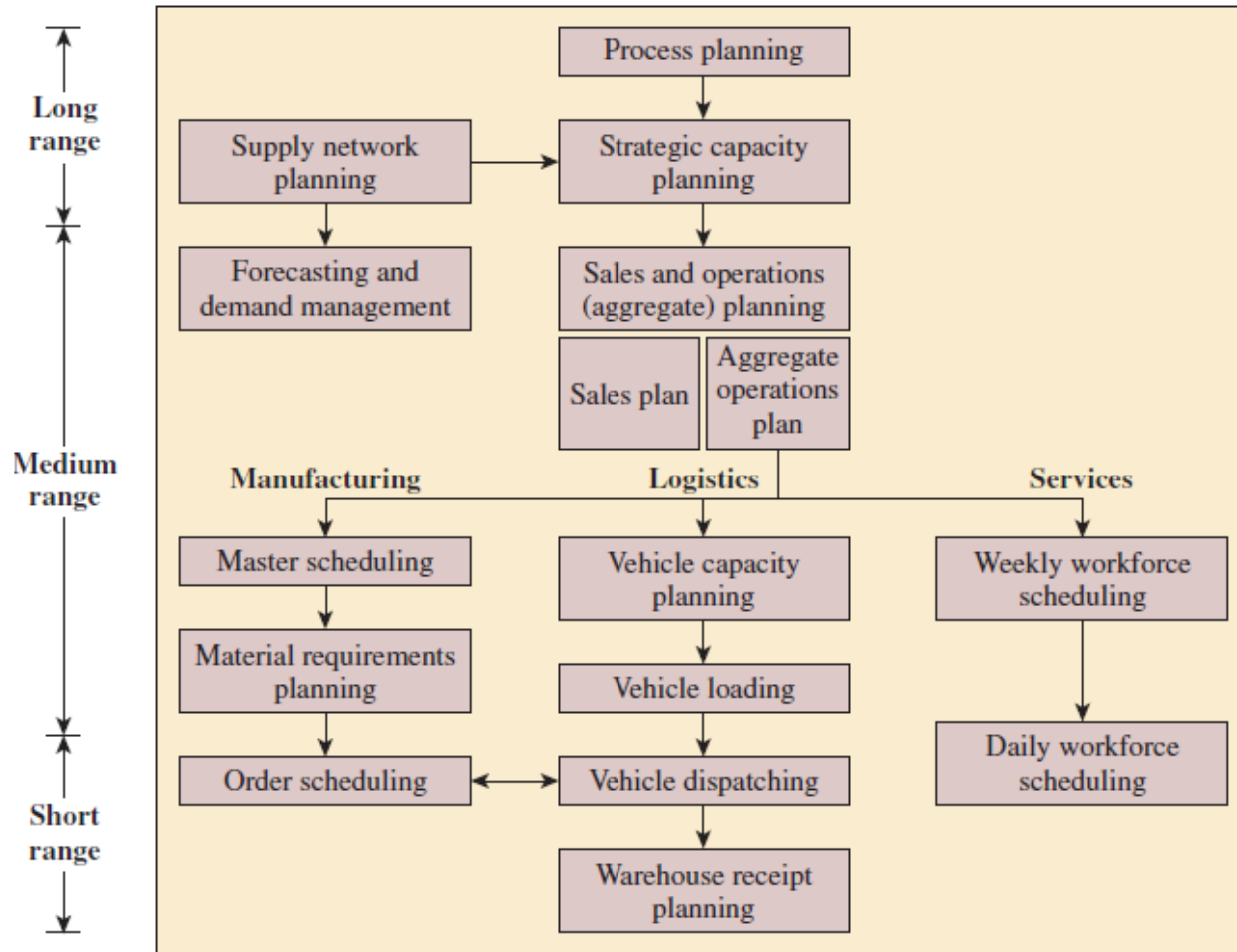
What is Sales and Operations Planning?

Sales and operations planning is a process that helps firms provide better customer service, lower inventory, shorten customer lead times, stabilize production rates, and give top management a handle on the business

The process consists of a series of meetings, finishing with a high-level meeting where key intermediate-term decisions are made

This must occur at an aggregate level and also at the detailed individual product level

◦ By aggregate we mean at the level of major groups of products

Major Sales and Operations Planning Activities

Sales and Operations Planning Activities - Overview

Sales and operations planning was coined by companies to refer to aggregate planning

The new terminology is meant to capture the importance of cross-functional work

Aggregation on the <u>supply side</u> is done by product families, and on the <u>demand side</u> it is done by groups of customers

Types of Planning

Long-range planning

- Planning focusing on a horizon greater than one year, usually performed annually

Intermediate-range planning

- Planning focusing on a period from 3 to 18 months, time increments are weekly, monthly, or quarterly

Short-range planning

- Planning covering a period from one day to six months with daily or weekly time increments

Aggregate Operations Plans

Specifies the optimal combination of

◦ Production rate (units completed per unit of time)

◦ Workforce level (number of workers needed in a period)

◦ Inventory on hand (inventory carried from previous period)

Product group or broad category (aggregation)

This planning is done over an intermediate-range planning period of 3 to18 months
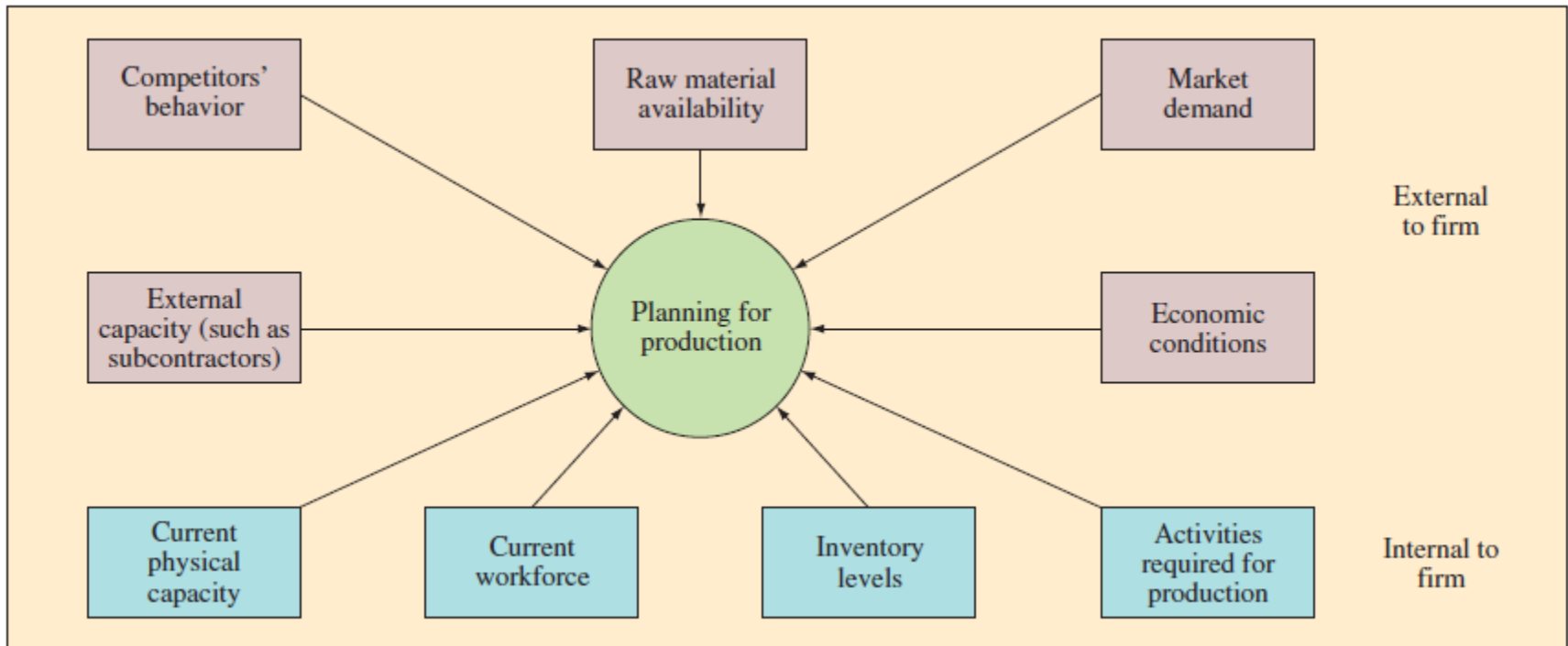
Production Planning Environment

In general, the external environment is outside the production planner's direct control

◦ In some firms, demand can be managed

Complementary products work for firms facing cyclical demand fluctuations

With services, cycles are more often measured in hours than months

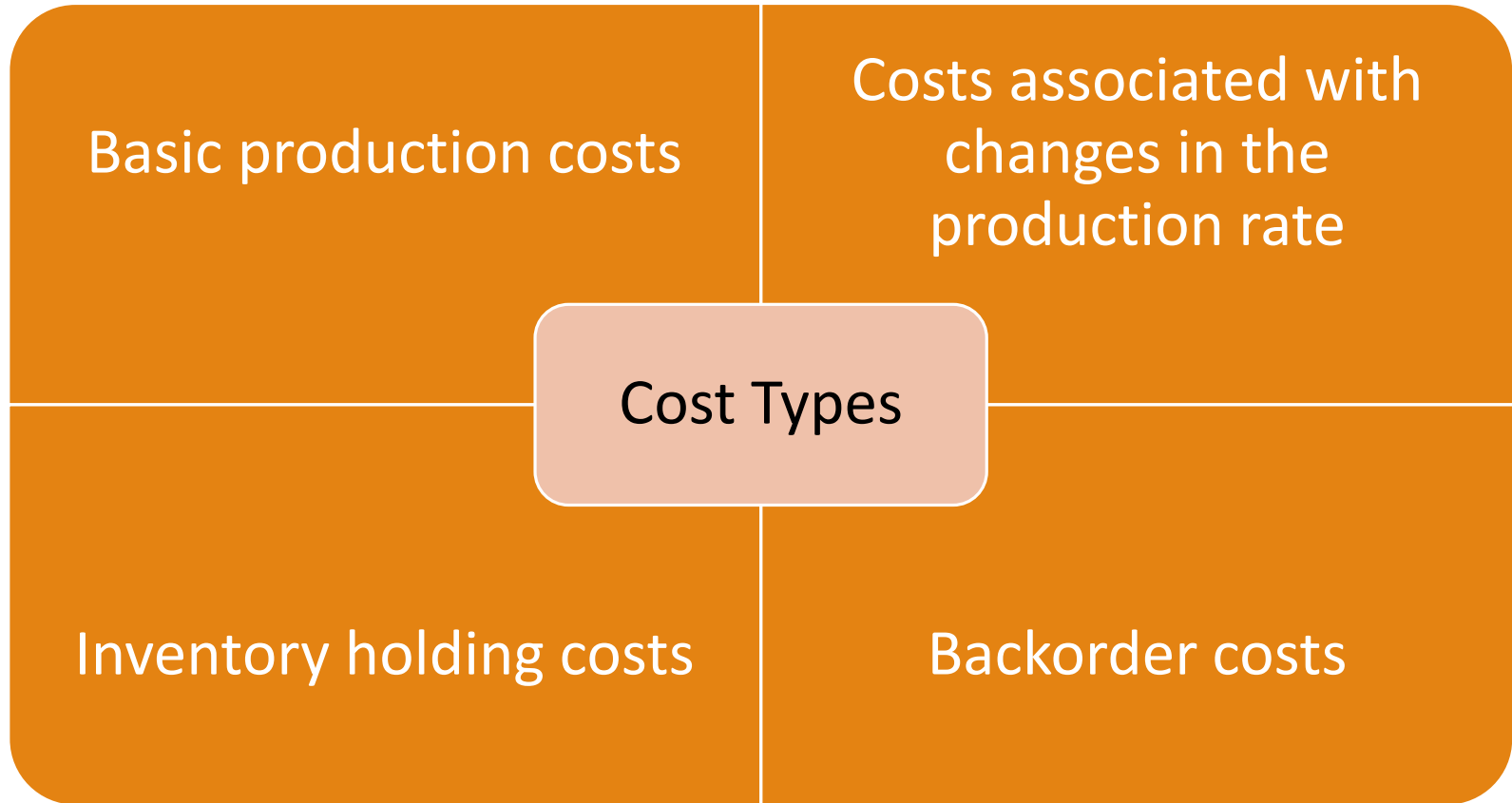# Inputs to the Production Planning System

以黑狗兄為例

Production Planning Strategies

Production planning strategies are the plans for meeting demand. Tradeoffs involved include workers employed, work hours, inventory and shortages.

A pure strategy uses just one of these approaches, a mixed strategy uses two or more

Chase strategy

Match the production rate by hiring and laying off employees

Must have a pool of easily trained applicants to draw on

Stable workforce —variable work hours

Vary the number of hours worked through flexible work schedules or overtime

Level strategy

Demand changes are absorbed by fluctuating inventory levels, order backlogs, and lost sales

Subcontracting

Hiring and laying off are translated into subcontracting

Relevant Costs

Basic production costs

Costs associated with changes in the production rate

Cost Types

Inventory holding costs

Backorder costs

Aggregate Planning Techniques

Cut-and-try approach

- Involves costing out various production planning alternatives and selecting the one that is best
- Elaborate spreadsheets are developed to facilitate the decision process

Linear programming

- Use of mathematical analysis to determine an optimal plan

Simulation

- What-if analysis using simulated demand to evaluate effectiveness of alternative plans

Cut and Try – JC Company

Since inventory holding cost is in $/unit, material cost is not relevant

DEMAND AND WORKING DAYS

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTALS
Demand forecast	1,800	1,500	1,100	900	1,100	1,600	8,000
Number of working days	22	19	21	21	22	20	125

COSTS

Materials	$100.00/unit
Inventory holding cost	$1.50/unit/month
Marginal cost of stockout	$5.00/unit/month
Marginal cost of subcontracting	$20.00/unit ($120 subcontracting cost less $100 material savings)
Hiring and training cost	$200.00/worker
Layoff cost	$250.00/worker
Labor hours required	5/unit
Straight-time cost (first eight hours each day)	$4.00/hour
Overtime cost (time and a half)	$6.00/hour

INVENTORY

Beginning inventory	400 units
Safety stock	25% of month demand

Aggregate Planning – JC Company

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Beginning inventory	400	450	375	275	225	275
Demand forecast	1,800	1,500	1,100	900	1,100	1,600
Safety stock (.25 × Demand forecast)	450	375	275	225	275	400
Production requirement (Demand forecast + Safety stock − Beginning inventory)	1,850	1,425	1,000	850	1,150	1,725
Ending inventory (Beginning inventory + Production requirement − Demand forecast)	450	375	275	225	275	400

January ending inventory becomes February beginning inventory

Evaluate Alternative Plans

Plan 1 - Produce to exact monthly production requirements by varying workforce size

Plan 2 - Produce to meet expected average demand by maintaining a constant workforce

Plan 3 - Produce to meet the minimum expected demand using a constant workforce and subcontract to meet additional requirements

Plan 4 - Produce to meet expected demand for all but the first two months using a constant workforce and use overtime to meet additional output requirements

Plan 1: Exact Production; Vary Workforce

PRODUCTION PLAN 1: EXACT PRODUCTION; VARY WORKFORCE							
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL
Production requirement (from Exhibit 12.3)	1,850	1,425	1,000	850	1,150	1,725	
Production hours required (Production requirement × 5 hr./unit)	9,250	7,125	5,000	4,250	5,75		
Working days per month	22	19	21	21			
Hours per month per worker (Working days × 8 hrs./day)	176	152	168	168	17		
Workers required (Production hours required/Hours per month per worker)	53	47	30	25	33	54	
New workers hired (assuming opening workforce equal to first month's requirement of 53 workers)	0	0	0	0	8	21	
Hiring cost	$0	$0	$0	$0	$1,600	$4,200	$5,800
Workers lai	0	6	17	5	0	0	
Layoff cost	$0	$1,500	$4,250	$1,250	$0	$0	$7,000
Straight-time cost (Production hours required × $4)	$37,000	$28,500	$20,000	$17,000	$23,000	$34,500	$160,000
						Total cost	$172,800

Production exactly matches requirements

Workers are added or reduced as needed

Plan 2: Constant Workforce; Vary Inventory and Stockout

Number of workers is set to meet average demand over the time horizon. This then determines production rate and inventory/backorders

PRODUCTION PLAN 2: CONSTANT WORKFORCE; VARY INVENTORY AND STOCKOUT	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL
Inventory	400	8	−276	−32	412	720	
ys per month	22	19	21	21	22	20	
hours available (Working days × 8 hr./day × 40 workers)*	7,040	6,080	6,720	6,720	7,040	6,400	
duction (Production hours 5 hr./unit)	1,408	1,216	1,344	1,344	1,408	1,280	
ecast (from Exhibit 12.3)	1,800	1,500	1,100	900	1,100	1,600	
ntory (Beginning inventory + duction − Demand forecast)	8	−276	−32	412	720	400	
Shortage cost (Units short × $5)	$0	$1,380	$160	$0	$0	$0	$1,540
Safety stock (from Exhibit 12.3)	450	375	275	225	275	400	
Units excess (Ending inventory − Safety stock) only if positive amount	0	0	0	187	445	0	
Inventory cost (Units excess × $1.50)	$0	$0	$0	$281	$668	$0	$948
Straight-time cost (Production hours available × $4)	$28,160	$24,320	$26,880	$26,880	$28,160	$25,600	$160,000
						Total cost	$162,488

*(Sum of production requirement in Exhibit 12.3 × 5 hr./unit)/(Sum of production hours available × 8 hr./day) = (8,000 × 5)/(125 × 8) = 40.

Plan 3: Constant Low Workforce; Subcontract

PRODUCTION PLAN 3: CONSTANT LOW WORKFORCE; SUBCONTRACT

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL
Production requirement (from Exhibit 12.3)	1,850	1,425	1,000	850	1,150	1,725	
Working days per month	22	19	21	21	22	20	
Production hours available (Working days × 8 hrs./day × 25 workers)*	4,400	3,800	4,200	4,200	4,400	4,000	
Actual production (Production hours available/5 hr. per unit)	880	760	840	840	880	800	
Units subcontracted (Production requirement − Actual production)	970	665	160	10	270	925	
Subcontracting cost (Units subcontracted × $20)	$19,400	$13,300	$3,200	$200	$5,400	$18,500	$60,000
Straight-time cost (Production hours available × $4)	$17,600	$15,200	$16,800	$16,800	$17,600	$16,000	$100,000
						Total cost	$160,000

*Minimum production requirement. In ___ ___ units. Number of workers required for April is $(850 \times 5)/(21 \times 8) = 25$.

Workforce sized to meet minimum demand (April)

Demand over minimum is met with subcontracting

Plan 4: Constant Workforce; Overtime

Demand in the first two months is high, so overtime is used to compensate. Then, inventory can be built for high demand in June.

PRODUCTION PLAN 4: CONSTANT WORKFORCE; OVERTIME							
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL
Beginning inventory	400	0	0	177	554	792	
Working days per month	22	19	21	21	22	20	
Production hours available (Working days × 8 hr./day × 38 workers)*	6,688	5,776	6,384	6,384	6,688	6,080	
Regular shift production (Production hours available/5 hrs. per unit)	1,338	1,155	1,277	1,277	1,338	1,216	
Demand forecast (from Exhibit 12.3)	1,800	1,500	1,100	900	1,100	1,600	
Units available before overtime (Beginning inventory + Regular shift production − Demand forecast). This number has been rounded to the nearest integer.	−62	−345	177	554	792	408	
Units overtime	62	375	0	0	0	0	
Overtime cost (Units overtime × 5 hr./unit × $6/hr.)	$1,860	$10,350	$0	$0	$0	$0	$12,210
Safety stock (from Exhibit 12.3)	450	375	275	225	275	400	
Units excess (Units available before overtime − Safety stock) only if positive amount	0	0	0	329	517	8	
Inventory cost (Units excessive × $1.50)	$0	$0	$0	$494	$776	$12	$1,281
Straight-time cost (Production hours available × $4)	$26,752	$23,104	$25,536	$25,536	$26,752	$24,320	$152,000
						Total cost	$165,491

*Workers determined by trial and error. See text for explanation.

Plan Comparison

Costs	PLAN 1: EXACT PRODUCTION; VARY WORKFORCE	PLAN 2: CONSTANT WORKFORCE; VARY INVENTORY AND STOCKOUT	PLAN 3: CONSTANT LOW WORKFORCE; SUBCONTRACT	PLAN 4: CONSTANT WORKFORCE; OVERTIME
Hiring	$ 5,800	$ 0	$ 0	$ 0
Layoff	7,000	0	0	0
Excess inventory	0	948	0	1,281
Shortage	0	1,540	0	0
Subcontract	0	0	60,000	0
Overtime	0	0	0	12,210
Straight time	160,000	160,000	100,000	152,000
	$172,800	$162,488	$160,000	$165,491

Graphical Summary
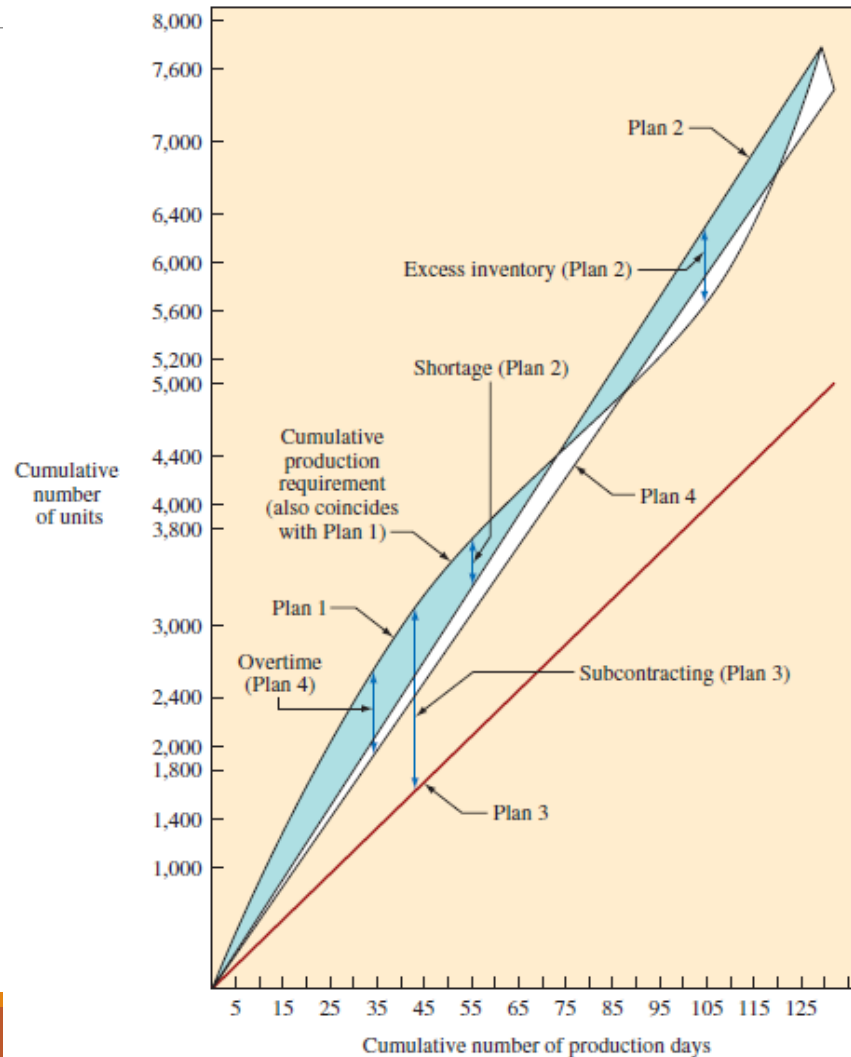
Yield Management

Yield management - the process of allocating the right type of capacity to the right type of customer at the right price and time to maximize revenue or yield

◦ Can be a powerful approach to making demand more predictable

Has existed as long as there has been limited capacity for serving customers

Its widespread scientific application began with American Airlines' computerized reservation system (SABRE)

Yield Management Success Factors

Demand can be segmented by customer

Fixed costs are high and variable costs are low

Inventory is perishable

Product can be sold in advance

Demand is highly variable

Homework

#11