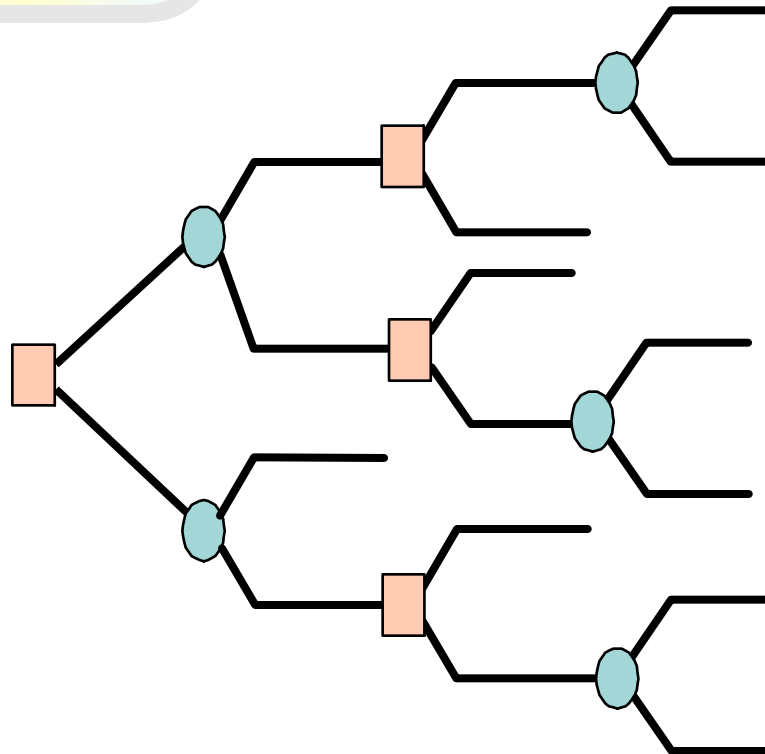


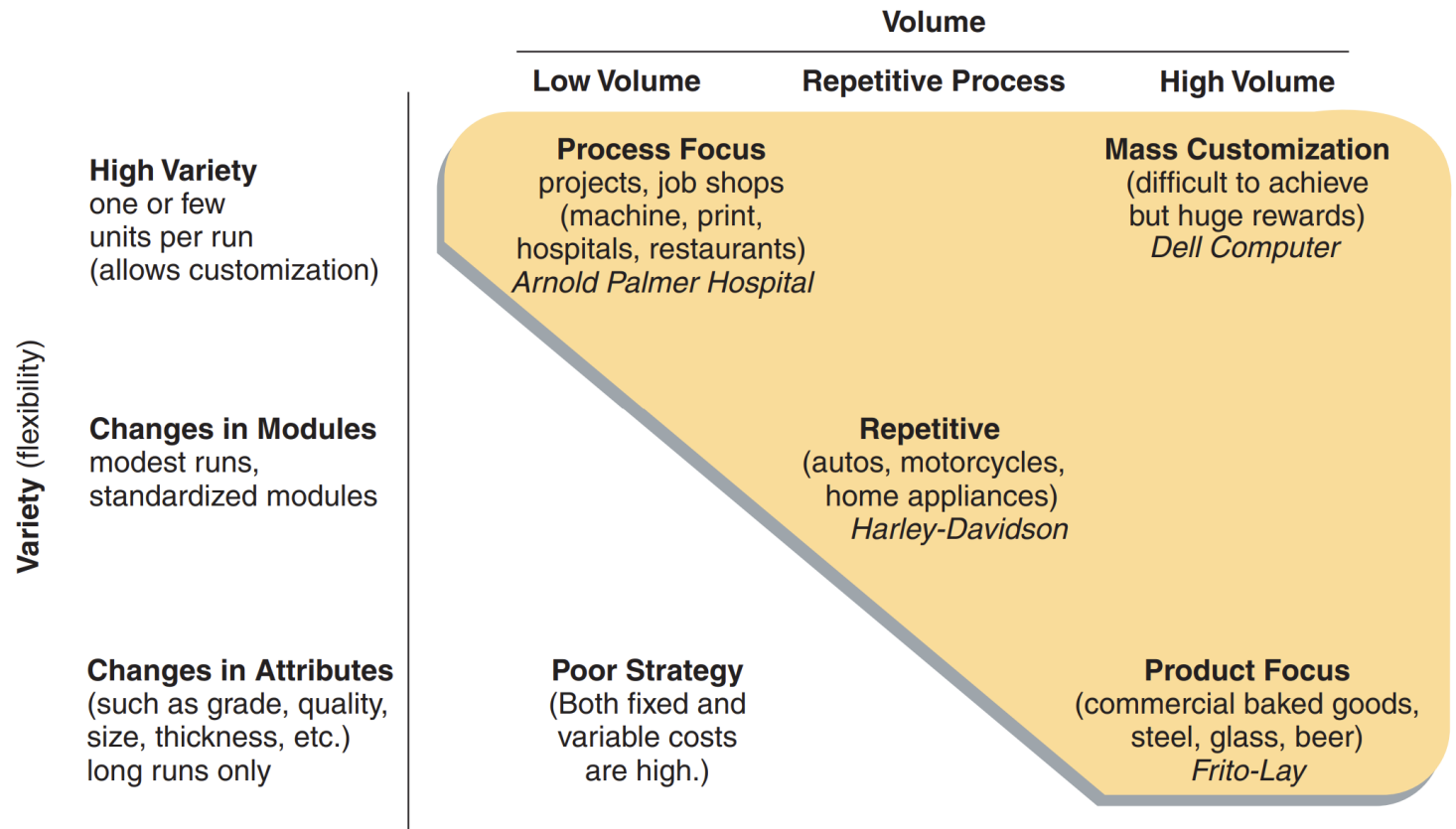
Part III- Process Capacity

Chapter 1 - introduction

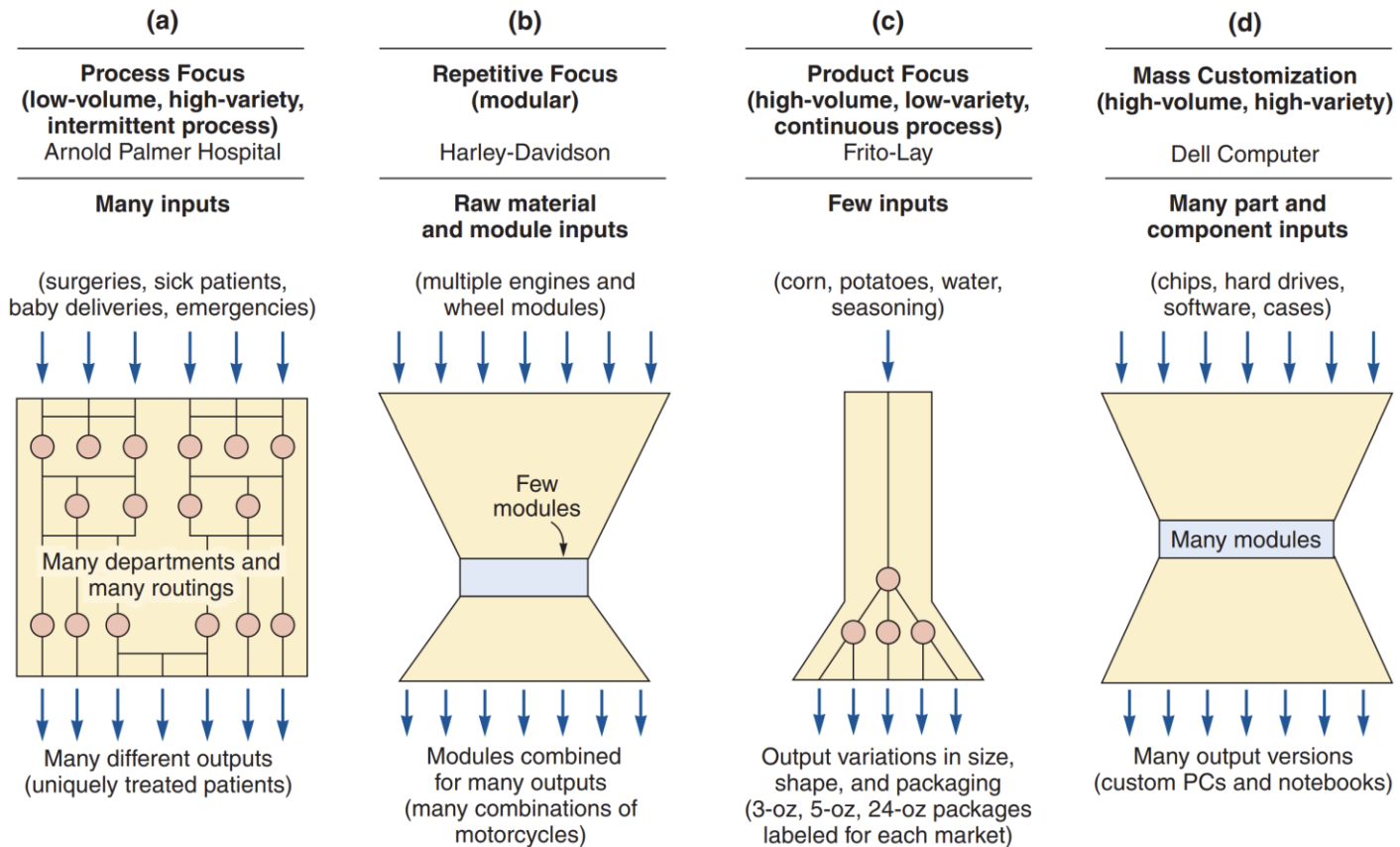


Tools & Decisions in Supply Chain

Redesigning a Process Through Capacity Change



Redesigning a Process Through Capacity Change



Comparison of Processes

Comparison of the Characteristics of Four Types of Processes

PROCESS FOCUS (LOW-VOLUME, HIGH-VARIETY; e.g., ARNOLD PALMER HOSPITAL)	REPETITIVE FOCUS (MODULAR; e.g., HARLEY-DAVIDSON)	PRODUCT FOCUS (HIGH-VOLUME, LOW-VARIETY; e.g., FRITO-LAY)	MASS CUSTOMIZATION (HIGH-VOLUME, HIGH-VARIETY; e.g., DELL COMPUTER)
1. Small quantity and large variety of products	1. Long runs, a standardized product from modules	1. Large quantity and small variety of products	1. Large quantity and large variety of products
2. Broadly skilled operators	2. Moderately trained employees	2. Less broadly skilled operators	2. Flexible operators

Comparison of Processes

Comparison of the Characteristics of Four Types of Processes

PROCESS FOCUS (LOW-VOLUME, HIGH-VARIETY; e.g., ARNOLD PALMER HOSPITAL)	REPETITIVE FOCUS (MODULAR; e.g., HARLEY-DAVIDSON)	PRODUCT FOCUS (HIGH-VOLUME, LOW-VARIETY; e.g., FRITO-LAY)	MASS CUSTOMIZATION (HIGH-VOLUME, HIGH-VARIETY; e.g., DELL COMPUTER)
3. Instructions for each job	3. Few changes in the instructions	3. Standardized job instructions	3. Custom orders requiring many job instructions
4. High inventory	4. Low inventory	4. Low inventory	4. Low inventory relative to the value of the product

Comparison of Processes

Comparison of the Characteristics of Four Types of Processes

PROCESS FOCUS (LOW-VOLUME, HIGH-VARIETY; e.g., ARNOLD PALMER HOSPITAL)	REPETITIVE FOCUS (MODULAR; e.g., HARLEY-DAVIDSON)	PRODUCT FOCUS (HIGH-VOLUME, LOW-VARIETY; e.g., FRITO-LAY)	MASS CUSTOMIZATION (HIGH-VOLUME, HIGH-VARIETY; e.g., DELL COMPUTER)
5. Finished goods are made to order and not stored	5. Finished goods are made to frequent forecasts	5. Finished goods are made to a forecast and stored	5. Finished goods are build-to-order (BTO)
6. Scheduling is complex	6. Scheduling is routine	6. Scheduling is routine	6. Sophisticated scheduling accommodates custom orders

Comparison of Processes (4 of 4)

Table 7.2 Comparison of the Characteristics of Four Types of Processes

PROCESS FOCUS (LOW-VOLUME, HIGH-VARIETY; e.g., ARNOLD PALMER HOSPITAL)	REPETITIVE FOCUS (MODULAR; e.g., HARLEY-DAVIDSON)	PRODUCT FOCUS (HIGH-VOLUME, LOW-VARIETY; e.g., FRITO-LAY)	MASS CUSTOMIZATION (HIGH-VOLUME, HIGH-VARIETY; e.g., DELL COMPUTER)
7. Fixed costs are low and variable costs high	7. Fixed costs are dependent on flexibility of the facility	7. Fixed costs are high and variable costs low	7. Fixed costs tend to be high and variable costs low

Redesigning a Process

Value Stream Mapping

Present Method ☒		PROCESS CHART		Proposed Method ☐	
SUBJECT CHARTED <u>Hamburger Assembly Process</u>		DATE <u>12 / 1 / 15</u>			
DEPARTMENT _____		CHART BY <u>KH</u>		SHEET NO. <u>1</u> OF <u>1</u>	

DIST. IN FEET	TIME IN MINS.	CHART SYMBOLS	PROCESS DESCRIPTION
	—	○ → □ ▢ ▽	Meat Patty in Storage
1.5	.05	○ → □ ▢ ▽	Transfer to Broiler
	2.50	○ → □ ▢ ▽	Broiler
	.05	○ → □ ▢ ▽	Visual Inspection
1.0	.05	○ → □ ▢ ▽	Transfer to Rack
	.15	○ → □ ▢ ▽	Temporary Storage
.5	.10	○ → □ ▢ ▽	Obtain Buns, Lettuce, etc.
	.20	○ → □ ▢ ▽	Assemble Order
.5	.05	○ → □ ▢ ▽	Place in Finish Rack
		○ → □ ▢ ▽	
3.5	3.15	2 4 1 - 2	TOTALS

Value-added time = Operation time/Total time = (2.50+.20)/3.15 = 85.7%

○ = operation; → = transport; □ = inspect; ▢ = delay; ▽ = storage.

PROCESS ANALYSIS,

Control and task

F Poka-yokes to address potential failure points

Poka-yoke: Bell in driveway in case customer arrival was unnoticed.

Poka-yoke: If customer remains in the work area, offer coffee and reading material in waiting room.

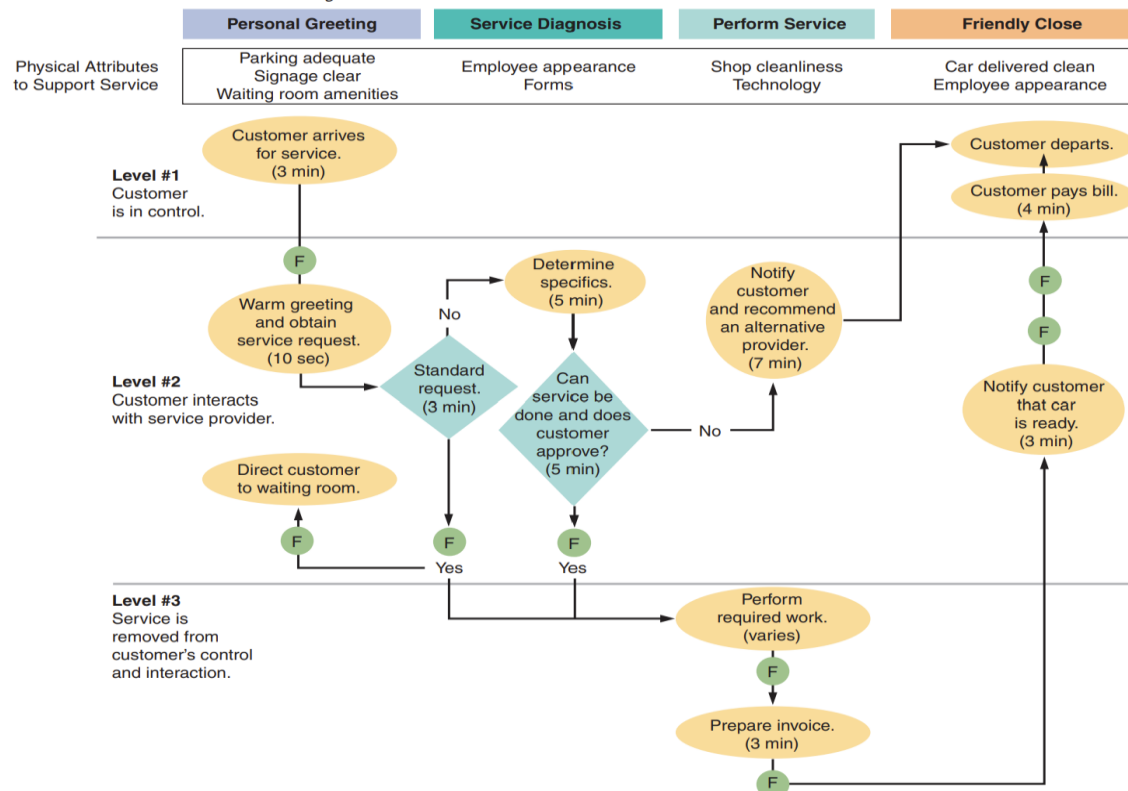
Poka-yoke: Conduct dialog with customer to identify customer expectation and assure customer acceptance.

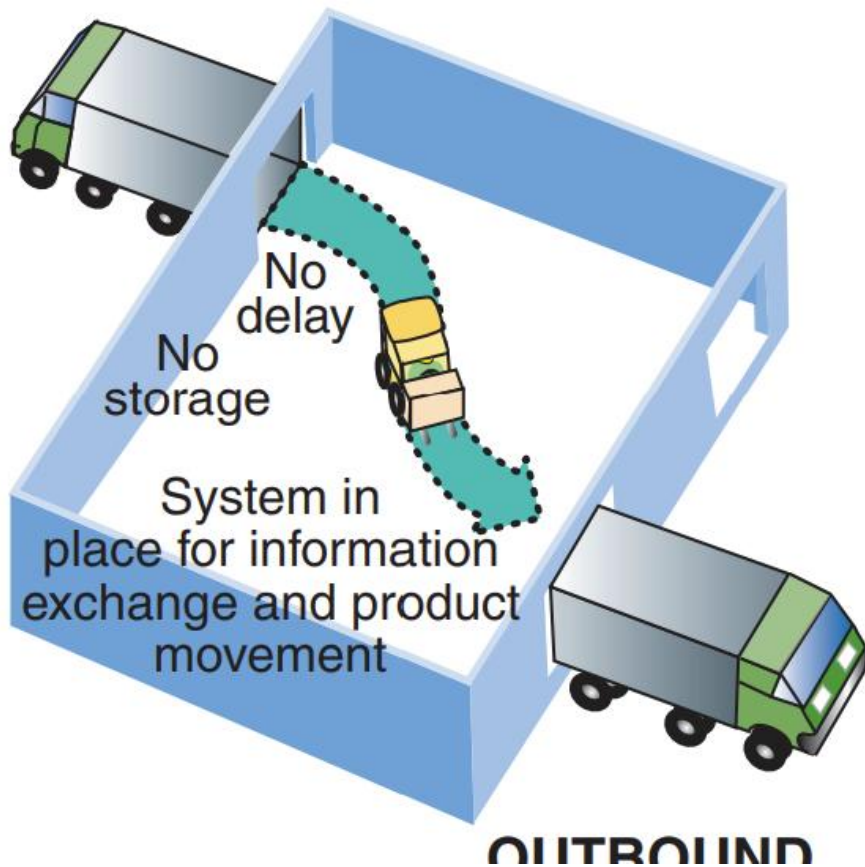
Poka-yoke: Review checklist for compliance.
Poka-yoke: Service personnel review invoice for accuracy.

Poka-yoke: Customer approves invoice.

Poka-yoke: Customer inspects car.

Personal Greeting	Service Diagnosis	Perform Service	Friendly Close
Parking adequate Signage clear Waiting room amenities	Employee appearance Forms	Shop cleanliness Technology	Car delivered clean Employee appearance



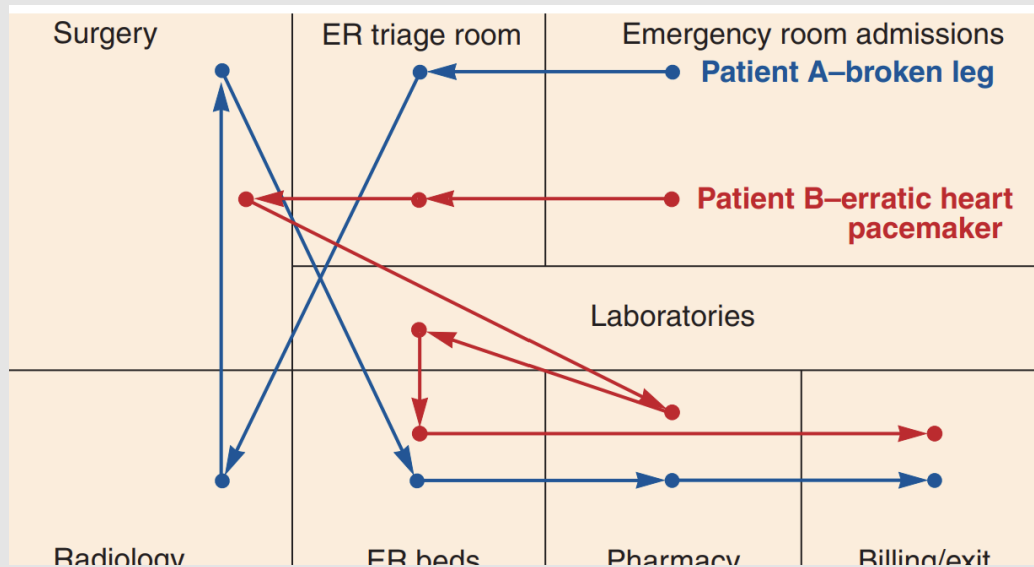


Processes Lay out
Maximum use of a
place

- Cross docking

- Random stocking
 1. Maintaining a **list of “open” locations**
 2. Maintaining accurate records of existing inventory and its locations
 3. Sequencing items **to minimize the travel time required to “pick” orders**
 4. **Combining orders** to reduce picking time
 5. Assigning certain items or **classes of items**, such as high-usage items, to particular warehouse areas so that the total distance traveled within the warehouse is minimized

Layout patterns

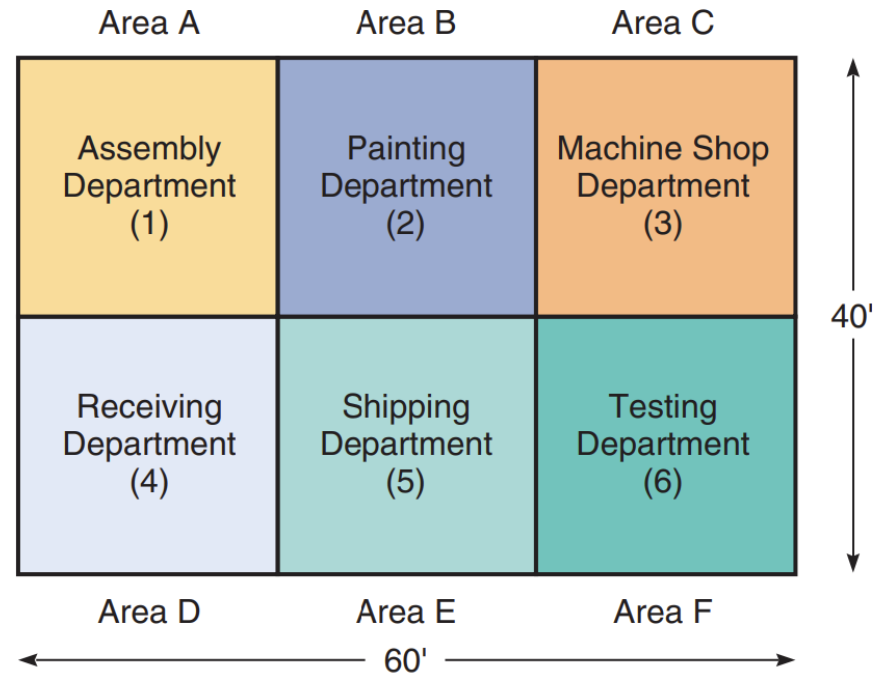


- **Fixed position layout**
 - A system that addresses the layout requirements of stationery products
- **Process oriented layout**
 - deals with low-volume, high-variety production in which like machines and equipment are grouped together

Example
Minimizing interdepartmental
material handling cost (**through distances**)

Department	Number of loads per week					
	Assembly (1)	Painting (2)	Machine Shop (3)	Receiving (4)	Shipping (5)	Testing (6)
Assembly (1)		50	100	0	0	20
Painting (2)			30	50	10	0
Machine Shop (3)				20	0	100
Receiving (4)					50	0
Shipping (5)						0
Testing (6)						

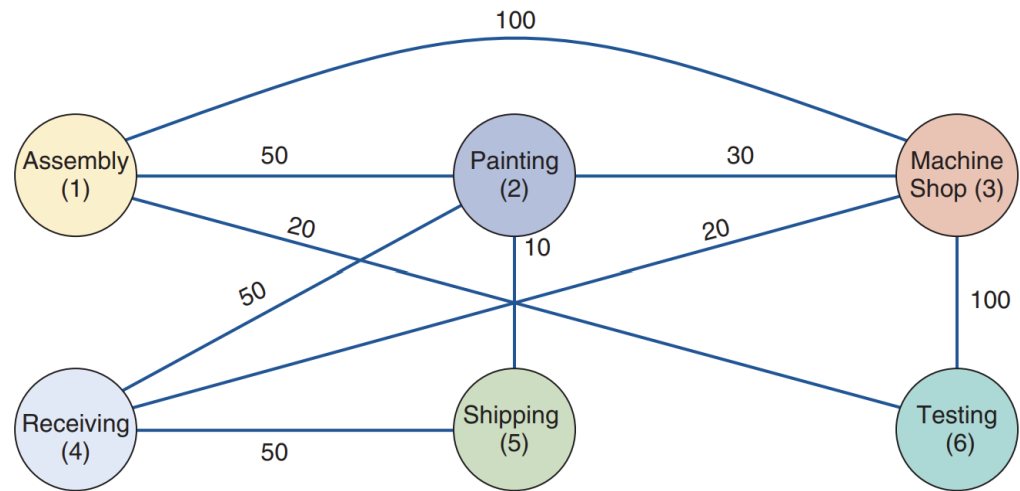
Determine space requirement



Department	Number of loads per week					
	Assembly (1)	Painting (2)	Machine Shop (3)	Receiving (4)	Shipping (5)	Testing (6)
Assembly (1)		50	100	0	0	20
Painting (2)			30	50	10	0
Machine Shop (3)				20	0	100
Receiving (4)					50	0
Shipping (5)						0
Testing (6)						

Let's try to do by yourself

In minimizing cost
as we know that
transport cost is \$1
for adjacent
departments and
\$2 for non adjacent
departments



$$\begin{aligned}
 \text{Cost} &= \$50 + \$200 + \$40 + \$30 + \$50 \\
 &\quad (1 \text{ and } 2) \quad (1 \text{ and } 3) \quad (1 \text{ and } 6) \quad (2 \text{ and } 3) \quad (2 \text{ and } 4) \\
 &\quad + \$10 + \$40 + \$100 + \$50 \\
 &\quad (2 \text{ and } 5) \quad (3 \text{ and } 4) \quad (3 \text{ and } 6) \quad (4 \text{ and } 5) \\
 &= \$570
 \end{aligned}$$

Goal is to minimize the cost

$$\text{Minimize cost} = \sum_{i=1}^n \sum_{j=1}^n X_{ij} C_{ij}$$

where n = total number of work centers or departments

i, j = individual departments

X_{ij} = number of loads moved from department i to department j

C_{ij} = cost to move a load between department i and department j

Capacity planning

Measures of capacity

- Output measures
- Input measures

Design capacity

- Available time x units per time unit

Efficiency

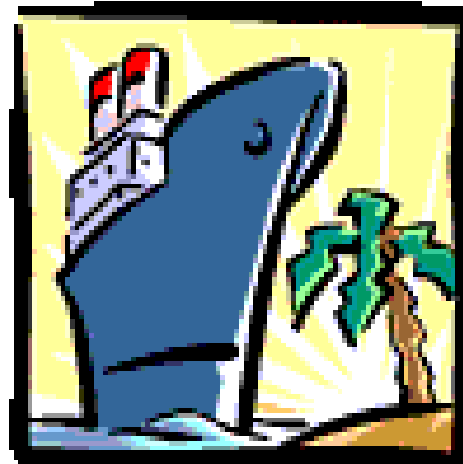
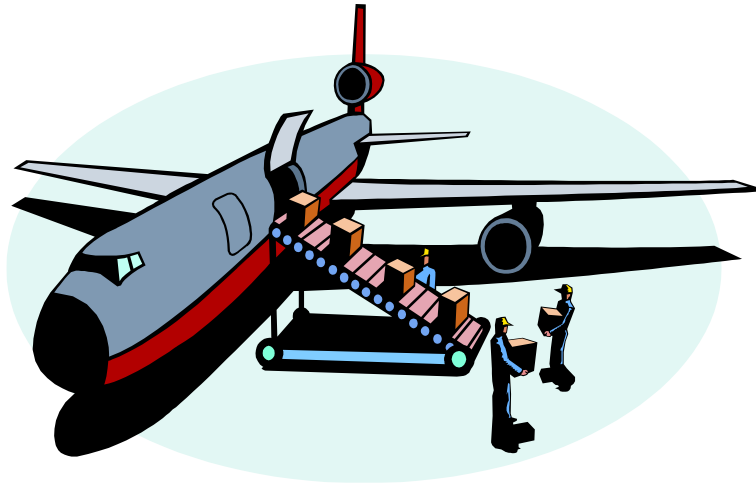
- Actual output / Effective capacity

Utilization

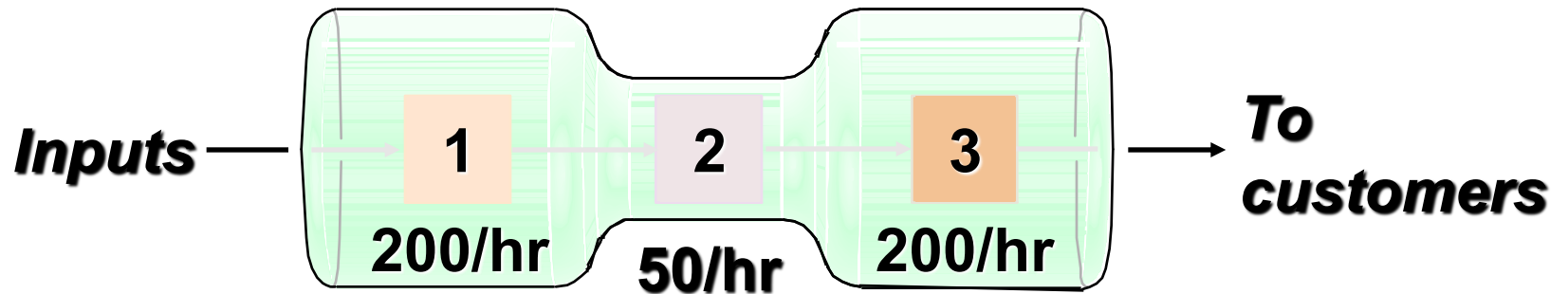
- Actual output / Design capacity

Utilization

$$\text{Utilization} = \frac{\text{Average output rate}}{\text{Maximum capacity}} \times 100 \text{ in \%}$$



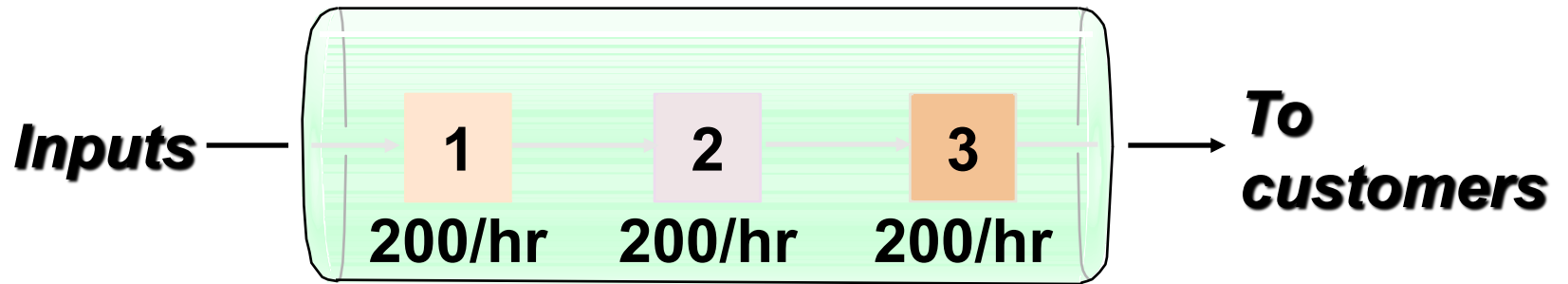
Capacity Bottlenecks



(a) Operation 2 a bottleneck

Figure 6.2

Capacity Bottlenecks

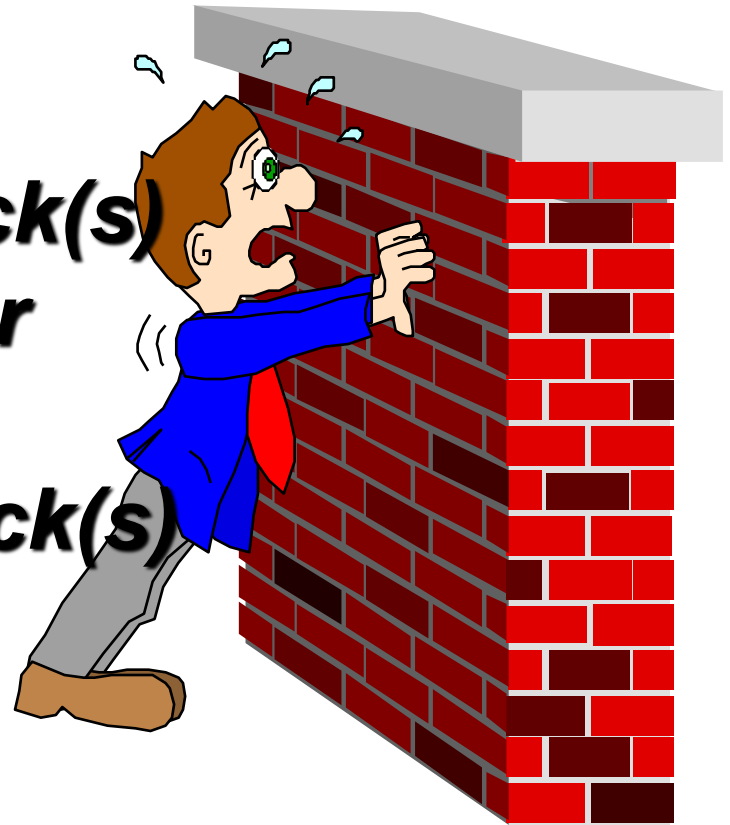


(b) All operations bottlenecks

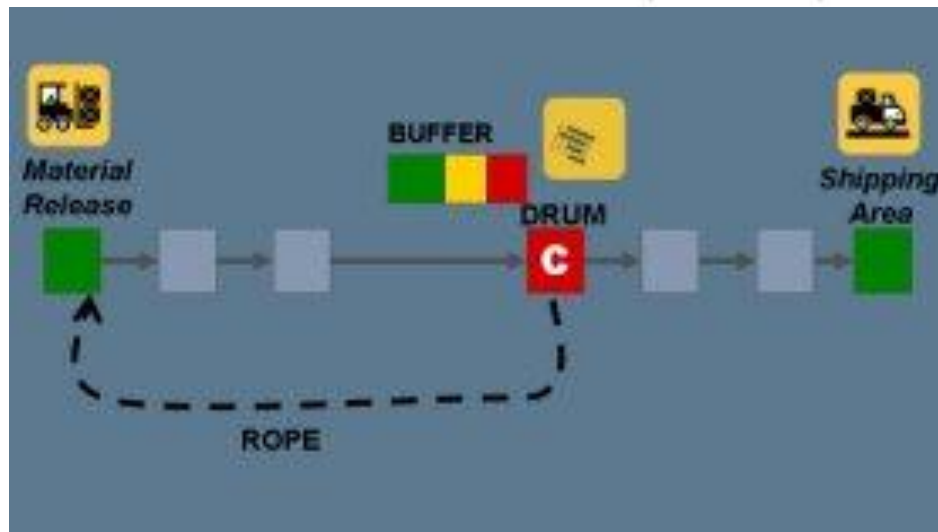
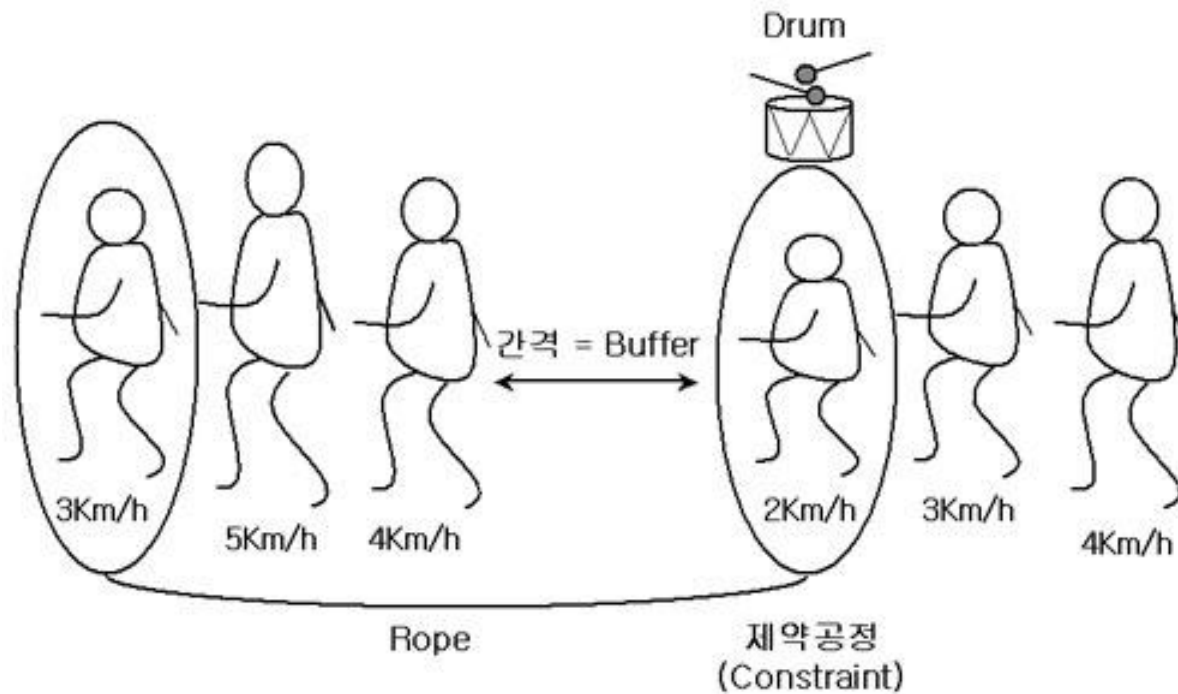
Figure 6.2

Theory of Constraints

- 1. Identify the system bottleneck(s)***
- 2. Exploit the bottleneck(s)***
- 3. Subordinate all other decisions to Step 2***
- 4. Elevate the bottleneck(s)***
- 5. Do not let inertia set in***



Drum-buffer-rope method



Economies and Diseconomies of Scale

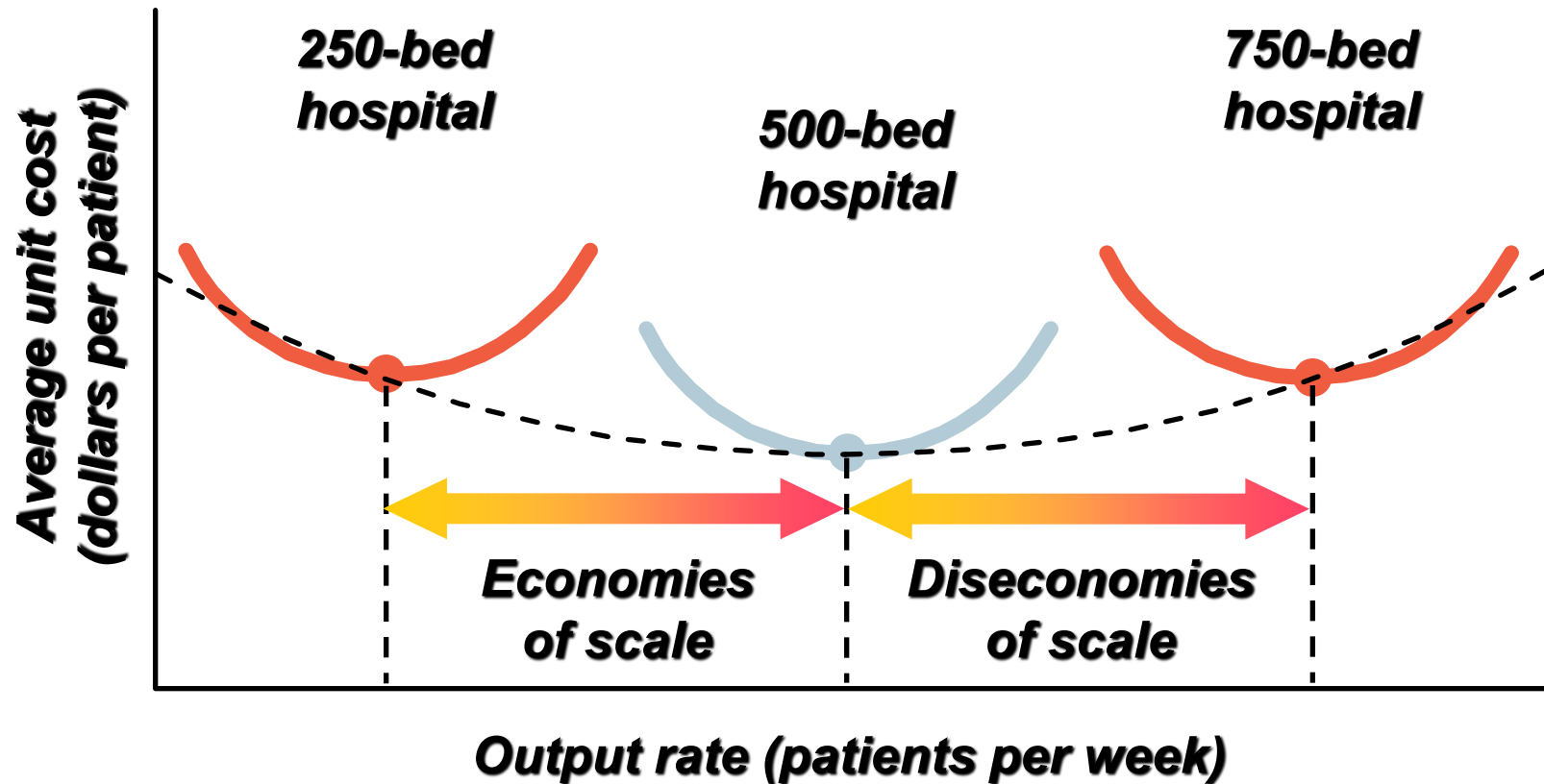


Figure 6.3



Economies of scale

- Spreading fixed costs
- Reducing construction costs
- Cutting costs of purchased materials
- Looking for process advantages

Diseconomies of scale

The size enlargement might creates cost :
complexity,
inefficiencies

...

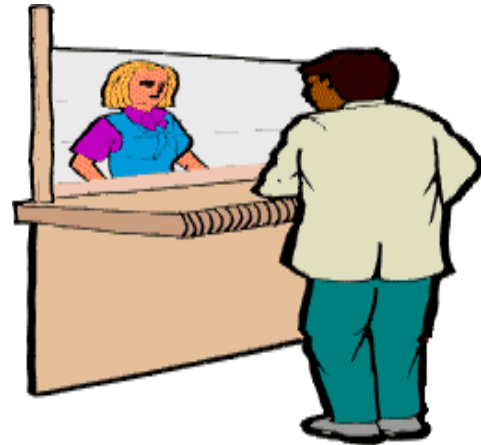
- Bureaucracy



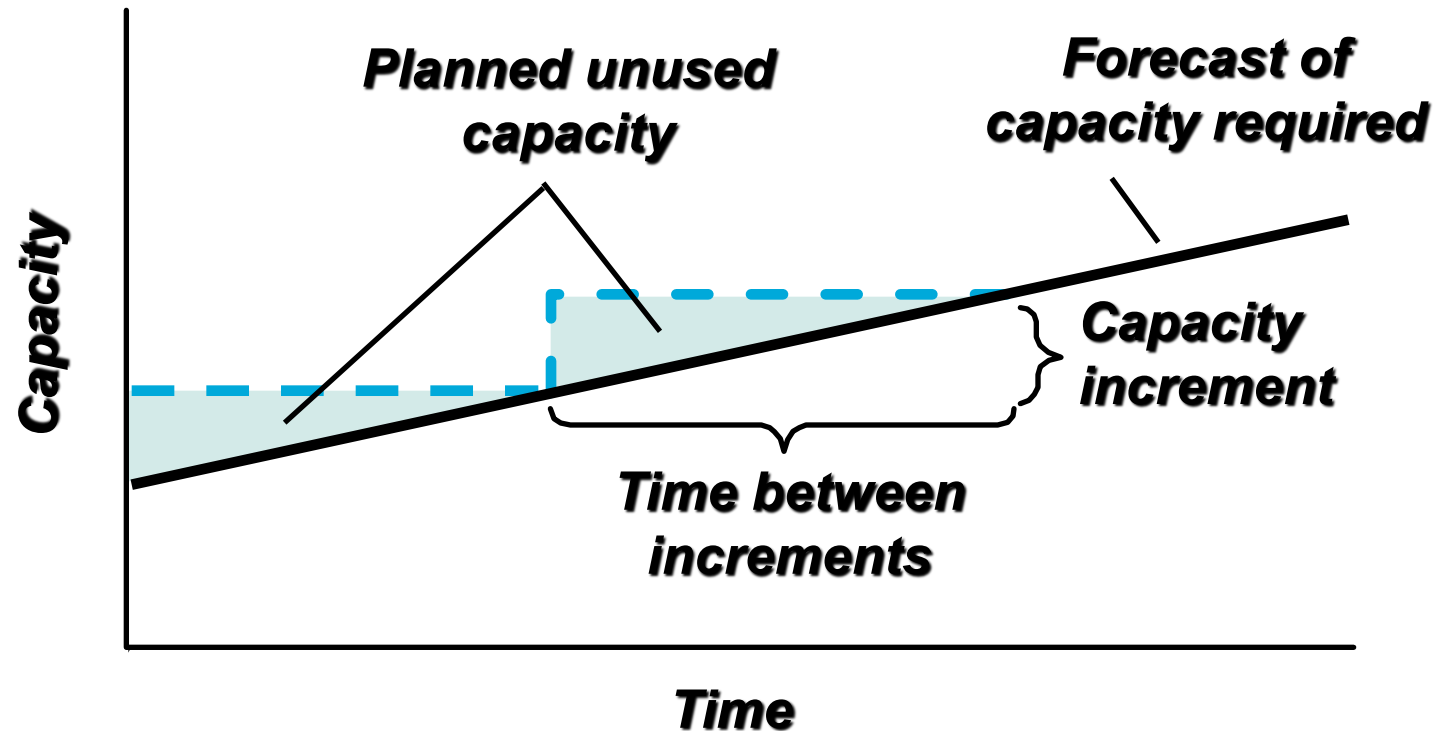
Loss of
flexibility

Capacity Cushions

Capacity Cushion = 100% - Utilization Rate (%)



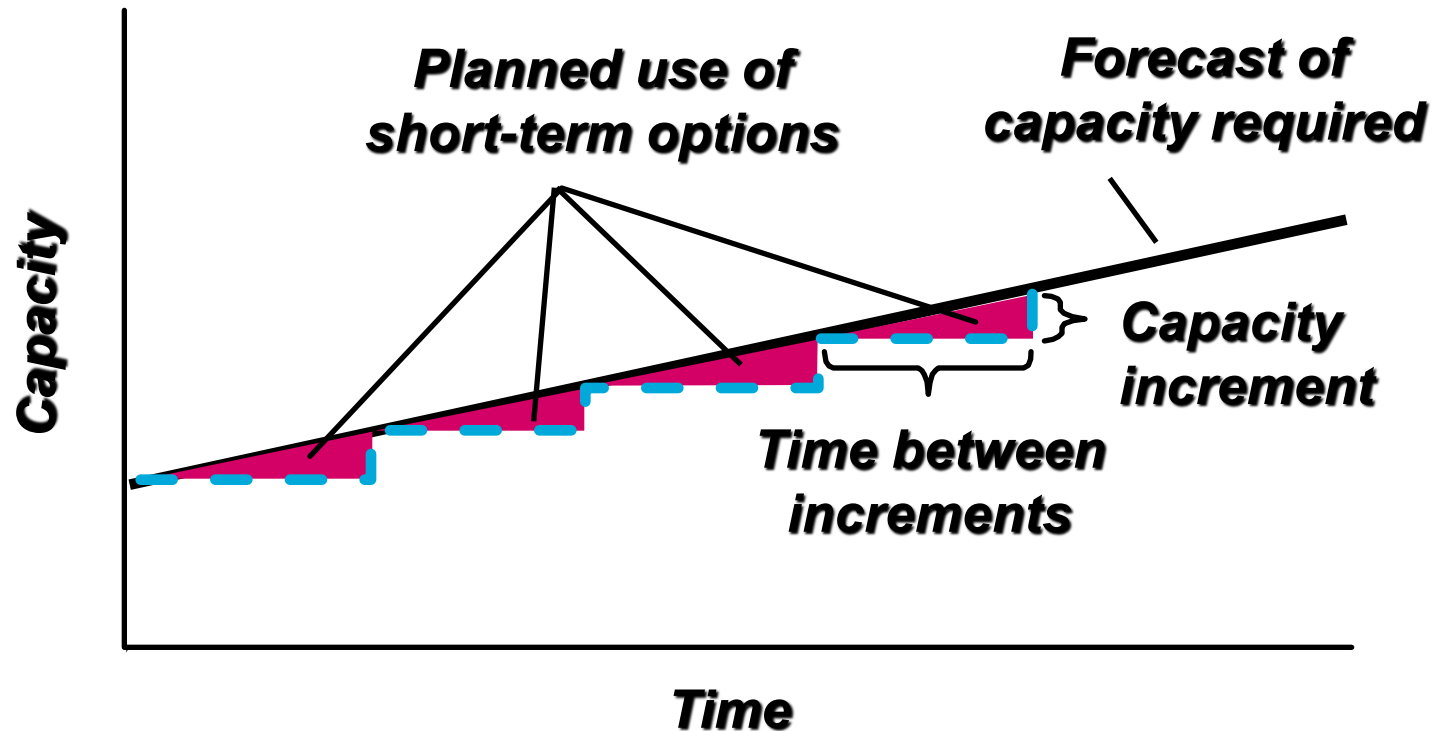
Capacity Strategies



(a) Expansionist strategy

Figure 6.4

Capacity Strategies

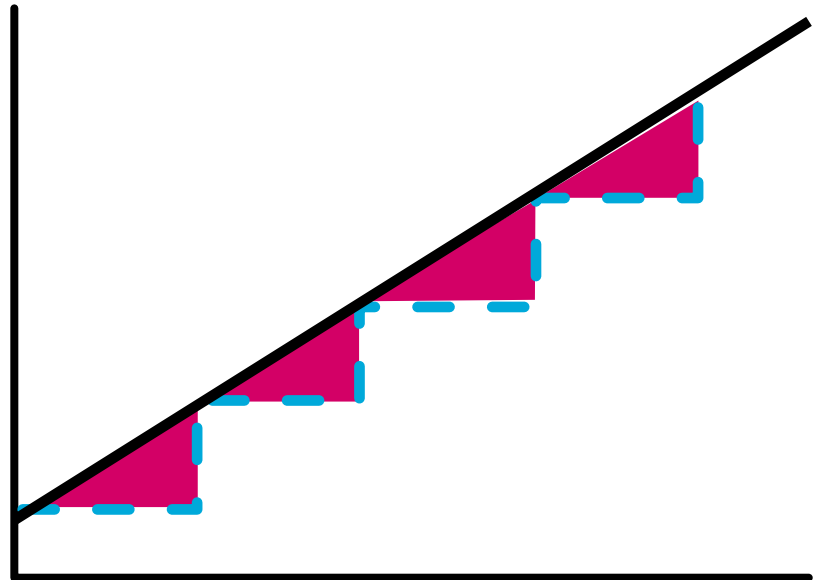


(b) Wait-and-see strategy

Figure 6.4

Linking Process Capacity and Other Decisions

- ***Competitive Priorities***
- ***Quality***
- ***Process Design***
- ***Aggregate Planning***





A systematic approach to capacity decisions

- Estimate capacity requirements
 - Using output measures

Estimating Capacity Requirements

A process serves 50 customers per day, utilization is about 90%, and demand is expected to double in five years. Management wants to increase the capacity cushion to 20%.

$$**M = \frac{50}{[1.0 - .20]} = 62.5 \text{ customers per day}**$$

**In 5 years if demand doubles,
M = 2 x 62.5 or 125 customers per day**

Estimating Capacity Requirements

Capacity requirement =

$$\frac{\text{Processing hours required for year's demand}}{\text{Hours available from a single capacity unit per year, after deducting desired cushion}}$$

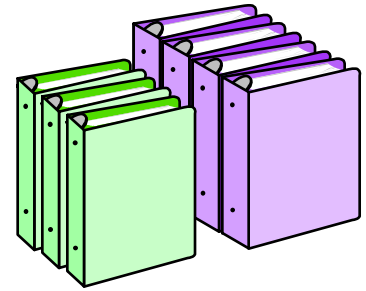
$$M = \frac{Dp}{N[1 - (C/100)]}$$

***D* = demand forecast for the year**

***p* = processing time**

***N* = total number of hours per year during which the process operates**

***C* = desired capacity cushion**

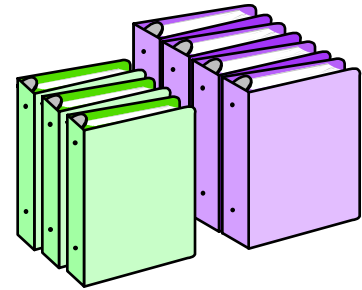


Chapter 2

Capacity Decisions

Capacity Decisions

Estimate Capacity Requirements



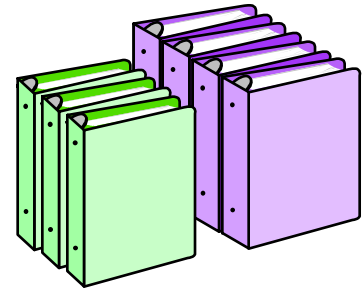
Item	Client X	Client Y
Annual demand forecast (copies)	2000.00	6000.00
Standard processing time (hour/copy)	0.50	0.70
Average lot size (copies per report)	20.00	30.00
Standard setup time (hours)	0.25	0.40

Data

250 working days a year
1 shift 8 hours a day
Capacity cushion 15%

Capacity Decisions

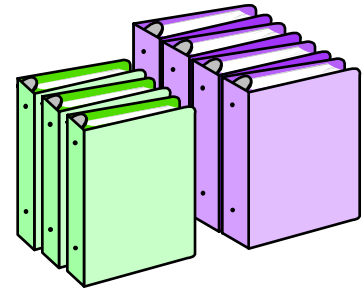
Estimate Capacity Requirements



Item	Client X	Client Y
Annual demand forecast (copies)	2000.00	6000.00
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Capacity Decisions

Estimate Capacity Requirements



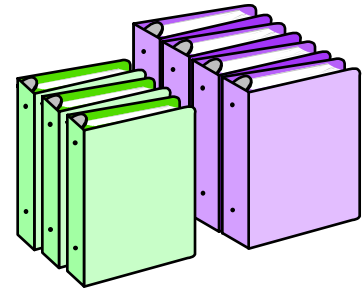
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Annual demand forecast (copies)	2000.00	6000.00
Standard processing time (hour/copy)	0.50	0.70
Average lot size (copies per report)	20.00	30.00
Standard setup time (hours)	0.25	0.40

$$M = \frac{[Dp + (D/Q)s]_{\text{product 1}} + \dots + [Dp + (D/Q)s]_{\text{product } n}}{N[1 - (C/100)]}$$

Example 6.2

Capacity Decisions

Estimate Capacity Requirements



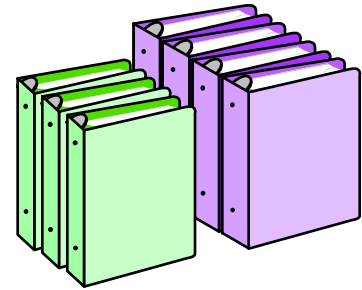
Item	Client X	Client Y
Annual demand forecast (copies)	2000.00	6000.00
Standard processing time (hour/copy)	0.50	0.70
Average lot size (copies per report)	20.00	30.00
Standard setup time (hours)	0.25	0.40

$$M = \frac{[2000(0.5) + (2000/20)(0.25)]_{\text{client X}} + [6000(0.7) + (6000/30)(0.4)]_{\text{client Y}}}{(250 \text{ days/year})(1 \text{ shift/day})(8 \text{ hours/shift})(1.0 - 15/100)}$$

Example 6.2

Capacity Decisions

Estimate Capacity Requirements



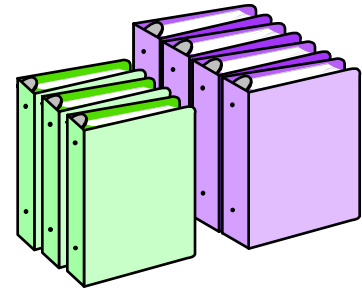
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$$M = \frac{[2000(0.5) + (2000/20)(0.25)]_{\text{client X}} + [6000(0.7) + (6000/30)(0.4)]_{\text{client Y}}}{(250 \text{ days/year})(1 \text{ shift/day})(8 \text{ hours/shift})(1.0 - 15/100)}$$

Example 6.2

Capacity Decisions

Estimate Capacity Requirements



Item	Client X	Client Y
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Average lot size (copies per report)	20.00	30.00
Standard setup time (hours)	0.25	0.40

$$M = \frac{5305}{1700} = 3.12 \approx 4 \text{ machines}$$

Example 6.2

Step 2 : identify
gaps

Between projected demand and current capacity

Step 3 : develop
alternatives

To cope with project gaps

Step 4 : evaluate
alternatives

Evaluate each alternative

Qualitative concerns : uncertainties about demand ...

Quantitative concerns

- Distribution of demand, peaks ...

Example

Grandmother's chicken restaurant is experiencing a boom in business. The owner expects to serve a total of **80000 meals this year**. Although the kitchen is operating at a **100% capacity**, the dining room can handle a total of **105000 diners per year**, followed by a **10000 meal increase** in each of the succeeding years. One alternative is to expand both the kitchen and the dining room now, bringing their **capacities up to 130000 meals per year**. The **initial investment would be \$ 200000**, made at the end of this year (year 0). The average meal is priced at \$ 10, and the before tax profit margin is 20%. The 20% figure was arrived at by determining that, for each \$ 10 meal, \$6 covers variable costs and \$2 goes toward fixed costs. The remaining **\$2 goes to pretax profit**.

What are the pretax cash flows from this project to the next 5 years compared to those of the basic case of doing nothing ?

Capacity Decisions

Decision Trees

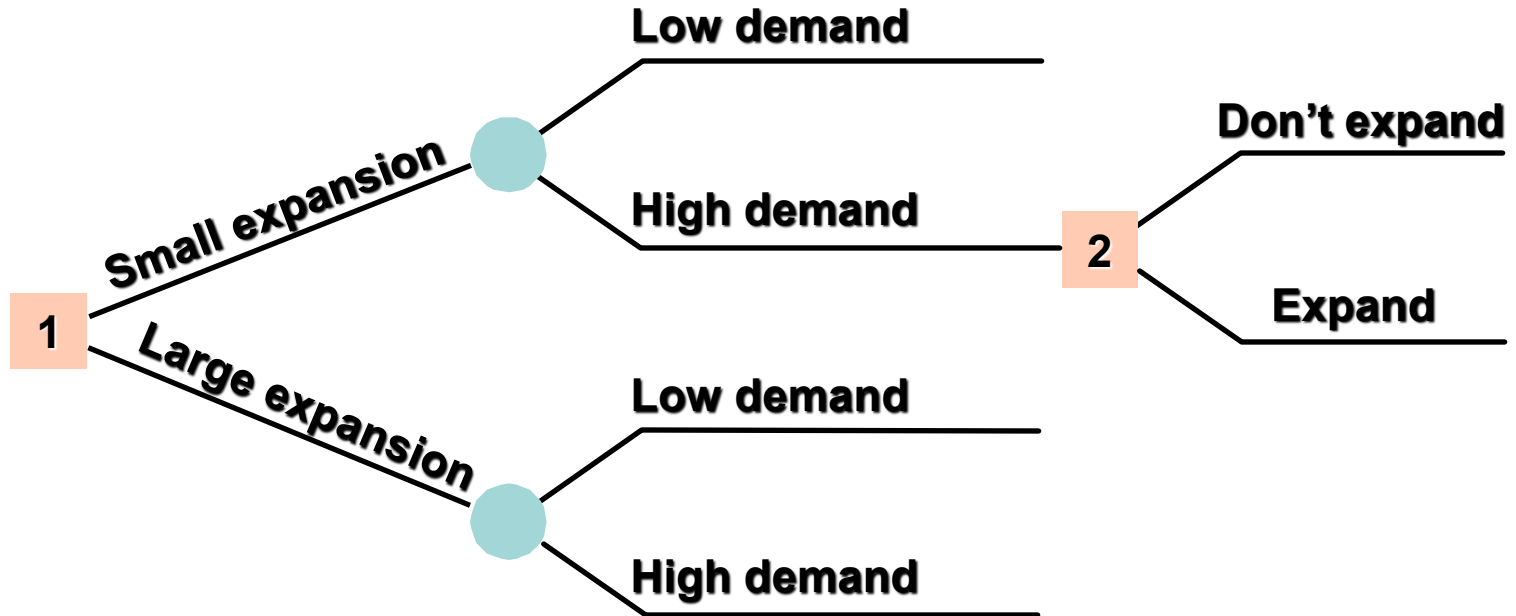
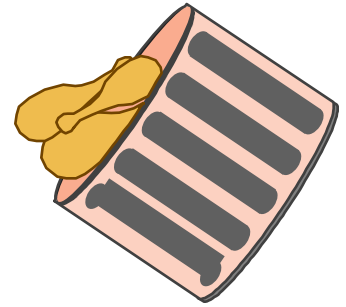


Figure 6.7

Capacity Decisions

Decision Trees

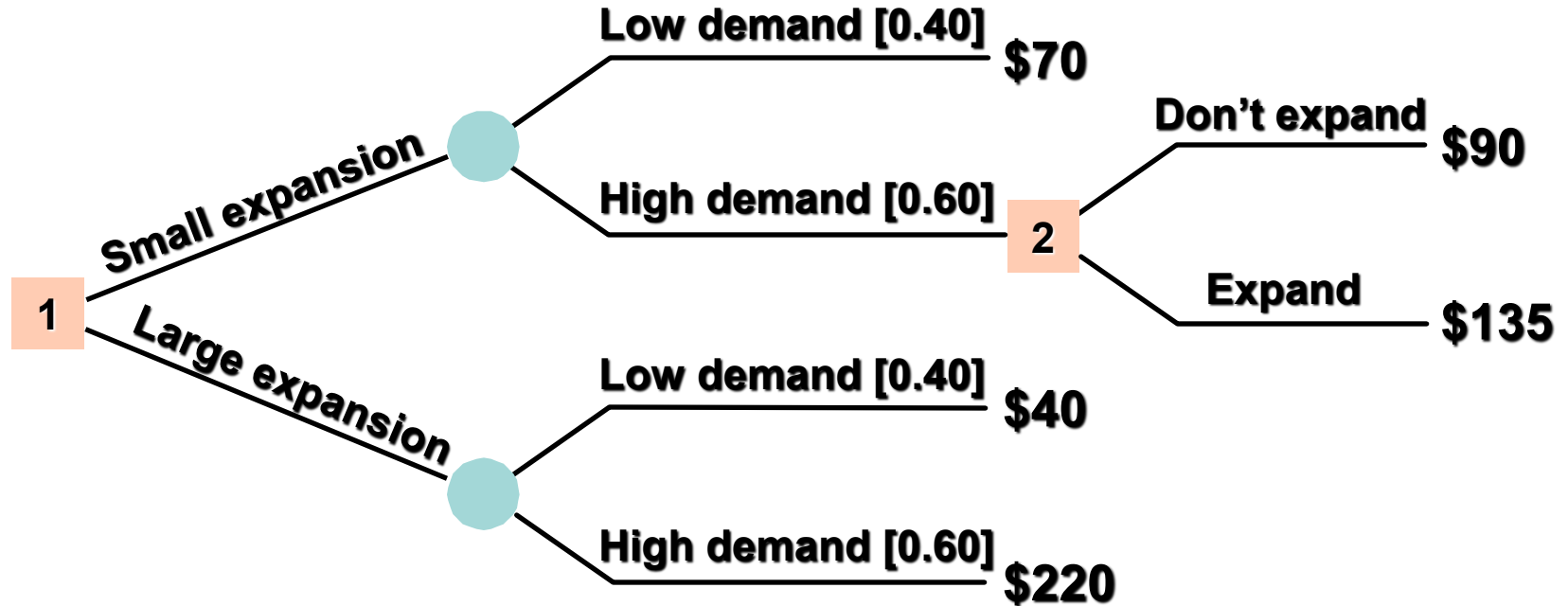


Figure 6.7

Capacity Decisions

Decision Trees

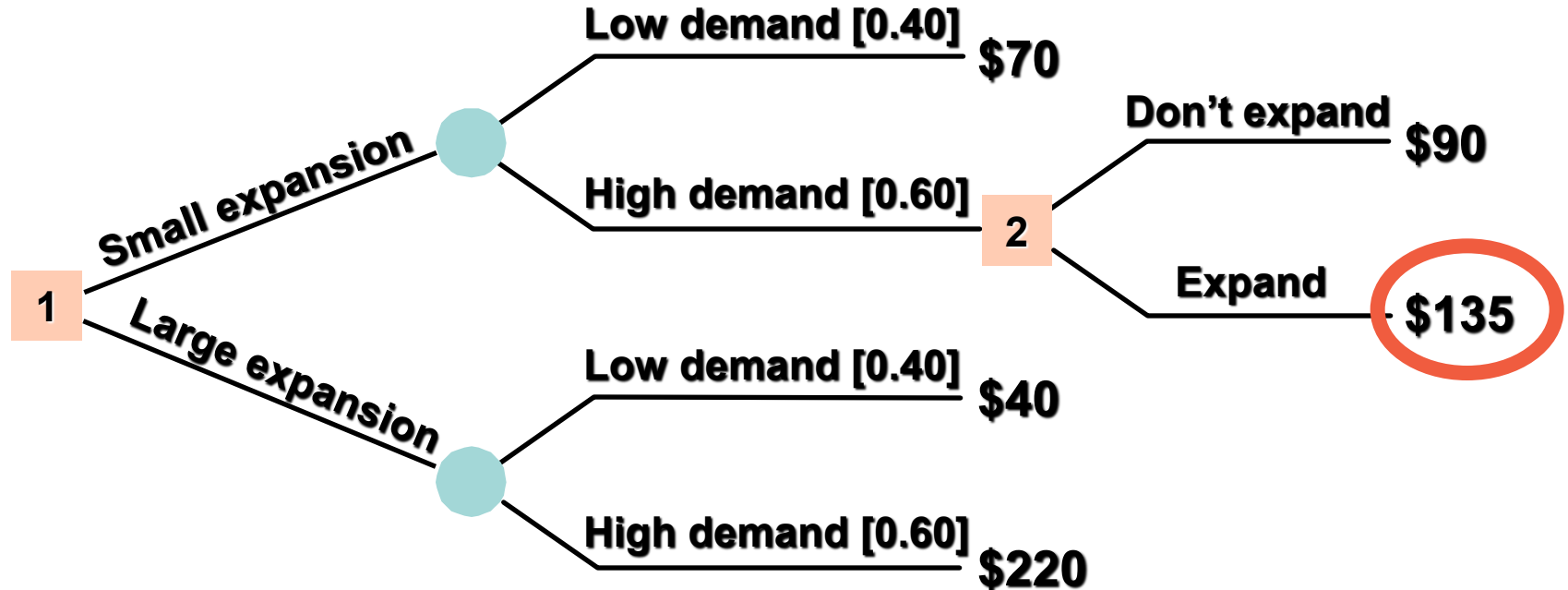


Figure 6.7

Capacity Decisions

Decision Trees



Figure 6.7

Capacity Decisions

Decision Trees

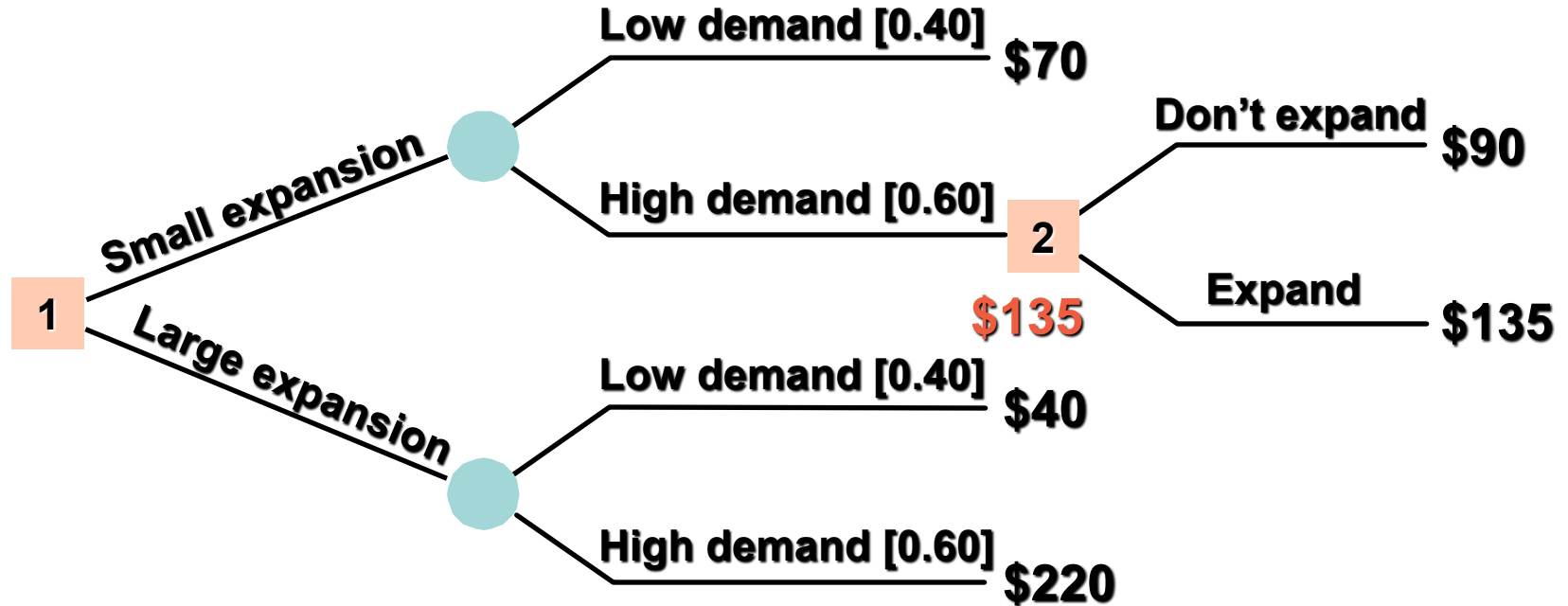


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

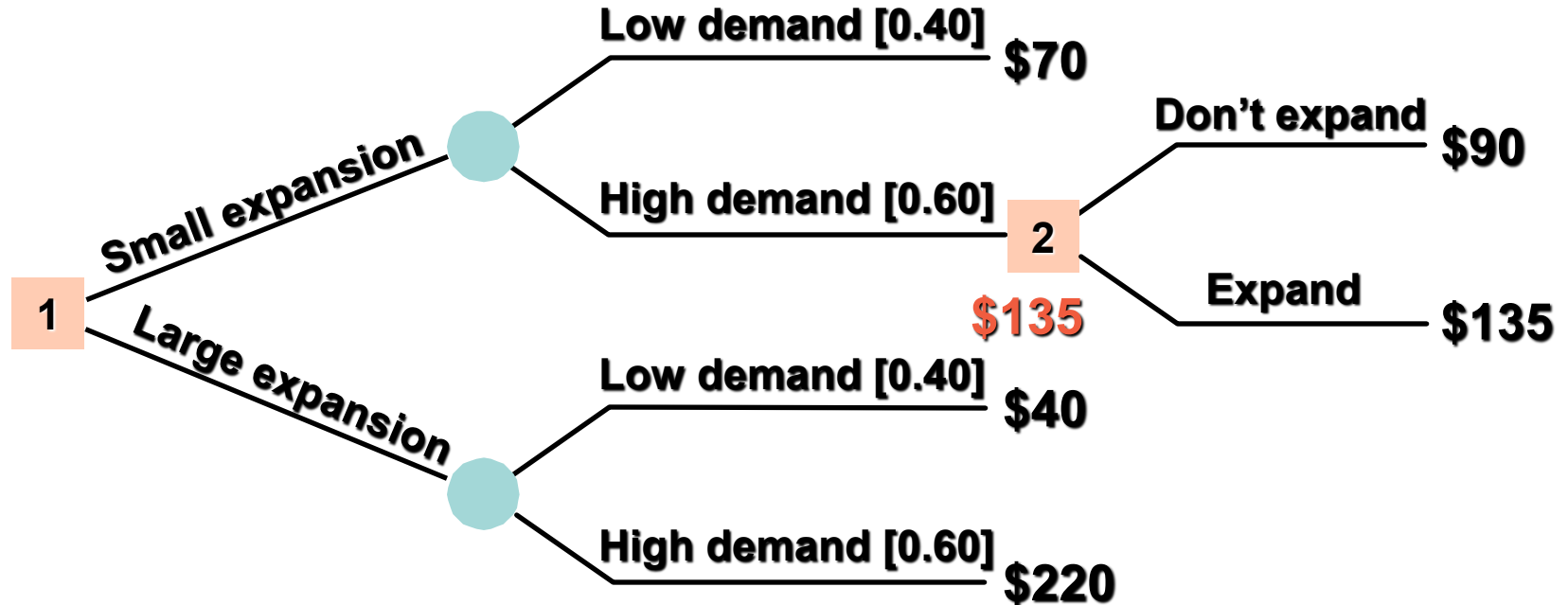


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40)

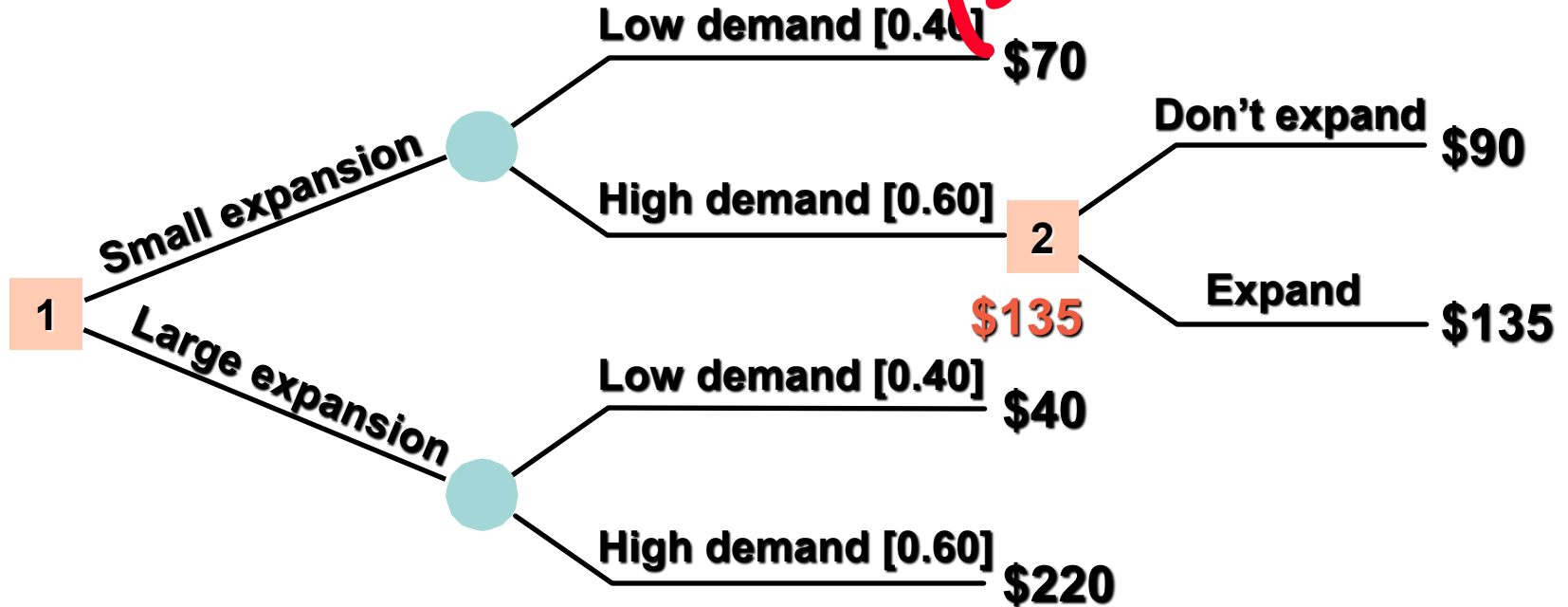


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40) = \$28

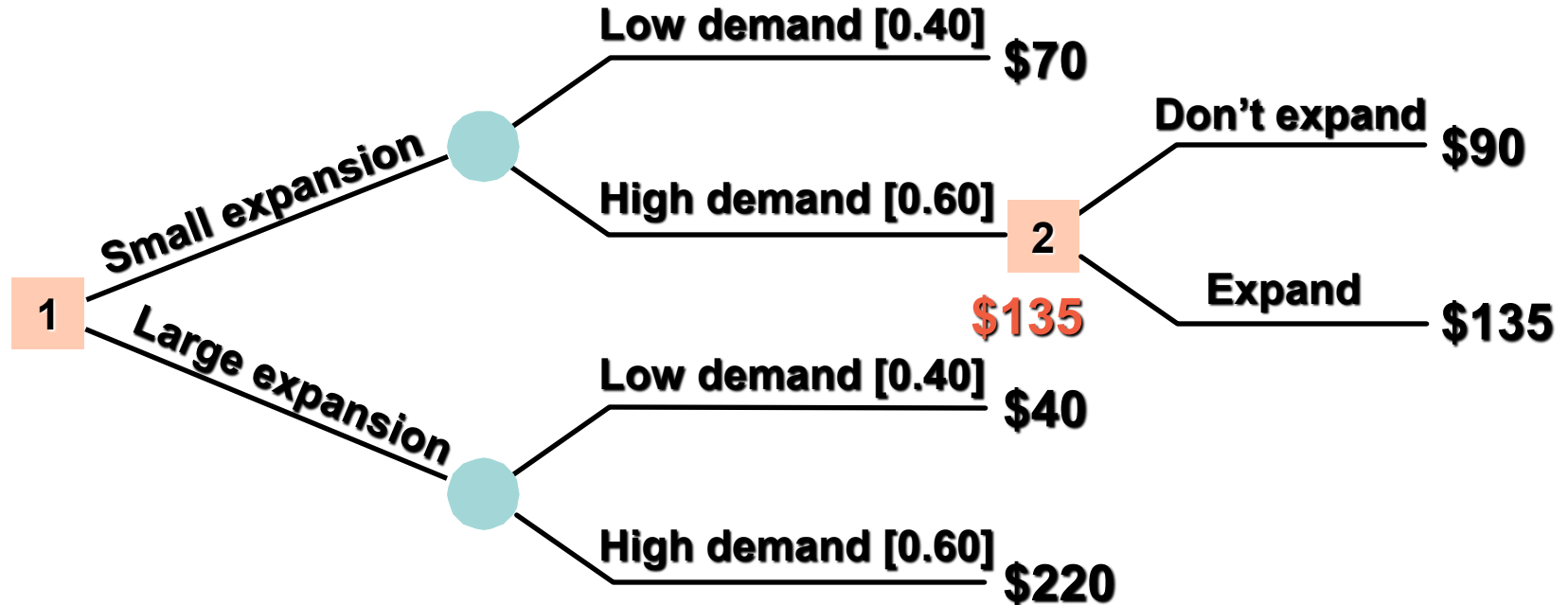


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40) = \$28

Small/High = \$135 (0.60)

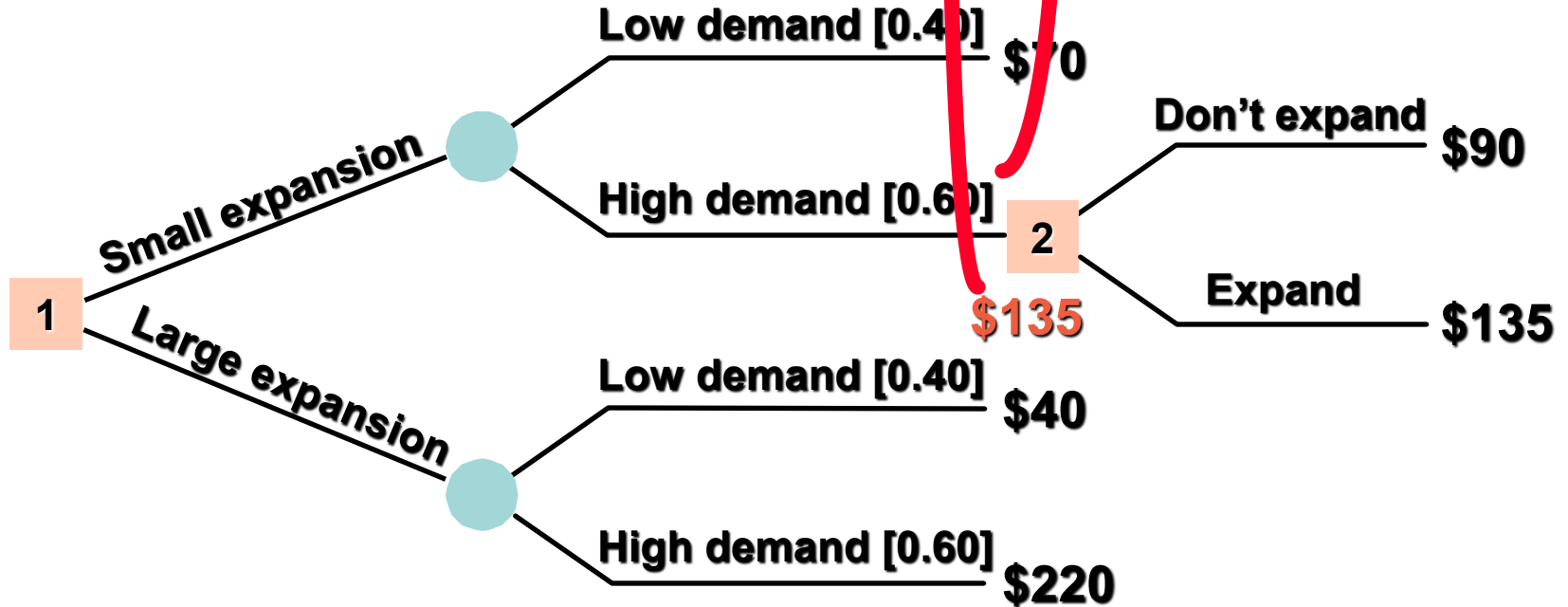


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40) = \$28

Small/High = \$135 (0.60) = \$81

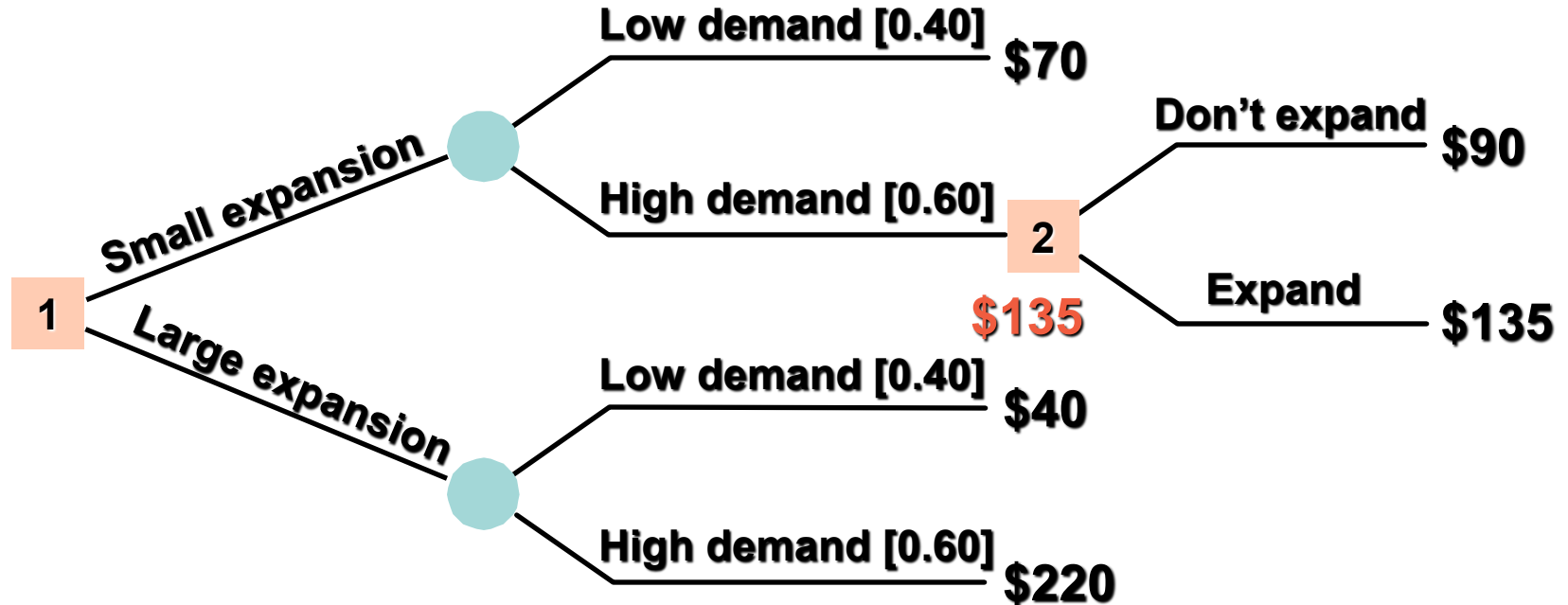


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40) = \$28

Small/High = \$135 (0.60) = \$81

Small = \$28 + \$81 = \$109

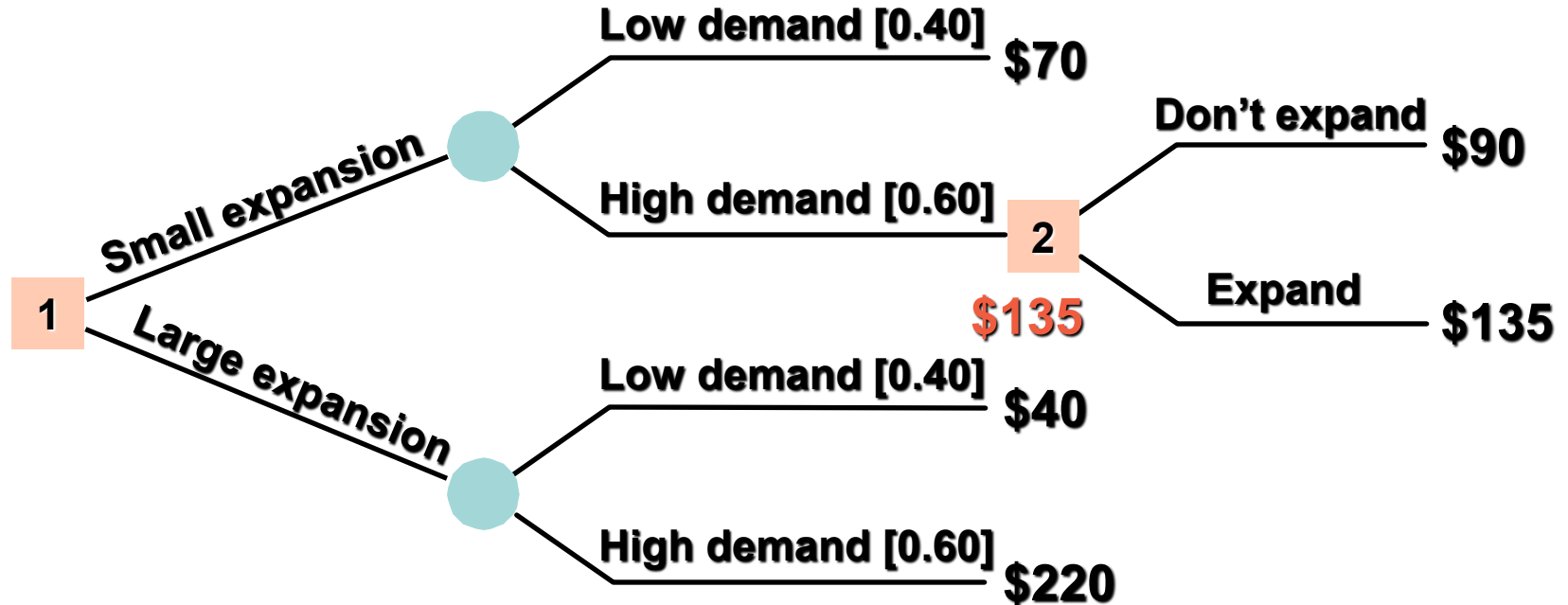


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40) = \$28

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Small = \$28 + \$81 = \$109

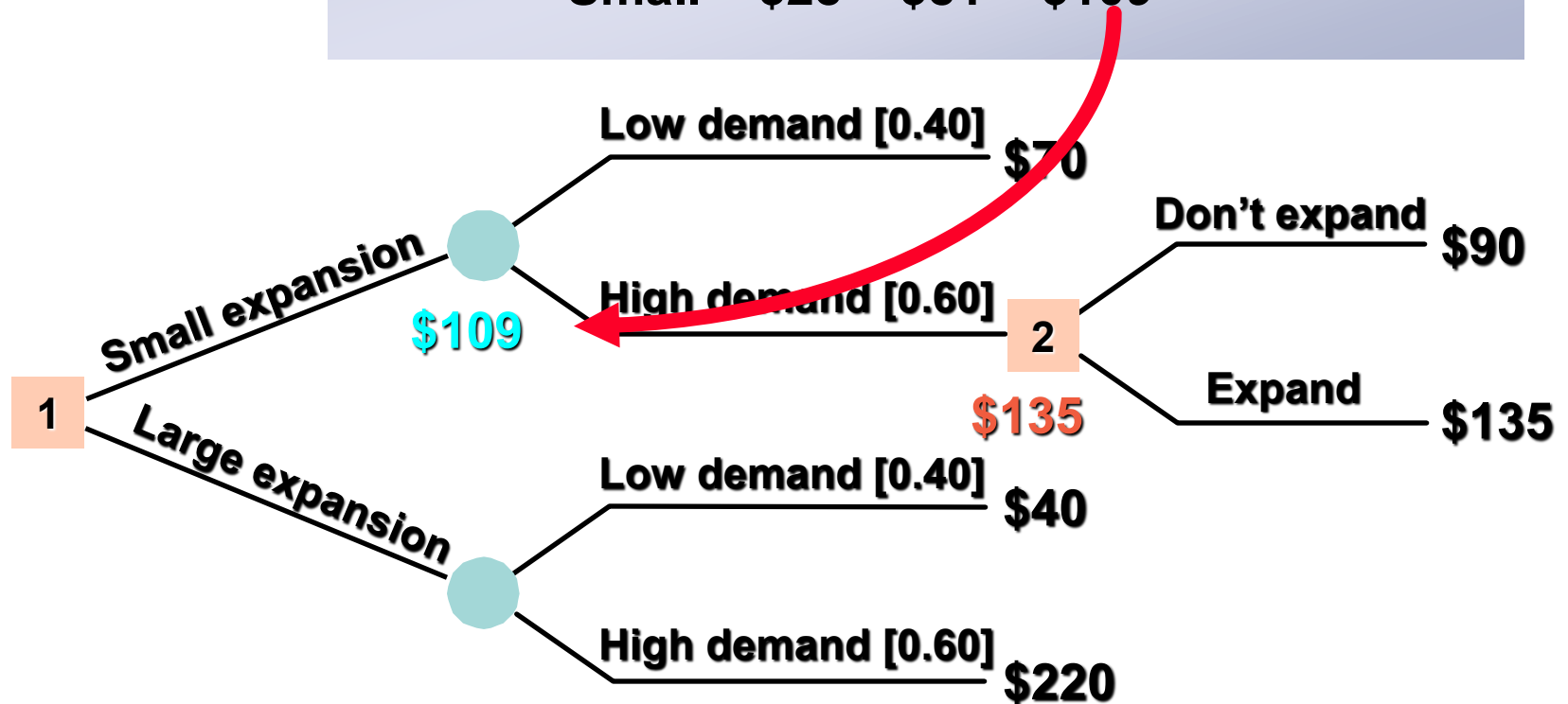


Figure 6.7

Capacity Decision

Expected Payoff = Event * Event Probability

Small/Low = \$70 (0.40) = \$28

Small/High = \$135 (0.60) = \$81

Small = \$28 + \$81 = \$109

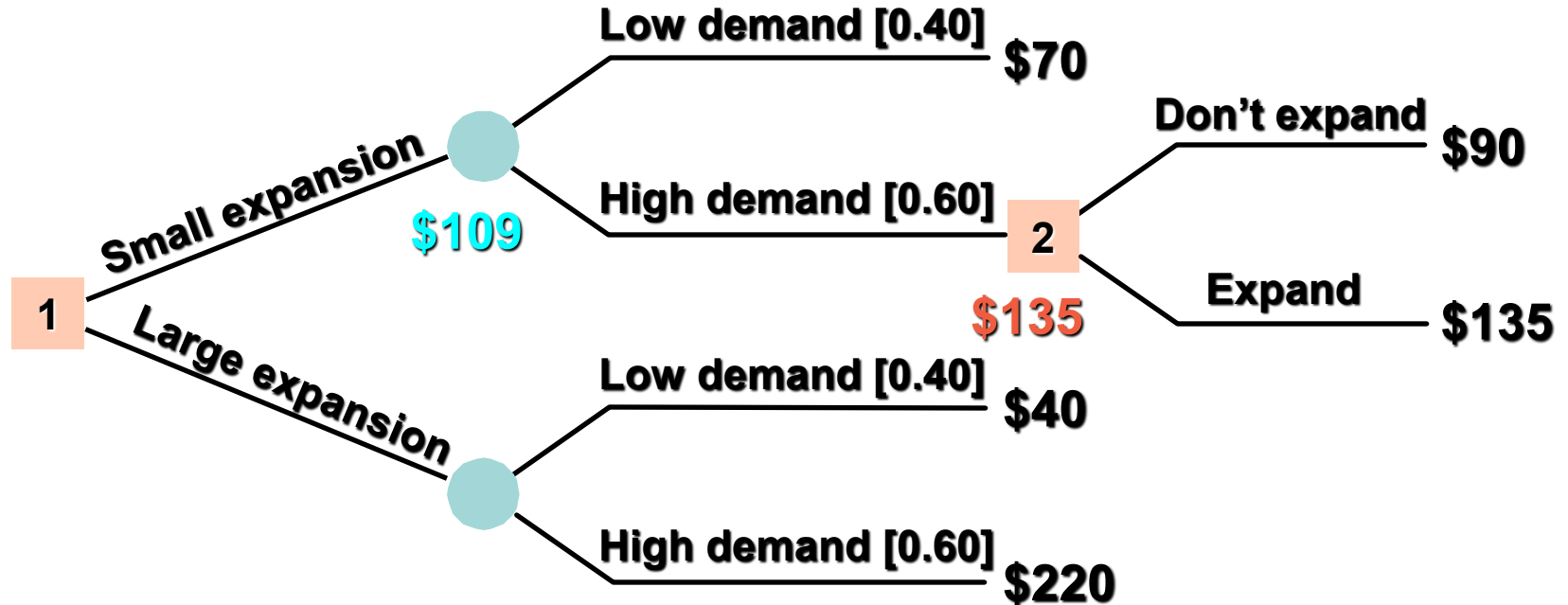


Figure 6.7

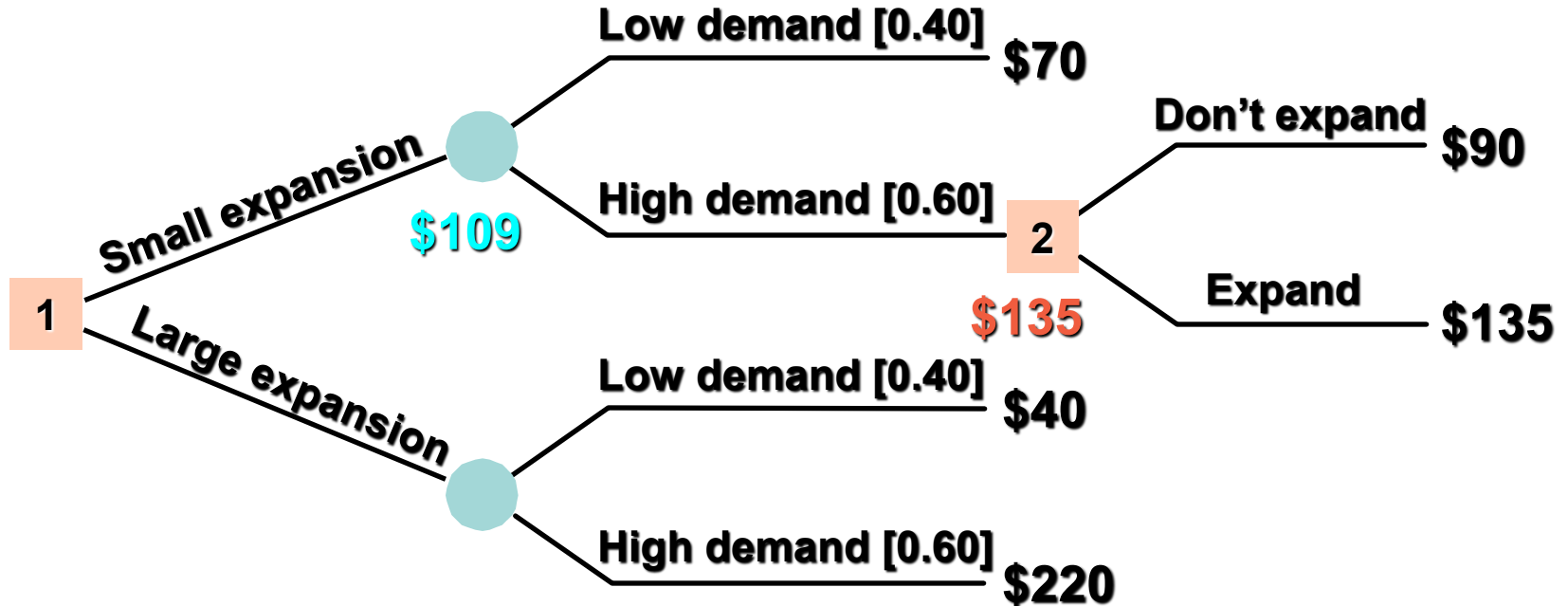
Capacity Decision

Expected Payoff = Event * Event Probability

Large/Low = \$40 (0.40) = \$16

Large/High = \$220 (0.60) = \$132

Large = \$16 + \$132 = \$148



Capacity Decision

Expected Payoff = Event * Event Probability

Large/Low = \$40 (0.40) = \$16

Large/High = \$220 (0.60) = \$132

Large = \$16 + \$132 = \$148

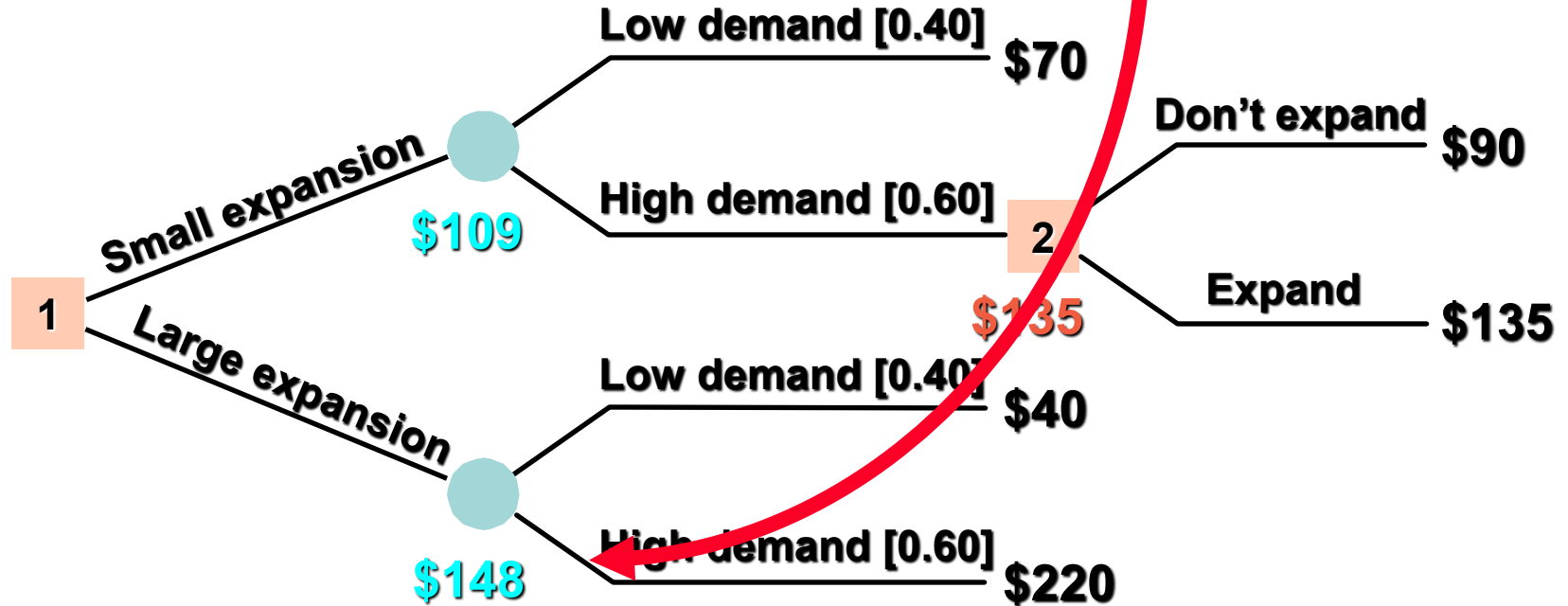


Figure 6.7

Capacity Decisions

Decision Trees

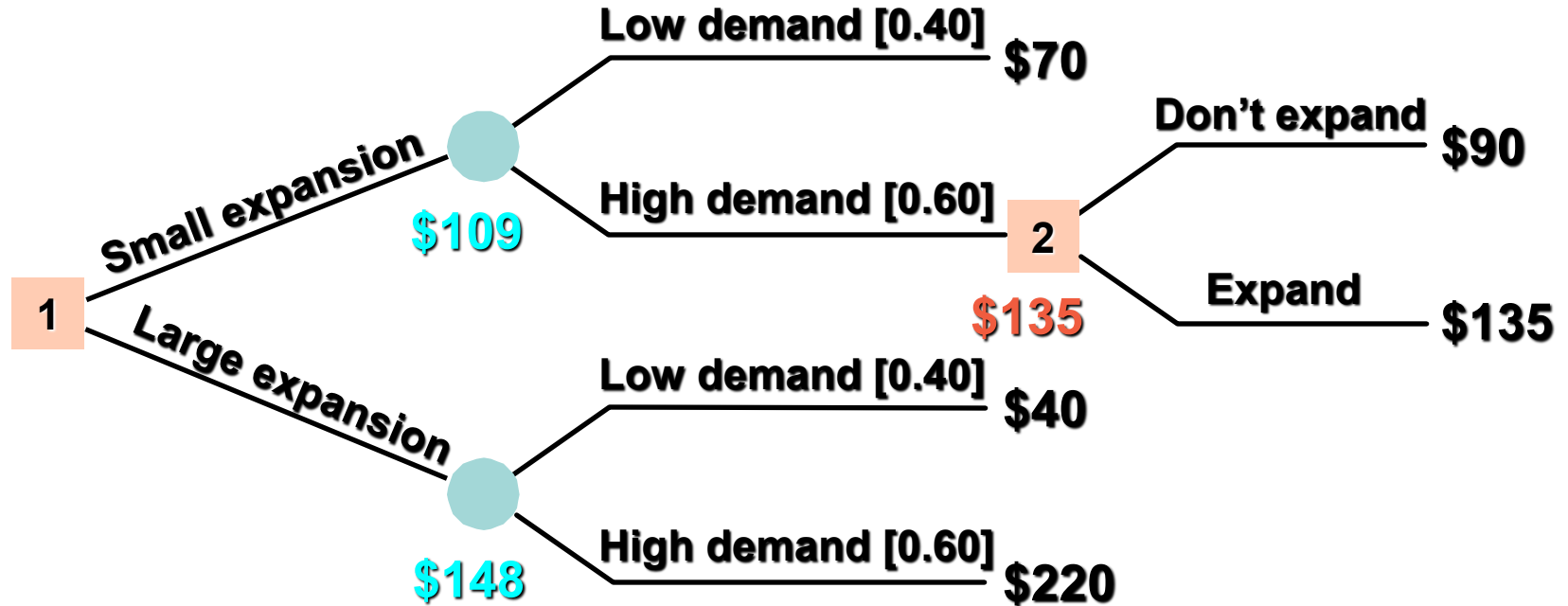


Figure 6.7

Capacity Decisions

Decision Trees

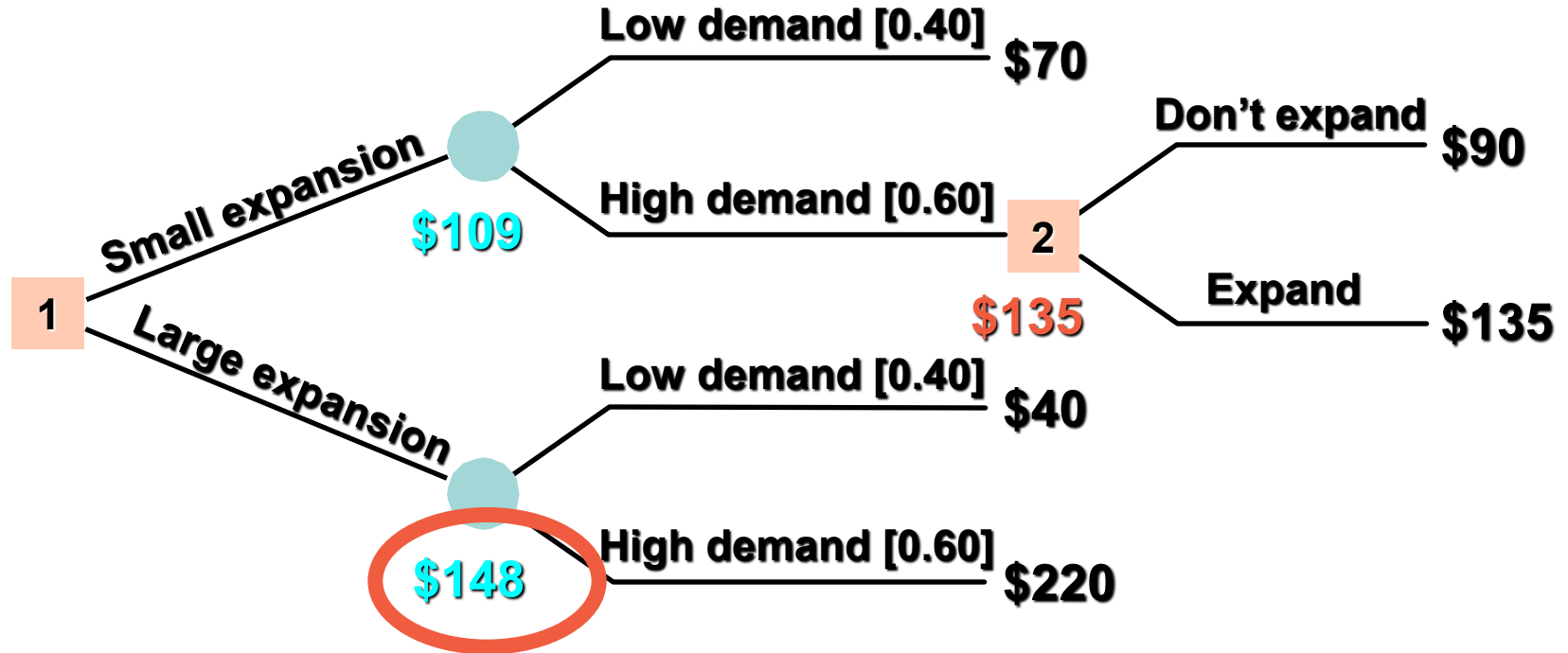


Figure 6.7

Capacity Decisions

Decision Trees

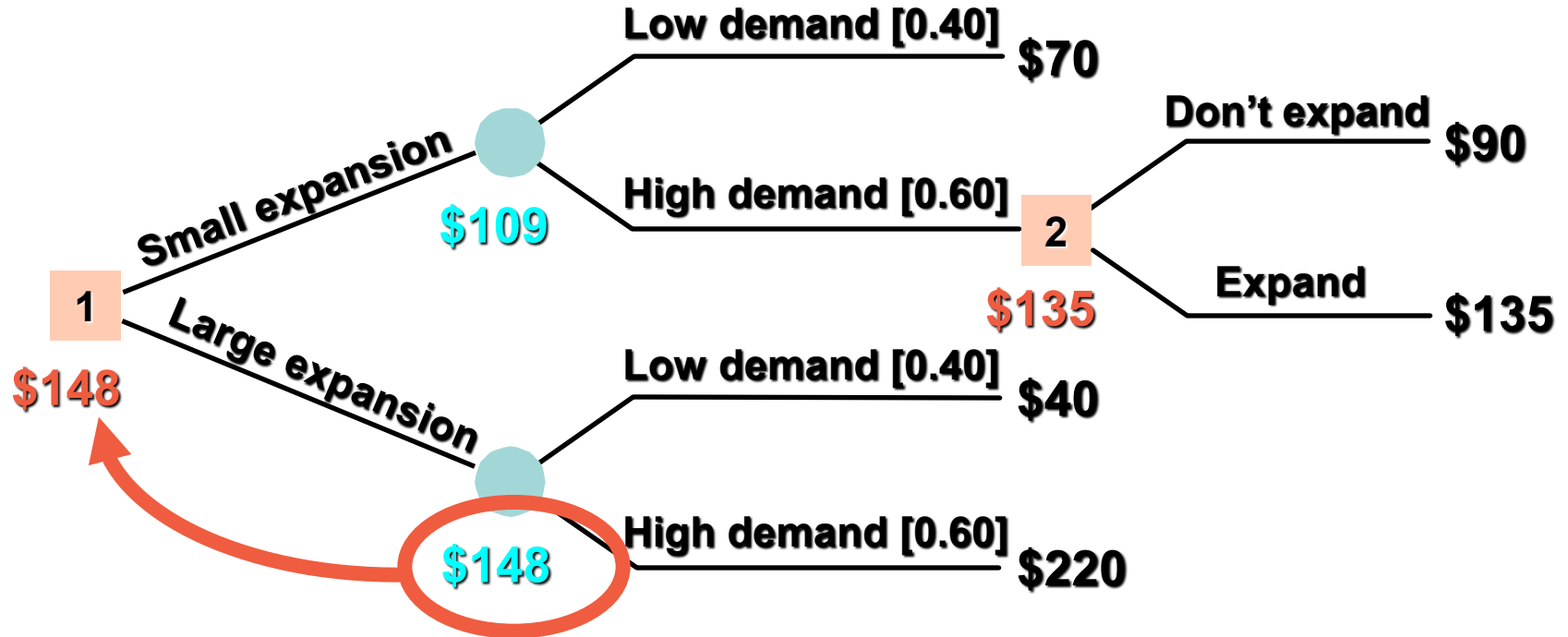


Figure 6.7

Capacity Decisions

Decision Trees

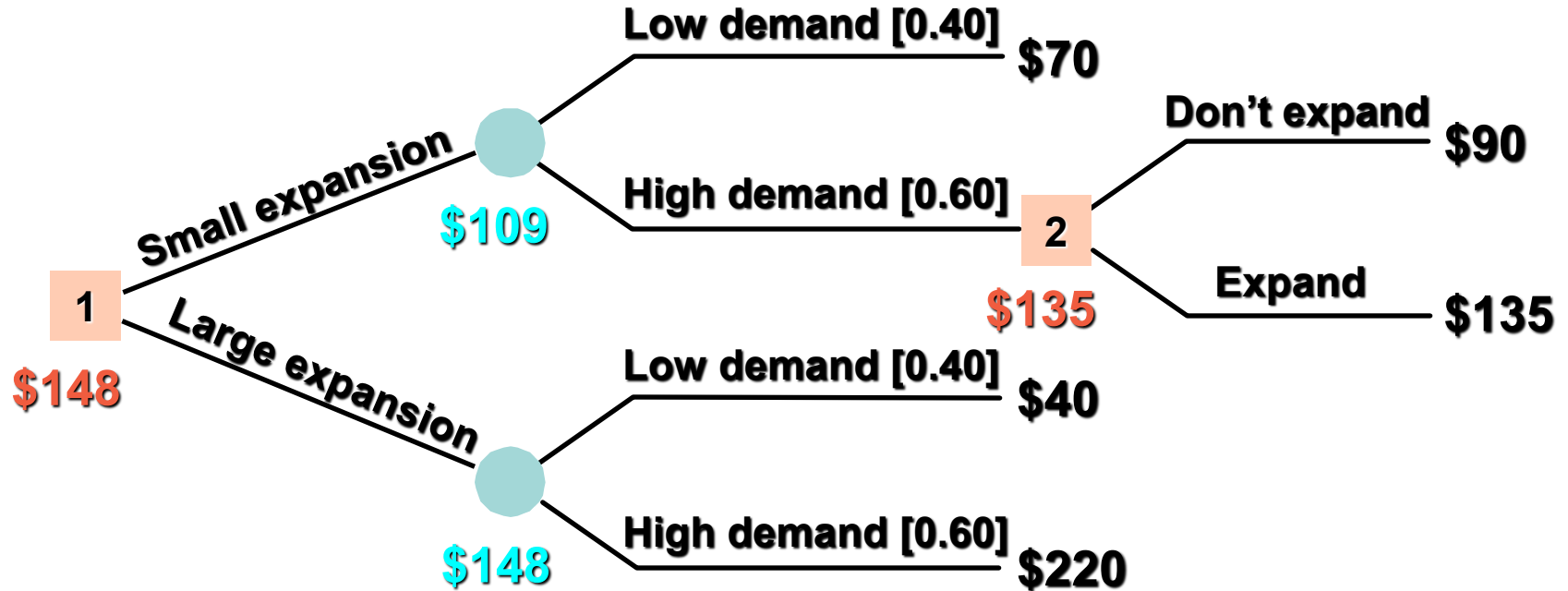


Figure 6.7

Problem 1

You have been asked to put together a capacity plan for a critical bottleneck operation at the Surefoot Sandal Company. Your capacity measure is number of machines. Three products (men's, women's, and children's sandals) are manufactured. The time standards (processing and setup), lot sizes, and demand forecasts are given in the following table. The firm operates two 8 hour shifts, 5 days per week, 50 weeks per year. Experience shows that a capacity cushion of 5 percent is sufficient :

Product	Time Standards		Lot Size (pairs/lot)	Demand Forecast (pairs/yr)
	Processing (hr/pair)	Setup (hr/pair)		
Men's sandals	0.05	0.5	240	80,000
Women's sandals	0.10	2.2	180	60,000
Children's sandals	0.02	3.8	360	120,000

- How many machines are needed?
- If the operation currently has two machines, what is the capacity gap?

Problem 2

- The base case for Grandmother's Chicken Restaurant (see Example 6.3) is to do nothing. The capacity of the kitchen in the base case is 80,000 meals per year. A capacity alternative for Grandmother's Chicken Restaurant is a two-stage expansion. This alternative expands the kitchen at the end of year 0, raising its capacity from 80,000 meals per year to that of the dining area (105,000 meals per year). If sales in year 1 and 2 live up to expectations, the capacities of both the kitchen and the dining room will be expanded at the *end* of year 3 to 130,000 meals per year. This upgraded capacity level should suffice up through year 5. The initial investment would be \$80,000 at the end of year 0 and an additional investment of \$170,000 at the end of year 3. The pretax profit is \$2 per meal. What are the pretax cash flows for this alternative through year 5 compared with the base case?

Capacity Decisions

Solved Problem 1

Figure 6.8(a)

Solver - Capacity Requirements

Enter data in yellow-shaded areas.

Shifts/Day	2
Hours/Shift	8
Days/Week	5
Weeks/Year	50
Cushion (as %)	5%
Current capacity	2

Components



More Components

Fewer Components

Components	Processing (hr/unit)	Setup (hr/lot)	Lot Size (units/lot)	Demand Forecasts		
				Pessimistic	Expected	Optimistic
Men's sandals	0.05	0.5	240		80,000	
Women's sandals	0.10	2.2	180		60,000	
Children's sandals	0.02	3.8	360		120,000	

Productive hours from
one capacity unit for a year 3,800

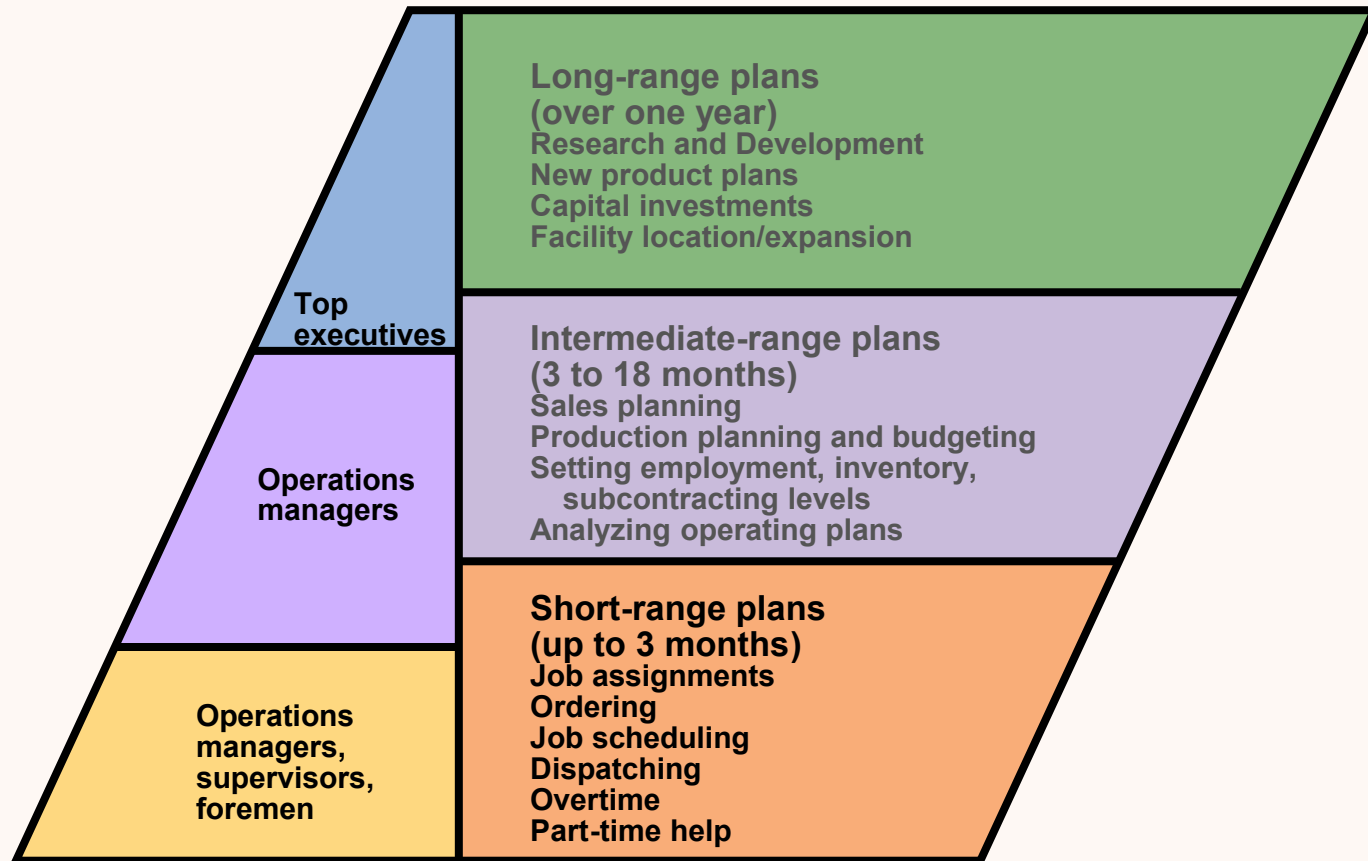
Capacity Decisions

Solved Problem 1

Figure 6.8(b)

	Pessimistic		Expected		Optimistic	
	Process	Setup	Process	Setup	Process	Setup
Men's sandals	0	0.0	4,000	166.7	0	0.0
Women's sandals	0	0.0	6,000	733.3	0	0.0
Children's sandals	0	0.0	2,400	1,266.7	0	0.0
	0	0.0	12,400	2,166.7	0	0.0
Total hours required		0.0		14,566.7		0.0
Total capacity requirements (M)		0.00		3.83		0.00
Rounded		0		4		0
Scenarios that can be met with current systems/capacity:				Pessimistic, Optimistic		
If capacity increased by		0%				
Expanded current capacity		3,800				
Total capacity requirements (M)		0.00		3.83		0.00
Rounded		0		4		0
Scenarios that can be met with expanded current capacity:				Pessimistic, Optimistic		

PLANNING HORIZONS



Responsibility

Planning tasks and horizon

Figure 13.1

Aggregate Planning

Quarter 1

Jan	Feb	Mar
150,000	120,000	110,000



Quarter 2

Apr	May	Jun
100,000	130,000	150,000



Quarter 3

Jul	Aug	Sep
180,000	150,000	140,000



Planning Relationships

**Business
or annual
plan**

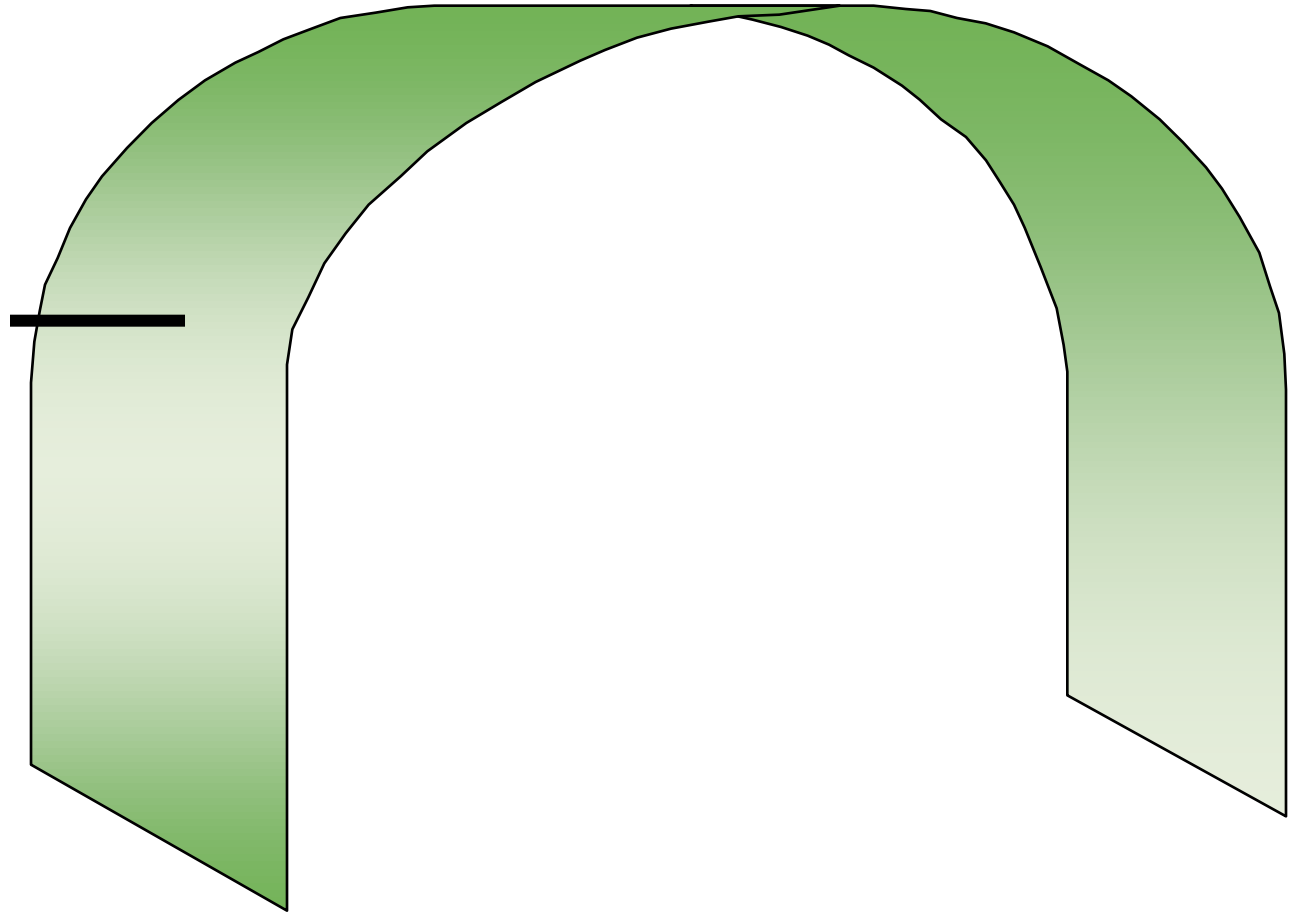


Figure 14.1

Planning Relationships

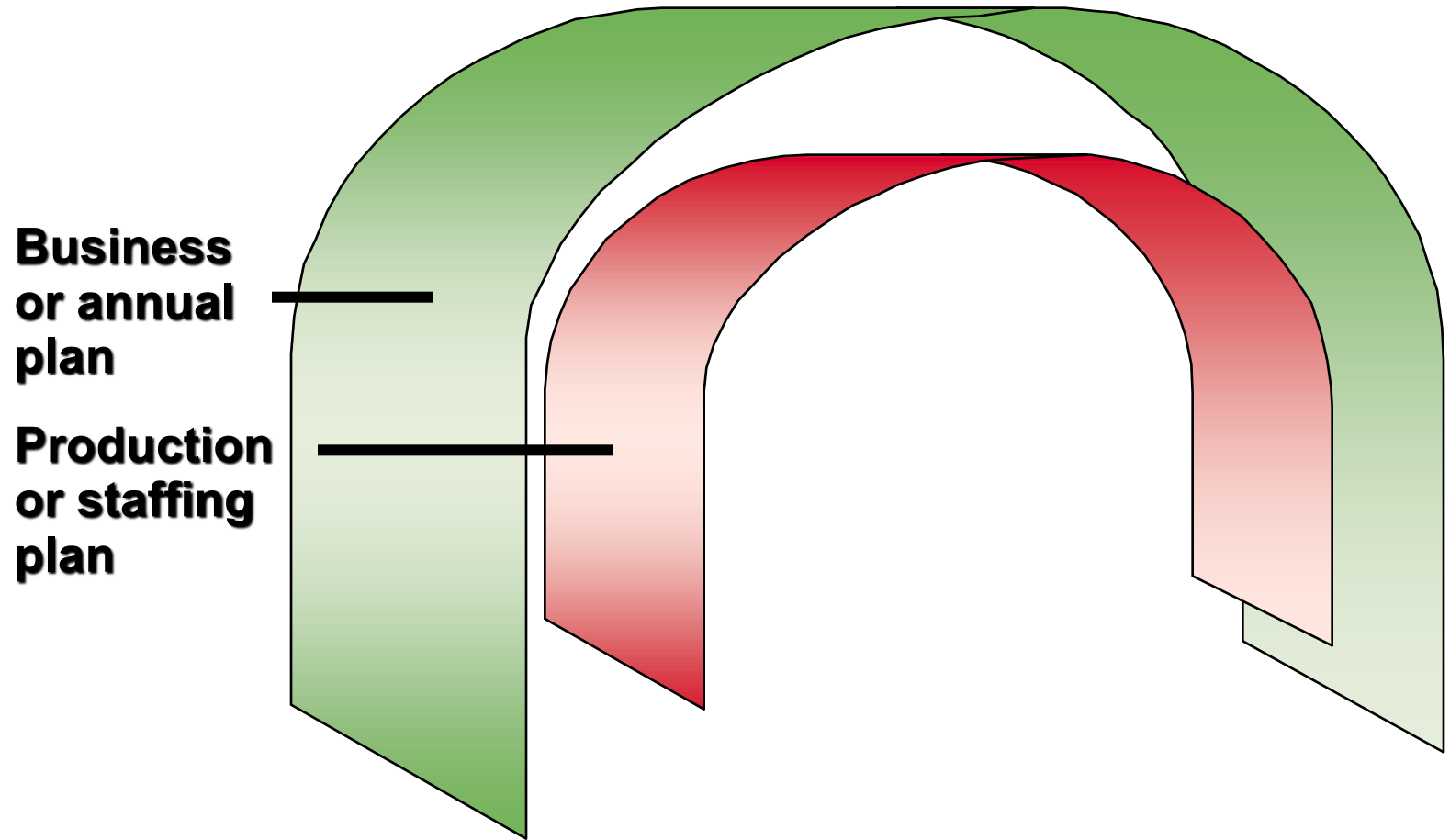
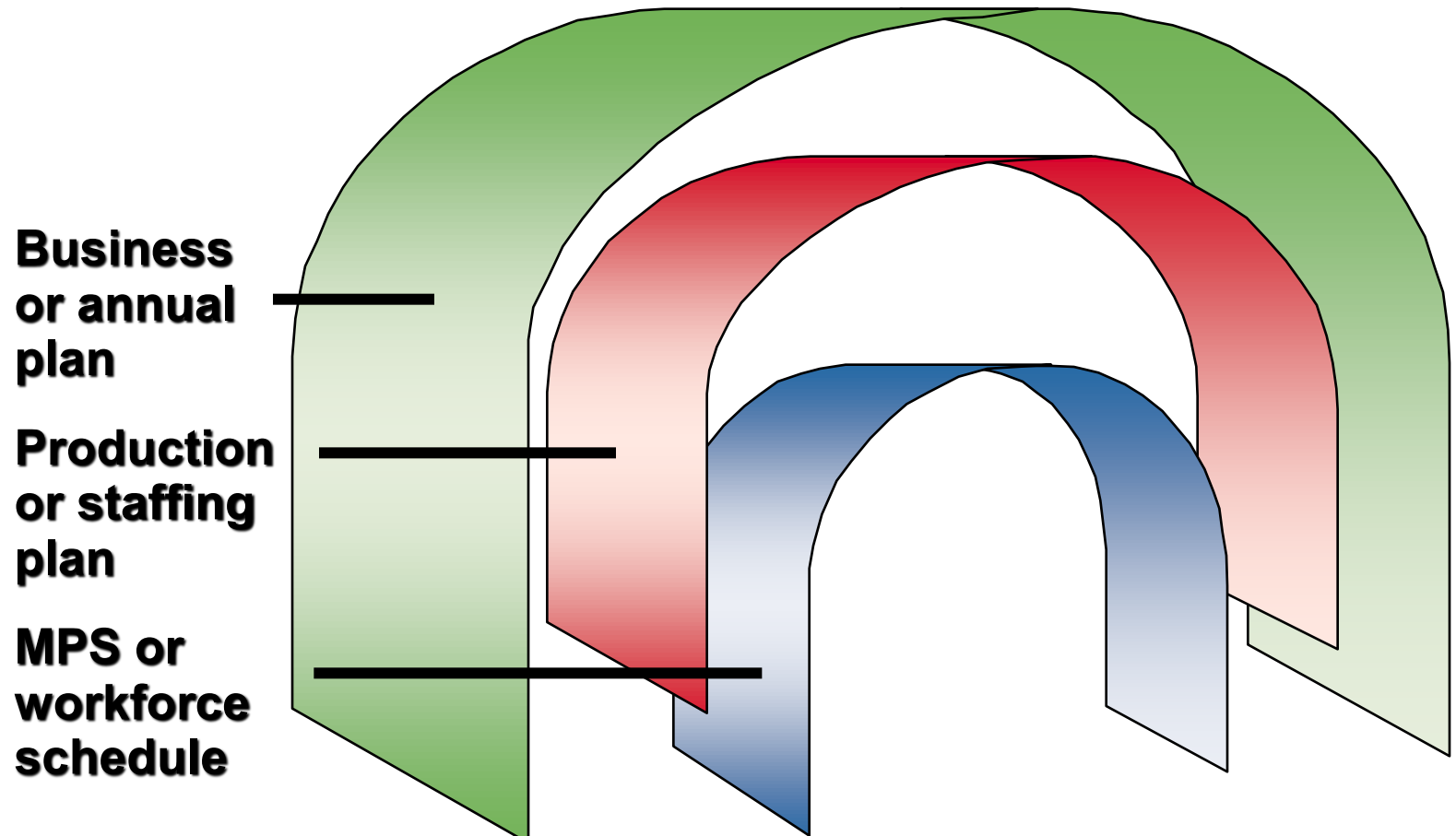


Figure 14.1

Planning Relationships



Manufacturing planning and Scheduling

Figure 14.1

Planning Relationships

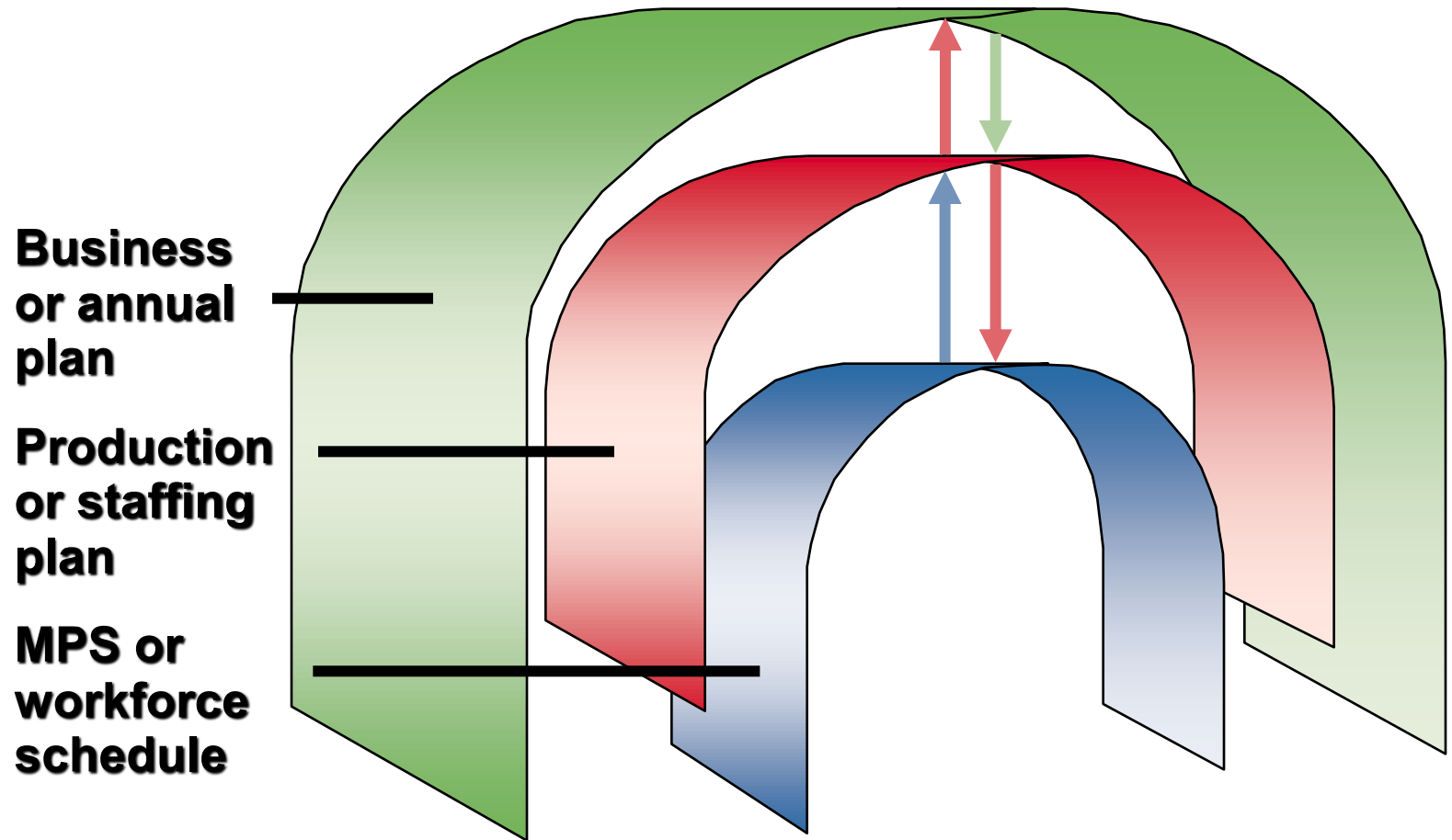


Figure 14.1

Managerial Inputs

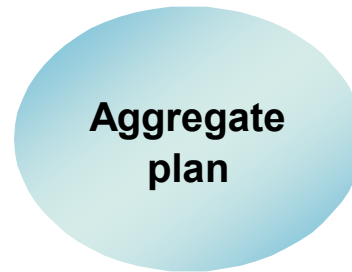


Figure 14.2

Managerial Inputs

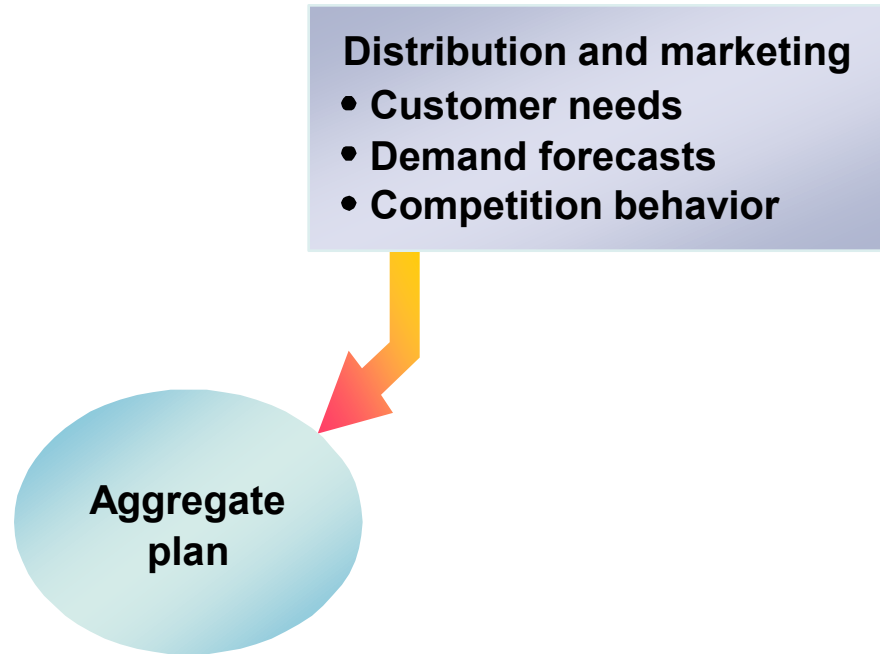


Figure 14.2

Managerial Inputs

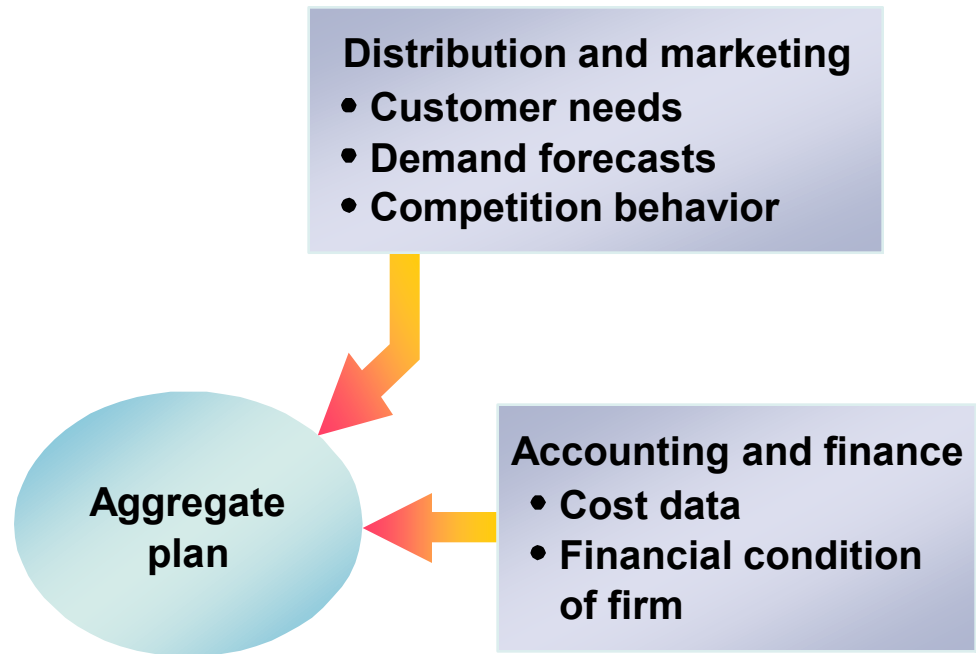


Figure 14.2

Managerial Inputs



Figure 14.2

Managerial Inputs

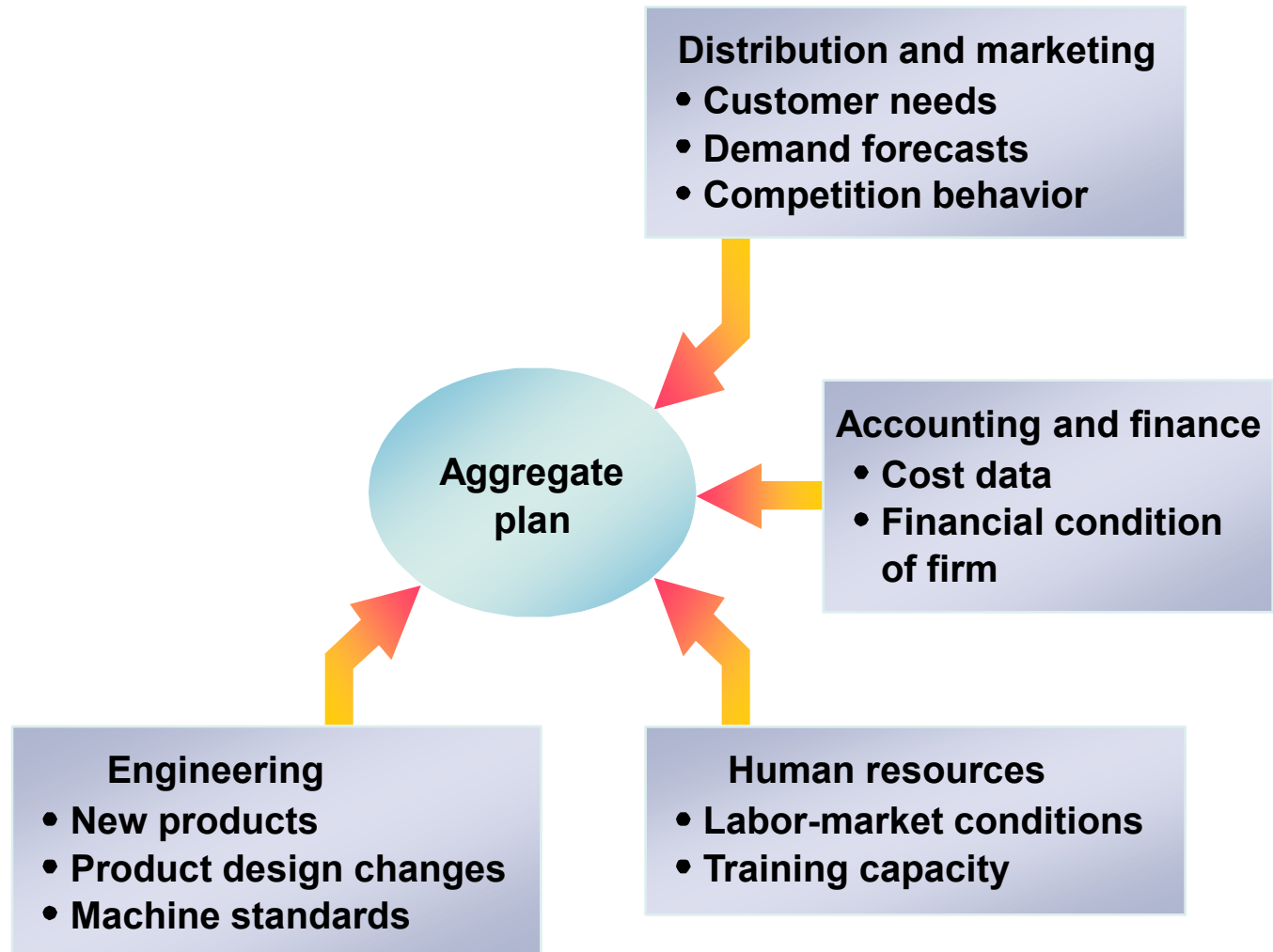


Figure 14.2

Managerial Inputs

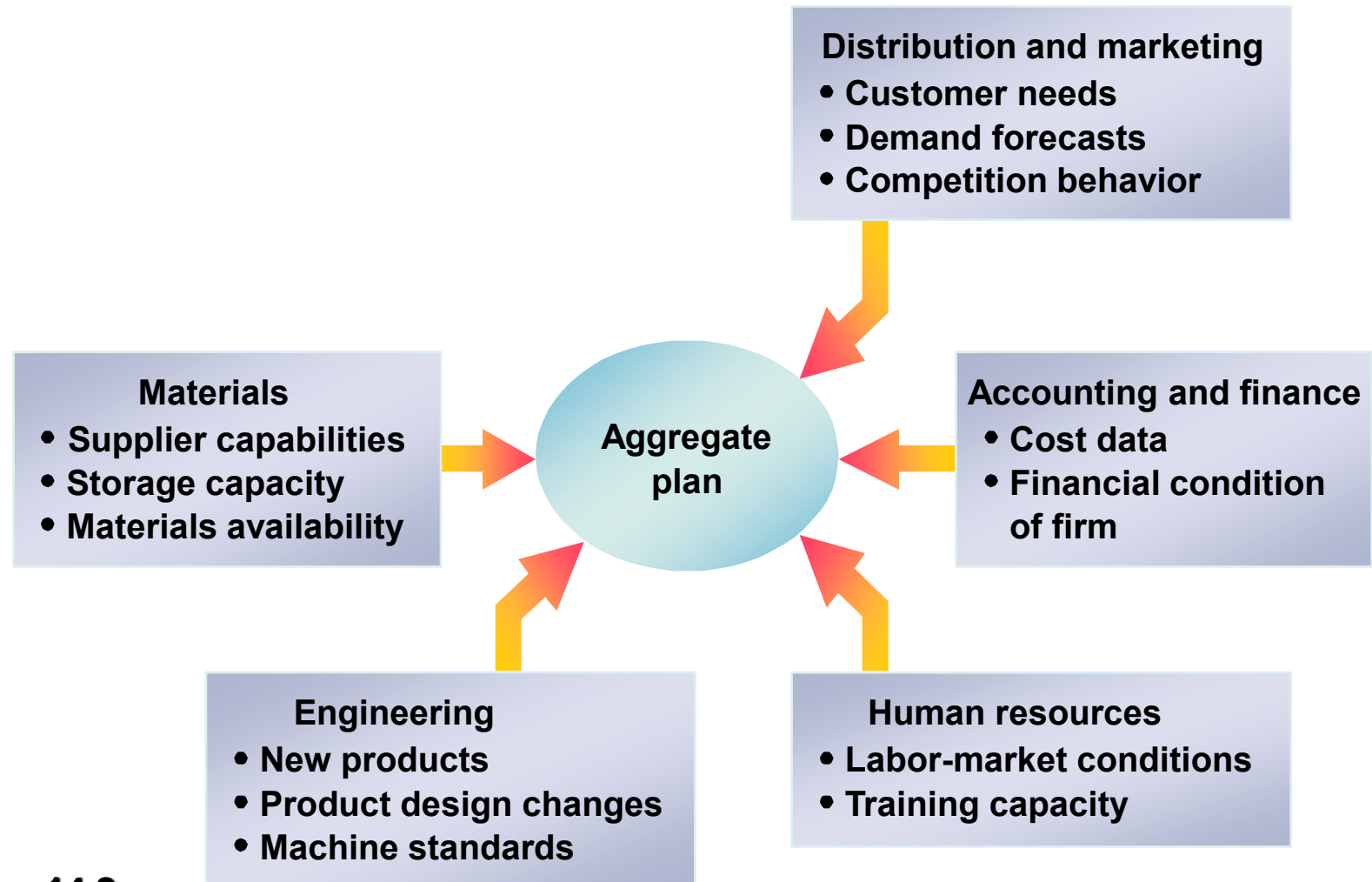


Figure 14.2

Managerial Inputs

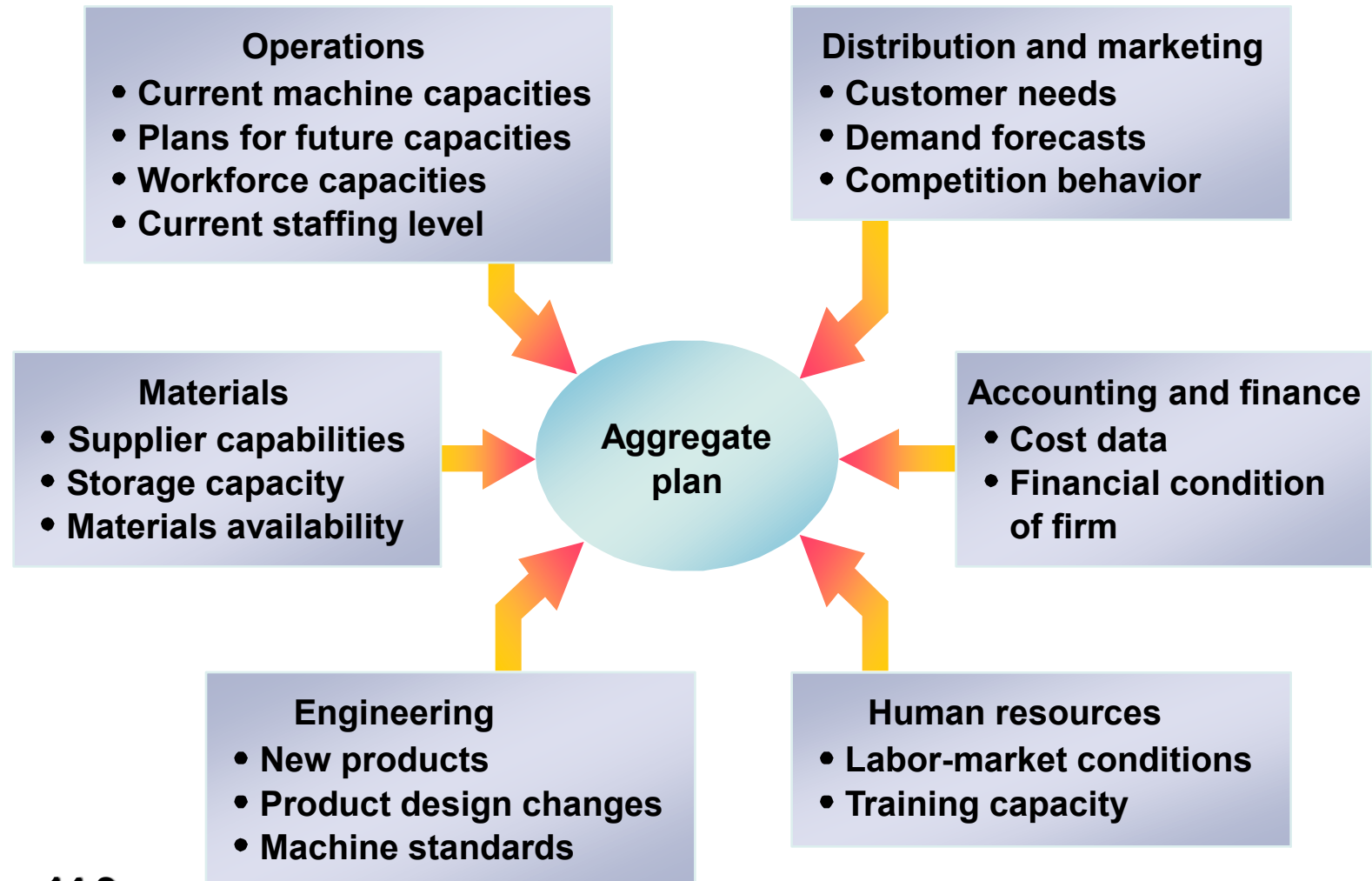
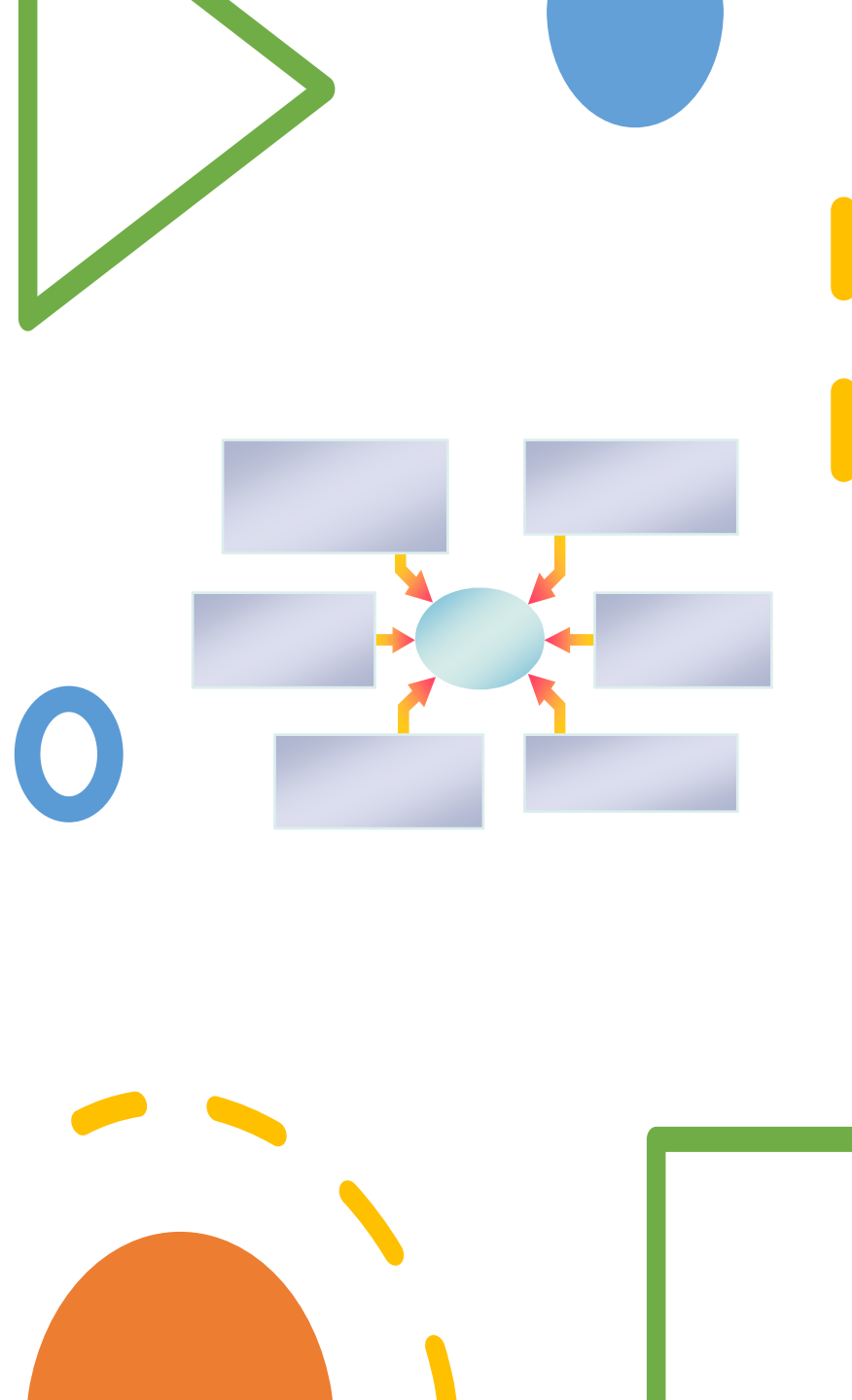


Figure 14.2

Aggregate Planning Objectives

- **Minimize Costs/Maximize Profits**
- **Maximize Customer Service**
- **Minimize Inventory Investment**
- **Minimize Changes in Production Rates**
- **Minimize Changes in Workforce Levels**
- **Maximize Utilization of Plant and Equipment**



Aggregate Planning Process

**Determine
requirements for
planning horizon**

Figure 14.3

Aggregate Planning Process

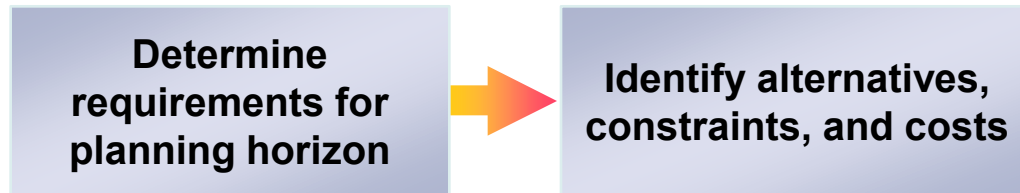


Figure 14.3

Aggregate Planning Process

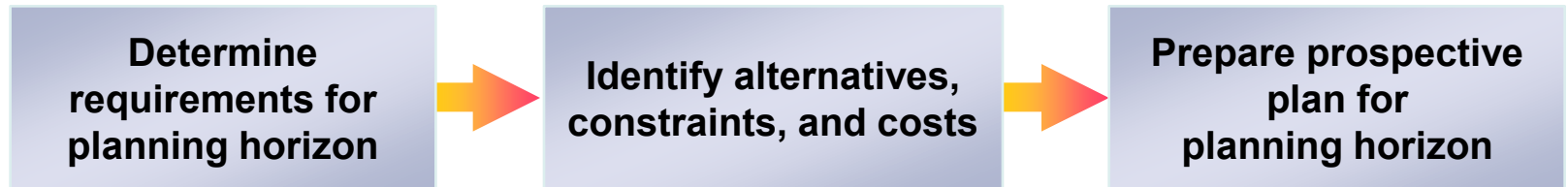


Figure 14.3

Aggregate Planning Process



Figure 14.3

Aggregate Planning Process

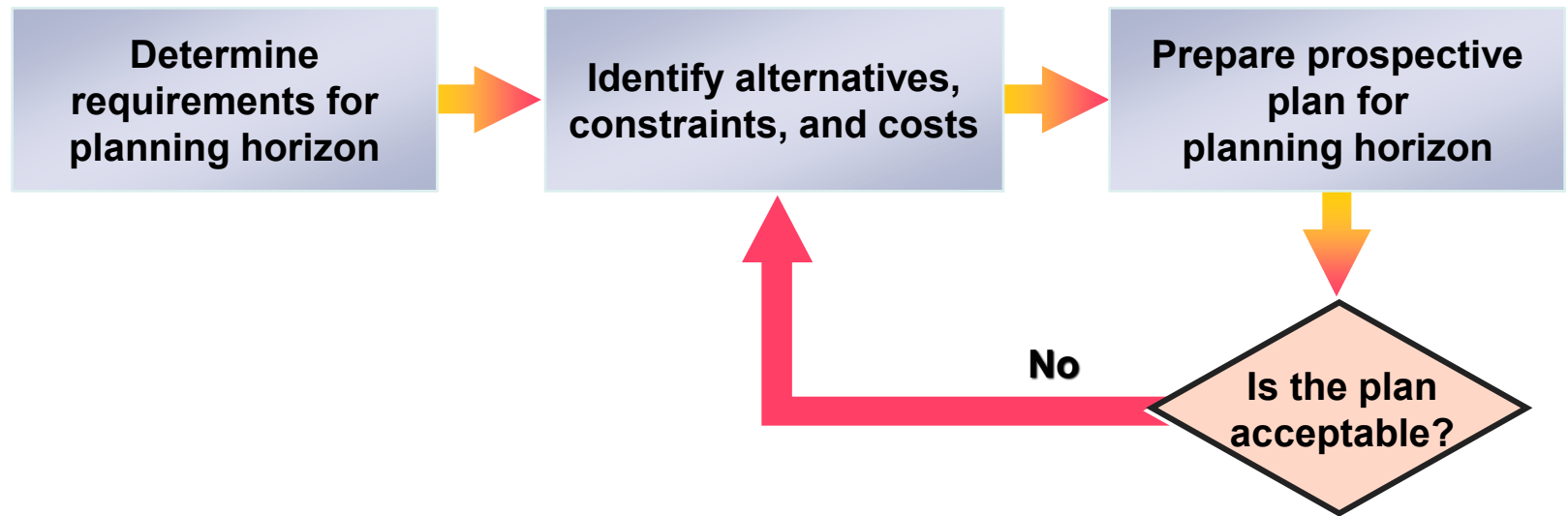


Figure 14.3

Aggregate Planning Process

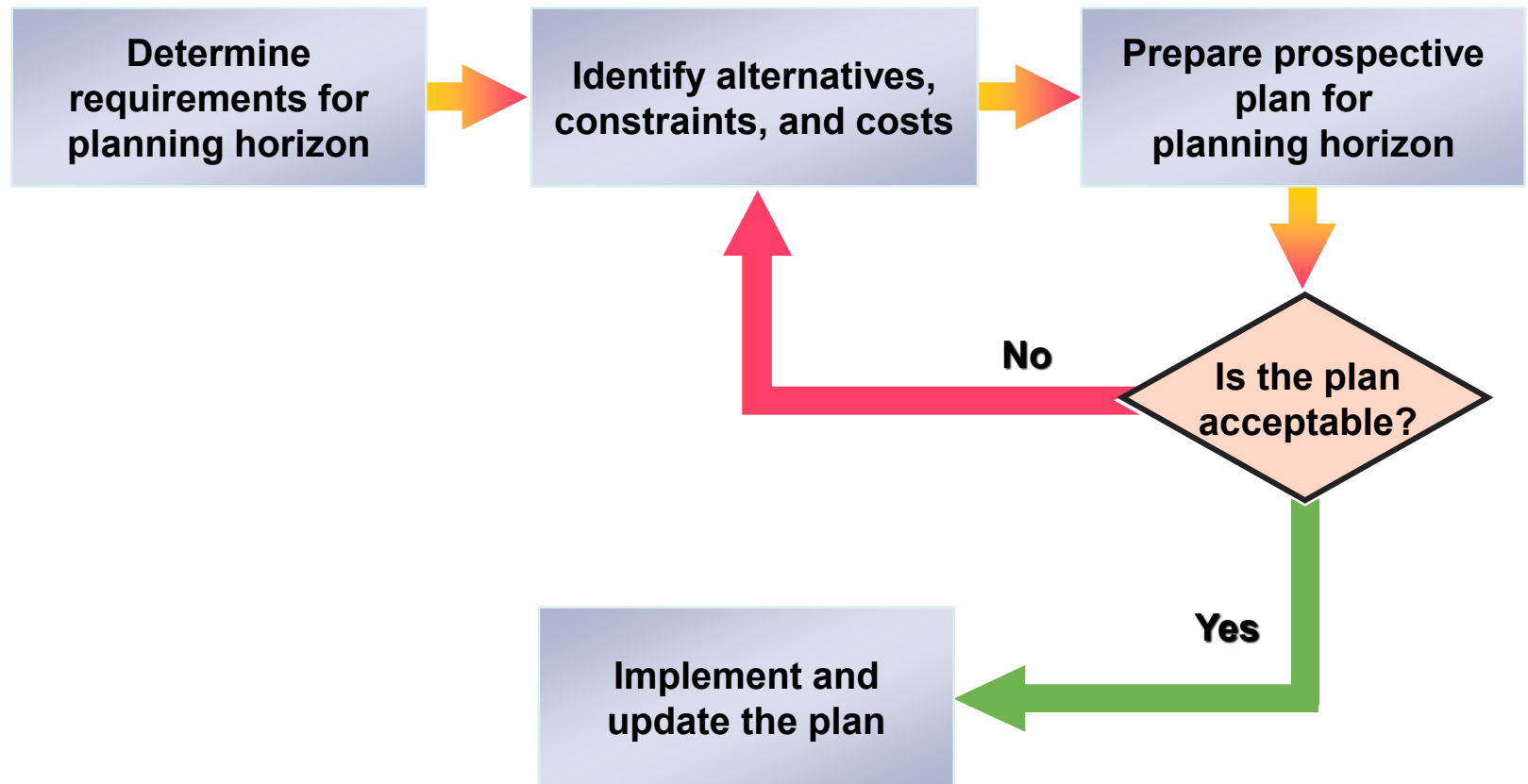


Figure 14.3

Aggregate Planning Process

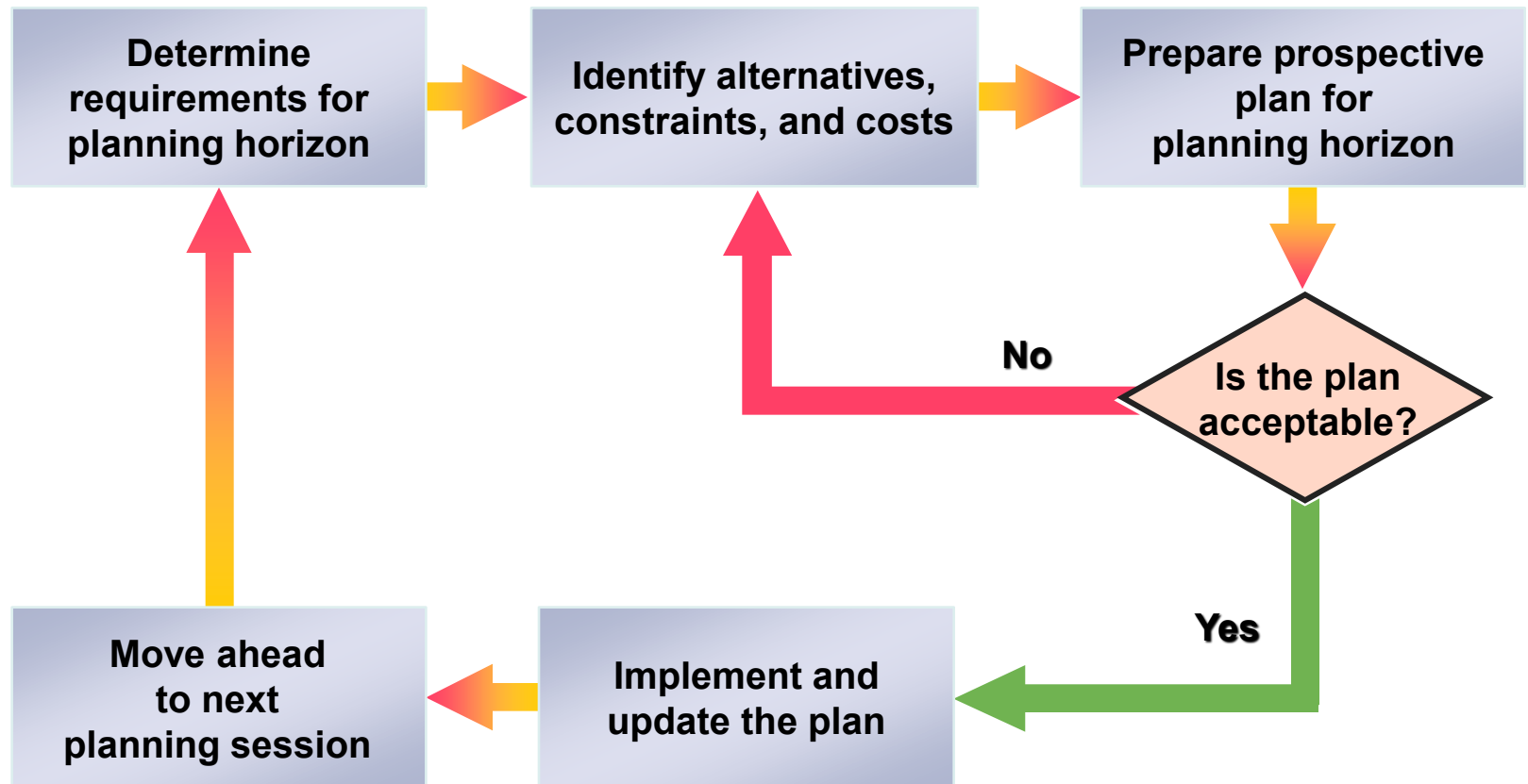


Figure 14.3

Issues

1. Should inventories be used to absorb changes in demand during the planning period?
2. Should changes be accommodated by varying the size of the workforce?
3. Should part-timers be used, or should overtime and idle time absorb fluctuations?
4. Should subcontractors be used on fluctuating orders so a stable workforce can be maintained?
5. Should prices or other factors be changed to influence demand?

TABLE 13.1**Aggregate Planning Options: Advantages and Disadvantages**

OPTION	ADVANTAGES	DISADVANTAGES	COMMENTS
Changing inventory levels	Changes in human resources are gradual or none; no abrupt production changes.	Inventory holding costs may increase. Shortages may result in lost sales.	Applies mainly to production, not service, operations.
Varying workforce size by hiring or layoffs	Avoids the costs of other alternatives.	Hiring, layoff, and training costs may be significant.	Used where size of labor pool is large.
Varying production rates through overtime or idle time	Matches seasonal fluctuations without hiring/training costs.	Overtime premiums; tired workers; may not meet demand.	Allows flexibility within the aggregate plan.
Subcontracting	Permits flexibility and smoothing of the firm's output.	Loss of quality control; reduced profits; potential loss of future business.	Applies mainly in production settings.
Using part-time workers	Is less costly and more flexible than full-time workers.	High turnover/training costs; quality suffers; scheduling difficult.	Good for unskilled jobs in areas with large temporary labor pools.
Influencing demand	Tries to use excess capacity. Discounts draw new customers.	Uncertainty in demand. Hard to match demand to supply exactly.	Creates marketing ideas. Overbooking used in some businesses.
Back ordering during high-demand periods	May avoid overtime. Keeps capacity constant.	Customer must be willing to wait, but goodwill is lost.	Many companies back order.
Counterseasonal product and service mixing	Fully utilizes resources; allows stable workforce.	May require skills or equipment outside firm's areas of expertise.	Risky finding products or services with opposite demand patterns.

Sum up



IDENTIFY LEVERAGES

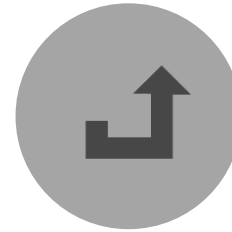


FOR AND COUNTER

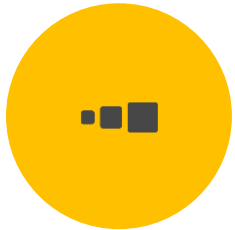
What we are going to do



Graphical techniques are popular because they are easy to understand and use. They are trial-and-error approaches that do not guarantee an optimal production plan, but they require only limited computations and can be performed by clerical staff.



1. Determine the **demand** in each period.



2. **Determine capacity** for regular time, overtime, and subcontracting each period.



3. Find labor costs, hiring and layoff costs, and inventory holding costs.



4. Consider **company policy** that may apply to the workers or to stock levels.



5. Develop **alternative plans** and examine their **total costs**.

GRAPHICAL APPROACH TO AGGREGATE PLANNING FOR A ROOFING SUPPLIER

A Juarez, Mexico, manufacturer of roofing supplies has developed monthly forecasts for a family of products. Data for the 6-month period January to June are presented in Table 13.2. The firm would like to begin development of an aggregate plan.

TABLE 13.2

Monthly Forecasts

MONTH	EXPECTED DEMAND	PRODUCTION DAYS	DEMAND PER DAY (COMPUTED)
Jan.	900	22	41
Feb.	700	18	39
Mar.	800	21	38
Apr.	1,200	21	57
May	1,500	22	68
June	<u>1,100</u>	<u>20</u>	55
	6,200	124	

**Average Total expected demand requirement = Number
of production days**

$$= \frac{6,200}{124} = 50 \text{ units per day}$$

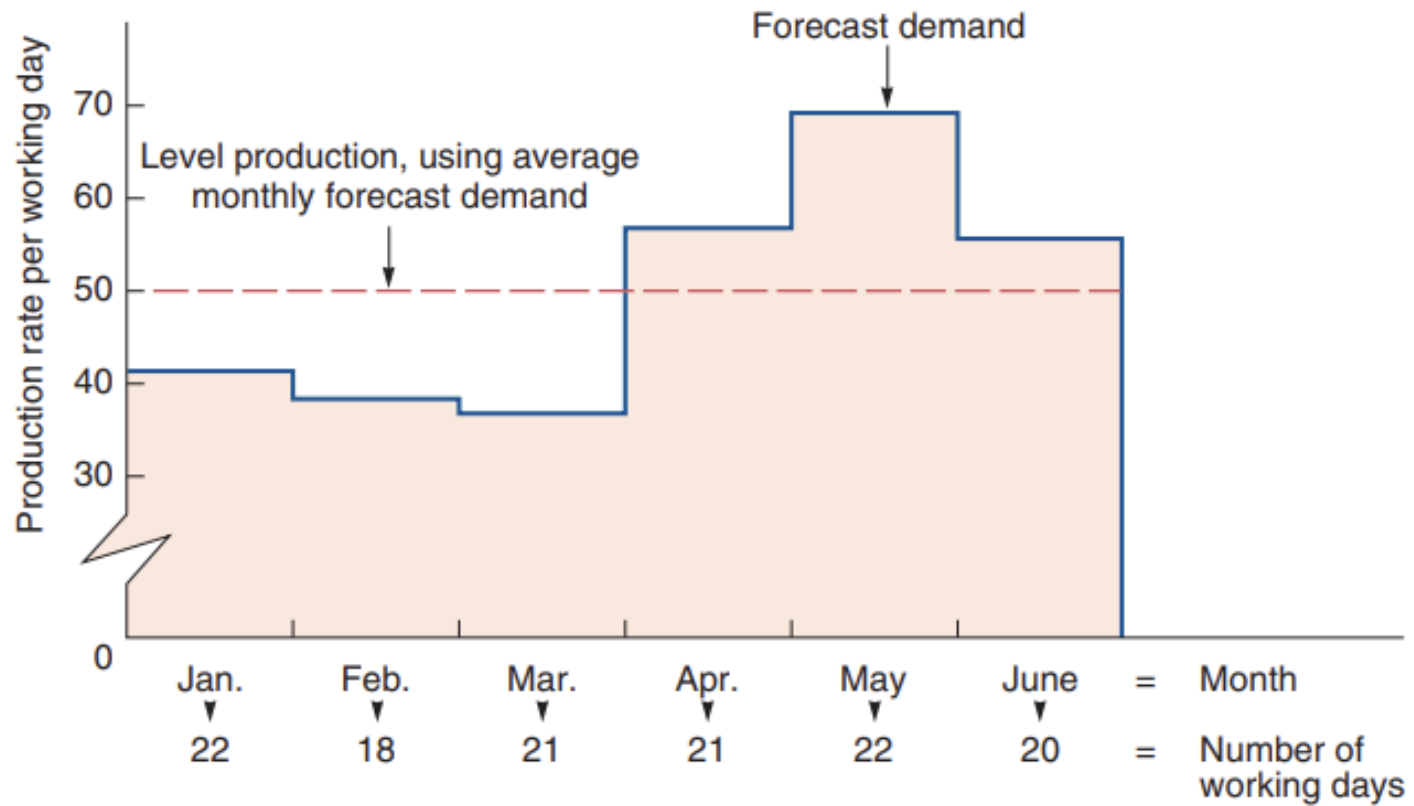


TABLE 13.3

Cost Information

Inventory carrying cost	\$ 5 per unit per month
Subcontracting cost per unit	\$ 20 per unit
Average pay rate	\$ 10 per hour (\$80 per day)
Overtime pay rate	\$ 17 per hour (above 8 hours per day)
Labor-hours to produce a unit	1.6 hours per unit
Cost of increasing daily production rate (hiring and training)	\$300 per unit
Cost of decreasing daily production rate (layoffs)	\$600 per unit

Constant workforce

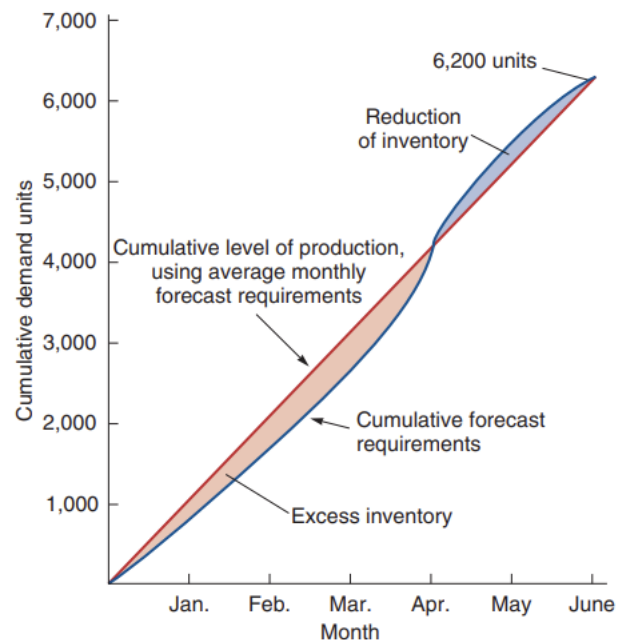
MONTH	PRODUCTION DAYS	PRODUCTION AT 50 UNITS PER DAY	DEMAND FORECAST	MONTHLY INVENTORY CHANGE	ENDING INVENTORY
Jan.	22	1,100	900	+200	200
Feb.	18	900	700	+200	400
Mar.	21	1,050	800	+250	650
Apr.	21	1,050	1,200	-150	500
May	22	1,100	1,500	-400	100
June	20	1,000	1,100	-100	<u>0</u>
					1,850

Total units of inventory carried over from one month to the next = 1,850 units

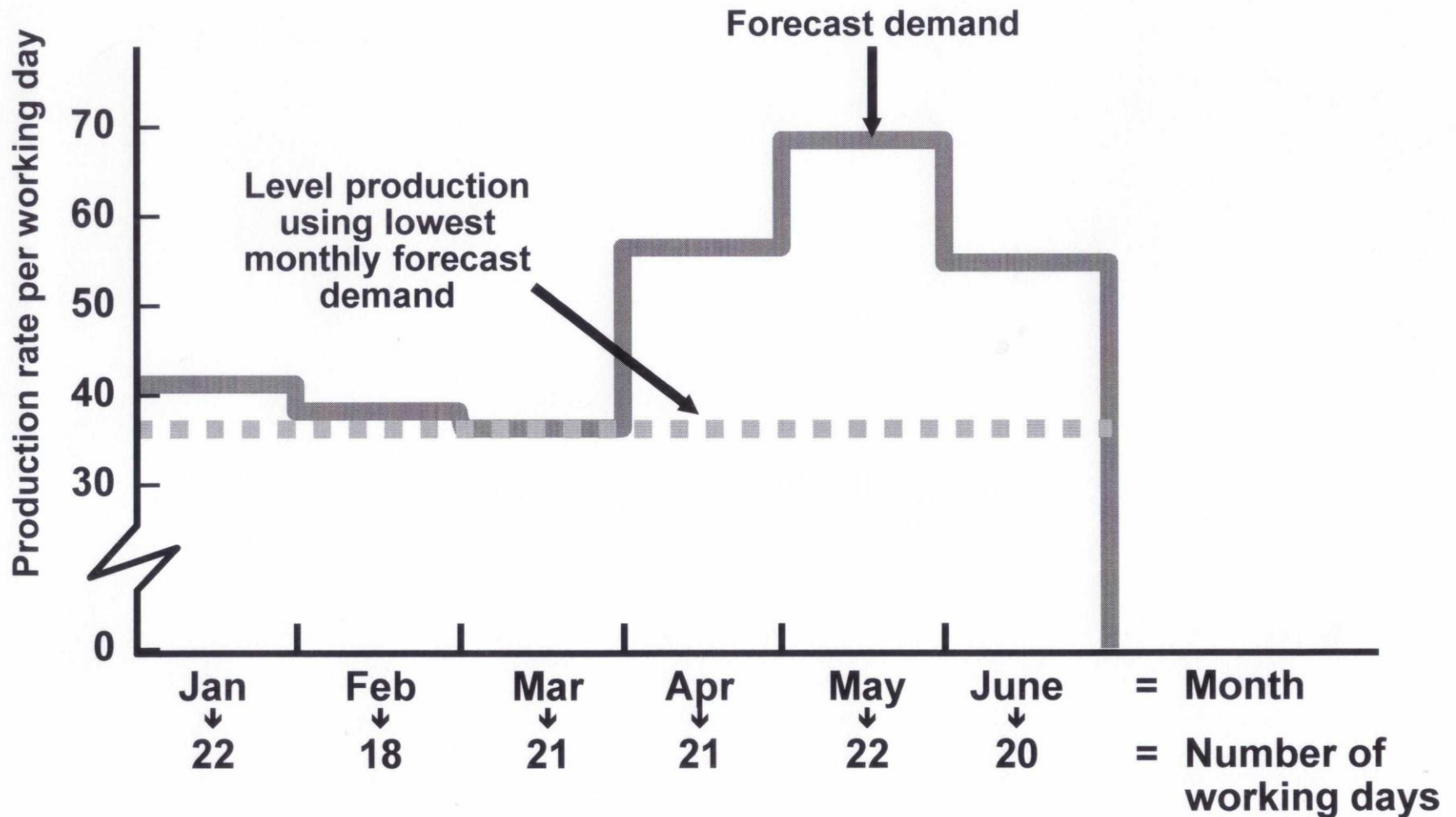
Workforce required to produce 50 units per day = 10 workers

COST		CALCULATIONS
Inventory carrying	\$ 9,250	(= 1,850 units carried × \$5 per unit)
Regular-time labor	99,200	(= 10 workers × \$80 per day × 124 days)
Other costs (overtime, hiring, layoffs, subcontracting)	<u>0</u>	
Total cost	\$108,450	

Total units of inventory carried over from one month to the next = 1,850 units
Workforce required to produce 50 units per day = 10 workers



Roofing Supplier Example 3



SUBCONTRACTING

$$\begin{aligned}\text{In-house production} &= 38 \text{ units per day} \times 124 \text{ production days} \\ &= 4,712 \text{ units}\end{aligned}$$

$$\text{Subcontract units} = 6,200 - 4,712 = 1,488 \text{ units}$$

The costs of plan 2 are computed as follows:

COST		CALCULATIONS
Regular-time labor	\$ 75,392	(= 7.6 workers $\times$ \$80 per day $\times$ 124 days)
Subcontracting	<u>29,760</u>	(= 1,488 units $\times$ \$20 per unit)
Total cost	\$105,152	

Roofing Supplier Example 4

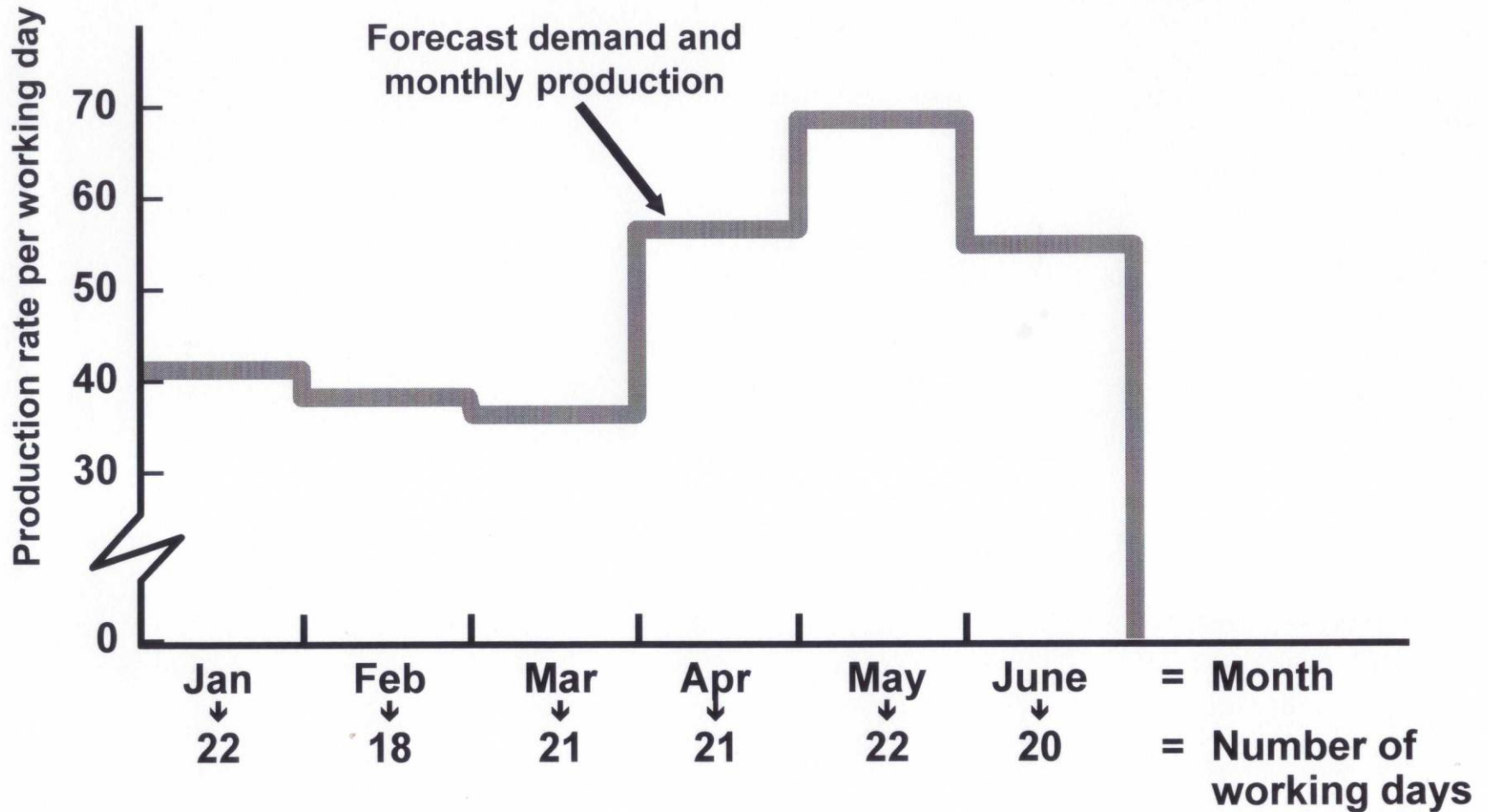
Month	Expected Demand	Production Days	Demand Per Day (computed)
Jan	900	22	41
Feb	700	18	39
Mar	800	21	38
Apr	1,200	21	57
May	1,500	22	68
June	<u>1,100</u>	<u>20</u>	55
	6,200	124	

Table 13.2

Plan 3 – hiring and layoffs

Production = Expected Demand

Roofing Supplier Example 4



Roofing Supplier Example 4

Cost Information

Inventory carrying cost	\$ 5 per unit per month
Subcontracting cost per unit	\$20 per unit
Average pay rate	\$10 per hour (\$80 per day)
Overtime pay rate	\$17 per hour (above 8 hours per day)
Labor-hours to produce a unit	1.6 hours per unit
Cost of increasing daily production rate (hiring and training)	\$300 per unit
Cost of decreasing daily production rate (layoffs)	\$600 per unit

Table 13.3

HIRING AND LAYOFF

TABLE 13.4

Cost Computations for Plan 3

MONTH	FORECAST (UNITS)	DAILY PRODUCTION RATE	BASIC PRODUCTION COST (DEMAND $\times 1.6$ HR PER UNIT $\times$ \$10 PER HR)	EXTRA COST OF INCREASING PRODUCTION (HIRING COST)	EXTRA COST OF DECREASING PRODUCTION (LAYOFF COST)	TOTAL COST
Jan.	900	41	\$14,400	—	—	\$ 14,400
Feb.	700	39	11,200	—	\$1,200 (= $2 \times \$600$)	12,400
Mar.	800	38	12,800	—	\$ 600 (= $1 \times \$600$)	13,400
Apr.	1,200	57	19,200	\$5,700 (= $19 \times \$300$)	—	24,900
May	1,500	68	24,000	\$3,300 (= $11 \times \$300$)	—	27,300
June	1,100	55	<u>17,600</u>	<u>—</u>	<u>\$7,800 (= $13 \times \\$600$)</u>	<u>\$ 25,400</u>
			\$99,200	\$9,000	\$9,600	\$117,800

TABLE 13.5**Comparison of the Three Plans**

COST	PLAN 1 (CONSTANT WORKFORCE OF 10 WORKERS)	PLAN 2 (WORKFORCE OF 7.6 WORKERS PLUS SUBCONTRACTORS)	PLAN 3 (HIRING AND LAYOFFS TO MEET DEMAND)
Inventory carrying	\$ 9,250	\$ 0	\$ 0
Regular labor	99,200	75,392	99,200
Overtime labor	0	0	0
Hiring	0	0	9,000
Layoffs	0	0	9,600
Subcontracting	<u>0</u>	<u>29,760</u>	<u>0</u>
Total cost	\$108,450	\$105,152	\$117,800

To do

SOLVED PROBLEM 13.2

A Dover, Delaware, plant has developed the accompanying supply, demand, cost, and inventory data. The firm has a constant workforce and meets all its demand. Allocate production capacity to satisfy demand at a minimum cost. What is the cost of this plan?

Supply Capacity Available (units)

PERIOD	REGULAR TIME	OVERTIME	SUBCONTRACT
1	300	50	200
2	400	50	200
3	450	50	200

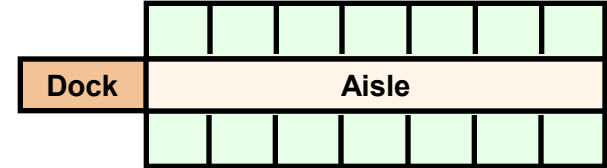
Demand Forecast

PERIOD	DEMAND (UNITS)
1	450
2	550
3	750

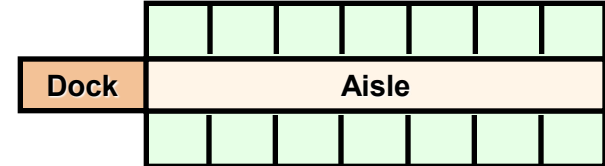
Other data

Initial inventory	50 units
Regular-time cost per unit	\$50
Overtime cost per unit	\$65
Subcontract cost per unit	\$80
Carrying cost per unit per period	\$ 1
Back order cost per unit per period	\$ 4

Level Strategy for Services



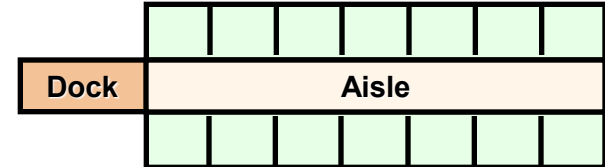
Level Strategy for Services



	TIME PERIOD						Total
	1	2	3	4	5	6	
Requirement*	6	12	18	15	13	14	78

Current employment = 10 part-time clerks * Number of part-time employees

Level Strategy for Services



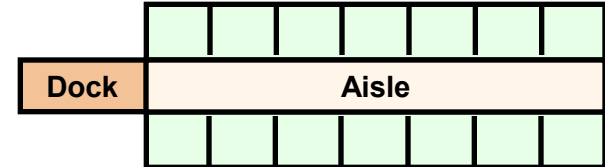
	TIME PERIOD						Total
	1	2	3	4	5	6	
Requirement*	6	12	18	15	13	14	78

Current employment = 10 part-time clerks * Number of part-time employees

1. No more than 10 new hires in any period
2. No backorders are permitted
3. Overtime can not exceed 20% of regular-time capacity
4. The following costs can be assigned:

Regular-time wage	\$2,000/period at 20 hours/week
Overtime wages	150% of regular-time
Hiring	\$1,000/person
Layoffs	\$500/person

Level Strategy for Services



	TIME PERIOD						Total
	1	2	3	4	5	6	
Requirement*	6	12	18	15	13	14	78

Current employment

Peak Requirement

1. No more than
2. No backorder
3. Overtime ca
4. The followin

Regular-ti

Overtime v

Hiring

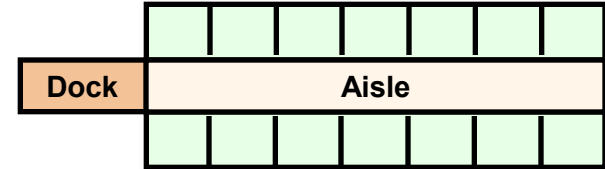
Layoffs

\$1,000/person

\$500/person

Example 14.1

Level Strategy for Services



	TIME PERIOD						
	1	2	3	4	5	6	Total
Requirement*	6	12	18	15	13	14	78

Current employment

1. No more than
2. No backorder
3. Overtime can
4. The following

Regular-time

Overtime

Hiring

Layoffs

Peak Requirement

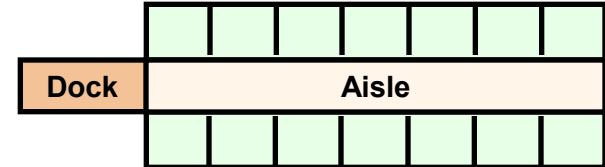
$1.20_w = 18$ employees in peak period

\$1,000/person

\$500/person

Example 14.1

Level Strategy for Services



	TIME PERIOD						Total
	1	2	3	4	5	6	
Requirement*	6	12	18	15	13	14	78

Current employment

Peak Requirement

1. No more than
2. No backorder
3. Overtime ca
4. The followin

$1.20w = 18$ employees in peak period

$$w = \frac{18}{1.20} = 15 \text{ employees}$$

Regular-ti

Overtime v

Hiring

Layoffs

\$1,000/person

\$500/person

Example 14.1

Aggregate planning case

- The president of Hill Enterprises, Terri Hill, projects the firm's aggregate demand requirements over the next 8 months as follows

Month	demand	Month	demand
January	1,400	May	2,200
February	1,600	June	2,200
March	1,800	July	1,800
April	1,800	August	1,400

Her operations manager is considering a new plan, which begins in. Stockout cost of lost sales is \$100 per unit. Inventory holding cost is \$20 per unit per month. Ignore any idle-time costs.

The plan is called plan A.

Plan A : Vary the workforce level to execute a 'chase' strategy by producing the quantity demanded in the prior month. The December demand and rate of production are both 1,600 units per month. The cost of hiring additional workers is \$5,000 per 100 units. The cost of laying off workers is \$7,500 per 100 units. Evaluate this plan.

Month	demand	Month	demand
January	1,400	May	2,200
February	1,600	June	2,200
March	1,800	July	1,800
April	1,800	August	1,400

Using the information, develop **plan B**.

Produce at a constant rate of 1,400 units per month, which will meet minimum demands. Then use subcontracting, with additional units at a premium price of \$75 per unit. Evaluate this plan by computing the costs for January through August.

Hill is now considering **plan C**.

Beginning inventory, stockout costs, and holding costs are provided previously. Keep a stable workforce by maintaining a constant production rate equal to the average requirements and allow varying inventory levels. Hills operations manager is also considering two mixed strategies for January – August

Plan D

Keep the current workforce stable at producing 1,600 units per month. Permit a maximum of 20% overtime at an additional cost of \$50 per unit. A warehouse now constraints the maximum allowable inventory on hand to 400 units or less.

Plan E

Keep the current workforce, which is producing 1,600 units per month, and subcontract to meet the rest of the demand. **Evaluate plans D and E and make a recommendation.**

About quality

Outline

 **Global Company Profile:** *Arnold Palmer Hospital*

 Quality and Strategy

 Defining Quality

 Total Quality Management

 Tools of T Q M

 The Role of Inspection

 T Q M in Services

Managing Quality Provides a Competitive Advantage - example

Arnold Palmer Hospital

- Delivers over 14,000 babies annually
- Virtually every type of quality tool is employed
 - Continuous improvement
 - Employee empowerment
 - Benchmarking
 - Just-in-time (JIT)
 - Quality tools

Quality and Strategy

Managing quality supports *differentiation*, *low cost*, and *response* strategies

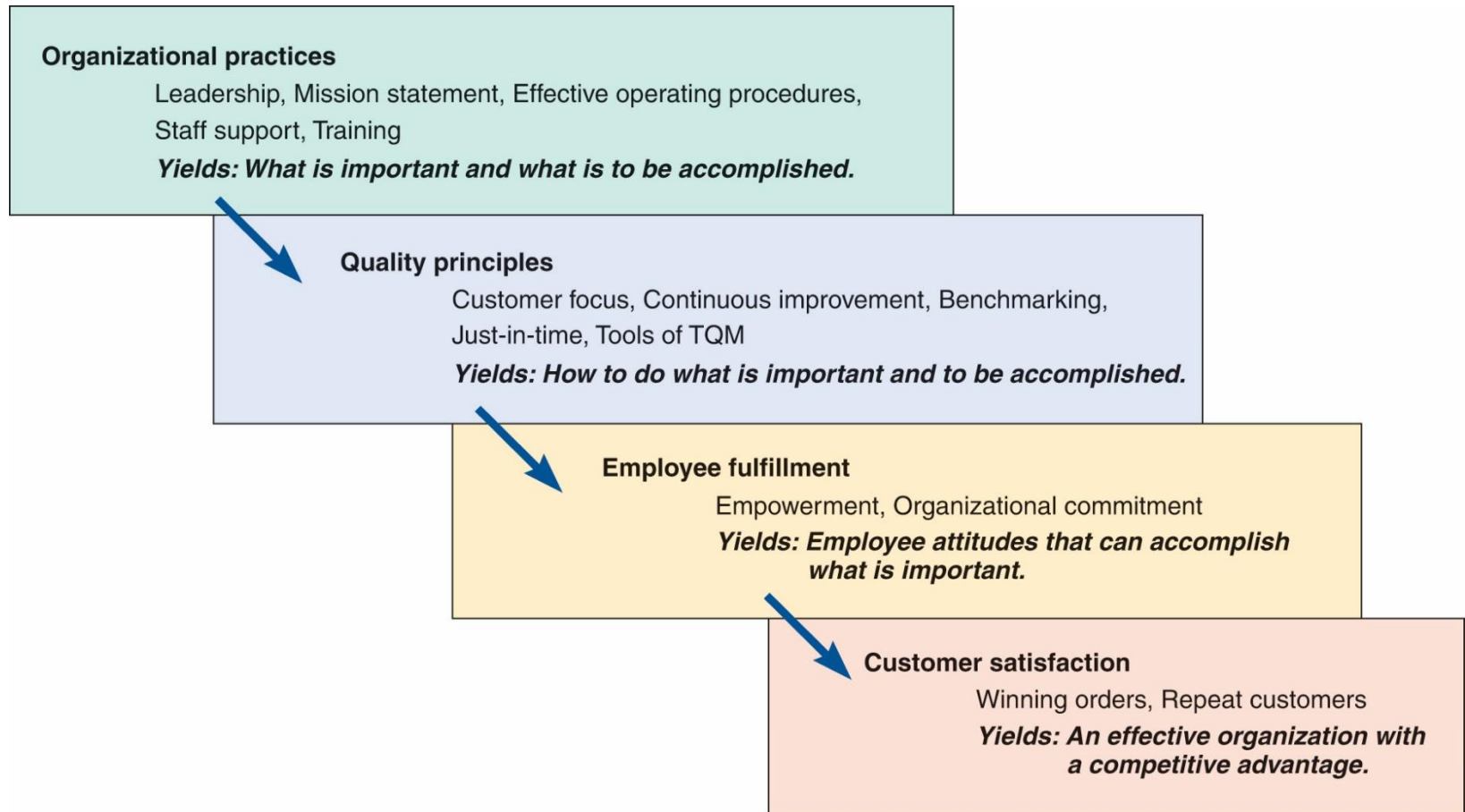
Quality helps firms increase sales and reduce costs

Building a quality organization is a **demanding task**

Two Ways Quality Improves Profitability



The Flow of Activities



Defining Quality

An operations manager's objective is to build a total quality management system that identifies and satisfies customer needs

Defining Quality

The totality of features and characteristics of a product or service that bears on its **ability to satisfy** stated or implied needs

American Society for Quality

Different Views

- ***User based:*** better performance, more features
- ***Manufacturing based:*** conformance to standards, making it right the first time
- ***Product based:*** specific and measurable attributes of the product

Implications of Quality

1. Company **reputation**
 - Perception of new products
 - Employment practices
 - Supplier relations
2. Product **liability**
 - Reduce risk
3. Global implications
 - Improved ability to compete

Baldrige Criteria

Applicants are evaluated on:

CATEGORIES	POINTS
Leadership	120
Strategic Planning	85
Customer Focus	85
Measurement, Analysis, and Knowledge Management	90
Workforce Focus	85
Operations Focus	85
Results	450

ISO 9000 International Quality Standards (1 of 2)

- International recognition
- **Encourages** quality management procedures, detailed documentation, work instructions, and recordkeeping
- 2015 revision gives greater emphasis to *risk-based thinking*
- *Interconnected departments*
- Over 1.6 million certifications in 201 countries
- Critical for global business

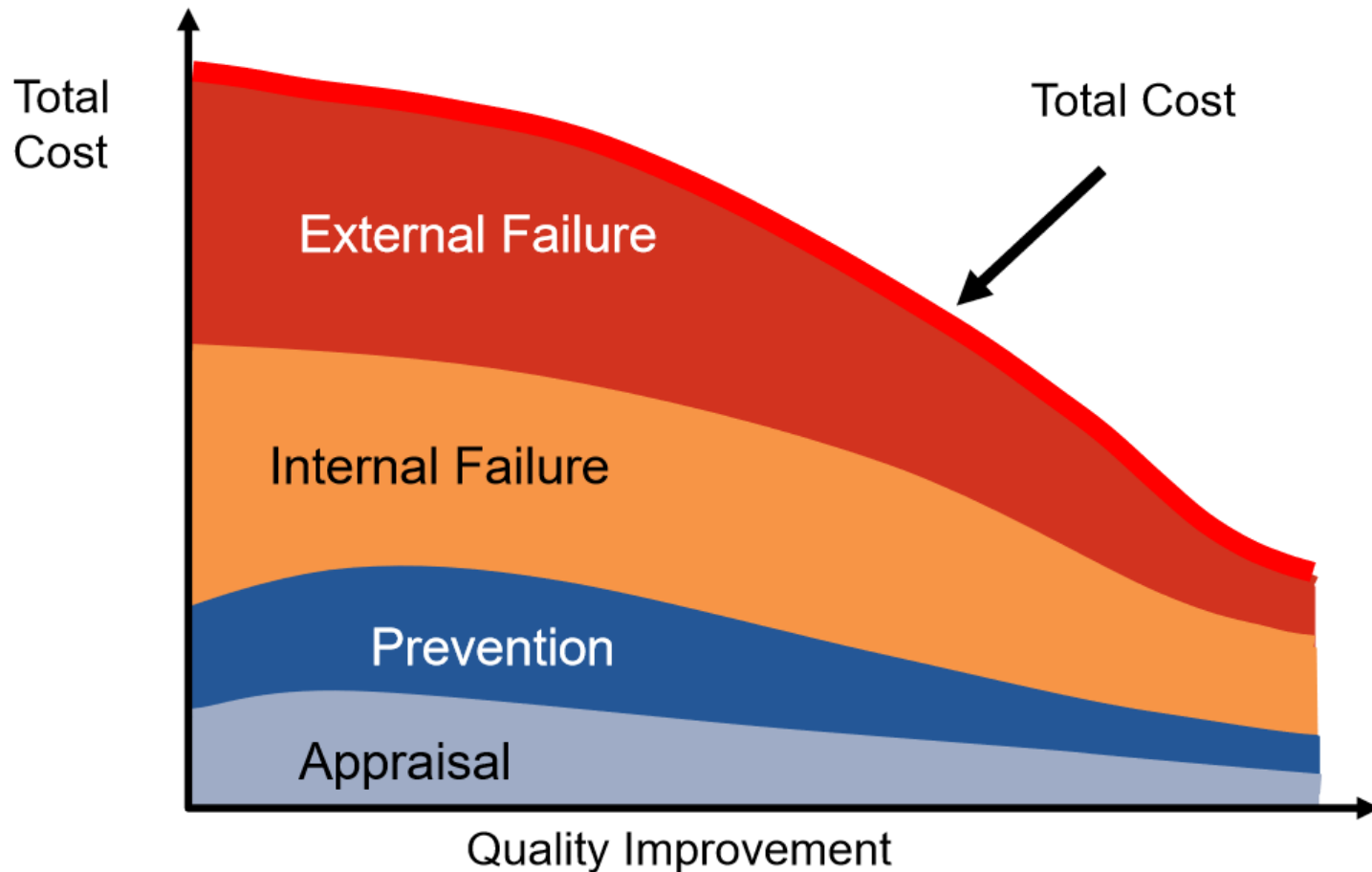
ISO 9000 International Quality Standards (2 of 2)

- Management principles
 1. Top management **leadership**
 2. Customer **satisfaction**
 3. Continual **improvement**
 4. Involvement of people
 5. Process analysis
 6. Use of **data-driven** decision making
 7. A systems approach to management
 8. Mutually beneficial supplier relationships

Costs of Quality

- ***Prevention costs*** - reducing the potential for defects
- *Appraisal costs* - **evaluating** products, parts, and services
- *Internal failure costs* - producing defective parts or service before delivery
- *External failure costs* - defects discovered after delivery

Costs of Quality



Takumi

A Japanese character that symbolizes a **broader** dimension than quality, a deeper process than education, and a **more** perfect method **than** persistence



Ethics and Quality Management



Operations managers must **deliver** healthy, safe, quality products and services



Poor quality risks injuries, lawsuits, recalls, and regulation



Ethical conduct must dictate response to problems



All stakeholders must be considered

Total Quality Management

- Encompasses entire organization from supplier to customer
- **Stresses a commitment by management** to have a continuing companywide drive toward excellence in all aspects of products and services that are important to the customer

Deming's Fourteen Points (1 of 2)

Table 6.2 Deming's 14 Points for Implementing Quality Improvement

1. Create **consistency** of purpose
2. Lead to promote change
3. Build quality into the product; **stop depending on inspections** to catch problems
4. Build long-term relationships **based on performance** instead of awarding business on price
5. **Continuously improve** product, quality, and service
6. Start training
7. Emphasize leadership

Deming's Fourteen Points (2 of 2)

Table 6.2 Deming's 14 Points for Implementing Quality Improvement

- | |
|---|
| 8. Drive out fear |
| 9. Break down barriers between departments |
| 10. Stop haranguing workers |
| 11. Support, help, and improve |
| 12. Remove barriers to pride in work |
| 13. Institute a vigorous program of education and self-improvement |
| 14. Put everyone in the company to work on the transformation |

Seven Concepts of TQM

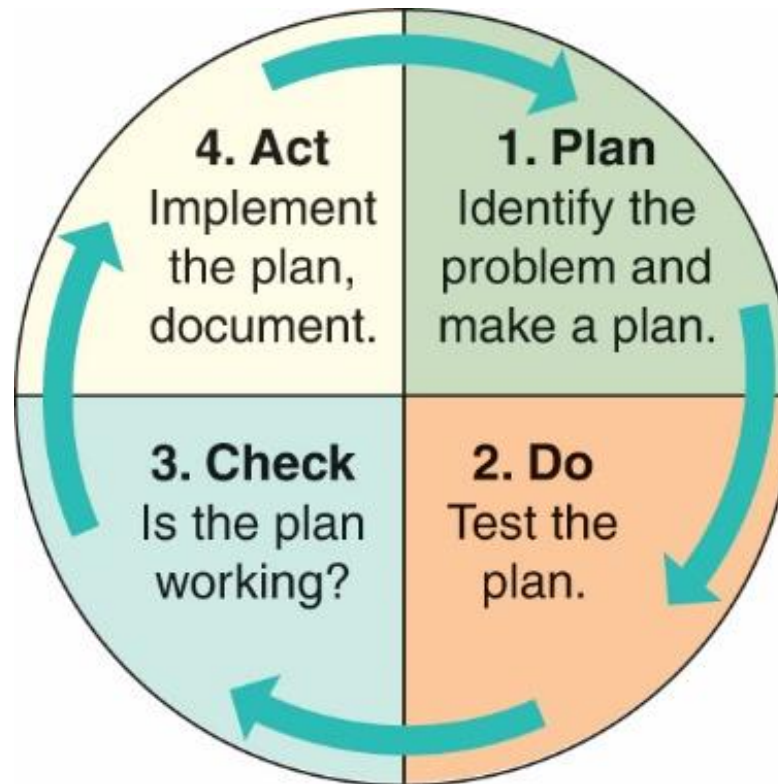
- 1) Continuous improvement
- 2) Six Sigma
- 3) Employee empowerment
- 4) Benchmarking
- 5) Just-in-time (JIT)
- 6) Taguchi concepts
- 7) Knowledge of TQM tools

Continuous Improvement (1 of 2)

- **Never-ending** process of continuous improvement
- Covers people, equipment, suppliers, materials, procedures
- Every operation can be improved

Shewhart's PDCA Model

Figure 6.3



Continuous Improvement (2 of 2)

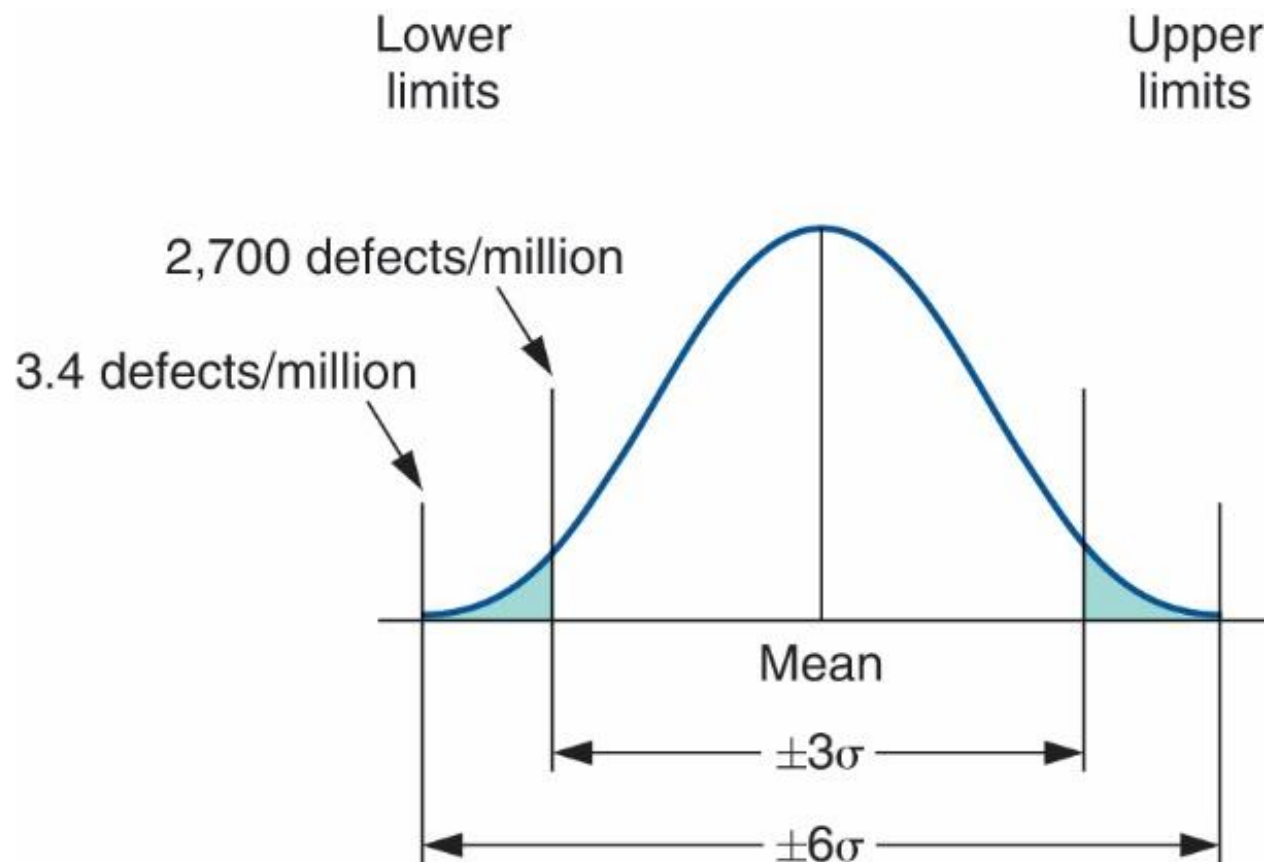
- ***Kaizen*** describes the ongoing process of unending improvement
- *TQM and zero defects* also used to describe continuous improvement

Six Sigma (1 of 3)

- Two meanings
 - *Statistical* definition of a process that is 99.9997% capable, 3.4 **defects per million opportunities** (DPMO)
 - A *program* designed to reduce defects, lower costs, save time, and improve customer satisfaction
- A comprehensive system for achieving and sustaining business success

Six Sigma (2 of 3)

Figure 6.4



Six Sigma Program

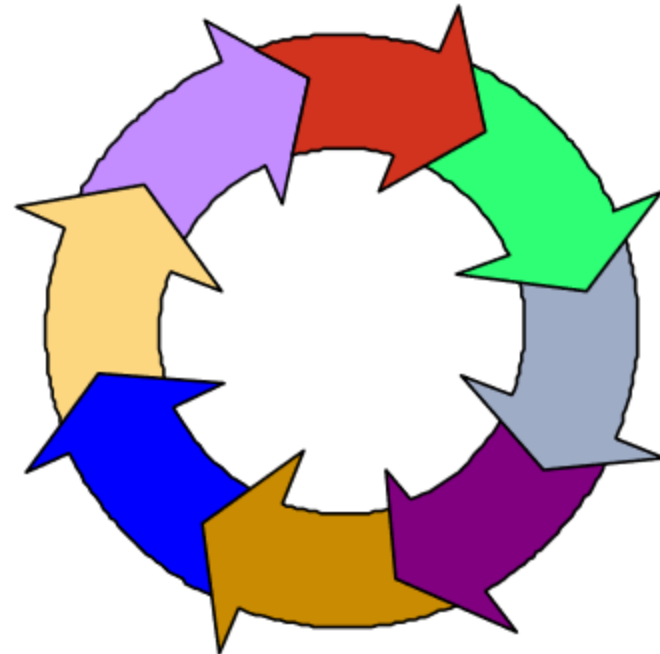
- Originally developed by Motorola, adopted and enhanced by Honeywell and GE
- Highly structured approach to process improvement
- A strategy
- A discipline – DMAIC
- A set of 7 tools



Six Sigma (3 of 3)

- **Defines** the project's **purpose, scope, and outputs**, then identifies the required process information keeping in mind the **customer's definition of quality**
- **Measures** the process and collects data
- **Analyzes** the data, ensuring repeatability and reproducibility
- **Improves** by modifying or redesigning existing processes and procedures
- **Controls** the new process to make sure performance levels are maintained

DMAIC Approach



Implementing Six Sigma (1 of 2)

- **Emphasize defects** per million opportunities as a standard metric
- Provide extensive **training**
- Focus on top management leadership (Champion)
- Create qualified process improvement **experts** (Black Belts, Green Belts, etc.)
- Set stretch objectives

Implementing Six Sigma (2 of 2)

- Emphasize defects per million opportunities as a standard metric
- Provide extensive training
- Focus on top management leadership (Champion)
- Create qualified process improvement experts (Black Belts, Green Belts, etc.)
- Set stretch objectives

This cannot be accomplished without a major commitment from top level management

Employee Empowerment

- Getting employees involved in product and process improvements
 - 85% of quality problems are **due to materials and process**
- Techniques
 1. Build communication networks that **include employees**
 2. Develop open, supportive supervisors
 3. **Move responsibility** to employees
 4. Build a **high-morale** organization
 5. Create formal team structures



Quality Circles

- Group of employees who meet regularly to solve problems
- Trained in planning, problem solving, and statistical methods
- Often **led by a *facilitator***
- *Very effective when done properly*

Benchmarking

Selecting best practices to use as a standard for performance very similar to your own

1. Determine what to benchmark
2. Form a benchmark team
3. Identify benchmarking partners
4. Collect and analyze benchmarking information
5. Take action to match or exceed the benchmark

Best Practices for Resolving Customer Complaints

Table 6.3

BEST PRACTICE	JUSTIFICATION
Make it easy for clients to complain	It is free market research
Respond quickly to complaints	It adds customers and loyalty
Resolve complaints on first contact	It reduces cost
Use computers to manage complaints	Discover trends, share them, and align your services
Recruit the best for customer service jobs	It should be part of formal training and career advancement

Internal Benchmarking

- When the organization is large enough
- Data more accessible
- Can and should be established in a variety of areas

Just-in-Time (JIT) (1 of 2)

- **'Pull' system** of production scheduling including supply management
 - Production only when signaled
- Allows **reduced inventory levels**
 - Inventory costs money and hides process and material problems
- Encourages improved process and product quality

Just-in-Time (JIT) (2 of 2)

Relationship to quality:

- JIT cuts the cost of quality
- JIT improves quality
- Better quality means less inventory and better, easier-to-employ JIT system

Taguchi Concepts

- Engineering and experimental design methods to improve product and process design
 - Identify key component and process variables affecting product variation
- Taguchi Concepts
 - *Quality **robustness***
 - *Target-oriented quality*
 - *Quality loss function*

Quality Robustness

- Ability to produce products uniformly in adverse manufacturing and environmental conditions
 - Remove the ***effects of adverse conditions***
 - **Small variations** in materials and process do not destroy product quality

Quality Loss Function (1 of 2)

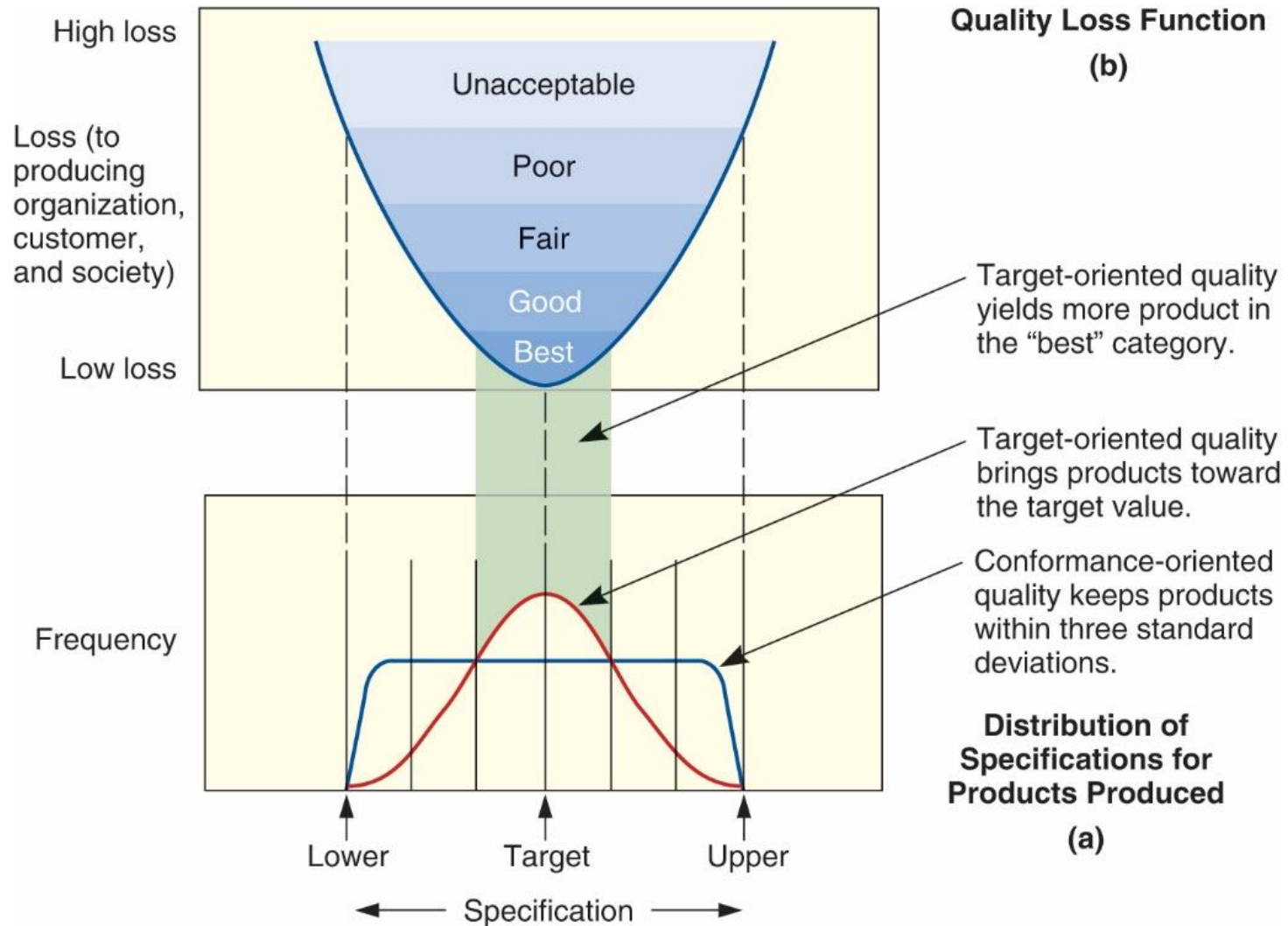
- Shows that **costs increase** as the **product moves away from what the customer wants**
- Costs **include** customer dissatisfaction, warranty and service, internal scrap and repair, and costs to society
- Traditional conformance specifications are **too simplistic**



Target-oriented
quality

Quality Loss Function (2 of 2)

Figure 6.5



TQM Tools (1 of 2)

- Tools for **Generating Ideas**
 - Check Sheet
 - Scatter Diagram (dispersion)
 - Cause-and-Effect Diagram
- Tools to **Organize the Data**
 - Pareto Chart
 - Flowchart (Process Diagram)

TQM Tools (2 of 2)

- Tools for Identifying Problems
 - Histogram
 - Statistical Process Control Chart

Seven Tools of TQM (1 of 7)

Figure 6.6

(a) *Check Sheet*: An organized method of recording data

Tools for Generating Ideas

(a) *Check Sheet*: An organized method of recording data

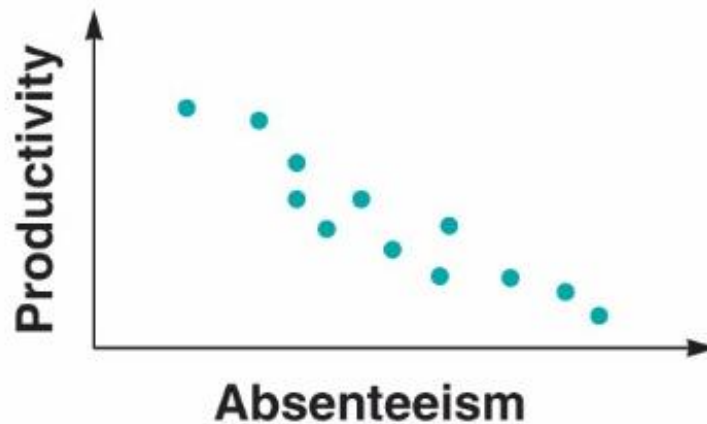
	Hour							
Defect	1	2	3	4	5	6	7	8
A	///	/		/	/	/	///	/
B	//	/	/	/			//	///
C	/	//					//	////

Seven Tools of TQM (2 of 7)

Figure 6.6

(b) *Scatter Diagram*: A graph of the value of one variable vs. another variable

(b) *Scatter Diagram*: A graph of the value of one variable vs. another variable

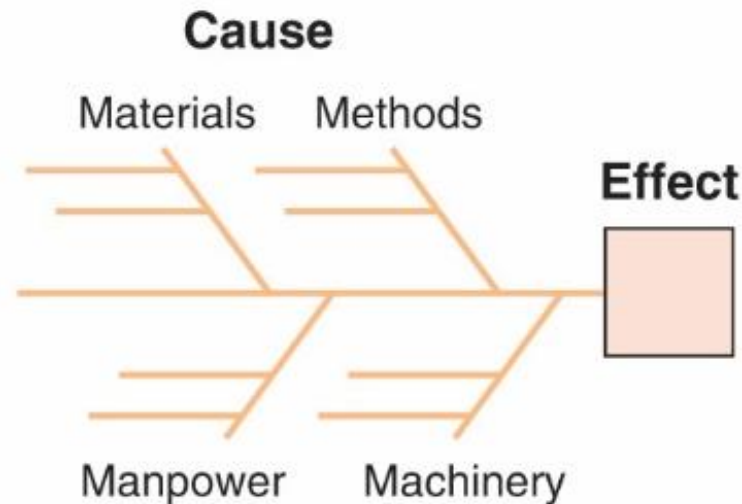


Seven Tools of TQM (3 of 7)

Figure 6.6

(c) *Cause-and-Effect Diagram*: A tool that identifies process elements (causes) that may effect an outcome

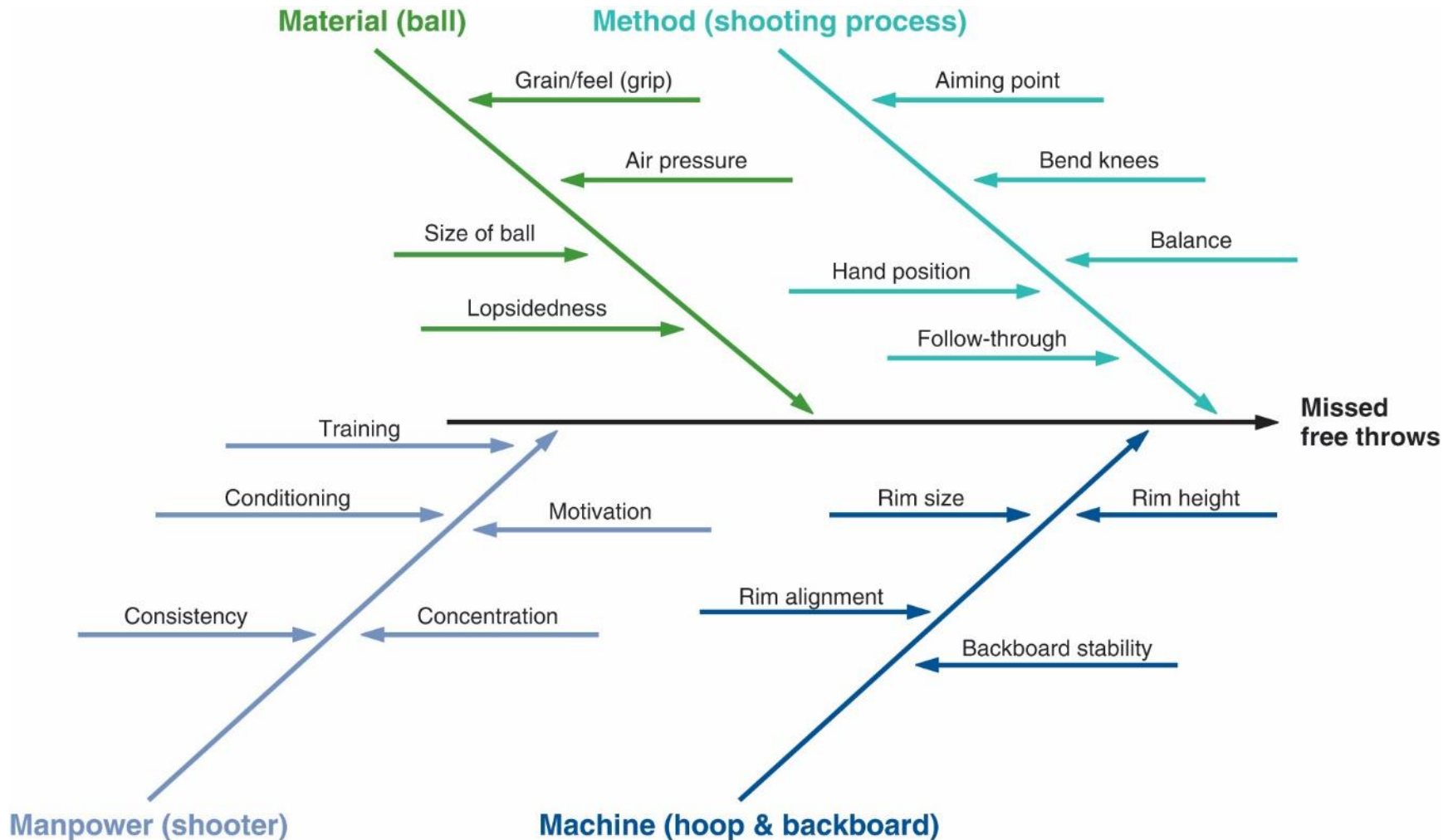
(c) *Cause-and-Effect Diagram*: A tool that identifies process elements (causes) that may affect an outcome



Cause-and-Effect Diagrams

Basketball quality control problem—missed free throws

Figure 6.7



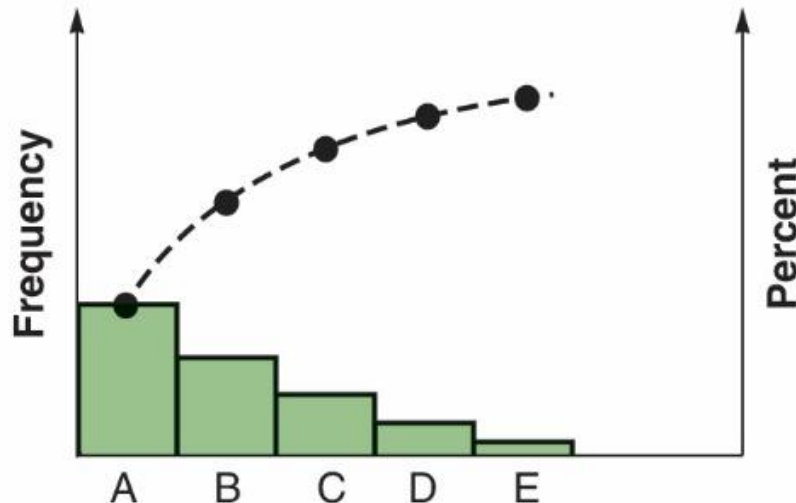
Seven Tools of TQM (4 of 7)

Figure 6.6

(d) *Pareto Chart*: A graph to identify and plot problems or defects in descending order of frequency

Tools for Organizing the Data

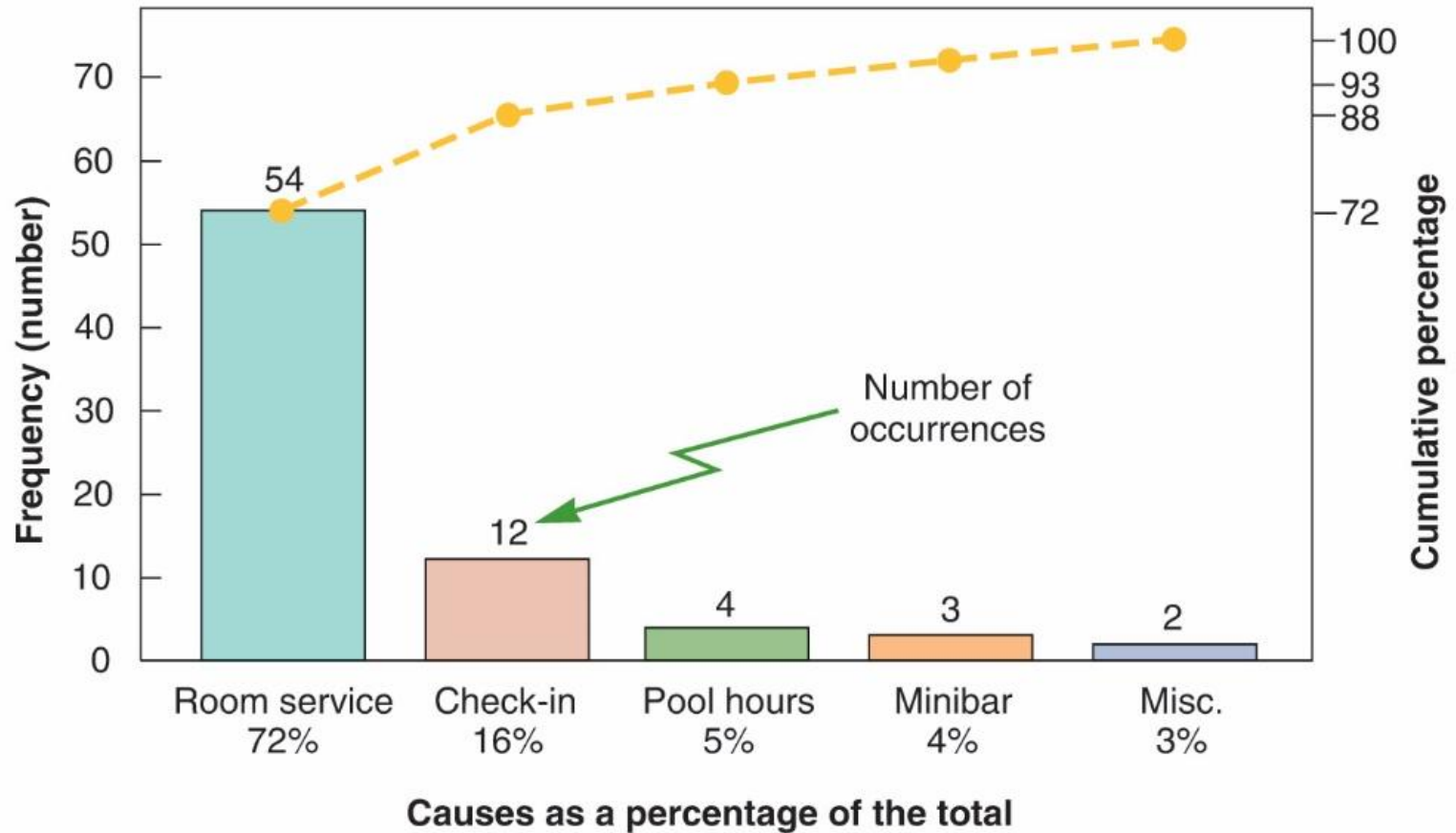
(d) *Pareto Chart*: A graph that identifies and plots problems or defects in descending order of frequency



Pareto Charts

Pareto Analysis of Hotel Complaints

Data for October

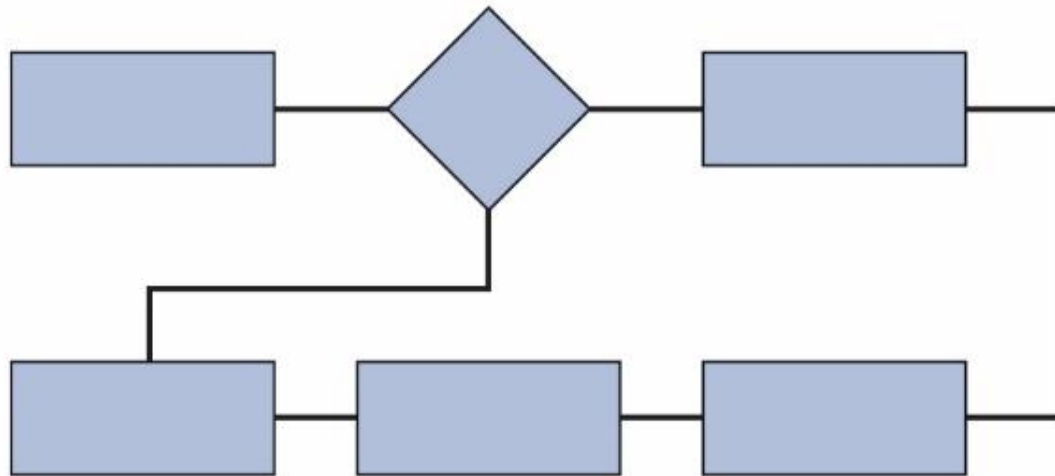


Seven Tools of TQM (5 of 7)

Figure 6.6

(e) *Flowchart (Process Diagram)*: A chart that describes the steps in a process

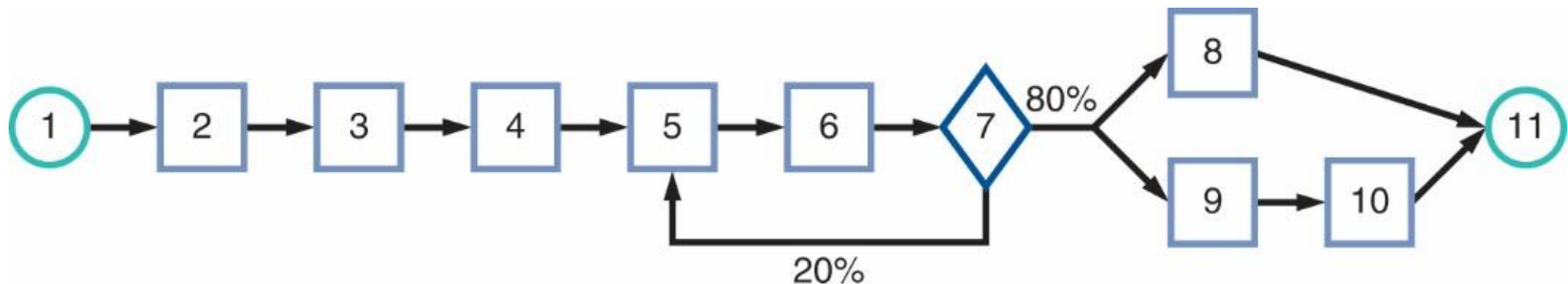
(e) *Flowchart (Process Diagram)*: A chart that describes the steps in a process



Flow Charts

MRI Flowchart = **Measure Record Improve**

1. Physician schedules MRI
2. Patient taken to MRI
3. Patient signs in
4. Patient is prepped
5. Technician carries out MRI
6. Technician inspects film
7. If unsatisfactory, repeat
8. Patient taken back to room
9. MRI read by radiologist
10. MRI report transferred to physician
11. Patient and physician discuss



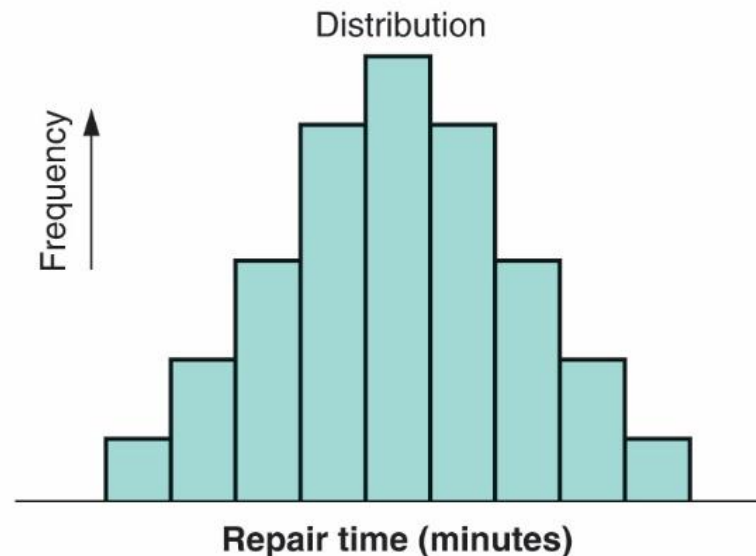
Seven Tools of TQM (6 of 7)

Figure 6.6

(f) *Histogram*: A distribution showing the frequency of occurrences of a variable

Tools for Identifying Problems

(f) *Histogram*: A distribution that shows the frequency of occurrences of a variable

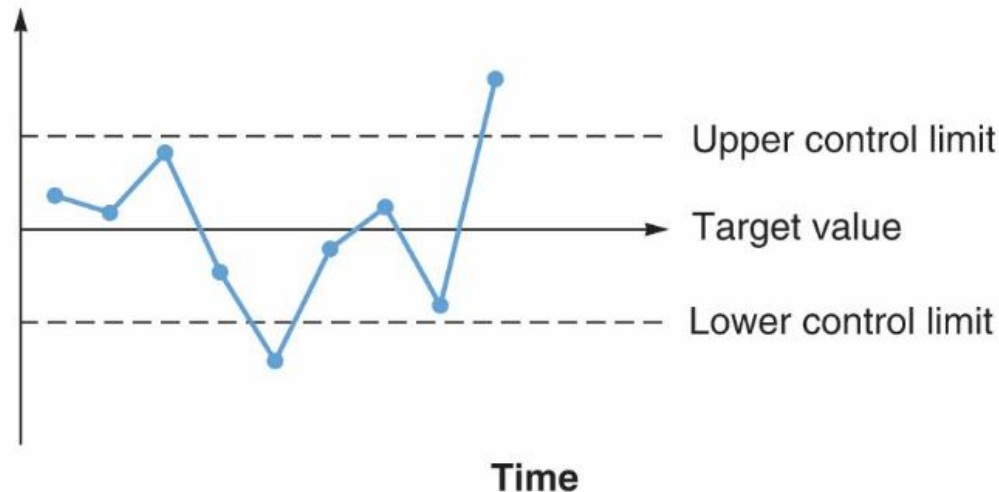


Seven Tools of TQM (7 of 7)

Figure 6.6

(g) *Statistical Process Control Chart*: A chart with time on the horizontal axis to plot values of a statistic

(g) *Statistical Process Control Chart*: A chart with time on the horizontal axis for plotting values of a statistic

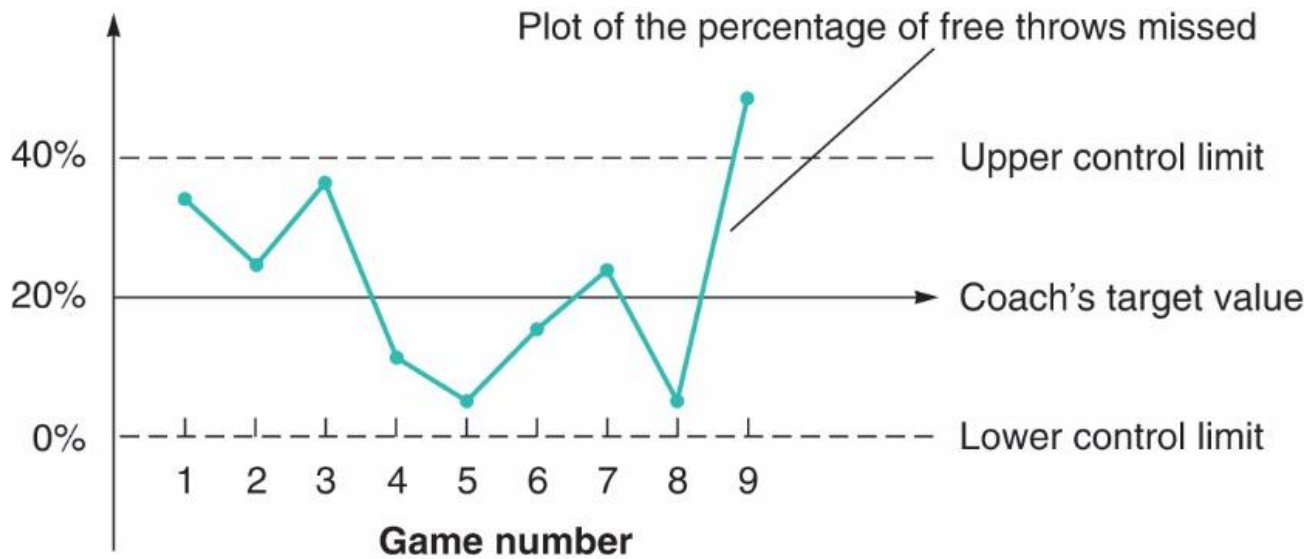


Statistical Process Control (SPC)

- Uses statistics and control charts to tell when to take corrective action
- Drives process improvement
- **Four key steps**
 - Measure the process
 - When a change is indicated, find the assignable cause
 - Eliminate or incorporate the cause
 - Restart the revised process

Control Charts

Figure 6.8



Inspection (1 of 2)

- Involves examining items to see if an item is good or defective
- **Detect a defective product**
 - Does not correct deficiencies in process or product
 - It is expensive
- Issues
 - When to inspect
 - Where in process to inspect

When and Where to Inspect (1 of 2)

1. At the supplier's plant while the supplier is producing
2. At your facility upon receipt of goods from your supplier
3. Before costly or irreversible processes
4. During the step-by-step production process
5. When production or service is complete
6. Before delivery to your customer
7. At the point of customer contact

When and Where to Inspect (2 of 2)

Table 6.4 How Samsung Tests Its Smartphones

Durability	Stress testing with nail punctures, extreme temperatures and overcharging
Visual inspection	Comparing the battery with standardized models
X-ray	Looking for internal abnormalities
Charge and discharge	Power up and down the completed phone
Organic pollution (TVOC)	Looking for battery leakage
Disassembling	Opening the battery cell to inspect tab welding and insulation tape conditions
Accelerated usage	Simulated 2 weeks of real-life use in 5 days
Volatility (OVC)	Checking for change in voltage throughout the manufacturing process

Inspection (2 of 2)

- Many problems
 - Worker **tiredness**
 - Measurement **error**
 - Process **variability**
- Cannot inspect quality into a product
- Robust design, empowered employees, and sound processes are better solutions

Source Inspection (1 of 2)

- Also known as **source control**
- The next step in the process is your customer
- Ensure perfect product to your customer



Source Inspection (2 of 2)

- **Poka-yoke** is the concept of foolproof devices or techniques designed to pass only acceptable products
- **Checklists** ensure consistency and completeness



Service Industry Inspection (1 of 3)

Table 6.5 Examples of Inspection in Services

ORGANIZATION	WHAT IS INSPECTED	STANDARD
Alaska Airlines	Last bag on carousel Airplane door opened	Less than 20 minutes after arrival at the gate Less than 2 minutes after arrival at the gate
Jones Law Office	Receptionist performance Billing Attorney	Phone answered by the second ring Accurate, timely, and correct format Promptness in returning calls
Hard Rock Hotel	Reception desk Doorman Room Minibar	Use customer's name Greet guest in less than 30 seconds All lights working, spotless bathroom Restocked and charges accurately posted to bill

Service Industry Inspection (2 of 3)

Table 6.5 Examples of Inspection in Services

ORGANIZATION	WHAT IS INSPECTED	STANDARD
Arnold Palmer Hospital	Billing Pharmacy Lab Nurses Admissions	Accurate, timely, and correct format Prescription accuracy, inventory accuracy Audit for lab-test accuracy Charts immediately updated Data entered correctly and completely
Olive Garden Restaurant	Busboy Busboy Waiter	Serves water and bread within 1 minute Clears all entrée items and crumbs prior to dessert Knows and suggests specials, desserts

Service Industry Inspection (3 of 3)

Table 6.5 Examples of Inspection in Services

ORGANIZATION	WHAT IS INSPECTED	STANDARD
Nordstrom Department Store	Display areas Stockrooms Salesclerks	Attractive, well-organized, stocked, good lighting Rotation of goods, organized, clean Neat, courteous, very knowledgeable

Attributes Versus Variables

- *Attributes*
 - Items are either good or bad, acceptable or unacceptable
 - Does not address degree of failure
- *Variables*
 - Measures dimensions such as weight, speed, height, or strength
 - Falls within an acceptable range
- Use different statistical techniques

TQM In Services

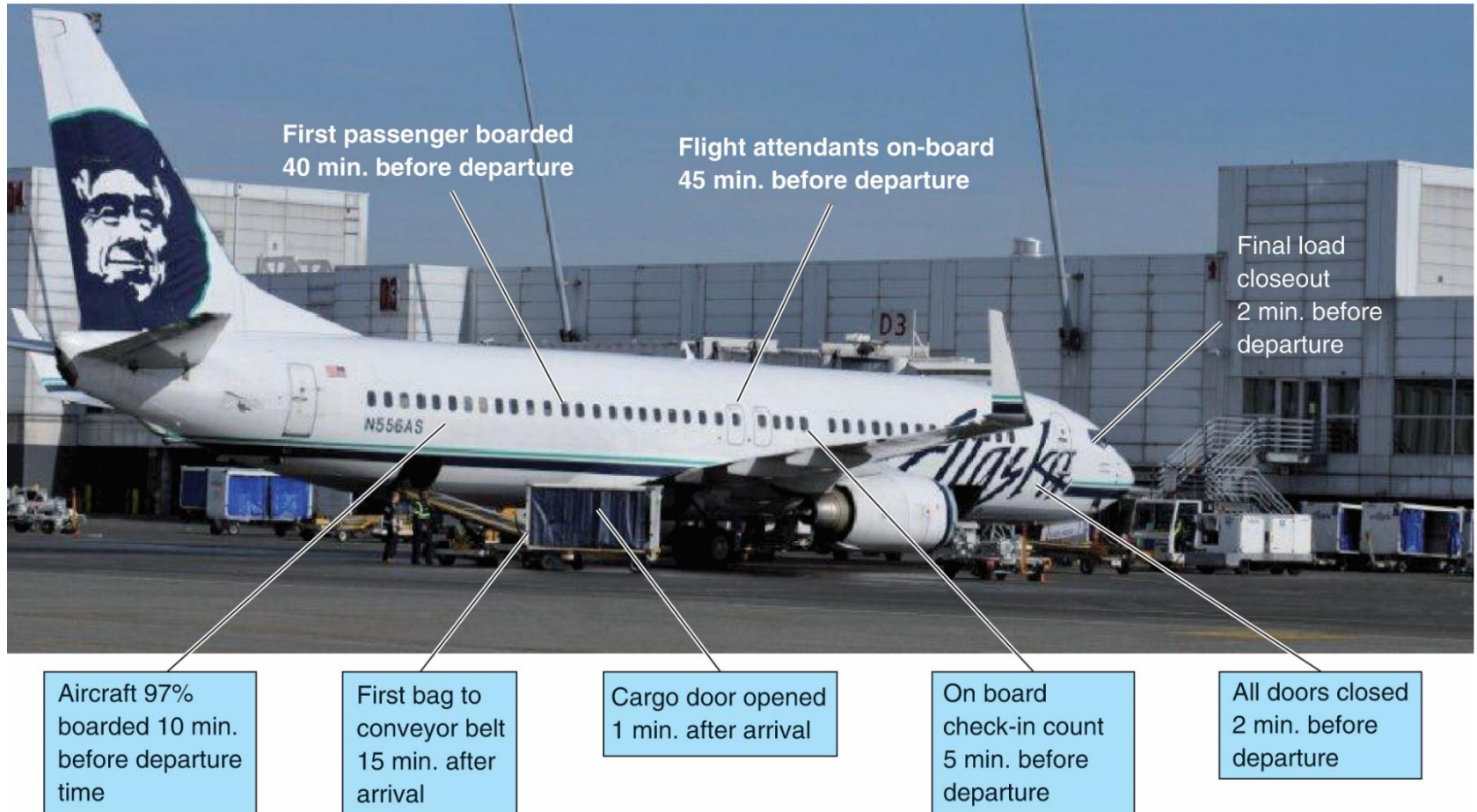
- Service quality is more difficult to measure than the quality of goods
- Service quality perceptions depend on
 - 1) ***Intangible differences between products***
 - 2) ***Intangible expectations customers have of those products***

Service Quality

The operations manager must recognize:

- Selecting best practices to use as a standard for performance
- The tangible component of services is important
- The service process is important
- The service is judged against the customer's expectations
- Exceptions will occur

Service Specifications



Determinants of Service Quality

Table 6.6

Reliability involves consistency of performance and dependability

Responsiveness concerns the willingness or readiness of employees to provide service

Competence means possession of the required skills and knowledge to perform the service

Access involves approachability and ease of contact

Courtesy involves politeness, respect, consideration, and friendliness

Communication means keeping customers informed and listening to them

Credibility involves trustworthiness, believability, and honesty

Security is the freedom from danger, risk, or doubt

Understanding/knowing the customer involves making the effort to understand the customer's needs

Tangibles include the physical evidence of the service

Service Recovery Strategy

- Managers should have a plan **for when services fail**
- Marriott's **LEARN** routine
 - Listen
 - Empathize
 - Apologize
 - React
 - Notify

Evaluating Performance (1 of 2)

- The SERVQUAL technique
- Direct comparisons **between customer service expectations and actual service provided**
- Focuses on gaps in the 10 service quality determinants

Evaluating Performance (2 of 2)

- Most common version collapses the determinants to
 - Reliability
 - Assurances
 - Tangibles
 - Empathy
 - Responsiveness

Together

Technology Implementation

Your company is considering implementing a new logistics management software to improve efficiency and accuracy. However, the software requires a significant investment and a steep learning curve.

Questions:

- How will you assess the cost-benefit analysis of this technology investment?
- What steps will you take to ensure a smooth implementation and adoption by your team?
- How will you measure the success of the new technology in improving your logistics operations?



SELF TEST



1- Low-volume, high-variety processes are also known as:

- a) continuous processes.
- b) process focused.
- c) repetitive processes.
- d) product focused.



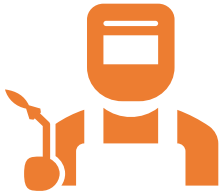
2 - A crossover chart for process selection focuses on:

- a) labor costs.
- b) material cost.
- c) both labor and material costs.
- d) fixed and variable costs.
- e) fixed costs.



3- Tools for process analysis include all of the following except:

- a) flowchart.
- b) vision systems.
- c) service blueprinting.
- d) time-function mapping.
- e) value-stream mapping.



4- Customer feedback in process design is lower as:

- a) the degree of customization is increased.
- b) the degree of labor is increased.
- c) the degree of customization is lowered.
- d) both a and b.
- e) both b and c.



5- Computer-integrated manufacturing (CIM) includes manufacturing systems that have:

- a) computer-aided design, direct numerical control machines, and material-handling equipment controlled by automation.
- b) transaction processing, a management information system, and decision support systems.
- c) automated guided vehicles, robots, and process control.
- d) robots, automated guided vehicles, and transfer equipment.

Quiz

Layout

1- Which of the statements below best describes office layout ?

- a) Groups workers, their equipment, and spaces/offices to provide for movement of information.
- b) Addresses the layout requirements of large, bulky projects such as ships and buildings.
- c) Seeks the best personnel and machine utilization in repetitive or continuous production.
- d) Allocates shelf space and responds to customer behavior.
- e) Deals with low-volume, high-variety production.

2- Which of the following does not support the retail layout objective of maximizing customer exposure to products?

- a) Locate high-draw items around the periphery of the store.
- b) Use prominent locations for high-impulse and high-margin items.
- c) Maximize exposure to expensive items.
- d) Use end-aisle locations.
- e) Convey the store's mission with the careful positioning of the lead-off department.

3- The major problem addressed by the warehouse layout strategy is:

- a) minimizing difficulties caused by material flow varying with each product.
- b) requiring frequent contact close to one another.
- c) addressing trade-offs between space and material handling or balancing product flow from one workstation to the next.
- d) none of the above.

4- A fixed-position layout:

- a) groups workers to provide for movement of information.
- b) addresses the layout requirements of large, bulky projects such as ships and buildings.
- c) seeks the best machine utilization in continuous production.
- d) allocates shelf space based on customer behavior.
- e) deals with low-volume, high-variety production.

5 -A process-oriented layout:

- a) groups workers to provide for movement of information.
- b) addresses the layout requirements of large, bulky projects such as ships and buildings.
- c) seeks the best machine utilization in continuous production.
- d) allocates shelf space based on customer behavior.
- e) deals with low-volume, high-variety production.

6-For a focused work center or focused factory to be appropriate, the following three factors are required:

- a)
- b)
- c)

7- Before considering a product-oriented layout, it is important to be certain of:

- a)
- b)
- c)
- d)

8- An assembly line is to be designed for a product whose completion requires 21 minutes of work. The factory works 400 minutes per day. Can a production line with five workstations make 100 units per day?

- a) Yes, with exactly 100 minutes to spare.
- b) No, but four workstations would be sufficient.
- c) No, it will fall short even with a perfectly balanced line.
- d) Yes, but the line's efficiency is very low.
- e) Cannot be determined from the information given.



SELF TEST

- **Which of the following is not one of the graphical method steps?**

- a) Determine the demand in each period.
- b) Determine capacity for regular time, overtime, and subcontracting each period.
- c) Find labor costs, hiring and layoff costs, and inventory holding costs.
- d) Construct the transportation table.
- e) Consider company policy that may apply to the workers or stock levels.
- f) Develop alternative plans and examine their total costs.

- **The outputs from an S&OP process are:**

- a) long-run plans.
- b) detail schedules.
- c) aggregate plans.
- d) revenue management plans.
- e) short-run plans.