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Content module 2. Management of operations system

Lecture 6. Strategic Capacity Management

References

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Issues to be discussed

- Strategic Capacity Planning
- Capacity Utilization & Best Operating Level
- Economies & Diseconomies of Scale
- The Experience Curve
- Capacity Focus, Flexibility & Planning
- Determining Capacity Requirements
- Decision Trees
- Capacity Utilization & Service Quality

What is Capacity?

Capacity is 'the ability to hold, receive, store, or accommodate'. (a dictionary definition)

Capacity is most frequently viewed as the amount of output that a system is capable of achieving over a specific period of time. (in a general business sense)

Capacity is the number of customers that can be handled between noon and 1:00 p.m. (in a service setting)

Capacity is the number of automobiles that can be produced in a single shift. (in manufacturing)

Strategic Capacity Planning

Strategic capacity planning is an approach for determining the overall capacity level of capital intensive resources, including facilities, equipment, and overall labor force size.

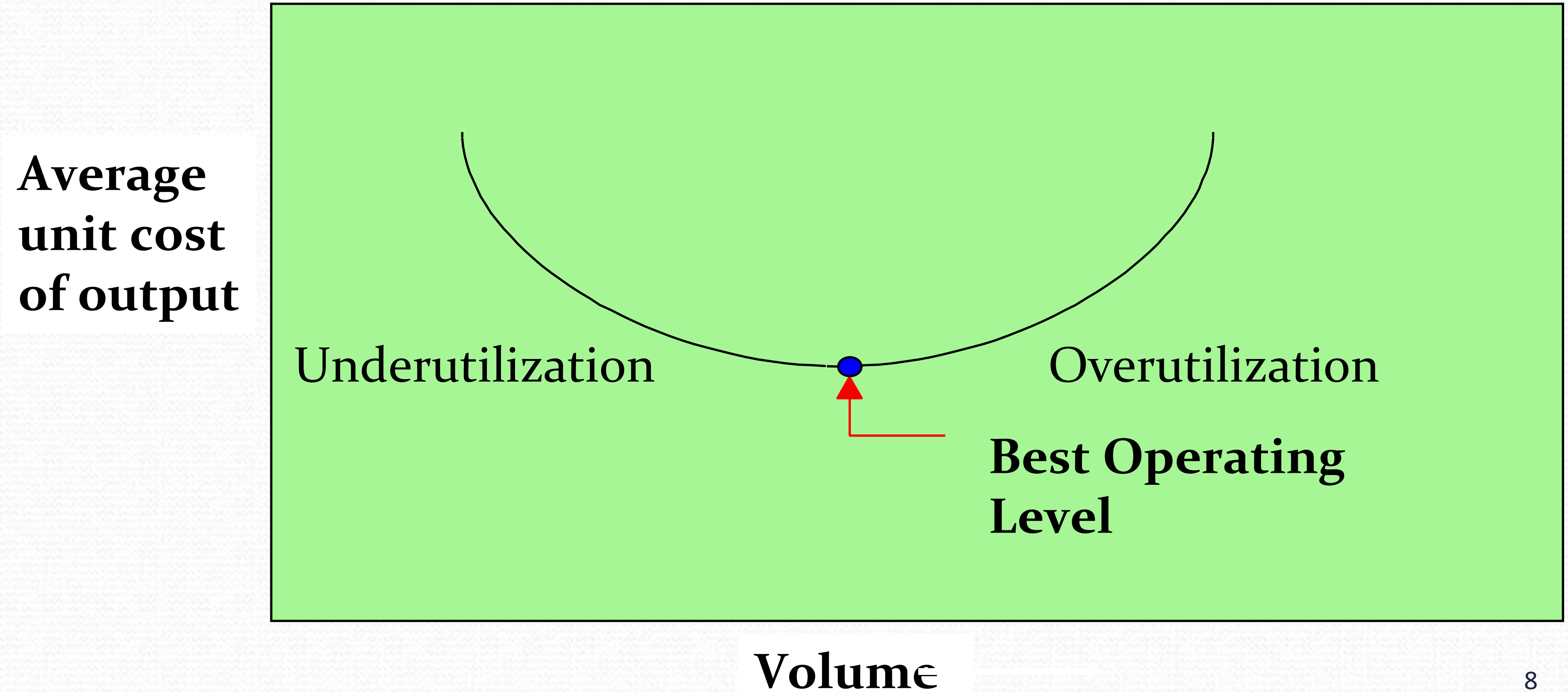
Capacity Utilization

The **capacity utilization rate** is expressed as a percentage and requires that the numerator and denominator be measured in the same units and time periods (such as machine hour/day, barrels of oil/day, dollar of output/day)

$$\text{Capacity utilization rate} = \frac{\text{Capacity used}}{\text{Best operating level}}$$

Best Operating Level

Example: Engineers design engines and assembly lines to operate at an ideal or “best operating level” to maximize output and minimize ware



Example of Capacity Utilization

During one week of production, a plant produced 83 units of a product. Its historic highest or best utilization recorded was 120 units per week. What is this plant's capacity utilization rate?

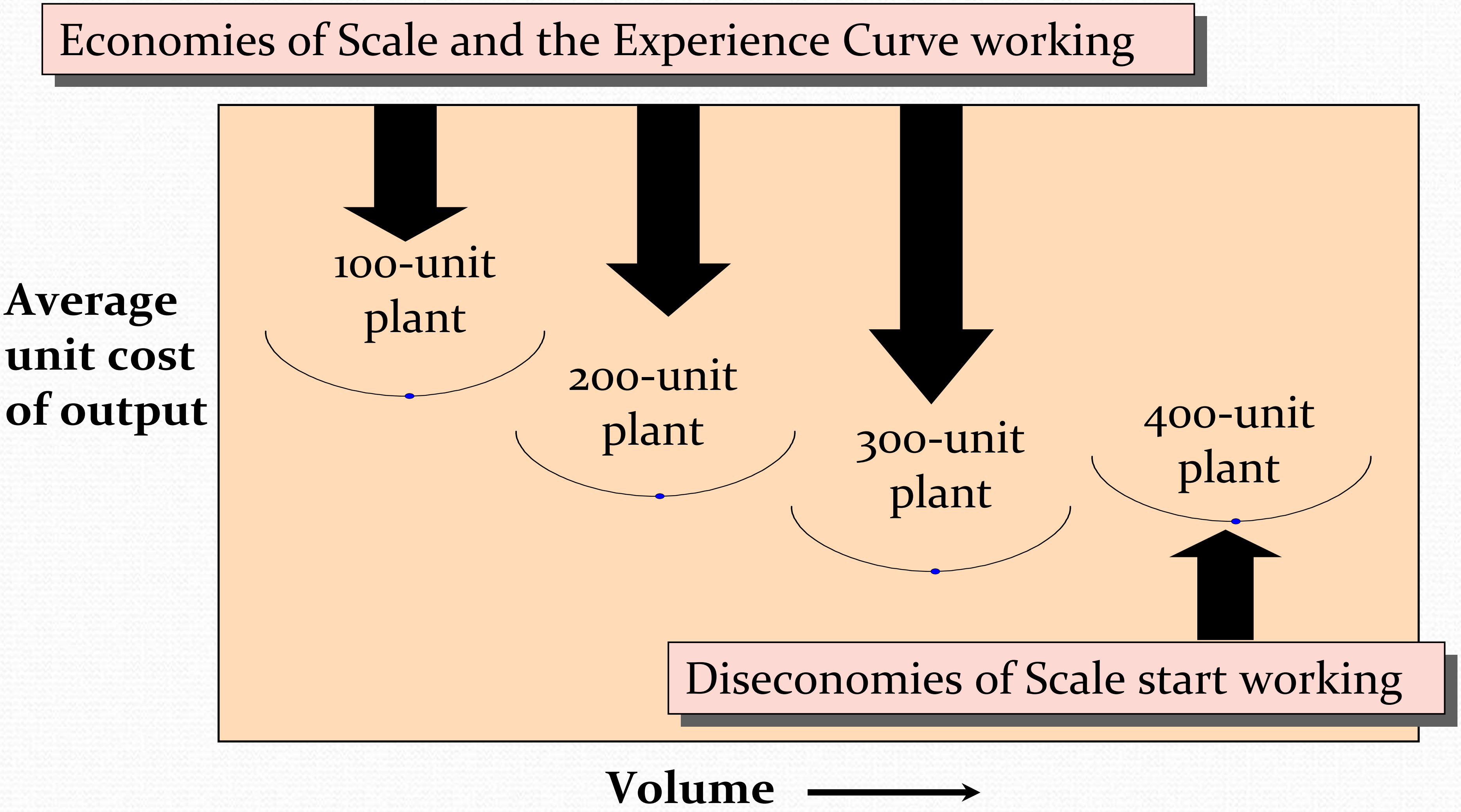
Answer:

$$\textbf{Capacity utilization rate} = \frac{\textbf{Capacity used}}{\textbf{Best operating level}}$$

= 83/120

=0.69 or 69%

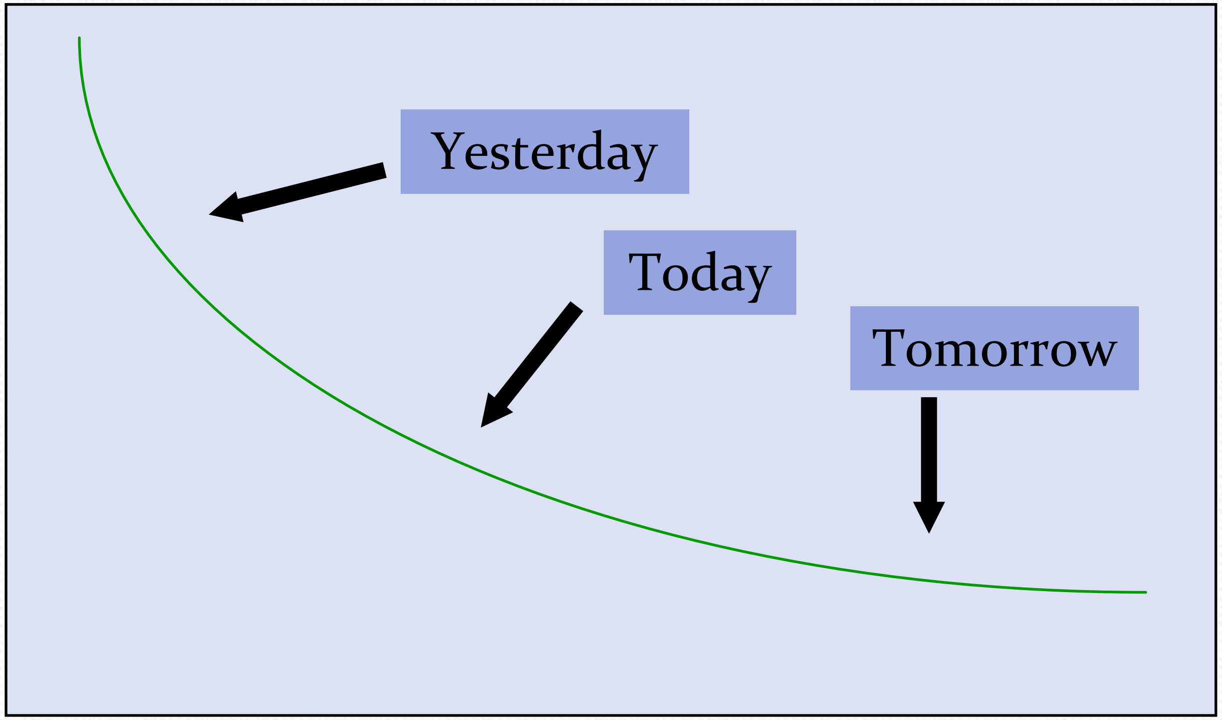
Economies & Diseconomies of Scale



The Experience Curve

As plants produce more products, they gain experience in the best production methods and reduce their costs per unit

Cost or price per unit



Total accumulated production of units

Capacity Focus

The concept of the ***focused factory*** holds that production facilities work best when they focus on a fairly limited set of production objectives

Plants Within Plants (PWP)
– Extend focus concept to operating level

Capacity Flexibility

- Flexible plants
- Flexible processes
- Flexible workers

Capacity Planning: Balance

Unbalanced stages of production

Units per month	Stage 1	Stage 2	Stage 3
	6,000	7,000	5,000

Maintaining System Balance: Output of one stage is the exact input requirements for the next stage

Balanced stages of production

Units per month	Stage 1	Stage 2	Stage 3
	6,000	6,000	6,000

Capacity Planning

- Frequency of Capacity Additions
- External Sources of Capacity

Determining Capacity Requirements

1. Forecast sales within each individual product line
2. Calculate equipment and labor requirements to meet the forecasts
3. Project equipment and labor availability over the planning horizon

Example of Capacity Requirements

A manufacturer produces two lines of mustard, FancyFine and Generic line. Each is sold in small and family-size plastic bottles.

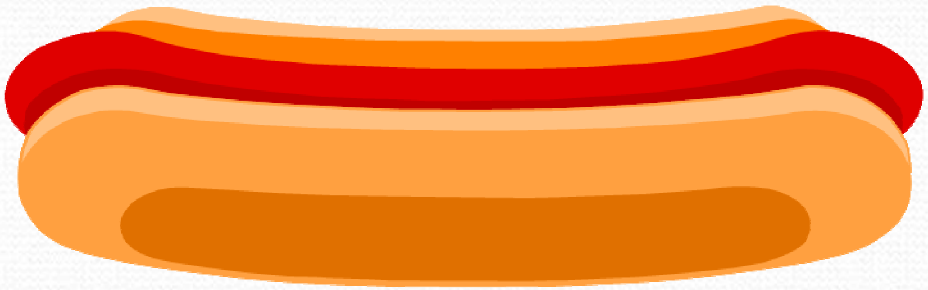
The following table shows forecast demand for the next four years.

Year:	1	2	3	4
FancyFine				
Small (000s)	50	60	80	100
Family (000s)	35	50	70	90
Generic				
Small (000s)	100	110	120	140
Family (000s)	80	90	100	110

Example of Capacity Requirements (Continued): Product from a Capacity Viewpoint

Question: Are we really producing two different types of mustards from the standpoint of capacity requirements?

Answer: No, it's the same product just packaged differently.



Example of Capacity Requirements (Continued) : Equipment and Labor Requirements

Year:	1	2	3	4
Small (000s)	150	170	200	240
Family (000s)	115	140	170	200

- Three 100,000 units-per-year machines are available for small-bottle production. Two operators required per machine.

- Two 120,000 units-per-year machines are available for family-sized-bottle production. Three operators required per machine.

Question: What are the Year 1 values for capacity, machine, and labor?

Year:	1	2	3	4
Small (000s)	150	170	200	240
Family (000s)	115	140	170	200
Small	Mach. Cap.	300,000	Labor	6
Family-size	Mach. Cap.	240,000	Labor	6
Small				
Percent capacity used	50.00%			
Machine requirement	1.50			
Labor requirement	3.00			
Family-size				
Percent capacity used	47.92%			
Machine requirement	0.96			
Labor requirement	2.88			

150,000/300,000=50%

At 1 machine for 100,000, it takes 1.5 machines for 150,000

At 2 operators for 100,000, it takes 3 operators for 150,000

Question: What are the values for columns 2, 3 and 4 in the table below?

Year:	1	2	3	4
Small (000s)	150	170	200	240
Family (000s)	115	140	170	200
Small	Mach. Cap.	300,000	Labor	6
Family-size	Mach. Cap.	240,000	Labor	6
Small				
Percent capacity used	50.00%	56.67%	66.67%	80.00%
Machine requirement	1.50	1.70	2.00	2.40
Labor requirement	3.00	3.40	4.00	4.80
Family-size				
Percent capacity used	47.92%	58.33%	70.83%	83.33%
Machine requirement	0.96	1.17	1.42	1.67
Labor requirement	2.88	3.50	4.25	5.00

Example of a Decision Tree Problem

A glass factory specializing in crystal is experiencing a substantial backlog, and the firm's management is considering three courses of action:

A) Arrange for subcontracting

B) Construct new facilities

C) Do nothing (no change)

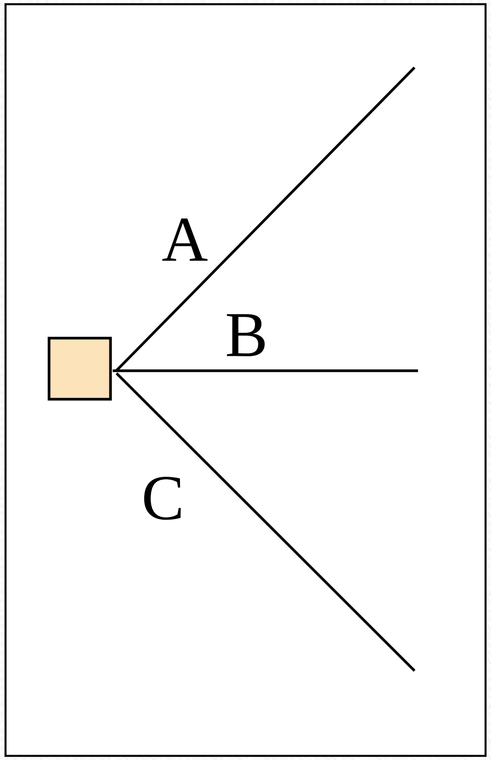
The correct choice depends largely upon demand, which may be low, medium, or high. By consensus, management estimates the respective demand probabilities as 0.1, 0.5, and 0.4.

Example of a Decision Tree Problem (Continued): The Payoff Table

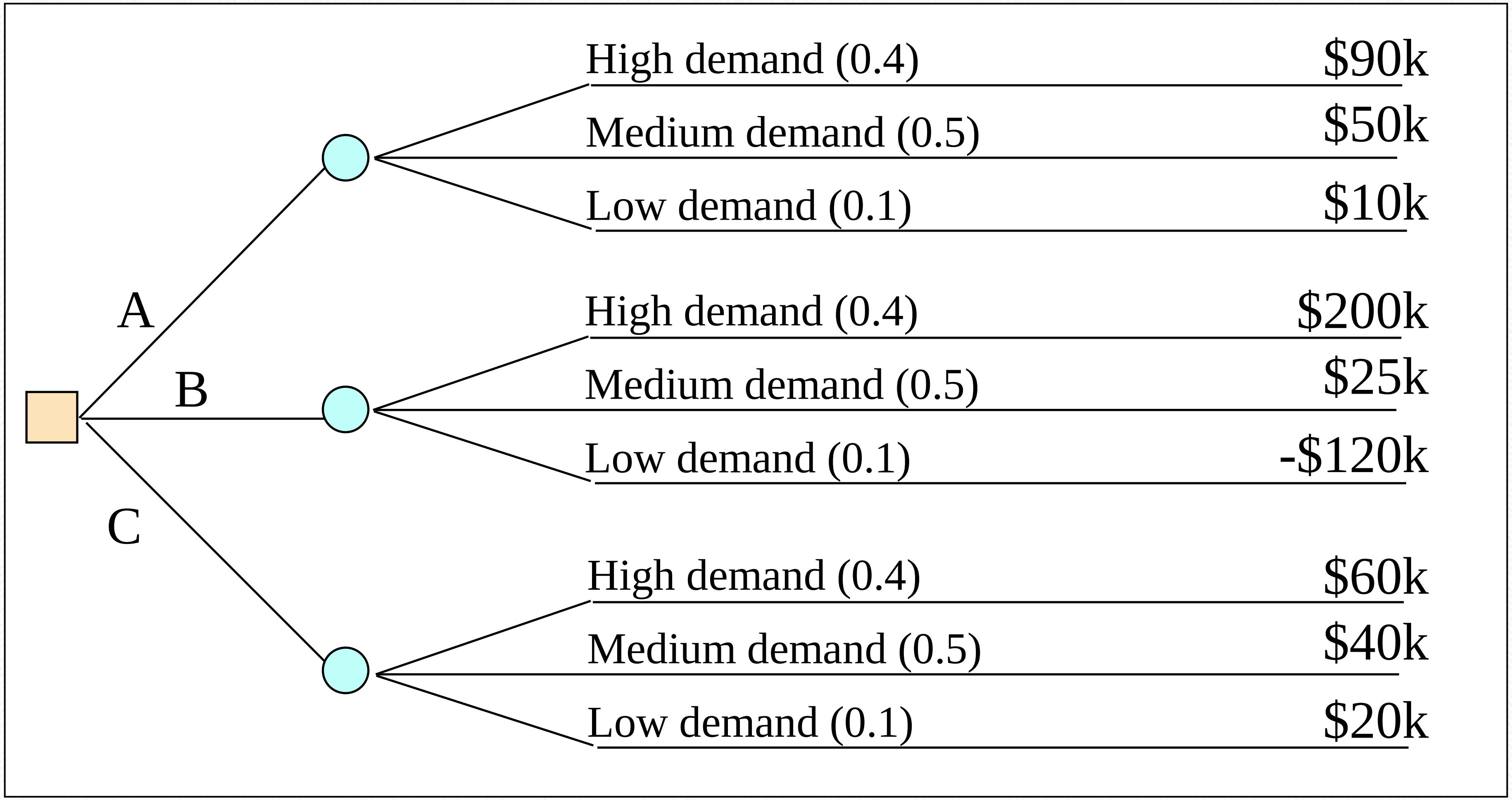
The management also estimates the profits when choosing from the three alternatives (A, B, and C) under the differing probable levels of demand. These profits, in thousands of dollars are presented in the table below:

	0.1	0.5	0.4
	Low	Medium	High
A	10	50	90
B	-120	25	200
C	20	40	60

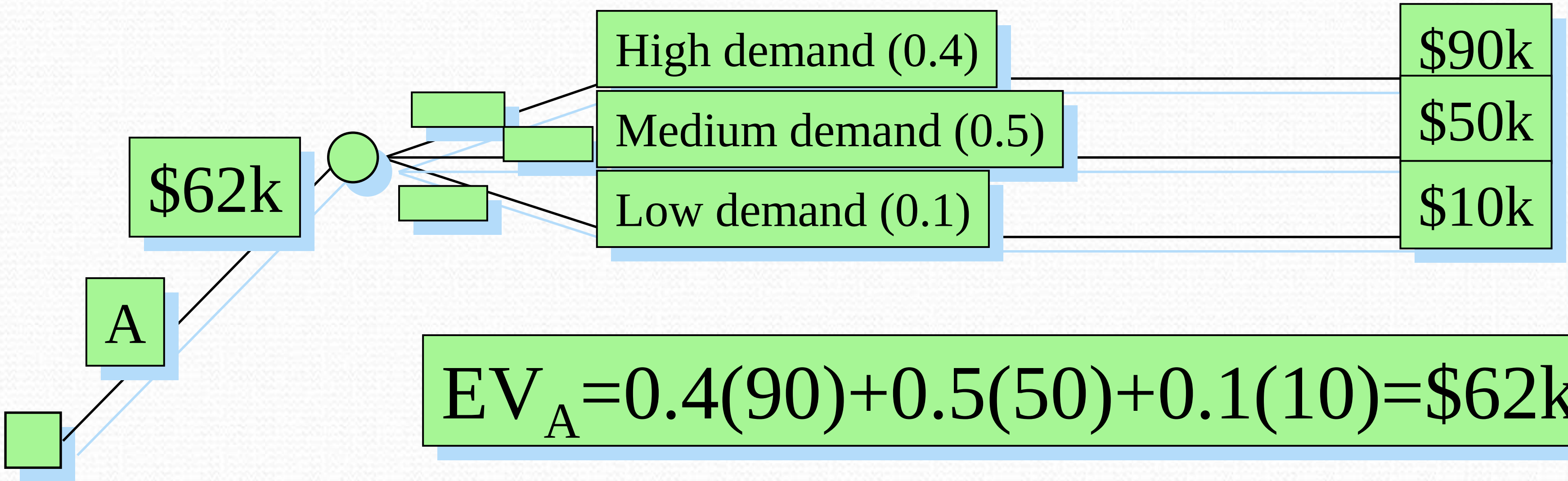
Example of a Decision Tree Problem (Continued): Step 1. We start by drawing the three decisions



Example of Decision Tree Problem(Continued): Step 2. Add our possible states of nature, probabilities, and payoffs

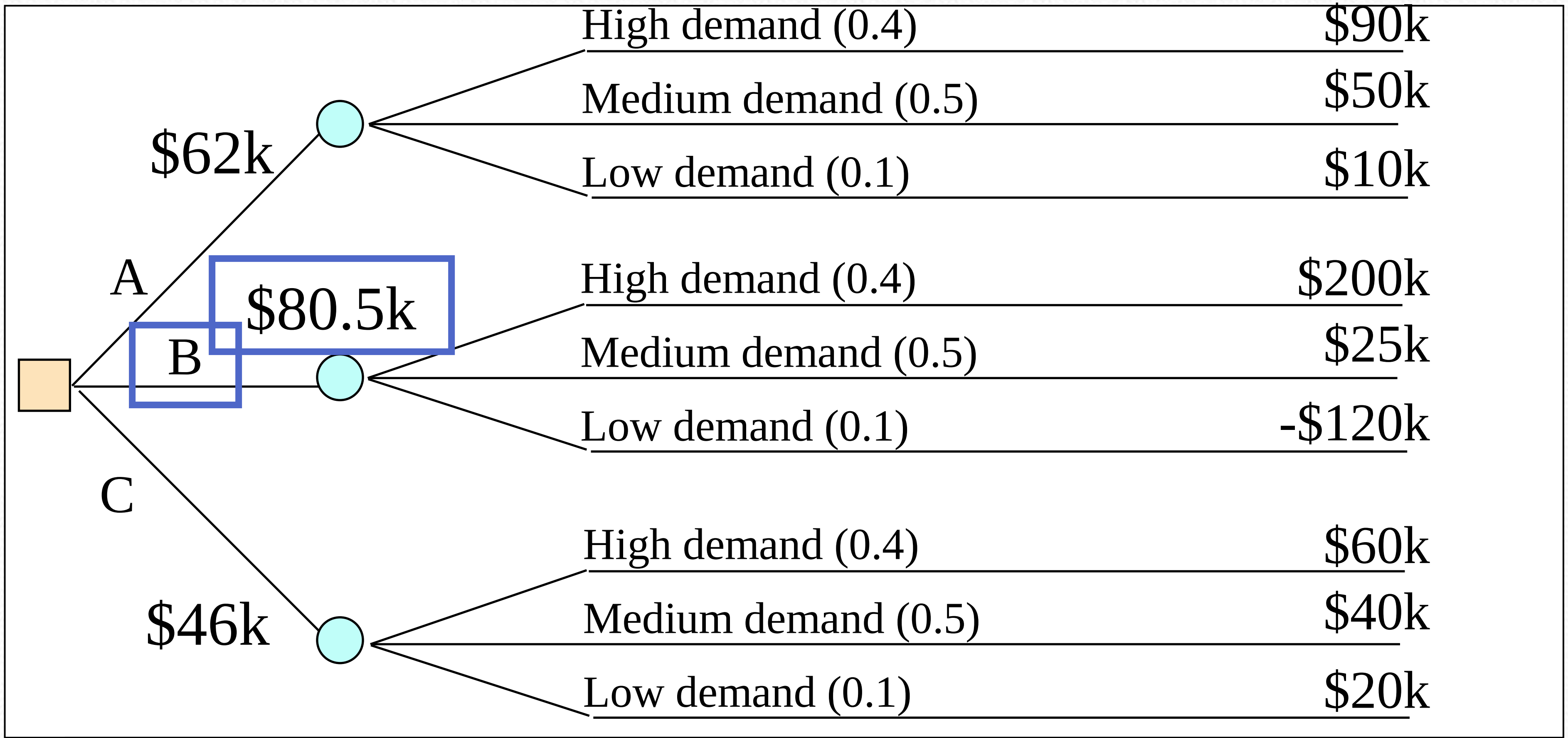


Example of Decision Tree Problem (Continued): Step 3. Determine the expected value of each decision



$$EV_A = 0.4(90) + 0.5(50) + 0.1(10) = \$62k$$

Example of Decision Tree Problem (Continued): Step 4. Make decision



Alternative B generates the greatest expected profit, so our choice is B or to construct a new facility

Planning Service Capacity vs. Manufacturing Capacity

Time: Goods can not be stored for later use and capacity must be available to provide a service when it is needed

Location: Service goods must be at the customer demand point and capacity must be located near the customer

Volatility of Demand: Much greater than in manufacturing

Thank you for your attention!