Supply Chain Modelling

SUPPLEMENT 11

PowerPoint presentation to accompany
Heizer and Render
Operations Management, Global Edition, Eleventh Edition
Principles of Operations Management, Global Edition, Ninth Edition

PowerPoint slides by Jeff Heyl

Outline

- Techniques for Evaluating Supply Chains
- Evaluating Disaster Risk in the Supply Chain
- Managing the Bullwhip Effect
- Supplier Selection Analysis
- Transportation Mode Analysis

Learning Objectives

When you complete this supplement you should be able to:

1. **Use** a decision tree to determine the best number of suppliers to manage disaster risk
2. **Explain** and measure the bullwhip effect
3. **Describe** the factor weighting approach to supplier evaluation
4. **Evaluate** cost-of-shipping alternatives

Evaluating Disaster Risk

- Many forms of potential disruptions
- For a given supply cycle, the probability of n suppliers being disrupted is

$$P(n) = S + (1 - S)U^n$$

S = the probability of a "super-event" that would disrupt *all* suppliers simultaneously

U = the probability of a "unique-event" that would disrupt only one supplier

L = the financial loss incurred in a supply cycle if *all* suppliers were disrupted

C = the marginal cost of managing a supplier

How Many Suppliers?

- Portfolio of suppliers to balance costs and risks
- Evaluate one, two, or three suppliers using a decision tree

S = 0.5%, U = 4%, C = \$10,000, L = \$10,000,000

$P(1)$ = 0.005 + (1 – 0.005)0.04 = 0.005 + 0.0398
= 0.044800, or 4.4800%

$P(2)$ = 0.005 + (1 – 0.005)0.04^2 = 0.005 + 0.001592
= 0.006592, or 0.6592%

$P(3)$ = 0.005 + (1 – 0.005)0.04^3 = 0.005 + 0.000064
= 0.005064, or 0.5064%

How Many Suppliers?

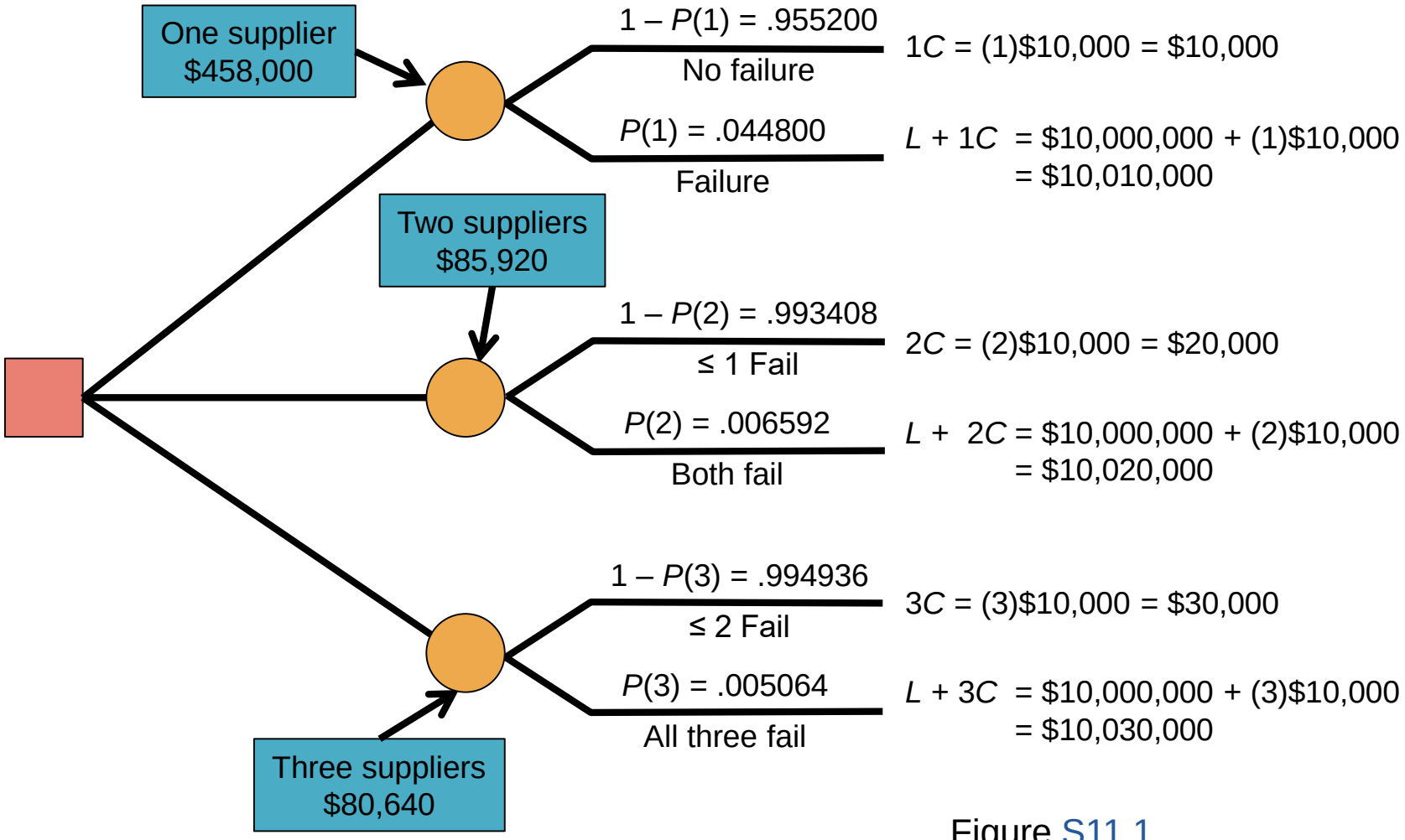


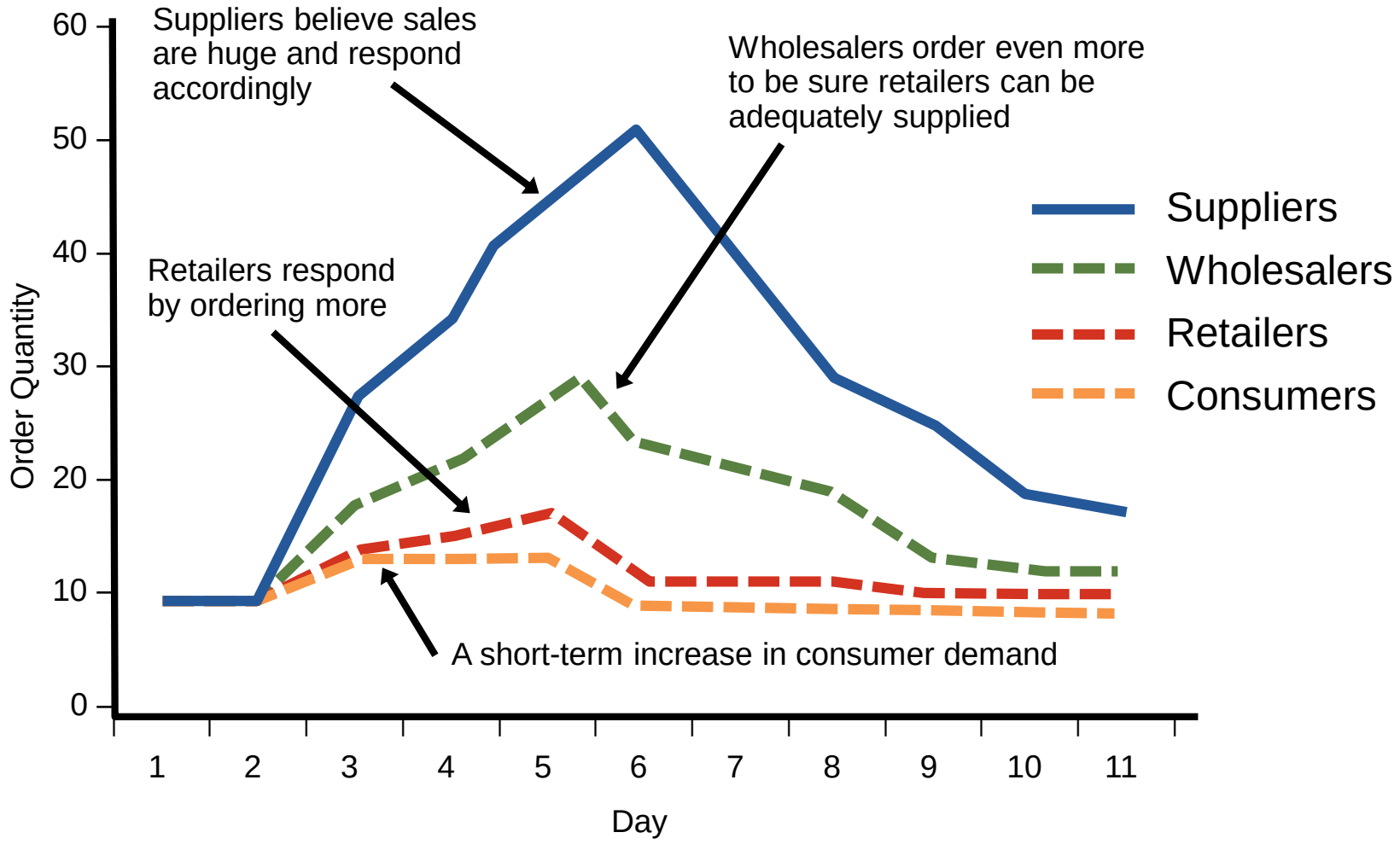
Figure S11.1

The Bullwhip Effect

- The tendency for larger order size fluctuations as orders are relayed through the supply chain
- Creates unstable production schedules, expensive capacity change costs, longer lead times, obsolescence
- Damage can be minimized with supplier coordination and planning

The Bullwhip Effect

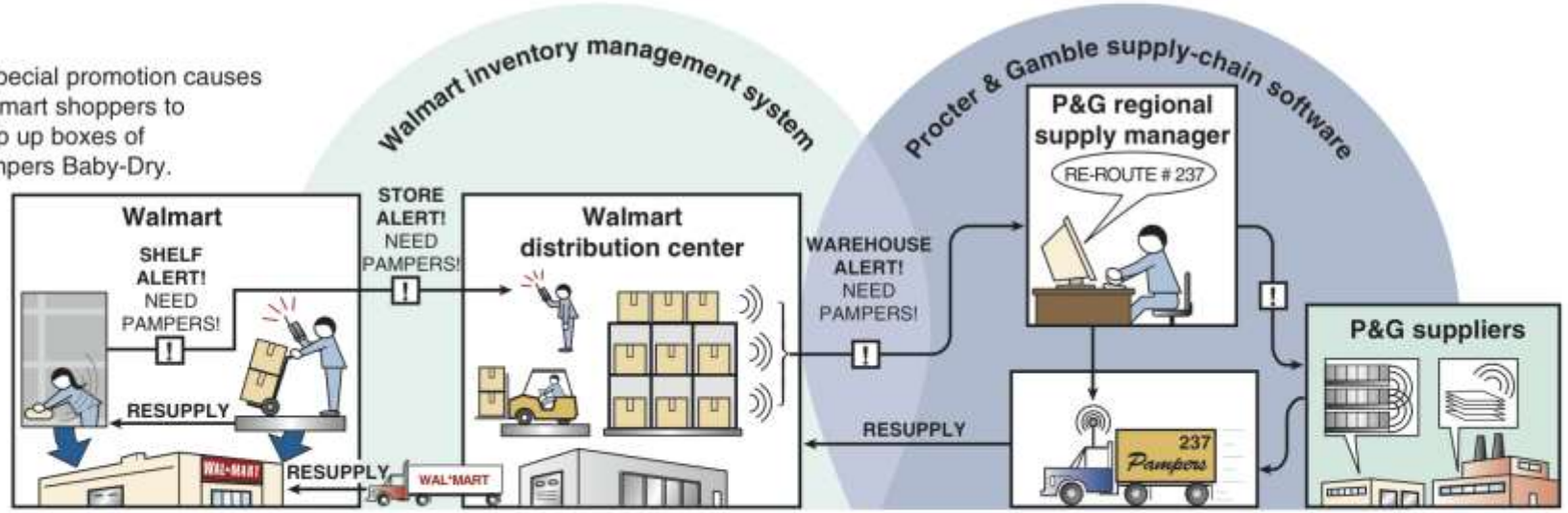
Figure S11.2



Managing the Bullwhip Effect

TABLE S11.1	The Bullwhip Effect
CAUSE	**REMEDY**
Demand forecast errors (cumulative uncertainty in the supply chain)	Share demand information throughout the supply chain
Order batching (large, infrequent orders leading suppliers to order even larger amounts)	Channel coordination: Determine lot sizes as though the full supply chain was one company
Price fluctuations (buying in advance of demand to take advantage of low prices, discounts, or sales)	Price stabilization (everyday low prices)
Shortage gaming (hoarding supplies for fear of a supply shortage)	Allocate orders based on past demand

RFID Helps Control Bullwhip



1. A special promotion causes Walmart shoppers to snap up boxes of Pampers Baby-Dry.

2. Each box of Pampers has an RFID tag. Shelf-mounted scanners alert the stockroom of urgent need for restock.

3. Walmart's inventory management system tracks and links its in-store stock and its warehouse stock, prompting quicker replenishment and providing accurate real-time data.

4. Walmart's systems are linked to the P&G supply-chain management system. Demand spikes reported by RFID tags are immediately visible throughout the supply chain.

5. P&G's logistics software tracks its trucks with GPS locators, and tracks their contents with RFID tag readers. Regional managers can reroute trucks to fill urgent needs.

6. P&G suppliers also use RFID tags and readers on their raw materials, giving P&G visibility several tiers down the supply chain, and giving suppliers the ability to accurately forecast demand and production.

The Bullwhip Effect Measure

$$\text{Bullwhip} = \frac{\text{Variance of orders}}{\text{Variance of demand}} = \frac{s^2_{\text{orders}}}{s^2_{\text{demand}}}$$

If measure is:

> 1 – Variance amplification is present
= 1 – No amplification is present
< 1 – Smoothing or dampening is occurring

Calculating the Bullwhip Effect

- Transform sheet steel to tabletops
- Each firm in the supply chain has one supplier and one customer

FIRM	VARIANCE OF DEMAND	VARIANCE OF ORDERS	BULLWHIP MEASURE
Furniture Mart, Inc.	100	110	110/100 = 1.10
Furniture Distributors, Inc.	110	180	180/110 = 1.64
Furniture Makers of America	180	300	300/180 = 1.67
Chieh Lee Metals, Inc.	300	750	750/300 = 2.50
Metal Suppliers Ltd.	750	2000	2000/750 = 2.67

Supplier Selection Analysis

- Many factors play a role
- Choosing lowest bid is becoming rare
- Factor weighting techniques consider multiple criteria
  - Each factor is assigned a weight and a score
  - Choose the supplier with the best weighted score

Factor Weighting Approach

		FABER PAINT		SMITH DYE	
CRITERION	WEIGHT	SCORE (1-5) (5 HIGHEST)	WEIGHT x SCORE	SCORE (1-5) (5 HIGHEST)	WEIGHT x SCORE
Engineering/innovation skills	.20	5	1.0	5	1.0
Production process capability	.15	4	0.6	5	0.75
Distribution capability	.05	4	0.2	3	0.15
Quality performance	.10	2	0.2	3	0.3
Facilities/location	.05	2	0.1	3	0.15
Financial strength	.15	4	0.6	5	0.75
Information systems	.10	2	0.2	5	0.5
Integrity	.20	5	1.0	3	0.6
Total	1.00		3.9		4.2

Transportation Mode Analysis

- Evaluate holding verses shipping options
  - Ship connectors from San Jos
  - Value of connectors = $1,750
  - Holding cost = 40% per year
  - One carrier is 1 day faster but $20 more expensive

$1.92 < $20.00
Choose slower shipping

$$\text{Daily cost of holding the product} = \left(\text{Annual holding cost} \times \text{Product value}\right)$$

$$= (.40 \times \$1{,}750)/365$$
$$= \$1.92$$