Sourcing Decisions in a Supply Chain

Outline

- The Role of Sourcing in a Supply Chain
- Supplier Scoring and Assessment
- Supplier Selection and Contracts
- Design Collaboration
- The Procurement Process
- Sourcing Planning and Analysis
- Summary of Learning Objectives

The Role of Sourcing in a Supply Chain

- Sourcing is the set of business processes required to purchase goods and services
- Sourcing processes include:
  - Supplier scoring and assessment
  - Supplier selection and contract negotiation
  - Design collaboration
  - Procurement
  - Sourcing planning and analysis

Benefits of Effective Sourcing Decisions

- Better economies of scale can be achieved if orders are aggregated
- More efficient procurement transactions can significantly reduce the overall cost of purchasing
- Design collaboration can result in products that are easier to manufacture and distribute, resulting in lower overall costs
- Good procurement processes can facilitate coordination with suppliers
- Appropriate supplier contracts can allow for the sharing of risk
- Firms can achieve a lower purchase price by increasing competition through the use of auctions

Supplier Scoring and Assessment

- Supplier performance should be compared on the basis of the supplier's impact on total cost
- There are several other factors besides purchase price that influence total cost

Supplier Assessment Factors

- Replenishment Lead Time
- On-Time Performance
- Supply Flexibility
- Delivery Frequency / Minimum Lot Size
- Supply Quality
- Inbound Transportation Cost
- Pricing Terms
- Information Coordination Capability
- Design Collaboration Capability
- Exchange Rates, Taxes, Duties
- Supplier Viability

Handling Double Uncertainty

- Consider the case where both demand and lead time are normally distributed. Then demand during the lead time is normally distributed with a mean of D_L and a standard deviation σ_L, where

  $D_L = D^*L$ and $\sigma_L = \sqrt{L\sigma_D^2 + D^2 s_L^2}$

  D is the average demand/period

  σ_D is the standard deviation of demand per period

  L is the average lead time for replenishment

  s_L is the standard deviation of the lead time

Supplier Selection

- **Example 1**
  - LawnMan, a manufacturer of lawn mowers has historically purchased bearings from a local supplier who charges $1.00 per bearing. The purchasing manager has identified another potential source willing to supply the bearings at $0.97 per bearing. The local supplier has an average lead time of 2 weeks and has agreed to deliver the bearing in batches of 2,000. Based on past on-time performance, the purchasing manager estimates that the lead time has a standard deviation of 1 week. The new source has an average lead time of 6 weeks with a standard deviation of 4 weeks. The new source requires a minimum batch size of 8,000 bearings.

Supplier Selection

LawnMan has a holding cost of 25 percent. It currently uses a continuous review policy for managing inventory and aims for a cycle service level of 95 percent. Weekly demand has a mean of 1,000 and a standard deviation of 300 bearings.

Which supplier should the purchasing manager go with (ignore ordering cost and focus on material cost and holding cost when making your decision)?

Supplier Selection

- **Solution**
  - The suppliers' performance along lead time variability affects the safety inventory that LawnMan must hold, and the minimum batch-size requirement affects the cycle inventory held. Thus, the purchasing manager should evaluate the total cost of using each supplier.
  - ***Current local supplier***
  - Annual cost of bearings = 1000*52*1 = $52,000
  - Average cycle inventory = 2000/2 = 1000
  - Annual cost of holding cycle inventory = 1000*1*0.25 = $250

Supplier Selection

- Standard deviation of demand during lead time,
- $\sigma_L = \sqrt{L\sigma_D^2 + D^2 s_L^2} = \sqrt{2*300^2 + 1000^2 * 1^2} = 1086.28$
- Safety inventory required = $F_S^{-1}(CSL)\sigma_L = F_S^{-1}(0.95)*1086.28$
  $= 1.645*1086.28 = 1787$
- Annual cost of holding safety inventory =1787*1*0.25 = $447
- Annual cost of this supplier = 52000 + 250 + 447 = **$52,697**

- ***New supplier***
- Annual cost of bearings = 1000*52*0.97 = $50,440
- Average cycle inventory = 8000/2 = 4000
- Annual cost of holding cycle inventory=4000*0.97*0.25= $970

Supplier Selection

- Standard deviation of demand during lead time,
- $\sigma_L = \sqrt{L\sigma_D^2 + D^2 s_L^2} = \sqrt{6*300^2 + 1000^2 * 4^2} = 4066.94$
- Safety inventory required = $F_S^{-1}(CSL)\sigma_L = F_S^{-1}(0.95)*4066.94$
  $= 1.645*4066.94 = 6690$
- Annual cost of holding safety inventory = 6690*0.97*0.25
  $= 1622
- Annual cost of this supplier = 50440 + 970 + 1622 = **$53,032**

Notice that the new supplier has a lower annual cost of bearings but a higher annual total cost. Thus, the purchasing manager should continue to use the current supplier.

Supplier Selection- Auctions and Negotiations

- Supplier selection can be performed through competitive bids, reverse auctions, and direct negotiations
- Supplier evaluation is based on total cost of using a supplier
- Auctions:
  - Sealed-bid first-price auctions
  - English auctions
  - Dutch auctions
  - Second-price (Vickery) auctions

Contracts and Supply Chain Performance

- Contracts for Product Availability and Supply Chain Profits
  - Buyback Contracts
  - Revenue-Sharing Contracts
  - Quantity Flexibility Contracts
- Contracts to Coordinate Supply Chain Costs
- Contracts to Increase Agent Effort
- Contracts to Induce Performance Improvement

Contracts for Product Availability and Supply Chain Profits

- Many shortcomings in supply chain performance occur because the buyer and supplier are separate organizations and each tries to optimize its own profit
- Total supply chain profits might therefore be lower than if the supply chain coordinated actions to have a common objective of maximizing total supply chain profits
- Double marginalization results in suboptimal order quantity
- An approach to dealing with this problem is to design a contract that encourages a buyer to purchase more and increase the level of product availability
- The supplier must share in some of the buyer's demand uncertainty

Contracts for Product Availability and Supply Chain Profits: Buyback Contracts

- Allows a retailer to return unsold inventory up to a specified amount at an agreed upon price
- Increases the optimal order quantity for the retailer, resulting in higher product availability and higher profits for both the retailer and the supplier
- Most effective for products with low variable cost, such as music, software, books, magazines, and newspapers
- Downside is that buyback contract results in surplus inventory that must be disposed of, which increases supply chain costs
- Can also increase information distortion through the supply chain because the supply chain reacts to retail orders, not actual customer demand

Contracts for Product Availability and Supply Chain Profits: Revenue Sharing Contracts

- The buyer pays a minimal amount for each unit purchased from the supplier but shares a fraction of the revenue for each unit sold
- Decreases the cost per unit charged to the retailer, which effectively decreases the cost of overstocking
- Can result in supply chain information distortion, just as in the case of buyback contracts

Contracts for Product Availability and Supply Chain Profits: Quantity Flexibility Contracts

- Allows the buyer to modify the order (within limits) as demand visibility increases closer to the point of sale
- Better matching of supply and demand
- Increased overall supply chain profits if the supplier has flexible capacity
- Lower levels of information distortion than either buyback contracts or revenue sharing contracts

Contracts to Coordinate Supply Chain Costs

- Differences in costs at the buyer and supplier can lead to decisions that increase total supply chain costs
- Example: Replenishment order size placed by the buyer. The buyer's EOQ does not take into account the supplier's costs.
- A quantity discount contract may encourage the buyer to purchase a larger quantity (which would be lower costs for the supplier), which would result in lower total supply chain costs
- Quantity discounts lead to information distortion because of order batching

Contracts to Increase Agent Effort

- There are many instances in a supply chain where an agent acts on the behalf of a principal and the agent's actions affect the reward for the principal
- Example: A car dealer who sells the cars of a manufacturer, as well as those of other manufacturers
- Examples of contracts to increase agent effort include two-part tariffs and threshold contracts
- Threshold contracts increase information distortion

Contracts to Induce Performance Improvement

- A buyer may want performance improvement from a supplier who otherwise would have little incentive to do so
- A shared savings contract provides the supplier with a fraction of the savings that result from the performance improvement
- Particularly effective where the benefit from improvement accrues primarily to the buyer, but where the effort for the improvement comes primarily from the supplier

Make to Order (no contract)

- **Example 2**
  - Consider two companies in the supply chain: a retailer who faces customer demand for swimsuits and a manufacturer who produces and sells swimsuits to the retailer. Demand for swimsuits follows the following pattern:

Make to Order (no contract)

Demand	Probability
8,000	0.11
10,000	0.11
12,000	0.28
14,000	0.22
16,000	0.18
18,000	0.10

Make to Order (no contract)

- The retailer pricing and costing information is as follows:
  - During the summer season, a swimsuit is sold to customers at $125 per unit.
  - The wholesale price paid by the retailer to the manufacturer is $80 per unit.
  - Any swimsuit not sold during the summer season is sold to a discount store for $20.
- For the manufacturer, we have the following information:
  - Fixed production cost is $100,000.
  - The variable production cost per unit equals $35.
- How much should the retailer order from the manufacturer (consider only the 6 demand values)?

Make to Order (no contract)

- **Solution**
  - If the retailer orders 8,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,000,000	$640,000	$360,000
10,000	0.11	$1,000,000	$640,000	$360,000
12,000	0.28	$1,000,000	$640,000	$360,000
14,000	0.22	$1,000,000	$640,000	$360,000
16,000	0.18	$1,000,000	$640,000	$360,000
18,000	0.10	$1,000,000	$640,000	$360,000
				Expected Profit = $360,000

  - Profit of the **manufacturer** = 8,000 * $80 – {$100,000 + 8,000*$35} = $260,000

Make to Order (no contract)

  - If the retailer orders 10,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,040,000	$800,000	$240,000
10,000	0.11	$1,250,000	$800,000	$450,000
12,000	0.28	$1,250,000	$800,000	$450,000
14,000	0.22	$1,250,000	$800,000	$450,000
16,000	0.18	$1,250,000	$800,000	$450,000
18,000	0.10	$1,250,000	$800,000	$450,000
				Expected Profit = $426,900

  - Profit of the **manufacturer** = 10,000 * $80 – {$100,000 + 10,000*$35} = $350,000

Make to Order (no contract)

– If the retailer orders 12,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,080,000	$960,000	$120,000
10,000	0.11	$1,290,000	$960,000	$330,000
12,000	0.28	$1,500,000	$960,000	$540,000
14,000	0.22	$1,500,000	$960,000	$540,000
16,000	0.18	$1,500,000	$960,000	$540,000
18,000	0.10	$1,500,000	$960,000	$540,000
				Expected Profit = **$470,700**

– Profit of the **manufacturer** = 12,000 * $80 – {$100,000 + 12,000*$35} = $440,000

Make to Order (no contract)

– If the retailer orders 14,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,120,000	$1,120,000	$0
10,000	0.11	$1,330,000	$1,120,000	$210,000
12,000	0.28	$1,540,000	$1,120,000	$420,000
14,000	0.22	$1,750,000	$1,120,000	$630,000
16,000	0.18	$1,750,000	$1,120,000	$630,000
18,000	0.10	$1,750,000	$1,120,000	$630,000
				Expected Profit = $455,700

– Profit of the **manufacturer** = 14,000 * $80 – {$100,000 + 14,000*$35} = $530,000

Make to Order (no contract)

- If the retailer orders 16,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,160,000	$1,280,000	-$120,000
10,000	0.11	$1,370,000	$1,280,000	$90,000
12,000	0.28	$1,580,000	$1,280,000	$300,000
14,000	0.22	$1,790,000	$1,280,000	$510,000
16,000	0.18	$2,000,000	$1,280,000	$720,000
18,000	0.10	$2,000,000	$1,280,000	$720,000
				Expected Profit =$394,500

- Profit of the **manufacturer** = 16,000 * $80 – {$100,000 + 16,000*$35} = $620,000

Make to Order (no contract)

- If the retailer orders 18,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,200,000	$1,440,000	-$240,000
10,000	0.11	$1,410,000	$1,440,000	-$30,000
12,000	0.28	$1,620,000	$1,440,000	$180,000
14,000	0.22	$1,830,000	$1,440,000	$390,000
16,000	0.18	$2,040,000	$1,440,000	$600,000
18,000	0.10	$2,250,000	$1,440,000	$810,000
				Expected Profit =$295,500

- Profit of the **manufacturer** = 18,000 * $80 – {$100,000 + 18,000*$35} = $710,000

Make to Order (no contract)

– The summary of the calculations is as follows:

Retailer's Order	Retailer's Profit	Manufacturer's Profit	Total Profit
8,000	$360,000	$260,000	$620,000
10,000	$426,900	$350,000	$776,900
12,000	**$470,700**	$440,000	$910,700
14,000	$455,700	$530,000	$985,700
16,000	$394,500	$620,000	**$1,014,500**
18,000	$295,500	**$710,000**	$1,005,500

Make to Order (no contract)

– The retailer assumes all the risk (of having more inventory than sales). Hence, he limits his order quantity (however, here too, there is a risk of going out of stock).

– The manufacturer has zero risk (hence, he would like the retailer to order as much as possible).

– If the manufacturer is willing to share some of the retailer's risk, it may be profitable for the retailer to order more items, thereby reducing the probability of going out of stock, and increasing the profits of both the manufacturer and the retailer.

Make to Order (buy-back contract)

- **Example 3**
  - Refer to Example 2. Suppose that the manufacturer offers to buy unsold swimsuits from the retailer for $50. How much should the retailer order from the manufacturer (consider only the 6 demand values)?

Make to Order (buy-back contract)

- **Solution**
  - If the retailer orders 8,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,000,000	$640,000	$360,000
10,000	0.11	$1,000,000	$640,000	$360,000
12,000	0.28	$1,000,000	$640,000	$360,000
14,000	0.22	$1,000,000	$640,000	$360,000
16,000	0.18	$1,000,000	$640,000	$360,000
18,000	0.10	$1,000,000	$640,000	$360,000
				Expected Profit = $360,000

Make to Order (buy-back contract)

– If the retailer orders 8,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$640,000	$380,000	$260,000
10,000	0.11	$640,000	$380,000	$260,000
12,000	0.28	$640,000	$380,000	$260,000
14,000	0.22	$640,000	$380,000	$260,000
16,000	0.18	$640,000	$380,000	$260,000
18,000	0.10	$640,000	$380,000	$260,000
				Expected Profit = $260,000

Make to Order (buy-back contract)

– If the retailer orders 10,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,100,000	$800,000	$300,000
10,000	0.11	$1,250,000	$800,000	$450,000
12,000	0.28	$1,250,000	$800,000	$450,000
14,000	0.22	$1,250,000	$800,000	$450,000
16,000	0.18	$1,250,000	$800,000	$450,000
18,000	0.10	$1,250,000	$800,000	$450,000
				Expected Profit = $433,500

Make to Order (buy-back contract)

– If the retailer orders 10,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$800,000	$550,000	$250,000
10,000	0.11	$800,000	$450,000	$350,000
12,000	0.28	$800,000	$450,000	$350,000
14,000	0.22	$800,000	$450,000	$350,000
16,000	0.18	$800,000	$450,000	$350,000
18,000	0.10	$800,000	$450,000	$350,000
				Expected Profit = $339,000

Make to Order (buy-back contract)

– If the retailer orders 12,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,200,000	$960,000	$240,000
10,000	0.11	$1,350,000	$960,000	$390,000
12,000	0.28	$1,500,000	$960,000	$540,000
14,000	0.22	$1,500,000	$960,000	$540,000
16,000	0.18	$1,500,000	$960,000	$540,000
18,000	0.10	$1,500,000	$960,000	$540,000
				Expected Profit = $490,500

Make to Order (buy-back contract)

– If the retailer orders 12,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$960,000	$720,000	$240,000
10,000	0.11	$960,000	$620,000	$340,000
12,000	0.28	$960,000	$520,000	$440,000
14,000	0.22	$960,000	$520,000	$440,000
16,000	0.18	$960,000	$520,000	$440,000
18,000	0.10	$960,000	$520,000	$440,000
				Expected Profit = $407,000

Make to Order (buy-back contract)

– If the retailer orders 14,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,300,000	$1,120,000	$180,000
10,000	0.11	$1,450,000	$1,120,000	$330,000
12,000	0.28	$1,600,000	$1,120,000	$480,000
14,000	0.22	$1,750,000	$1,120,000	$630,000
16,000	0.18	$1,750,000	$1,120,000	$630,000
18,000	0.10	$1,750,000	$1,120,000	$630,000
				Expected Profit = **$505,500**

Make to Order (buy-back contract)

– If the retailer orders 14,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,120,000	$890,000	$230,000
10,000	0.11	$1,120,000	$790,000	$330,000
12,000	0.28	$1,120,000	$690,000	$430,000
14,000	0.22	$1,120,000	$590,000	$530,000
16,000	0.18	$1,120,000	$590,000	$530,000
18,000	0.10	$1,120,000	$590,000	$530,000
				Expected Profit = $447,000

Make to Order (buy-back contract)

– If the retailer orders 16,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,400,000	$1,280,000	$120,000
10,000	0.11	$1,350,000	$1,280,000	$70,000
12,000	0.28	$1,700,000	$1,280,000	$420,000
14,000	0.22	$1,850,000	$1,280,000	$570,000
16,000	0.18	$2,000,000	$1,280,000	$720,000
18,000	0.10	$2,000,000	$1,280,000	$720,000
				Expected Profit =$465,500

Make to Order (buy-back contract)

– If the retailer orders 16,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,280,000	$1,060,000	$220,000
10,000	0.11	$1,280,000	$960,000	$320,000
12,000	0.28	$1,280,000	$860,000	$420,000
14,000	0.22	$1,280,000	$760,000	$520,000
16,000	0.18	$1,280,000	$660,000	$620,000
18,000	0.10	$1,280,000	$660,000	$620,000
				Expected Profit = $465,000

Make to Order (buy-back contract)

– If the retailer orders 18,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,500,000	$1,440,000	$60,000
10,000	0.11	$1,650,000	$1,440,000	$210,000
12,000	0.28	$1,800,000	$1,440,000	$360,000
14,000	0.22	$1,950,000	$1,440,000	$510,000
16,000	0.18	$2,100,000	$1,440,000	$660,000
18,000	0.10	$2,250,000	$1,440,000	$810,000
				Expected Profit =$442,500

Make to Order (buy-back contract)

– If the retailer orders 18,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,440,000	$1,230,000	$210,000
10,000	0.11	$1,440,000	$1,130,000	$310,000
12,000	0.28	$1,440,000	$1,030,000	$410,000
14,000	0.22	$1,440,000	$930,000	$510,000
16,000	0.18	$1,440,000	$830,000	$610,000
18,000	0.10	$1,440,000	$730,000	$710,000
				Expected Profit = **$465,000**

Make to Order (buy-back contract)

– The summary of the calculations is as follows:

Retailer's Order	Retailer's Profit	Manufacturer's Profit	Total Profit
8,000	$360,000	$260,000	$620,000
10,000	$433,500	$339,000	$772,500
12,000	$490,500	$407,000	$897,500
14,000	**$505,500**	$447,000	**$952,500**
16,000	$465,500	**$465,000**	$930,500
18,000	$442,500	**$465,000**	$907,500

Make to Order (revenue-sharing contract)

- **Example 4**
  - Refer to Example 2. Suppose that the manufacturer and the retailer have a revenue-sharing contract, in which the manufacturer agrees to decrease the wholesale price from $80 to $60, and in return, the retailer provides 15 percent of the product revenue (derived from the swimsuits sold to customers) to the manufacturer. How much should the retailer order from the manufacturer (consider only the 6 demand values)?

Make to Order (revenue-sharing contract)

- **Solution**
  - If the retailer orders 8,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$850,000	$480,000	$370,000
10,000	0.11	$850,000	$480,000	$370,000
12,000	0.28	$850,000	$480,000	$370,000
14,000	0.22	$850,000	$480,000	$370,000
16,000	0.18	$850,000	$480,000	$370,000
18,000	0.10	$850,000	$480,000	$370,000
				Expected Profit = $370,000

Make to Order (revenue-sharing contract)

– If the retailer orders 8,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$630,000	$380,000	$250,000
10,000	0.11	$630,000	$380,000	$250,000
12,000	0.28	$630,000	$380,000	$250,000
14,000	0.22	$630,000	$380,000	$250,000
16,000	0.18	$630,000	$380,000	$250,000
18,000	0.10	$630,000	$380,000	$250,000
				Expected Profit = $250,000

Make to Order (revenue-sharing contract)

– If the retailer orders 10,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$890,000	$600,000	$290,000
10,000	0.11	$1,062,500	$600,000	$462,500
12,000	0.28	$1,062,500	$600,000	$462,500
14,000	0.22	$1,062,500	$600,000	$462,500
16,000	0.18	$1,062,500	$600,000	$462,500
18,000	0.10	$1,062,500	$600,000	$462,500
				Expected Profit = $443,525

Make to Order (revenue-sharing contract)

– If the retailer orders 10,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$750,000	$450,000	$300,000
10,000	0.11	$787,500	$450,000	$337,500
12,000	0.28	$787,500	$450,000	$337,500
14,000	0.22	$787,500	$450,000	$337,500
16,000	0.18	$787,500	$450,000	$337,500
18,000	0.10	$787,500	$450,000	$337,500
				Expected Profit = $333,375

Make to Order (revenue-sharing contract)

– If the retailer orders 12,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$930,000	$720,000	$210,000
10,000	0.11	$1,102,500	$720,000	$382,500
12,000	0.28	$1,275,000	$720,000	$555,000
14,000	0.22	$1,275,000	$720,000	$555,000
16,000	0.18	$1,275,000	$720,000	$555,000
18,000	0.10	$1,275,000	$720,000	$555,000
				Expected Profit = $498,075

Make to Order (revenue-sharing contract)

– If the retailer orders 12,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$870,000	$520,000	$350,000
10,000	0.11	$907,500	$520,000	$387,500
12,000	0.28	$945,000	$520,000	$425,000
14,000	0.22	$945,000	$520,000	$425,000
16,000	0.18	$945,000	$520,000	$425,000
18,000	0.10	$945,000	$520,000	$425,000
				Expected Profit = $412,625

Make to Order (revenue-sharing contract)

– If the retailer orders 14,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$970,000	$840,000	$130,000
10,000	0.11	$1,142,500	$840,000	$302,500
12,000	0.28	$1,315,000	$840,000	$475,000
14,000	0.22	$1,487,500	$840,000	$647,500
16,000	0.18	$1,487,500	$840,000	$647,500
18,000	0.10	$1,487,500	$840,000	$647,500
				Expected Profit = **$504,325**

Make to Order (revenue-sharing contract)

– If the retailer orders 14,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$990,000	$590,000	$400,000
10,000	0.11	$1,027,500	$590,000	$437,500
12,000	0.28	$1,065,000	$590,000	$475,000
14,000	0.22	$1,102,500	$590,000	$512,500
16,000	0.18	$1,102,500	$590,000	$512,500
18,000	0.10	$1,102,500	$590,000	$512,500
				Expected Profit = $481,375

Make to Order (revenue-sharing contract)

– If the retailer orders 16,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,010,000	$960,000	$50,000
10,000	0.11	$1,182,500	$960,000	$222,500
12,000	0.28	$1,355,000	$960,000	$395,000
14,000	0.22	$1,527,500	$960,000	$567,500
16,000	0.18	$1,700,000	$960,000	$740,000
18,000	0.10	$1,700,000	$960,000	$740,000
				Expected Profit =$472,625

Make to Order (revenue-sharing contract)

– If the retailer orders 16,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,110,000	$660,000	$450,000
10,000	0.11	$1,147,500	$660,000	$487,500
12,000	0.28	$1,185,000	$660,000	$525,000
14,000	0.22	$1,222,500	$660,000	$562,500
16,000	0.18	$1,260,000	$660,000	$600,000
18,000	0.10	$1,260,000	$660,000	$600,000
				Expected Profit = $541,875

Make to Order (revenue-sharing contract)

– If the retailer orders 18,000 units from the manufacturer, the **retailer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,050,000	$1,080,000	($30,000)
10,000	0.11	$1,222,500	$1,080,000	$142,500
12,000	0.28	$1,395,000	$1,080,000	$315,000
14,000	0.22	$1,567,500	$1,080,000	$487,500
16,000	0.18	$1,740,000	$1,080,000	$660,000
18,000	0.10	$1,912,500	$1,080,000	$832,500
				Expected Profit =$409,875

Make to Order (revenue-sharing contract)

– If the retailer orders 18,000 units from the manufacturer, the **manufacturer**'s expected profit is calculated as follows:

Demand	Probability	Revenue	Cost	Profit
8,000	0.11	$1,230,000	$730,000	$500,000
10,000	0.11	$1,267,500	$730,000	$537,500
12,000	0.28	$1,305,000	$730,000	$575,000
14,000	0.22	$1,342,500	$730,000	$612,500
16,000	0.18	$1,380,000	$730,000	$650,000
18,000	0.10	$1,417,500	$730,000	$687,500
				Expected Profit = **$595,625**

Make to Order (revenue-sharing contract)

– The summary of the calculations is as follows:

Retailer's Order	Retailer's Profit	Manufacturer's Profit	Total Profit
8,000	$370,000	$250,000	$620,000
10,000	$443,525	$333,375	$776,900
12,000	$498,075	$412,625	$910,700
14,000	**$504,325**	$481,375	$985,700
16,000	$472,625	$541,875	**$1,014,500**
18,000	$409,875	**$595,625**	$1,005,500

Make to Order (other possibilities)

- **Make-to-Order (quantity-flexibility contract):** Full refund for a limited number of unsold goods (as opposed to a buy-back contract which provides partial refund for all returned items).

- **Make-to-Order (sales rebate contract):** Sales rebate contracts provide a direct incentive to the retailer to increase sales by means of a rebate paid by the manufacturer for any item sold above a certain quantity.

Make to Stock

- **Make-to-Stock (no contract)**
- **Make-to-Stock (pay-back contract)**
- **Make-to-Stock (cost-sharing contract)**
- **Make-to-Stock (quantity-flexibility contract)**
- **Make-to-Stock (sales rebate contract)**

Design Collaboration

- 50-70 percent of spending at a manufacturer is through procurement
- 80 percent of the cost of a purchased part is fixed in the design phase
- Design collaboration with suppliers can result in reduced cost, improved quality, and decreased time to market
- Important to employ design for logistics, design for manufacturability
- Manufacturers must become effective design coordinators throughout the supply chain

The Procurement Process

- The process in which the supplier sends product in response to orders placed by the buyer
- Goal is to enable orders to be placed and delivered on schedule at the lowest possible overall cost
- Two main categories of purchased goods:
  - Direct materials: components used to make finished goods
  - Indirect materials: goods used to support the operations of a firm
- Focus for direct materials should be on improving coordination and visibility with supplier
- Focus for indirect materials should be on decreasing the transaction cost for each order
- Procurement for both should consolidate orders where possible to take advantage of economies of scale and quantity discounts

Sourcing Planning and Analysis

- A firm should periodically analyze its procurement spending and supplier performance and use this analysis as an input for future sourcing decisions
- Procurement spending should be analyzed by part and supplier to ensure appropriate economies of scale
- Supplier performance analysis should be used to build a portfolio of suppliers with complementary strengths
  - Cheaper but lower performing suppliers should be used to supply base demand
  - Higher performing (but perhaps more expensive) suppliers should be used to buffer against variation in demand and supply from the other source

Summary of Learning Objectives

- What is the role of sourcing in a supply chain?
- What dimensions of supplier performance affect total cost?
- What is the effect of supply contracts on supplier performance and information distortion?
- What are different categories of purchased products and services? What is the desired focus for procurement for each of these categories?