15
Sourcing Decisions in a Supply Chain
Learning Objectives

1. Understand the role of sourcing in a supply chain
2. Discuss factors that affect the decision to outsource a supply chain function
3. Identify dimensions of supplier performance that affect total cost
4. Structure successful auctions and negotiations
5. Describe the impact of risk sharing on supplier performance and information distortion
6. Design a tailored supplier portfolio
The Role of Sourcing in a Supply Chain

• Sourcing is the set of business processes required to purchase goods and services
  – Outsourcing
  – Offshoring
The Role of Sourcing in a Supply Chain

• Outsourcing questions
  1. Will the third party increase the supply chain surplus relative to performing the activity in-house?
  2. How much of the increase in surplus does the firm get to keep?
  3. To what extent do risks grow upon outsourcing?
The Role of Sourcing in a Supply Chain

Figure 15-1
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 Selection

• Identify one or more appropriate suppliers
• Contract should account for all factors that affect supply chain performance
• Should be designed to increase supply chain profits in a way that benefits both the supplier and the buyer
Design Collaboration

• About 80% of the cost of a product is determined during design
• Suppliers should be actively involved at this stage
Procurement

• A supplier sends product in response to orders placed by the buyer
• Orders placed and delivered on schedule at the lowest possible overall cost
Sourcing Planning and Analysis

• Analyze spending across various suppliers and component categories
• Identify opportunities for decreasing the total cost
Cost of Goods Sold

• Cost of goods sold (COGS) represents well over 50 percent of sales for most major manufacturers
• Purchased parts a much higher fraction than in the past
• Companies have reduced vertical integration and outsourced
Benefits of Effective Sourcing Decisions

• Better economies of scale through aggregated
• More efficient procurement transactions
• Design collaboration can result in products that are easier to manufacture and distribute
• 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
In-House or Outsource

• Increase supply chain surplus through
  1. Capacity aggregation
  2. Inventory aggregation
  3. Transportation aggregation by transportation intermediaries
  4. Transportation aggregation by storage intermediaries
  5. Warehousing aggregation
  6. Procurement aggregation
  7. Information aggregation
  8. Receivables aggregation
  9. Relationship aggregation
  10. Lower costs and higher quality
Factors Influencing Growth of Surplus by a Third Party

• **Scale**
  - Large scale it is unlikely that a third party can achieve further scale economies and increase the surplus

• **Uncertainty**
  - If requirements are highly variable over time, third party can increase the surplus through aggregation

• **Specificity of assets**
  - If assets required are specific to a firm, a third party is unlikely to increase the surplus
Factors Influencing Growth of Surplus by a Third Party

<table>
<thead>
<tr>
<th>Specificity of Assets Involved in Function</th>
<th>Low</th>
<th>High</th>
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<tr>
<td></td>
<td>Low</td>
<td>High growth in surplus</td>
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<td>Firm scale</td>
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<td>Low to medium growth in surplus</td>
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<tr>
<td></td>
<td>Low</td>
<td>Low growth in surplus</td>
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<tr>
<td>High</td>
<td>High</td>
<td>No growth in surplus unless cost of capital is lower for third party</td>
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<tr>
<td>Demand uncertainty for firm</td>
<td>Low</td>
<td>Low to medium growth in surplus</td>
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<td></td>
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<td>Low growth in surplus</td>
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<tr>
<td>High</td>
<td>High growth in surplus</td>
<td>Low to medium growth in surplus</td>
</tr>
</tbody>
</table>

Table 15-1
Risks of Using a Third Party

1. The process is broken
2. Underestimation of the cost of coordination
3. Reduced customer/supplier contact
4. Loss of internal capability and growth in third-party power
5. Leakage of sensitive data and information
6. Ineffective contracts
7. Loss of supply chain visibility
8. Negative reputational impact
Third- and Fourth-Party Logistics Providers

• *Third-party logistics* (3PL) providers performs one or more of the logistics activities relating to the flow of product, information, and funds that could be performed by the firm itself

• A 4PL (fourth-party logistics) designs, builds and runs the entire supply chain process
### Third- and Fourth-Party Logistics Providers

<table>
<thead>
<tr>
<th>Service Category</th>
<th>Basic Service</th>
<th>Some Specific Value-Added Services</th>
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<tbody>
<tr>
<td>Transportation</td>
<td>Inbound, outbound by ship, truck, rail, air</td>
<td>Tendering, track/trace, mode conversion, dispatch, freight pay, contract management</td>
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<tr>
<td>Warehousing</td>
<td>Storage, facilities management</td>
<td>Cross-dock, in-transit merge, pool distribution across firms, pick/pack, kitting, inventory control, labeling, order fulfillment, home delivery of catalog orders</td>
</tr>
<tr>
<td>Information technology</td>
<td>Provide and maintain advanced information/computer systems</td>
<td>Transportation management systems, warehousing management, network modeling and site selection, freight bill payment, automated broker interfaces, end-to-end matching, forecasting, EDI, worldwide track and trace, global visibility</td>
</tr>
<tr>
<td>Reverse logistics</td>
<td>Handle reverse flows</td>
<td>Recycling, used-asset disposition, customer returns, returnable container management, repair/refurbish</td>
</tr>
<tr>
<td>Other 3PL services</td>
<td></td>
<td>Brokering, freight forwarding, purchase-order management, order taking, loss and damage claims, freight bill audits, consulting, time-definite delivery</td>
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<tr>
<td>International</td>
<td></td>
<td>Customs brokering, port services, export crating, consolidation</td>
</tr>
<tr>
<td>Special skills/handling</td>
<td></td>
<td>Hazardous materials, temperature controlled, package/parcel delivery, food-grade facilities/equipment, bulk</td>
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</table>

Table 15-2
Using Total Cost to Score and Assess Suppliers

<table>
<thead>
<tr>
<th>Performance Category</th>
<th>Category Components</th>
<th>Quantifiable?</th>
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<tbody>
<tr>
<td>Supplier price</td>
<td>Labor, material, overhead, local taxes, and compliance costs</td>
<td>Yes</td>
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<tr>
<td>Supplier terms</td>
<td>Net payment terms, delivery frequency, minimum lot size, quantity discounts</td>
<td>Yes</td>
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<tr>
<td>Delivery costs</td>
<td>All transportation costs from source to destination, packaging costs</td>
<td>Yes</td>
</tr>
<tr>
<td>Inventory costs</td>
<td>Supplier inventory, including raw material, in process and finished goods, in-transit inventory, finished goods inventory in supply chain</td>
<td>Yes</td>
</tr>
<tr>
<td>Warehousing cost</td>
<td>Warehousing and material handling costs to support additional inventory</td>
<td>Yes</td>
</tr>
<tr>
<td>Quality costs</td>
<td>Cost of inspection, rework, product returns</td>
<td>Yes</td>
</tr>
<tr>
<td>Reputation</td>
<td>Reputation impact of quality problems</td>
<td>No</td>
</tr>
<tr>
<td>Other costs</td>
<td>Exchange rate trends, taxes, duties</td>
<td>Yes</td>
</tr>
<tr>
<td>Support</td>
<td>Management overhead and administrative support</td>
<td>Difficult</td>
</tr>
<tr>
<td>Supplier capabilities</td>
<td>Replenishment lead time, on-time performance, flexibility, information coordination capability, design coordination capability, supplier viability</td>
<td>To some extent</td>
</tr>
</tbody>
</table>

Table 15-3
Comparing Suppliers Based on Total Cost

Annual material cost
= 1,000 x 52 x 1 = $52,000

Average cycle inventory
= 2,000/2 = 1,000

Annual cost of holding cycle inventory
= 1,000 x 1 x 0.25 = $250

Standard deviation of ddlP
= \sqrt{2 \cdot 300^2 + 1,000^2 \cdot 1^2} = 1,086.28

Safety inventory required with current supplier
= NORMSINV(0.95) \cdot 1,086.28 = 1,787

Annual cost of holding safety inventory
= 1,787 x 1 x 0.25 = $447

Annual cost of using current supplier
= 52,000 + 250 + 447 = $52,697
Comparing Suppliers Based on Total Cost

Annual material cost
= 1,000 \times 52 \times 0.97 = $50,440

Average cycle inventory
= \frac{8,000}{2} = 4,000

Annual cost of holding cycle inventory
= 4,000 \times 0.97 \times 0.25 = $970

Standard deviation of ddlt
= \sqrt{6 \times 300^2 + 1,000^2} \times 4^2 = 4,066.94

Safety inventory required with current supplier
= \text{NORMSINV}(0.95) \times 4,066.94 = 6,690

Annual cost of holding safety inventory
= 6,690 \times 0.97 \times 0.25 = $1,622

Annual cost of using current supplier
= 50,440 + 970 + 1,622 = $53,032
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
Supplier Selection – Auctions and Negotiations

• Factors influence the performance of an auction
  – Is the supplier’s cost structure private (not affected by factors that are common to other bidders)?
  – Are suppliers symmetric or asymmetric; that is, ex ante, are they expected to have similar cost structures?
  – Do suppliers have all the information they need to estimate their cost structure?
  – Does the buyer specify a maximum price it is willing to pay for the supply chain?
Supplier Selection – Auctions and Negotiations

- Collusion among bidders
- Second-price auctions are particularly vulnerable
- Can be avoided with any first-price auction
Basic Principles of Negotiation

• The difference between the values of the buyer and seller is the *bargaining surplus*

• The goal of each negotiating party is to capture as much of the bargaining surplus as possible
  
  – Have a clear idea of your own value and as good an estimate of the third party’s value as possible
  
  – Look for a fair outcome based on equally or equitably dividing the bargaining surplus
  
  – A win-win outcome
Contracts, Risk Sharing, and Supply Chain Performance

1. How will the contract affect the firm’s profits and total supply chain profits?
2. Will the incentives in the contract introduce any information distortion?
3. How will the contract influence supplier performance along key performance measures?
Contracts for Product Availability and Supply Chain Profits

• Independent actions taken by two parties in a supply chain often result in profits that are lower than those that could be achieved if the supply chain were to coordinate its actions.

• Three contracts that increase overall profits by making the supplier share some of the buyer’s demand uncertainty are:
  1. Buyback or returns contracts
  2. Revenue-sharing contracts
  3. Quantity flexibility contracts
Buyback Contracts

• Allows a retailer to return unsold inventory up to a specified amount at an agreed upon price
• The manufacturer specifies a wholesale price $c$ and a buyback price $b$
• The manufacturer can salvage $s_M$ for any units that the retailer returns
• The manufacturer has a cost of $v$ per unit produced and the retail price is $p$

Expected manufacturing profit $= O \cdot (c - v) - (b - s_M)$

expected overstock at retailer
Buyback Contracts

<table>
<thead>
<tr>
<th>Wholesale Price $c$</th>
<th>Buyback Price $b$</th>
<th>Optimal Order Size for Music Store</th>
<th>Expected Profit for Music Store</th>
<th>Expected Returns to Supplier</th>
<th>Expected Profit for Supplier</th>
<th>Expected Supply Chain Profit</th>
</tr>
</thead>
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<tr>
<td>$5</td>
<td>$0</td>
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<td>$5,732</td>
<td>$8,351</td>
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Table 15-4
Buyback Contracts

• *Holding-cost subsidies*
  – Manufacturers pay retailers a certain amount for every unit held in inventory over a given period
  – Encourage retailers to order more

• *Price support*
  – Manufacturers share the risk of product becoming obsolete
  – Guarantee that in the event they drop prices they will lower prices for all current inventories
Revenue-Sharing Contracts

- Manufacturer charges the retailer a low wholesale price $c$ and shares a fraction $f$ of the retailer’s revenue
  - Allows both the manufacturer and retailer to increase their profits
  - Results in lower retailer effort
  - Requires an information infrastructure
  - Information distortion results in excess inventory in the supply chain and a greater mismatch of supply and demand
Revenue-Sharing Contracts

\[ CSL^* = \text{probability (demand } O^*) = \frac{C_u}{C_u + C_o} = \frac{(1-f)p-c}{(1-f)p-s_R} \]

Expected manufacturers profits = \((c - v)O^* + fp(O^* - \text{expected overstock at retailer})\)

Expected retailer profit

\[ = (1-f)p(O^* - \text{expected overstock at retailer}) + s_R \text{ expected overstock at retailer} - cO^* \]
## Revenue-Sharing Contracts

<table>
<thead>
<tr>
<th>Wholesale Price $c$</th>
<th>Revenue-Sharing Fraction $f$</th>
<th>Optimal Order Size for Music Store</th>
<th>Expected Overstock at Music Store</th>
<th>Expected Profit for Music Store</th>
<th>Expected Profit for Supplier</th>
<th>Expected Supply Chain Profit</th>
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<td>$1,521</td>
<td>$6,282</td>
<td>$7,803</td>
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Table 15-5
Quantity Flexibility Contracts

- Allows the buyer to modify the order (within limits) after observing demand
- 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
Quantity Flexibility Contracts

Expected quantity purchased by retailer, $Q_R$

$$= qF(q) + Q(1 - F(Q))$$

$$+ F_s \frac{Q}{f_s} - f_s \frac{q}{f_s}$$

$$= - f_s \frac{Q}{f_s} - f_s \frac{q}{f_s}$$

Expected quantity sold by retailer, $D_R$

$$= Q(1 - F(Q))$$

$$+ F_s \frac{Q}{f_s} - f_s \frac{q}{f_s}$$
Quantity Flexibility Contracts

Expected quantity overstock
at manufacturer = $Q_R - D_R$

Expected retailer profit = $D_R \cdot p + \left( Q_R - D_R \right) s_R - Q_R \cdot c$

Expected manufacturer profit = $Q_R \cdot c + \left( Q - Q_R \right) s_M - Q \cdot v$
Quantity Flexibility Contracts

<table>
<thead>
<tr>
<th>α</th>
<th>β</th>
<th>Wholesale Price (c)</th>
<th>Order Size (O)</th>
<th>Expected Purchase by Retailer</th>
<th>Expected Sale by Retailer</th>
<th>Expected Profits for Retailer</th>
<th>Expected Profits for Supplier</th>
<th>Expected Supply Chain Profit</th>
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Table 15-6
Contracts to Coordinate Supply Chain Costs

• Differences in costs at the buyer and supplier can lead to decisions that increase total supply chain costs
• A quantity discount contract may encourage the buyer to purchase a larger quantity which would result in lower total supply chain costs
• Quantity discounts lead to information distortion because of order batching
Contracts to Increase Agent Effort

• In many supply chains, agents act on behalf of a principal and the agents’ efforts affect the reward for the principal

• A two-part tariff offers the right incentives for the dealer to exert the appropriate amount of effort

• Threshold contracts increase information distortion

• Offer threshold incentives over a rolling horizon
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 performance improvement

• Effective in aligning supplier and buyer incentives when the supplier is required to improve performance and most of the benefits of improvement accrue to the buyer
Design Collaboration

• 50-70% of spending at a manufacturer comes from procurement
• 80% 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
• Design for logistics, design for manufacturability
• Modular, adjustable, dimensional customization
The Procurement Process

• The process in which the supplier sends product in response to orders placed by the buyer

• Main categories of purchased goods
  – Direct materials
  – Indirect materials

• Procurement process for direct materials should be designed to ensure that components are available in the right place, in the right quantity, and at the right time

• Focus for indirect materials should be on reducing transaction cost
### Differences Between Direct and Indirect Materials

<table>
<thead>
<tr>
<th></th>
<th>Direct Materials</th>
<th>Indirect Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use</strong></td>
<td>Production</td>
<td>Maintenance, repair, and support operations</td>
</tr>
<tr>
<td><strong>Accounting</strong></td>
<td>Cost of goods sold</td>
<td>Selling, general, and administrative expenses (SG&amp;A)</td>
</tr>
<tr>
<td><strong>Impact on production</strong></td>
<td>Any delay will delay production</td>
<td>Less direct impact</td>
</tr>
<tr>
<td><strong>Processing cost relative to value of transaction</strong></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Number of transactions</strong></td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 15-7
Product Categorization

![Product Categorization Diagram](image)

**Figure 15-2**
Designing a Sourcing Portfolio: Tailored Sourcing

• Options with regard to whom and where to source from
  – Produce in-house or outsource to a third party
  – Will the source be cost efficient or responsive
  – Onshoring, near-shoring, and offshoring

• Tailor supplier portfolio based on a variety of product and market characteristics
## Designing a Sourcing Portfolio: Tailored Sourcing

<table>
<thead>
<tr>
<th>Feature</th>
<th>Responsive Source</th>
<th>Low-Cost Source</th>
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</thead>
<tbody>
<tr>
<td>Product life cycle</td>
<td>Early phase</td>
<td>Mature phase</td>
</tr>
<tr>
<td>Demand volatility</td>
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<td>Low</td>
</tr>
<tr>
<td>Demand volume</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Product value</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Rate of product obsolescence</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Desired quality</td>
<td>High</td>
<td>Low to medium</td>
</tr>
<tr>
<td>Engineering/design support</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table 15-8
Designing a Sourcing Portfolio: Tailored Sourcing

<table>
<thead>
<tr>
<th></th>
<th>Onshore</th>
<th>Near-shore</th>
<th>Offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of innovation/product variety</td>
<td>High</td>
<td>Medium to High</td>
<td>Low</td>
</tr>
<tr>
<td>Demand volatility</td>
<td>High</td>
<td>Medium to High</td>
<td>Low</td>
</tr>
<tr>
<td>Labor content</td>
<td>Low</td>
<td>Medium to High</td>
<td>High</td>
</tr>
<tr>
<td>Volume or weight-to-value ratio</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Impact of supply chain disruption</td>
<td>High</td>
<td>Medium to High</td>
<td>Low</td>
</tr>
<tr>
<td>Inventory costs</td>
<td>High</td>
<td>Medium to High</td>
<td>Low</td>
</tr>
<tr>
<td>Engineering/management support</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table 15-9
Risk Management in Sourcing

- Inability to meet demand on time
- An increase in procurement costs
- Loss of intellectual property
Making Sourcing Decisions in Practice

1. Use multifunction teams
2. Ensure appropriate coordination across regions and business units
3. Always evaluate the total cost of ownership
4. Build long-term relationships with key suppliers
Summary of Learning Objectives

1. Understand the role of sourcing in a supply chain
2. Discuss factors that affect the decision to outsource a supply chain function
3. Identify dimensions of supplier performance that affect total cost
4. Structure successful auctions and negotiations
5. Describe the impact of risk sharing on supplier performance and information distortion
6. Design a tailored supplier portfolio