

Supply Chain Management (6th Edition)

Chapter 15 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
- ◆ Making Sourcing Decisions in Practice
- ◆ Summary of Learning Objectives

The Role of Sourcing in a Supply Chain

- ◆ *Purchasing*, also called *procurement*, is the process by which companies acquire raw materials, components, products, services, or other resources from suppliers to execute their operations
- ◆ *Sourcing* is the set of business processes required to purchase goods and services
- ◆ For any supply chain function, the most significant decision is whether to outsource the function or perform it in-house
- ◆ *Outsourcing* results in the supply chain function being performed by a third party
- ◆ Outsourcing decisions are important and tend to vary across firms and industries

The Role of Sourcing in a Supply Chain

- ◆ We address the outsourcing of supply chain activities by a firm based on the following three questions:
 - Will the third party increase the supply chain surplus relative to performing the activity in-house?
 - To what extent do risks grow upon outsourcing?
 - Are there strategic reasons to outsource?
- ◆ Sourcing processes include:
 - Supplier scoring and assessment
 - Supplier selection and contract negotiation
 - Design collaboration
 - Procurement
 - Sourcing planning and analysis

Benefits of Effective Sourcing Decisions

- ◆ Identifying the right source can result in an activity performed at higher quality and lower cost
- ◆ Better economies of scale can be achieved if orders within a firm are aggregated
- ◆ More efficient procurement transactions can significantly reduce the overall cost of purchasing. This is most important for items for which a large number of low-value transactions occur
- ◆ Design collaboration can result in products that are easier to manufacture and distribute, resulting in lower overall costs. This factor is most important for components that contribute a significant amount to product cost and value
- ◆ Good procurement processes can facilitate coordination with the supplier and improve forecasting and planning. Better coordination lowers inventories and improves the matching of supply and demand.

Benefits of Effective Sourcing Decisions

- ◆ Appropriate sharing of risk and benefits can result in higher profits for both the supplier and the buyer
- ◆ Firms can achieve a lower purchase price by increasing competition through the use of auctions

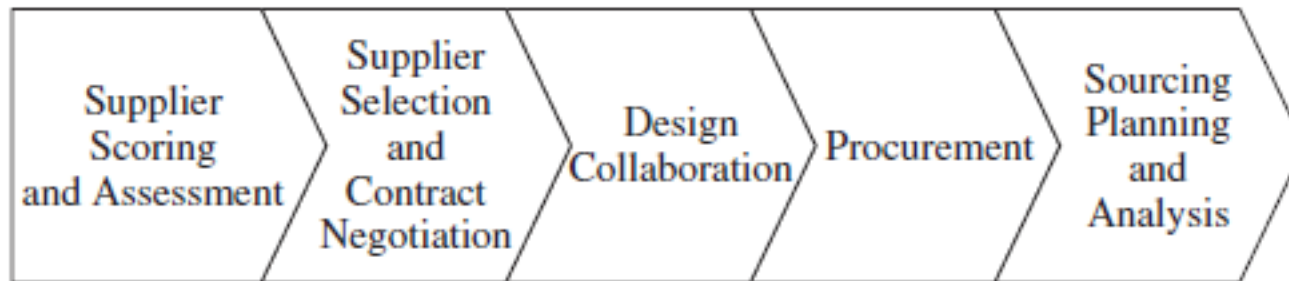


FIGURE 15-1 Key Sourcing-Related Processes

How Do Third Parties Increase the Supply Chain Surplus?

- ◆ The decision to outsource is based on the growth in supply chain surplus provided by the third party and the increase in risk incurred by using a third party. A firm should consider outsourcing if the growth in surplus is large with a small increase in risk
- ◆ Third parties increase the supply chain surplus if they either increase value for the customer or decrease the supply chain cost relative to a firm performing the task in-house
- ◆ Here, we discuss various mechanisms that third parties can use to grow the surplus:

◆ **1. Capacity aggregation.** A third party can increase the supply chain surplus by aggregating demand across multiple firms and gaining production economies of scale that no single firm can on its own

- ◆ This is the most common reason for outsourcing production in a supply chain
- ◆ One of the reasons that all smartphone manufacturers outsource glass manufacturing for their screens is that the third parties achieve manufacturing economies that no single smartphone manufacturer can on its own
- ◆ The growth in surplus from outsourcing is highest when the needs of the firm are significantly lower than the volumes required to gain economies of scale. A good example in this context is Magna Steyr, a third party that has taken over assembly of automobiles for several manufacturers.

◆ Magna Steyr designs flexible assembly lines that can build up to five different vehicle types on a single line. This flexible capacity allows the company to produce a variety of low volume cars economically. In 2013, Magna Steyr assembled the G class for Mercedes, the RCZ for Peugeot, and the Mini Countryman and Mini Paceman for BMW in the same plant. In each case, the models had relatively low demand volume

◆ **2. *Inventory aggregation.*** A third party can increase the supply chain surplus by aggregating inventories across a large number of customers.

◆ The third party performing inventory aggregation adds most to the supply chain surplus when demand from customers is fragmented and uncertain

- ◆ **3. *Transportation aggregation by transportation intermediaries.*** A third party may increase the surplus by aggregating the transportation function to a higher level than any shipper can on its own
- ~~◆ UPS, FedEx, and a host of LTL carriers are examples of transportation intermediaries that increase the supply chain surplus by aggregating transportation across a variety of shippers~~
- ◆ When shippers want to send small quantities, the transportation intermediary aggregates shipments across multiple shippers, thus lowering the cost of each shipment below what could be achieved by the shipper alone
- ◆ A transportation intermediary increases the supply chain surplus when shippers are sending packages or LTL quantities to customers that are geographically distributed.

- ◆ **4. *Transportation aggregation by storage intermediaries.*** A third party that stores inventory can also increase the supply chain surplus by aggregating inbound and outbound transportation
- ◆ ~~Storage intermediaries such as W.W. Grainger and McMaster-Carr stock products from more than a thousand manufacturers each and sell to hundreds of thousands of customers. On the inbound side, they are able to aggregate shipments from several manufacturers onto a single truck. This results in a lower transportation cost than could be achieved by each manufacturer independently.~~
- ◆ On the outbound side, they aggregate packages for customers at a common destination, resulting in a significantly lower transportation cost than can be achieved if each supplier shipped to each customer separately.
- ◆ This form of aggregation is most effective if the intermediary stocks products from many suppliers and serves many customers, each ordering in small quantities. This form of aggregation becomes less effective as the scale of shipment from a supplier to customer grows.

- ◆ **5. Warehousing aggregation.** A third party may increase the supply chain surplus by aggregating warehousing needs over several firms.
- ◆ The growth in surplus is achieved in terms of lower real estate costs and lower processing costs within the warehouse. Savings through warehousing aggregation arise if a firm's warehousing needs are small or if its needs fluctuate over time.
- ◆ In either case, the intermediary with the warehouse can exploit economies of scale in warehouse construction and operation by aggregating across multiple customers.
- ◆ Warehousing aggregation by an intermediary adds a lot to the surplus for small suppliers and for companies that are starting out in a geographic location.
- ◆ Warehousing aggregation is unlikely to add much to the surplus for a large supplier or customer whose warehousing needs are large and relatively stable over time.

◆ **6. Procurement aggregation.** A third party increases the supply chain surplus if it aggregates procurement for many small players and facilitates economies of scale in ordering, production, and

inbound transportation.

- ◆ Procurement aggregation is most effective across many small buyers. Small retailers in India purchase goods from distributors that aggregate buying from manufacturers.
- ◆ Procurement aggregation is not likely to be a big factor with a few large customers.
- ◆ For example, Walmart has sufficient scale that it manages its own procurement.
- ◆ It sees no value added in procuring through a third party.

◆ **7. Information aggregation.** A third party may increase the surplus by aggregating information to a higher level than can be achieved by a firm performing the function in-house.

- ◆ All retailers aggregate information on products from many manufacturers in a single location.
- ◆ This information aggregation reduces search costs for customers. eBags is an example of an online retailer that primarily provides information aggregation.
- ◆ eBags holds little inventory but is a single point of display for information on bags from many manufacturers.
- ◆ By aggregating product information, eBags significantly reduces search costs for the online customer.
- ◆ Relative to eBags, if each manufacturer set up its own website and online store, search costs for the customer would be higher, and each manufacturer would have to invest in the information infrastructure.

- ◆ **8. *Receivables aggregation.*** A third party may increase the supply chain surplus if it can aggregate the receivables risk to a higher level than the firm or it has a lower collection cost than the firm.
- ◆ ~~Brightstar, for example, was a distributor for Motorola in most Latin American countries other than Brazil. Cell phones in the area are sold through many small, independently owned retail outlets.~~
- ◆ Collecting receivables from each retail outlet is an expensive proposition for a manufacturer. Given that a retailer buys from many manufacturers, the power of each manufacturer to collect is also reduced. Brightstar, as a distributor, was able to aggregate collection across all manufacturers that it served, reducing the collection cost.
- ◆ By aggregating collection to a greater extent than any one manufacturer can, Brightstar also lowered the default risk.
- ◆ Receivables aggregation is likely to increase the supply chain surplus if retail outlets are small and numerous and each outlet stocks products from many manufacturers that are all served by the same distributor.

◆ **9. Relationship aggregation.** An intermediary can increase the supply chain surplus by decreasing the number of relationships required between multiple buyers and sellers.

- ◆ Without an intermediary, connecting a thousand sellers to a million buyers requires a billion relationships.
- ◆ The presence of an intermediary lowers the number of relationships required to just over a million.
- ◆ Relationship aggregation increases the supply chain surplus by increasing the size of each transaction and decreasing their number.
- ◆ Relationship aggregation is most effective when many buyers sporadically purchase small amounts at a time, but each order often has products from multiple suppliers.
- ◆ A third party, however, does not increase the surplus by being a relationship aggregator between a few buyers and sellers for which the relationships are longer term and large.

◆ **10. *Lower costs and higher quality.*** A third party can increase the supply chain surplus if it provides lower cost or higher quality relative to the firm.

- ◆ If these benefits come from specialization and learning, they are likely to be sustainable over the longer term.
- ◆ A specialized third party that is further along the learning curve for some supply chain activity is likely to maintain its advantage over the long term.
- ◆ A common scenario, however, is one in which the third party has a low-cost location that the firm does not have.
- ◆ In such a situation, lower labor and overhead costs are temporary reasons for outsourcing, because if the wage differential is persistent and the third party offers none of the other advantages discussed earlier, it is best for the firm to maintain ownership and offshore production to the low-cost location.

◆ Key Points

- ◆ A third party may be able to provide a sustainable growth of the surplus by aggregating to a higher level than the firm itself.
- ◆ The growth in surplus comes from aggregating capacity, inventory, inbound or outbound transportation, warehousing, procurement, information, receivables, or relationships to a level that the firm cannot achieve on its own.
- ◆ A growth in surplus may also occur if the third party has lower costs or higher quality because of specialization or learning.

◆ Factors Influencing Growth of Surplus by a Third Party

- ◆ Three important factors affect the increase in surplus that a third party provides: scale, uncertainty, and the specificity of assets.
- ◆ How and when a third party can increase the supply chain surplus is summarized in Table 15-1.

TABLE 15-1 Growth in Surplus by Third Party as a Function of Scale, Uncertainty, and Specificity

		Specificity of Assets Involved in Function	
		Low	High
Firm scale	Low	High growth in surplus	Low to medium growth in surplus
	High	Low growth in surplus	No growth in surplus unless cost of capital is lower for third party
Demand uncertainty for firm	Low	Low to medium growth in surplus	Low growth in surplus
	High	High growth in surplus	Low to medium growth in surplus

- ◆ **Key Point:** A firm gains the most by outsourcing to a third party if its needs are small, highly uncertain, and shared by other firms sourcing from the same third party.

◆ **Risks of Using a Third Party**

- ◆ **1. *The process is broken.*** The biggest problems arise when a firm outsources supply chain functions simply because it has lost control of the process. Keep in mind that introducing a third party into a broken supply chain process only makes it worse and harder to control.
- ◆ **2. *Underestimation of the cost of coordination.*** A common mistake when outsourcing is to underestimate the effort required to coordinate activities across multiple entities performing supply chain tasks. This is especially true if a firm plans to outsource specific supply chain functions to different third parties.
- ◆ **3. *Reduced customer/supplier contact.*** A firm may lose customer/supplier contact by introducing an intermediary. The loss of customer contact is particularly significant for firms that sell directly to consumers but decide to use a third party to either collect incoming orders or deliver outgoing product.

◆ **4. *Loss of internal capability and growth in third-party power.*** A firm may choose to keep a supply chain function in-house if outsourcing will significantly increase the third party's power.

◆ An example can be found in the electronics industry. Companies such as HP and Motorola have moved most of their manufacturing to contract manufacturers but are reluctant to move either procurement or design, even though contract manufacturers have developed both capabilities.

◆ **5. *Leakage of sensitive data and information.*** Using a third party requires a firm to share demand information and, in some cases, intellectual property.

◆ If the third party also serves competitors, leakage is always a danger.

- ◆ **6. *Ineffective contracts.*** Contracts with performance metrics that distort the third party's incentives often significantly reduce any gains from outsourcing. For example, cost-plus pricing of third-party services presents incentive problems even if the third party opens its books. This form of pricing eliminates incentives for the third party to innovate further to reduce costs.
- ◆ **7. *Loss of supply chain visibility.*** Introducing third parties reduces the visibility of supply chain operations, making it harder for the firm to respond quickly to local customer and market demands. This loss of visibility can be particularly harmful for long supply chains.
- ◆ **8. *Negative reputational impact.*** In many instances, actions regarding labor or the environment taken by the third party can have a significant negative impact on the reputation of the firm. Nike has had difficulty with several of its suppliers regarding labor practices and the environment. In 2008, Nike produced its first supply chain report on suppliers in China and reported several questionable labor practices, including underage workers, unpaid wages, and falsified documents.

◆ **Strategic Factors in Sourcing**

- ◆ **1. *Support the business strategy.*** Harley-Davidson illustrates the importance of linking business strategy to the make or buy decision. To maintain its strong “Made in America” brand image, the company manufactures mostly in the United States even though cheaper components may be found overseas.
- ◆ **2. *Improve firm focus.*** In today’s complex world, it is impossible for a firm to do everything. A lack of focus because a firm is doing everything in-house can be a major problem. Among the required activities, a firm must identify those that are core and provide a strategic advantage. Outsourcing all other activities helps improve focus and, thus, performance. A good example of increased outsourcing comes from the automotive industry. At one time, most auto manufacturers produced many of their components in-house. With the increasing complexity of an automobile, however, companies outsource most of their parts today, focusing instead on design, assembly, and coordination.

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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
- ◆ Read in the book: Section 15.3 page 441 (Examples of Successful 3rd Party Suppliers)
- ◆ Read in the book: page 447, Basic Principles of Negotiation
- ◆ Read in the book: page 448-450 Section 15.6 Sharing Risk and Reward in the Supply Chain

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

TABLE 15-2 Factors Influencing Total Cost of Ownership

Performance Category	Category Components	Quantifiable?
<i>Acquisition Costs</i>		
Supplier price	Labor, material, and overhead	Yes
Supplier terms	Net payment terms, delivery frequency, minimum lot size, quantity discounts	Yes
Taxes and duties	All tariffs and compliance costs	Yes
Delivery costs	All transportation costs from source to destination, packaging costs	Yes
Incoming quality costs	Cost of inspection, defectives, and rework	Yes
Management costs	Cost of managing and planning the purchase	Difficult
<i>Ownership Costs</i>		
Inventory costs	Supplier inventory, including raw material, in process and finished goods, in-transit inventory, finished goods inventory in supply chain	Yes
Warehousing cost	Warehousing and material handling costs to support additional inventory	Yes
Manufacturing cost	Cost of manufacturing associated with the sourced part	Yes
Production quality costs	Impact of sourced part on finished product quality	Difficult
Cycle time costs	Impact of sourced part on production cycle time	Yes
<i>Post-Ownership Costs</i>		
Reputation	Reputation impact of quality problems	No
Warranty and product liability costs	Warranty and product liability costs associated with sourced part	Difficult
Environmental costs	Environmental costs affected by sourced part	Difficult
Supplier capabilities	Replenishment lead time, on-time performance, flexibility, information coordination capability, design coordination capability, supplier viability	To some extent

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 and not just the purchase price.
- ◆ In general, auctions are best used when the quantifiable acquisition cost is the primary component of total cost. If ownership or post-ownership costs are significant, auctions are not appropriate when selecting suppliers. In such settings, direct negotiations often lead to the best outcome.
- ◆ Auctions:
 - » Sealed-bid first-price auctions
 - » English auctions
 - » Dutch auctions
 - » Second-price (Vickery) auctions

- ◆ **Sealed-bid first-price auctions:** A first-price sealed-bid auction (FPSBA) is a common type of auction. It is also known as blind auction. In this type of auction, all **bidders** simultaneously submit sealed bids, so that no bidder knows the bid of any other participant. The lowest bidder (3rd party) pays the price they submitted.
- ◆ **English auctions:** a process in which an asset is sold through a suggested opening bid reserve or a starting price that is set by the seller. Increasingly higher bids are accepted from the gamut of buyers. Ultimately, the price is adjusted in a direction that's unfavorable to the bidders.
- ◆ **Dutch auctions:** it means an **auction** in which the auctioneer begins with a high asking price, and lowers it until some participant accepts the price, or it reaches a predetermined reserve price.
- ◆ **Second-price (Vickery) auctions:** each potential supplier submits a bid and the contract is assigned to the lowest bidder— but at the price quoted by the second-lowest bidder. In general, it is in the buyer's interest to reveal all available information before bidding.

- ◆ If bidders perceive a lack of information, they are all likely to increase their bids to account for this lack of information.
-
- ◆ A significant factor that must be accounted for when designing an auction is the possibility of collusion among bidders.
 - ◆ Second-price auctions are particularly vulnerable to collusion.
 - ◆ If there is collusion and all bidders but the lowest cost bidder raise their bids, the contract goes to the lowest-cost bidder, but at a high price.
 - ◆ Firms must take care to ensure that no collusion occurs when using an auction.

EXAMPLE 15-1 Impact of Local Optimization

Consider a music store that sells compact discs. The supplier manufactures compact discs at \$1 per unit and sells them to the music store at \$5 per unit. The retailer sells each disc to the end consumer at \$10. At this retail price, market demand is normally distributed, with a mean of 1,000 and a standard deviation of 300. Any leftover discs at the end of the sale period are worthless. How many discs should an independent retailer order? What are the supply chain profits with an independent retailer? If the manufacturer and the retailer are vertically integrated (they are a single firm), how many discs should the retailer order? What are the supply chain profits when the manufacturer and retailer are a single firm?

Analysis:

We first consider the case of the independent retailer. The retailer has a margin of \$5 per disc and can potentially lose \$5 for each unsold disc. The retailer thus has a cost of overstocking $C_o = \$5$ and a cost of understocking $C_u = \$5$. Using Equation 13.1, it is optimal for the retailer to aim for a service level of $5/(5 + 5) = 0.5$ and order $NORMINV(0.5, 1000, 300) = 1,000$ discs. From Equation 13.3, the retailer's expected profits are \$3,803, and the manufacturer makes \$4,000 from selling 1,000 discs. The total supply chain profit with an independent retailer is thus $\$3,803 + \$4,000 = \$7,803$.

Now, consider the case in which the supply chain is vertically integrated. The supply chain has a margin of $\$10 - \$1 = \$9$ per disc and can potentially lose \$1 for each unsold disc. The supply chain thus has a cost of overstocking $C_o = \$1$ and a cost of understocking $C_u = \$9$. Using Equation 13.1, it is optimal for the supply chain to aim for a service level of $9/(1 + 9) = 0.9$ and order $NORMINV(0.9, 1000, 300) = 1,384$ discs. From Equation 13.3, the supply chain's expected profits are \$8,474.

Thus, the vertically integrated supply chain makes \$670 more than when the retailer makes the ordering decision independently.

Contracts and Supply Chain Performance **page 450**

- ◆ Contracts for Product Availability and Supply Chain Profits
- ◆ The following three approaches to risk sharing increase overall supply chain profits:
 - Buyback Contracts
 - Revenue-Sharing Contracts
 - Quantity Flexibility Contracts

RISK SHARING THROUGH BUYBACKS A buyback or returns clause allows a retailer to return unsold inventory up to a specified amount, at an agreed-upon price. In this case, the supplier is sharing risk by agreeing to buy back unsold inventory at the retailer. In a *buyback contract*, the manufacturer specifies a wholesale price c along with a buyback price b at which the retailer can return any unsold units at the end of the season. We assume that the manufacturer can salvage $\$s_M$ for any units that the retailer returns. The manufacturer has a cost of v per unit produced. The retail price is p .

The optimal order quantity O^* for a retailer in response to a buyback contract is evaluated using Equations 13.1 and 13.2, where the salvage value for the retailer is $s = b$. The cost of overstocking for the retailer is given by $C_o = c - b$, and the cost of understocking for the retailer is given by $C_u = p - c$. Using Equation 13.1, the optimal service level that the retailer targets is thus given by $CSL^* = (p - c)/(p - b)$. Using Equation 13.2, the optimal order size by the retailer is given by $O^* = NORMINV(CSL^*, \mu, \sigma)$. The expected retailer profit is evaluated using Equation 13.3 with the salvage value s equal to the buyback price b . The expected profit at the manufacturer depends on the overstock at the retailer (evaluated using Equation 13.4) that is returned. We obtain

$$\begin{aligned} \text{Expected manufacturer profit} &= O^*(c - v) - (b - s_M) \\ &\quad \times \text{expected overstock at retailer} \end{aligned}$$

EXAMPLE 15-2 Impact of Risk Sharing Through Buybacks

We return to the music store in Example 15-1 with all data as specified. Assume that the supplier agrees to buy back any unsold discs for \$3 even though any leftover discs at the end of the sale period are worthless. With the buyback clause, how many discs should an independent retailer order? What are the supply chain profits with a buyback clause?

Analysis:

With a buyback clause as specified, the retailer has a salvage value of \$3 for each unsold unit. Given the wholesale price of \$5 and a retail price of \$10, the retailer thus has a cost of overstocking, $C_o = \$5 - \$3 = \$2$ and a cost of understocking $C_u = \$10 - \$5 = \$5$. Using Equation 13.1, it is optimal for the retailer to aim for a service level of $5/(2 + 5) = 0.71$ and order 1,170 [= $NORMINV(5/7, 1000, 300)$] discs. From Equation 13.3, the retailer's expected profits are \$4,286. Given an expected overstock of 223 units (using Equation 13.4), the manufacturer's expected profit is \$4,011 [= $1170 \times (5 - 1) - (223 \times 3)$]. The total supply chain profit with buybacks is thus $\$4,286 + \$4,011 = \$8,297$.

Observe that risk sharing using a buyback clause for \$3 increases profits for the retailer as well as the manufacturer (and the supply chain as a whole) compared with Example 15-1, in which there was no risk sharing.

RISK SHARING THROUGH REVENUE SHARING In *revenue-sharing* contracts, the manufacturer charges the retailer a lower wholesale price c (compared with the case without risk sharing), but shares a fraction f of the retailer's revenue. In this case, the manufacturer is sharing risk because the retailer's cost is lower (than without risk sharing) if demand is low. Even if no returns are allowed, the lower wholesale price decreases the cost to the retailer in case of an overstock. The retailer thus increases the level of product availability, resulting in higher profits for both the manufacturer and the retailer when revenue sharing is suitably designed.

Assume that the manufacturer has a production cost v ; the retailer charges a retail price p and can salvage any leftover units for s_R . The optimal order quantity O^* ordered by the retailer is evaluated using Equations 13.1 and 13.2, where the cost of understocking is $C_u = (1 - f)p - c$ and the cost of overstocking is $C_o = c - s_R$. We thus obtain

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

The manufacturer obtains the wholesale price c for each unit purchased by the retailer and a share of the revenue for each unit sold by the retailer. The expected overstock at the retailer is obtained using Equation 13.4. The manufacturer's profits are thus evaluated as

$$\begin{aligned} \text{Expected manufacturers profits} &= (c - v)O^* \\ &\quad + fp(O^* - \text{expected overstock at retailer}) \end{aligned}$$

The retailer pays a wholesale price c for each unit purchased and obtains a revenue of $(1 - f)p$ for each unit sold and a revenue of s_R for each unit overstocked. The retailer's expected profit is thus evaluated as

$$\begin{aligned} \text{Expected retailer profit} &= (1 - f)p(O^* - \text{expected overstock at retailer}) \\ &\quad + s_R \times \text{expected overstock at retailer} - cO^* \end{aligned}$$

EXAMPLE 15-3 **Impact of Risk Sharing Through Revenue Sharing**

We return to the music store in Example 15-1 with all data as specified. Assume that the supplier agrees to a revenue sharing contract under which the retailer is charged only \$1 for each disc, with the manufacturer getting 45 percent of the retail revenues. Given the retail price of \$10, the manufacturer gets \$4.50 for each disc sold while the retailer keeps \$5.50. With the revenue-sharing clause, how many discs should an independent retailer order? What are the supply chain profits with a revenue-sharing clause?

Analysis:

With a revenue-sharing clause as specified, we have $c = \$1$, $p = \$10$, $s_R = 0$, and a revenue share fraction $f = 0.45$. The manufacturer has a production cost of $v = \$1$. The music store thus has a cost of overstocking of $C_o = c - s_R = 1 - 0 = \1 and a cost of understocking of $C_u = (1 - f)p - c = (1 - 0.45) \times 10 - 1 = \4.50 . The music store targets a service

level of $CSL^* = 4.5/(4.5 + 1) = 0.818$, or 81.8 percent (see Equation 13.1) and orders 1,273 [= $NORMINV(4.5/5.5, 1000, 300)$] discs. Observe that this is much larger than the 1,000 discs ordered in Example 15-1, when the wholesale price was \$5 and there was no revenue sharing. The increase in order size occurs because the retailer loses only \$1 per unsold disc (instead of \$5 per disc without revenue sharing), while making a margin of \$4.50 for each disc that sells.

Given an order of 1,273 discs, the retailer has an expected overstock of 302 discs (use Equation 13.4). As a result, the expected manufacturer's profit = $(c - v)O^* + fp(O^* - \text{expected overstock}) = (1 - 1) \times 1273 + 0.45 \times 10 \times (1273 - 302) = \$4,369$. The expected retailer's profit = $(1 - f)p(O^* - \text{expected overstock at retailer}) + s_R \times \text{expected overstock at retailer} - cO^* = (1 - 0.45) \times 10 \times (1273 - 302) + 0 \times 302 - 1 \times 1273 = \$4,068$. The total supply chain profit = $4,369 + 4,068 = \$8,437$.

Observe that risk sharing using a revenue sharing clause with a \$1 wholesale price and a 45 percent share for the supplier increases profits for the retailer as well as the manufacturer (and the supply chain as a whole) compared with Example 15-1, in which there was no risk sharing.

RISK SHARING USING QUANTITY FLEXIBILITY Under *quantity flexibility contracts*, the manufacturer allows the retailer to change the quantity ordered (within limits) after observing demand. If a retailer orders O units, the manufacturer commits to providing up to $Q = (1 + \alpha)O$ units, whereas the retailer is committed to buying at least $q = (1 - \beta)O$ units. Both α and β are between 0 and 1.

The retailer can purchase anywhere between q and Q units, depending on the demand it observes. Quantity flexibility contracts are similar in spirit to the contract that Mattel offered its retailers prior to 1999. In quantity flexibility contracts the manufacturer shares risk by allowing the retailer to adjust its order as better market information is received. Because no returns are required, these contracts can be more effective than buyback contracts when the cost of returns is high. When the supplier is selling to multiple retailers, these contracts are more effective than buyback contracts because they allow the supplier to aggregate uncertainties across multiple retailers and thus lower the level of excess inventory. Quantity flexibility contracts increase the average amount the retailer purchases and may increase total supply chain profits when structured appropriately.

Assume that the manufacturer incurs a production cost of $\$v$ per unit and charges a wholesale price of $\$c$ from the retailer. The retailer, in turn, sells to customers for a price of $\$p$. The retailer salvages any leftover units for s_R . The manufacturer salvages any leftover units for s_M . If retailer demand is normally distributed, with a mean of μ and a standard deviation of σ , we can evaluate the impact of a quantity flexibility contract. If the retailer orders O units, the manufacturer is committed to supplying Q units. As a result, we assume that the manufacturer produces Q units. The retailer purchases q units if demand D is less than q , D units if demand D is between q and Q , and Q units if demand D is greater than Q . In the following formulas, F_S is the standard normal cumulative distribution function and f_S is the standard normal density function discussed in Appendix 12A in Chapter 12. We thus obtain

$$\begin{aligned} \text{Expected quantity purchased by retailer, } Q_R &= qF(q) + Q[1 - F(Q)] \\ &\quad + \mu \left[F_s \left(\frac{Q - \mu}{\sigma} \right) - F_s \left(\frac{q - \mu}{\sigma} \right) \right] \\ &\quad - \sigma \left[f_s \left(\frac{Q - \mu}{\sigma} \right) - f_s \left(\frac{q - \mu}{\sigma} \right) \right] \end{aligned}$$

$$\begin{aligned} \text{Expected quantity sold by retailer, } D_R &= Q[1 - F(Q)] \\ &\quad + \mu F_s \left(\frac{Q - \mu}{\sigma} \right) - \sigma f_s \left(\frac{q - \mu}{\sigma} \right) \end{aligned}$$

$$\text{Expected overstock at manufacturer} = Q_R - D_R$$

$$\text{Expected retailer profit} = D_R \times p + (Q_R - D_R)s_R - Q_R \times c$$

$$\text{Expected manufacturer profit} = Q_R \times c + (Q - Q_R)s_M - Q \times v$$

EXAMPLE 15-4 Impact of Risk Sharing Through Quantity Flexibility

We return to the music store in Example 15-1 with all data as specified. The retailer is charged \$5 for each disc and has a retail price of \$10. Assume that the supplier agrees to a quantity flexibility

contract where the supplier agrees to $\alpha = 0.05$ and $\beta = 0.05$. For this contract, the retailer decides to place an order for 1,017 units. With the quantity flexibility clause, how many discs does the independent retailer expect to purchase? How many discs does the retailer expect to sell? What are the supply chain profits with a quantity flexibility clause?

Analysis:

In this case, we have $v = \$1$, $c = \$5$, $p = \$10$, $s_R = 0$, and $s_M = 0$. With the quantity flexibility clause as specified, and an order for $O = 1,017$ from the retailer, the manufacturer is committed to supplying any quantity between $q = (1 - \beta)O = (1 - 0.05) \times 1017 = 966$ units and $Q = (1 + \alpha)O = (1 + 0.05) \times 1017 = 1,068$ units. We thus obtain

Expected quantity purchased by retailer, $Q_R = 1,015$ units

Expected quantity sold by retailer, $D_R = 911$ units

Expected overstock at retailer = $Q_R - D_R = 1,015 - 911 = 104$ units

Expected retailer profit = $D_R \times p + (Q_R - D_R)s_R - Q_R \times c$
 $= 911 \times 10 + (1015 - 911) \times 0 - 1015 \times 5 = \$4,038$

Expected manufacturer profit = $Q_R \times c + (Q - Q_R)s_M - Q \times v$
 $= 1015 \times 5 + (1068 - 1015) \times 0 - 1068 \times 1 = \$4,007$

Given an order of 1,017 discs (which is adjusted between 966 and 1,068 based on actual demand), the total supply chain profit = $4,038 + 4,007 = \$8,045$.

Observe that risk sharing using a quantity flexibility clause with a flexibility of 5 percent above and below the order quantity increases profits for the retailer as well as the manufacturer (and the supply chain as a whole) compared with Example 15-1, in which there was no risk sharing.

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
 - Differences between direct and indirect materials are listed in Table 15.8
- ◆ 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

Product Categorization by Value and Criticality (Figure 15.1)

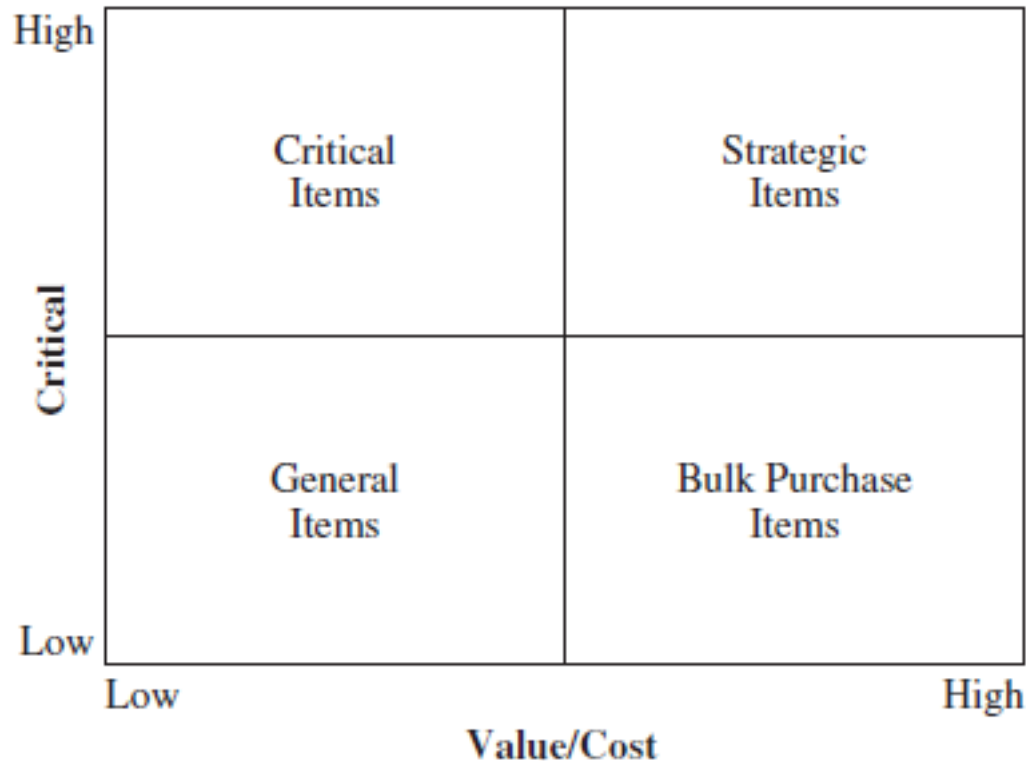


FIGURE 15-1 Product Categorization by Value and Criticality

In addition to the categorization of materials into direct and indirect, all products purchased may also be categorized as shown in Figure 15-1, based on their value/cost and how critical they are. Most indirect materials are included in general items. Direct materials can be further classified into bulk purchase, critical, and strategic items. For most bulk purchase items, such as packaging materials and bulk chemicals, suppliers tend to have the same selling price. It is thus important to make a distinction between suppliers based on the services they provide and their performance along all dimensions that affect the total cost of ownership. Critical items include specialty chemicals and components with long lead times. The key sourcing objective for critical items is not low price, but ensuring availability. The presence of a responsive, even if high-cost, supply source can be valuable for critical items. The last category, strategic items, includes examples such as electronics for an auto manufacturer. For strategic items, the buyer–supplier relationship is long term. Thus, suppliers should be evaluated based on the lifetime cost/value of the relationship. The goal should be to identify suppliers that can collaborate in the design phase and coordinate design and production activities with other players in the supply chain.

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 more expensive suppliers should be used to buffer against variation in demand and supply from the other source

Making Sourcing Decisions in Practice

- ◆ **1. *Use multifunctional teams.*** Effective strategies for sourcing result from multifunctional collaboration within the firm. A sourcing strategy from the purchasing group is likely to be relatively narrow and focus on purchase price.
- ◆ A strategy developed with the collaboration of purchasing, manufacturing, engineering, and planning is much more likely to identify the correct drivers of total cost.
- ◆ The collaboration must be continued beyond strategy formulation to the procurement phase, because that is where manufacturing and engineering are most likely to realize the full benefits of good sourcing strategy.

- ◆ **2. *Ensure appropriate coordination across regions and business units.*** Coordination of purchasing across all regions and business units allows a firm to maximize economies of scale in purchasing and also to reduce transaction costs.
- ◆ Other opportunities from improved sourcing, such as better supply chain coordination and design collaboration, however, may require strong involvement at the business-unit level to be effective.
- ◆ Mandating global coordination across all business units may complicate these efforts.

◆ **3. *Always evaluate the total cost of ownership.*** An effective sourcing strategy should not make price reduction its sole objective.

- ◆ All factors that influence the total cost of ownership should be identified and used in selecting suppliers.
- ◆ Supplier performance along all relevant dimensions should be measured, and its impact on total cost should be quantified.
- ◆ Focusing on the total cost of ownership also allows a buyer to better identify opportunities for better collaboration in design, planning, and fulfillment.

- ◆ **4. *Build long-term relationships with key suppliers.*** A basic principle of good sourcing is that a buyer and supplier working together can generate more opportunities for savings than the two parties working independently.
- ◆ Solid cooperation is likely to result only when the two parties have a long-term relationship and a degree of trust.
- ◆ A long-term relationship encourages the supplier to expend greater effort on issues that are important to a particular buyer.
- ◆ This includes investment in buyer-specific technology and design collaboration. A long-term relationship also improves communication and coordination between the two parties.
- ◆ These capabilities are very important when sourcing direct materials. Thus, long-term relationships should be nurtured with suppliers of critical and strategic direct materials.