

# CHAPTER 4

## DESIGNING DISTRIBUTION NETWORKS AND APPLICATIONS TO E-BUSINESS



### Learning Objectives

After reading this chapter, you will be able to:

1. Identify the key factors to be considered when designing a distribution network.
2. Discuss the strengths and weaknesses of various distribution options.
3. Understand how e-business has affected the design of distribution networks in different industries.

In this chapter, we provide an understanding of the role of distribution within a supply chain and identify factors that should be considered when designing a distribution network. We identify several potential designs for distribution networks and evaluate the strengths and weaknesses of each option. We apply these ideas to discuss the evolution of distribution networks in various industries since the advent of e-business. Our goal is to provide managers with a logical framework for selecting the appropriate distribution network given product, competitive, and market characteristics.

### 4.1 THE ROLE OF DISTRIBUTION IN THE SUPPLY CHAIN

*Distribution* refers to the steps taken to move and store a product from the supplier stage to a customer stage in the supply chain. Distribution occurs between every pair of stages in the supply chain. Raw materials and components are moved from suppliers to manufacturers, whereas finished products are moved from the manufacturer to the end consumer. Distribution is a key driver of the overall profitability of a firm because it affects both the supply chain cost and the customer experience directly. Distribution-related costs make up about 10.5 percent of the U.S. economy and about 20 percent of the cost of manufacturing. For commodity products, distribution forms an even higher fraction of the product cost. In India, the outbound distribution cost of cement is about 30 percent of the cost of producing and selling cement. X

It would be no exaggeration to state that two of the world's most profitable companies, Wal-Mart and Seven-Eleven Japan, have built the success of their entire business around outstanding distribution design and operation. In the case of Wal-Mart, distribution allows the company to provide high availability levels of relatively common products at a very low cost. In the case of Seven-Eleven Japan, effective distribution provides a very high level of customer responsiveness at a reasonable cost.

The appropriate distribution network can be used to achieve a variety of supply chain objectives ranging from low cost to high responsiveness. As a result, companies in the same industry often select very different distribution networks. Next, we discuss

industry examples that highlight the variety of distribution network choices and the issues that arise when selecting among these options.

Dell distributes its PCs directly to end consumers, whereas companies such as HP distribute through resellers. Dell customers wait several days to get a PC, whereas customers can walk away with an HP PC from a reseller. Gateway opened Gateway Country stores, where customers could examine the products and have salespeople help them configure a PC that suited their needs. Gateway, however, chose to sell no products at the stores; all PCs were shipped directly from the factory to the customer. In 2001, Gateway closed several of these stores because of their poor financial performance. Apple Computer, in contrast, has opened many retail stores where computers are sold. These PC companies have chosen different distribution models. How can we evaluate this wide range of distribution choices? Which ones serve the companies and their customers better?

P&G has chosen to distribute directly to large supermarket chains while obligating smaller players to buy P&G products from distributors. Products move directly from P&G to the larger chains, but move through an additional stage when going to smaller supermarkets. Texas Instruments, which once used only direct sales, now sells about 30 percent of its volume to 98 percent of its customers through distributors, while serving the remaining 2 percent of customers with 70 percent of the volume directly.<sup>1</sup> What value do these distributors provide? When should a distribution network include an additional stage such as a distributor? Proponents of e-business had predicted the death of intermediaries such as distributors. Why were they proved wrong in many industries? Distributors play a much more significant role for consumer goods distribution in a country such as India compared to the United States. Why might this be the case?

W.W. Grainger stocks about 100,000 SKUs that can be sent to customers within a day of order placement. The remaining, slower-moving products are not stocked but instead are shipped directly from the manufacturer when a customer places an order. It takes several days for the customer to receive the product in this case. Are these distribution choices appropriate? How can they be justified?

As the preceding examples illustrate, firms can make many different choices when designing their distribution network. A poor distribution network can hurt the level of service that customers receive while increasing the cost. An inappropriate network can have a significant negative effect on the profitability of the firm, as evident in the failure of many business-to-consumer (B2C) companies such as Webvan. The appropriate choice of distribution network results in customer needs being satisfied at the lowest possible cost.

In the next section, we identify performance measures that need to be considered when designing the distribution network.

## 4.2 FACTORS INFLUENCING DISTRIBUTION NETWORK DESIGN

At the highest level, performance of a distribution network should be evaluated along two dimensions:

1. Customer needs that are met
2. Cost of meeting customer needs

<sup>1</sup>A Tale of Two Electronic Component Distributors, Ananth Raman and Bharat P. Rao, Harvard Business School Case 9-697-064, 1997.

Thus, a firm must evaluate the impact on customer service and cost as it compares different distribution network options. The customer needs that are met influence the company's revenues, which along with cost decide the profitability of the delivery network.

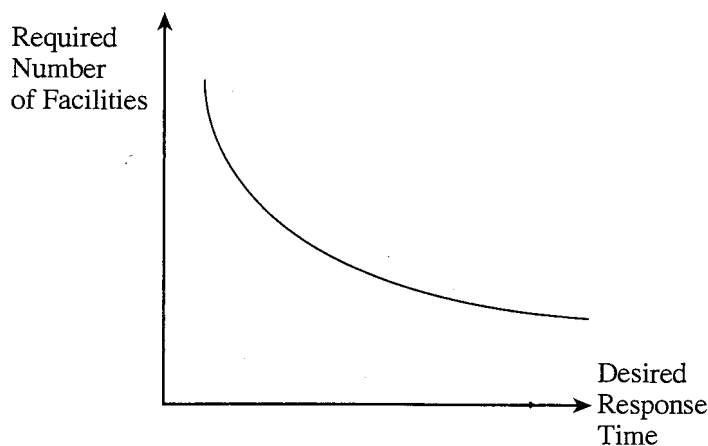
Although customer service consists of many components, we focus on those measures that are influenced by the structure of the distribution network. These include:

- Response time
- Product variety
- Product availability
- Customer experience
- Time to market
- Order visibility
- Returnability

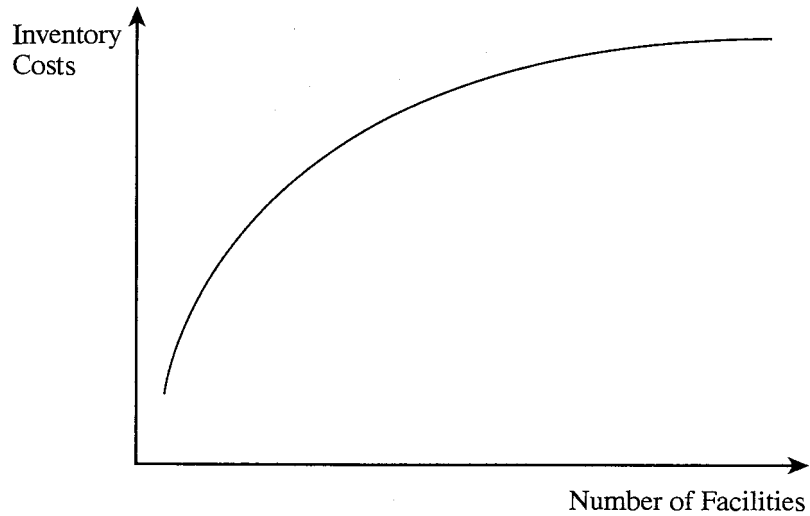
Response time is the amount of time it takes for a customer to receive an order. Product variety is the number of different products/configurations that are offered by the distribution network. Product availability is the probability of having a product in stock when a customer order arrives. Customer experience includes the ease with which customers can place and receive orders as well as the extent to which this experience is customized. It also includes purely experiential aspects, such as the possibility of getting a cup of coffee and the value that the sales staff provides. Time to market is the time it takes to bring a new product to the market. Order visibility is the ability of customers to track their orders from placement to delivery. Returnability is the ease with which a customer can return unsatisfactory merchandise and the ability of the network to handle such returns.

It may seem at first that a customer always wants the highest level of performance along all these dimensions. In practice, however, this is not the case. Customers ordering a book at Amazon.com are willing to wait longer than those who drive to a nearby Borders store to get the same book. In contrast, customers can find a much larger variety of books at Amazon compared to the Borders store. Thus, Amazon customers trade off fast response times for high levels of variety.

Firms that target customers who can tolerate a long response time require only a few locations that may be far from the customer. These companies can focus on increasing the capacity of each location. In contrast, firms that target customers who value short response times need to locate facilities close to them. These firms must have many facilities, each with a low capacity. Thus, a decrease in the response time customers desire increases the number of facilities required in the network, as shown in Figure 4-1.



**FIGURE 4-1**  
Relationship Between  
Desired Response Time  
and Number of Facilities

**FIGURE 4-2** Relationship Between Number of Facilities and Inventory Costs

For example, Borders provides its customers with books on the same day but requires about 400 stores to achieve this goal for most of the United States. Amazon, in contrast, takes about a week to deliver a book to its customers, but uses only about six locations to store its books.

Changing the distribution network design affects the following supply chain costs (notice that these are four of the six supply chain drivers we discussed earlier):

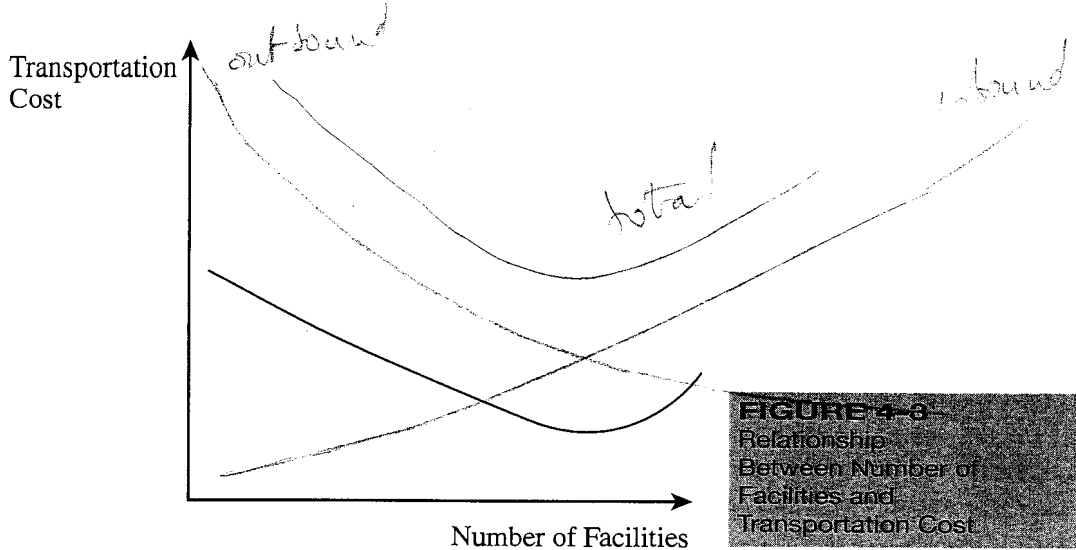
- Inventories
- Transportation
- Facilities and handling
- Information

SC costs  
influenced by  
distribution  
network

The other two drivers, sourcing and pricing, also affect the choice of the distribution system; the link will be discussed when relevant. As the number of facilities in a supply chain increases, the inventory and resulting inventory costs also increase (see Chapter 11), as shown in Figure 4-2.

To decrease inventory costs, firms try to consolidate and limit the number of facilities in their supply chain network. For example, with fewer facilities, Amazon is able to turn its inventory about 12 times a year, whereas Borders, with about 400 facilities, achieves only about two turns per year.

*Inbound transportation costs* are the costs incurred in bringing material into a facility. *Outbound transportation costs* are the costs of sending material out of a facility. Outbound transportation costs per unit tend to be higher than inbound costs because inbound lot sizes are typically larger. For example, the Amazon warehouse receives full truckload shipments of books on the inbound side, but ships out small packages with only a few books per customer on the outbound side. Increasing the number of warehouse locations decreases the average outbound distance to the customer and makes outbound transportation distance a smaller fraction of the total distance traveled by the product. Thus, as long as inbound transportation economies of scale are maintained, increasing the number of facilities decreases total transportation cost, as shown in Figure 4-3. If the number of facilities is increased to a point where inbound lot sizes



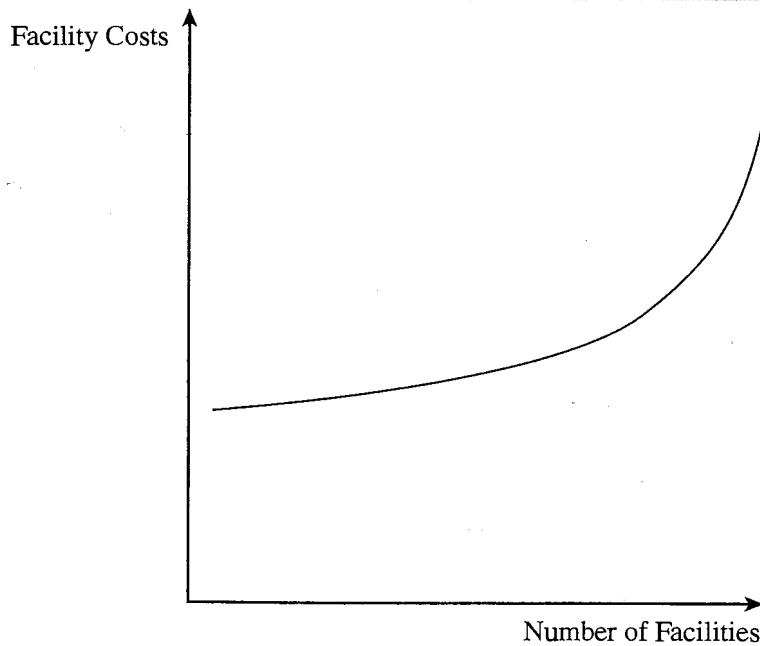
**FIGURE 4-3**  
Relationship  
Between Number of  
Facilities and  
Transportation Cost

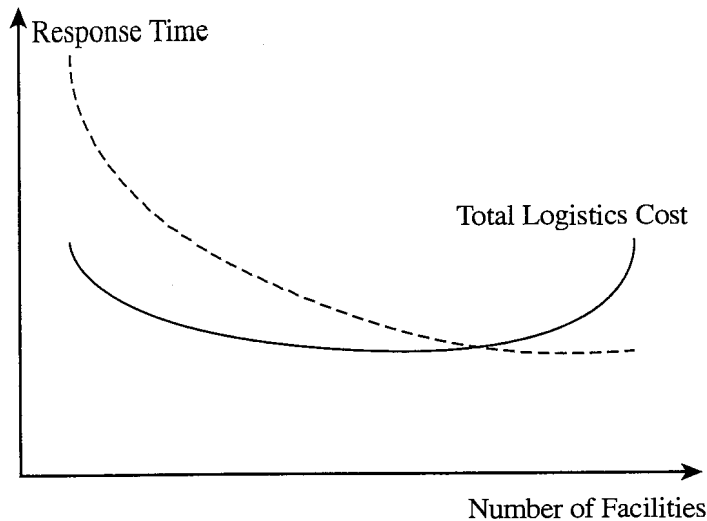
are also very small and result in a significant loss of economies of scale in inbound transportation, increasing the number of facilities increases total transportation cost, as shown in Figure 4-3.

Facility costs decrease as the number of facilities is reduced, as shown in Figure 4-4, because a consolidation of facilities allows a firm to exploit economies of scale.

Total logistics costs are the sum of inventory, transportation, and facility costs for a supply chain network. As the number of facilities increases, total logistics costs first decrease and then increase as shown in Figure 4-5. Each firm should have *at least* the number of facilities that minimize total logistics costs. For example, Amazon has more

**FIGURE 4-4** Relationship Between Number of Facilities and Facility Costs





**FIGURE 4-5**  
Variation in Logistics Cost  
and Response Time with  
Number of Facilities

than one warehouse primarily to reduce its logistics costs (and improve response time). As a firm wants to reduce the response time to its customers further, it may have to increase the number of facilities beyond the point that minimizes logistics costs. A firm should add facilities beyond the cost-minimizing point only if managers are confident that the increase in revenues because of better responsiveness is greater than the increase in costs because of the additional facilities.

The customer service and cost components listed earlier are the primary measures used to evaluate different delivery network designs. In general, no distribution network will outperform others along all dimensions. Thus, it is important to ensure that the strengths of the distribution network fit with the strategic position of the firm.

In the next section, we discuss various distribution networks and their relative strengths and weaknesses.

### 4.3 DESIGN OPTIONS FOR A DISTRIBUTION NETWORK

In this section, we discuss distribution network choices from the manufacturer to the end consumer. When considering distribution between any other pair of stages, such as supplier to manufacturer or even a service company serving its customers through a distribution network, many of the same options still apply. Managers must make two key decisions when designing a distribution network:

1. Will product be delivered to the customer location or picked up from a preordained site?
2. Will product flow through an intermediary (or intermediate location)?

Based on the firm's industry and the answers to these two questions, one of six distinct distribution network designs may be used to move products from factory to customer, which are classified as follows:

1. Manufacturer storage with direct shipping
2. Manufacturer storage with direct shipping and in-transit merge
3. Distributor storage with package carrier delivery

4. Distributor storage with last-mile delivery
5. Manufacturer/distributor storage with customer pickup
6. Retail storage with customer pickup

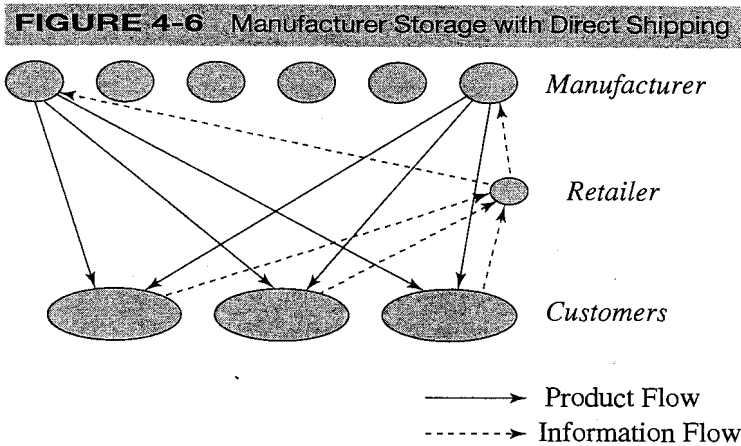
Next we describe each distribution option and discuss its strengths and weaknesses.

**MANUFACTURER STORAGE WITH DIRECT SHIPPING**

In this option, product is shipped directly from the manufacturer to the end customer, bypassing the retailer (who takes the order and initiates the delivery request). This option is also referred to as drop-shipping, with product delivered directly from the manufacturer to the customer. The retailer, if independent of the manufacturer, carries no inventories. Information flows from the customer, via the retailer, to the manufacturer, and product is shipped directly from the manufacturer to customers as shown in Figure 4-6. Online retailers such as eBags and Nordstrom.com use drop-shipping to deliver goods to the end consumer. eBags holds few bags in inventory. Nordstrom carries some products in inventory and uses the drop-ship model for slow-moving footwear. W.W. Grainger also uses drop-shipping to deliver slow-moving items to customers.

The biggest advantage of drop-shipping is the ability to centralize inventories at the manufacturer. A manufacturer can aggregate demand across all retailers that it supplies. As a result, the supply chain is able to provide a high level of product availability with lower levels of inventory. A key issue with regard to drop-shipping is the ownership structure of the inventory at the manufacturer. If specified portions of inventory at the manufacturer are allocated to individual retailers, there is little benefit of aggregation even though the inventory is physically aggregated. Benefit of aggregation is achieved only if the manufacturer can allocate at least a portion of the available inventory across retailers on an as-needed basis. The benefits from centralization are highest for high-value, low-demand items with unpredictable demand. The decision of Nordstrom to drop-ship low-demand shoes satisfies these criteria. Similarly, bags sold by eBags tend to have high value and relatively low demand per SKU. The inventory benefits of aggregation are small for items with predictable demand and low value. Thus, drop-shipping does not offer a significant inventory advantage to an online grocer selling a staple item such as detergent. For slow-moving items, inventory turns can increase by a factor of 6 or higher if drop-shipping is used instead of storage at retail stores.

Drop-shipping also offers the manufacturer the opportunity to postpone customization until after a customer has placed an order. Postponement, if implemented,



further lowers inventories by aggregating to the component level. Build-to-order companies such as Dell hold inventories as common components and postpone product customization, thus lowering the level of inventory carried.

Although inventory costs are typically low with drop-shipping, transportation costs are high because the average outbound distance to the end consumer is large, and package carriers are used to ship the product. Package carriers have high shipping costs per unit compared to truckload or less-than-truckload carriers. With drop-shipping, a customer order including items from several manufacturers will involve multiple shipments to the customer. This loss in aggregation of outbound transportation increases cost.

Supply chains save on the fixed cost of facilities when using drop-shipping because all inventories are centralized at the manufacturer. This eliminates the need for other warehousing space in the supply chain. There can be some savings of handling costs as well, because the transfer from manufacturer to retailer no longer occurs. Handling cost savings must be evaluated carefully, however, because the manufacturer is now required to transfer items to the factory warehouse in full cases and then ship out from the warehouse in single units. The inability of a manufacturer to develop single-unit delivery capabilities can have a significant negative effect on handling cost and response time. Handling costs can be reduced significantly if the manufacturer has the capability to ship orders directly from the production line.

A good information infrastructure is needed between the retailers and the manufacturer so that the retailer can provide product availability information to the customer, even though the inventory is located at the manufacturer. The customer should also have visibility into order processing at the manufacturer, even with the order being placed with the retailer. Drop-shipping generally requires significant investment in information infrastructure. The information infrastructure requirement is somewhat simpler for direct sellers like Dell because two stages (retailer and manufacturer) do not need to be integrated.

Response times tend to be long when drop-shipping is used because the order has to be transmitted from the retailer to the manufacturer and shipping distances are generally longer from the manufacturer's centralized site. eBags, for example, states that order processing may take from one to five days and ground transportation after that may take from three to 11 business days. This implies that customer response time at eBags will be four to 16 days using ground transportation and drop-shipping.

Another issue is that the response time need not be identical for every manufacturer that is part of a customer order. Given an order containing products from several sources, the customer will receive multiple partial shipments over time, making receiving more complicated for the customer.

Manufacturer storage allows a high level of product variety to be available to the customer. With a drop-shipping model, every product at the manufacturer can be made available to the customer without any limits imposed by shelf space. W.W. Grainger is able to offer hundreds of thousands of slow-moving items from thousands of manufacturers using drop-shipping. This would be impossible if each product had to be stored by W.W. Grainger. Drop-shipping allows a new product to be available to the market the day the first unit is produced.

Drop-shipping provides a good customer experience in the form of delivery to the customer location. The experience, however, suffers when a single order containing products from several manufacturers is delivered in partial shipments.

Order visibility is very important in the context of manufacturer storage, because two stages in the supply chain are involved in every customer order. Failure to provide this capability is likely to have a significant negative effect on customer satisfaction.



Order tracking, however, becomes harder to implement in a drop-ship system because it requires complete integration of information systems at both the retailer and the manufacturer. For direct sellers such as Dell, order visibility is simpler to provide.

A manufacturer storage network is likely to have difficulty handling returns, hurting customer satisfaction. The handling of returns is more expensive under drop-shipping because each order may involve shipments from more than one manufacturer. There are two ways that returns can be handled. One is for the customer to return the product directly to the manufacturer. The second approach is for the retailer to set up a separate facility (across all manufacturers) to handle returns. The first approach incurs high transportation and coordination costs, whereas the second approach requires investment in a facility to handle returns.

The performance characteristics of drop-shipping along various dimensions are summarized in Table 4-1.

Given its performance characteristics, manufacturer storage with direct shipping is best suited for a large variety of low-demand, high-value items for which customers are willing to wait for delivery and accept several partial shipments. Manufacturer storage is also suitable if it allows the manufacturer to postpone customization, thus reducing inventories. For drop-shipping to be effective, there should be few sourcing locations per order. It is thus ideal for direct sellers that are able to build-to-order. Drop-shipping will be hard to implement if there are more than 20 or 30 sourcing locations that have to ship directly to customers on a regular basis. For products with very low demand, however, drop-shipping may be the only option.

**TABLE 4-1** Performance Characteristics of Manufacturer Storage with Direct Shipping Network

<i>Cost Factor</i>	<i>Performance</i>
Inventory	Lower costs because of aggregation. Benefits of aggregation are highest for low-demand, high-value items. Benefits are very large if product customization can be postponed at the manufacturer.
Transportation	Higher transportation costs because of increased distance and disaggregate shipping.
Facilities and handling	Lower facility costs because of aggregation. Some saving on handling costs if manufacturer can manage small shipments or ship from production line.
Information	Significant investment in information infrastructure to integrate manufacturer and retailer.
<i>Service Factor</i>	<i>Performance</i>
Response time	Long response time of one to two weeks because of increased distance and two stages for order processing. Response time may vary by product, thus complicating receiving.
Product variety	Easy to provide a very high level of variety.
Product availability	Easy to provide a high level of product availability because of aggregation at manufacturer.
Customer experience	Good in terms of home delivery but can suffer if order from several manufacturers is sent as partial shipments.
Time to market	Fast, with the product available as soon as the first unit is produced.
Order visibility	More difficult but also more important from a customer service perspective.
Returnability	Expensive and difficult to implement.

### MANUFACTURER STORAGE WITH DIRECT SHIPPING AND IN-TRANSIT MERGE

Unlike pure drop-shipping, under which each product in the order is sent directly from its manufacturer to the end customer, in-transit merge combines pieces of the order coming from different locations so that the customer gets a single delivery. Information and product flows for the in-transit merge network are as shown in Figure 4-7. In-transit merge has been used by direct sellers such as Dell and can be used by companies implementing drop-shipping. When a customer orders a PC from Dell along with a Sony monitor, the package carrier picks up the PC from the Dell factory and the monitor from the Sony factory; it then merges the two together at a hub before making a single delivery to the customer.

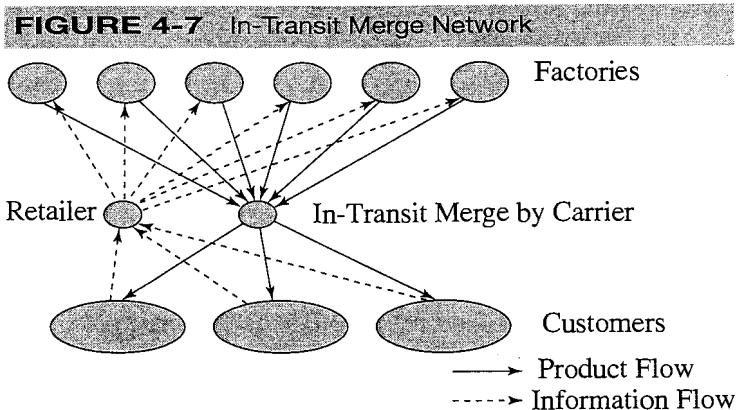
As with drop-shipping, the ability to aggregate inventories and postpone product customization is a significant advantage of in-transit merge. In-transit merge allows Dell and Sony to hold all their inventories at the factory. This approach has the greatest benefits for products with high value whose demand is difficult to forecast, particularly if product customization can be postponed.

In most cases, transportation costs are lower than with drop-shipping because of the merge that takes place at the carrier hub before delivery to the customer, although an increase in coordination is required. An order with products from three manufacturers thus requires only one delivery to the customer, compared to three that would be required with drop-shipping. Fewer deliveries save transportation cost and simplify receiving.

Facility and processing costs for the manufacturer and the retailer are similar to those for drop-shipping. The party performing the in-transit merge has higher facility costs because of the merge capability required. Receiving costs at the customer are lower because a single delivery is received. Overall supply chain facility and handling costs are somewhat higher than with drop-shipping.

A very sophisticated information infrastructure is needed to allow in-transit merge. In addition to information, operations at the retailer, manufacturers, and the carrier must be coordinated. The investment in information infrastructure is higher than for drop-shipping.

Response times, product variety, availability, and time to market are similar to drop-shipping. Response times may be marginally higher because of the need to perform the merge. Customer experience is likely to be better than with drop-shipping, because the customer receives only one delivery for an order instead of many partial



**TABLE 4-2** Performance Characteristics of In-Transit Merge

<i>Cost Factor</i>	<i>Performance</i>
Inventory	Similar to drop-shipping.
Transportation	Somewhat lower transportation costs than drop-shipping.
Facilities and handling	Handling costs higher than drop-shipping at carrier; receiving costs lower at customer.
Information	Investment is somewhat higher than for drop-shipping.
<i>Service Factor</i>	<i>Performance</i>
Response time	Similar to drop-shipping; may be marginally higher.
Product variety	Similar to drop-shipping.
Product availability	Similar to drop-shipping.
Customer experience	Better than drop-shipping because a single delivery has to be received.
Time to market	Similar to drop-shipping
Order visibility	Similar to drop-shipping.
Returnability	Similar to drop-shipping.

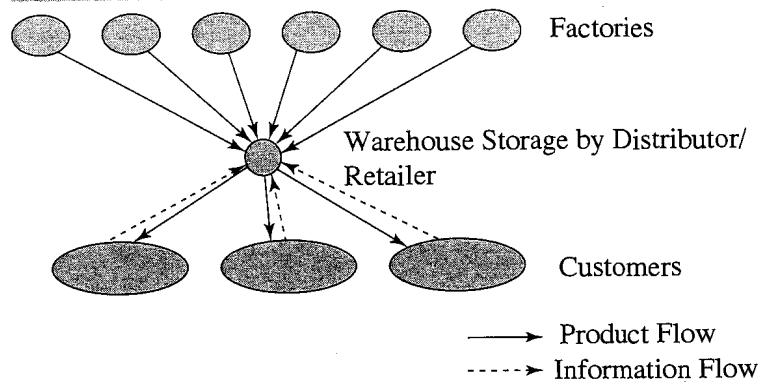
shipments. Order visibility is a very important requirement. Although the initial setup is difficult because it requires integration of manufacturer, carrier, and retailer, tracking itself becomes easier given the merge that occurs at the carrier hub. Up to the point of merge, the order from each manufacturer is tracked separately. After that, the order can be tracked as a single unit.

Returnability is similar to that with drop-shipping. Problems in handling returns are very likely, and the reverse supply chain will continue to be expensive and difficult to implement, as with drop-shipping.

The performance of factory storage with in-transit merge is compared with that of drop-shipping in Table 4-2. The main advantages of in-transit merge over drop-shipping are lower transportation cost and improved customer experience. The major disadvantage is the additional effort during the merge itself. Given its performance characteristics, manufacturer storage with in-transit merge is best suited for low- to medium-demand, high-value items the retailer is sourcing from a limited number of manufacturers. Compared to drop-shipping, in-transit merge requires a higher demand from each manufacturer (not necessarily each product) in order to be effective. When there are too many sources, in-transit merge can be very difficult to coordinate and implement. In-transit merge is best implemented if there are no more than four or five sourcing locations. The in-transit merge of a Dell PC with a Sony monitor is appropriate because product variety is high but there are few sourcing locations with relatively large total demand from each sourcing location.

#### **DISTRIBUTOR STORAGE WITH CARRIER DELIVERY**

Under this option, inventory is not held by manufacturers at the factories but is held by distributors/retailers in intermediate warehouses, and package carriers are used to transport products from the intermediate location to the final customer. Amazon, as well as industrial distributors such as W.W. Grainger and McMaster-Carr, have used this approach combined with drop-shipping from a manufacturer (or distributor). Information and product flows when using distributor storage with delivery by a package carrier are shown in Figure 4-8.

**FIGURE 4-8** Distributor Storage with Carrier Delivery

Relative to manufacturer storage, distributor storage requires a higher level of inventory, as the distributor/retailer warehouse generally aggregates demand uncertainty at a lower level than the manufacturer that is able to aggregate demand across all distributors/retailers. From an inventory perspective, distributor storage makes sense for products with somewhat higher demand. This is seen in the operations of both Amazon and W.W. Grainger. They stock only the medium- to fast-moving items at their warehouses, with slower-moving items stocked farther upstream. In some instances, postponement can be implemented with distributor storage, but it does require that the warehouse develop some assembly capability. Distributor storage, however, requires much less inventory than a retail network. Amazon achieves about 12 turns of inventory annually using warehouse storage, whereas Borders achieves about two turns using retail stores.

Transportation costs are somewhat lower for distributor storage compared to manufacturer storage because an economic mode of transportation (e.g., truckloads) can be employed for inbound shipments to the warehouse, which is closer to the customer. Unlike manufacturer storage, under which multiple shipments may need to go out for a single customer order with multiple items, distributor storage allows outbound orders to the customer to be bundled into a single shipment, further reducing transportation cost. Distributor storage provides savings on the transportation of faster-moving items relative to manufacturer storage.

Compared to manufacturer storage, facility costs (of warehousing) are somewhat higher with distributor storage because of a loss of aggregation. Processing and handling costs are comparable to manufacturer storage unless the factory is able to ship to the end customer directly from the production line. In that case, distributor storage has higher processing costs. From a facility cost perspective, distributor storage is not appropriate for extremely slow-moving items.

The information infrastructure needed with distributor storage is significantly less complex than that needed with manufacturer storage. The distributor warehouse serves as a buffer between the customer and the manufacturer, decreasing the need to coordinate the two completely. Real-time visibility between customers and the warehouse is needed, whereas real-time visibility between the customer and the manufacturer is not. Visibility between the distributor warehouse and manufacturer can be achieved at a much lower cost than real-time visibility between the customer and manufacturer.

Response time under distributor storage is better than under manufacturer storage because distributor warehouses are, on average, closer to customers and the entire

**TABLE 4-3** Performance Characteristics of Distributor Storage with Carrier Delivery

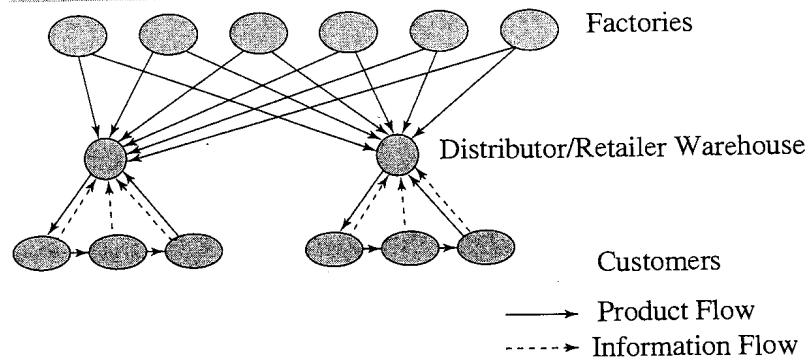
<i>Cost Factor</i>	<i>Performance</i>
Inventory	Higher than manufacturer storage. Difference is not large for faster-moving items.
Transportation	Lower than manufacturer storage. Reduction is highest for faster-moving items.
Facilities and handling	Somewhat higher than manufacturer storage. The difference can be large for very slow-moving items.
Information	Simpler infrastructure compared to manufacturer storage.
<i>Service Factor</i>	<i>Performance</i>
Response time	Faster than manufacturer storage.
Product variety	Lower than manufacturer storage.
Product availability	Higher cost to provide the same level of availability as manufacturer storage.
Customer experience	Better than manufacturer storage with drop-shipping.
Time to market	Higher than manufacturer storage.
Order visibility	Easier than manufacturer storage.
Returnability	Easier than manufacturer storage.

order is aggregated at the warehouse before being shipped. Amazon, for example, processes most warehouse-stored items within a day and then it takes three to seven business days using ground transportation for the order to reach the customer. W.W. Grainger processes customer orders on the same day and has enough warehouses to deliver most orders the next day using ground transport. Warehouse storage limits to some extent the variety of products that can be offered. W.W. Grainger does not store very-low-demand items at its warehouse, relying on manufacturers to drop-ship those products to the customer. Customer convenience is high with distributor storage because a single shipment reaches the customer in response to an order. Time to market under distributor storage is somewhat higher than under manufacturer storage because of the need to stock another stage in the supply chain. Order visibility becomes easier than with manufacturer storage because there is a single shipment from the warehouse to the customer and only one stage of the supply chain is involved directly in filling the customer order. Returnability is better than with manufacturer storage because all returns can be processed at the warehouse itself. The customer also has to return only one package, even if the items are from several manufacturers.

The performance of distributor storage with carrier delivery is summarized in Table 4-3. Distributor storage with carrier delivery is well suited for medium- to fast-moving items. Distributor storage also makes sense when customers want delivery faster than is offered by manufacturer storage but do not need it immediately. Distributor storage can handle somewhat lower variety than manufacturer storage but can handle a much higher level of variety than a chain of retail stores.

#### **DISTRIBUTOR STORAGE WITH LAST-MILE DELIVERY**

Last-mile delivery refers to the distributor/retailer delivering the product to the customer's home instead of using a package carrier. Webvan, Peapod, and Albertsons have used last-mile delivery in the grocery industry. Companies such as Kozmo and Urbanfetch tried to set up home-delivery networks for a variety of products but failed

**FIGURE 4-9** Distributor Storage with Last-Mile Delivery

to survive. Unlike package carrier delivery, last-mile delivery requires the distributor warehouse to be much closer to the customer. Given the limited radius that can be served with last-mile delivery, more warehouses are required compared to the case when package delivery is used. The warehouse storage with last-mile delivery network is as shown in Figure 4-9.

Distributor storage with last-mile delivery requires higher levels of inventory than the other options (except for retail stores) because it has a lower level of aggregation. From an inventory perspective, warehouse storage with last-mile delivery is suitable for relatively fast-moving items for which disaggregation does not lead to a significant increase of inventory. Staple items in the grocery industry fit this description.

Among all the distribution networks, transportation costs are highest for last-mile delivery. This is because package carriers aggregate delivery across many retailers and are able to obtain better economies of scale than are available to a distributor/retailer attempting last-mile delivery. Delivery costs (including transportation and processing) can be about \$30 to \$40 per home delivery in the grocery industry. Last-mile delivery may be somewhat less expensive in large, dense cities. Transportation costs may also be justifiable for bulky products for which the customer is willing to pay for home delivery. Home delivery of water and large bags of rice has proved quite successful in China, where the high population density has helped decrease delivery costs.

Facility and processing costs are very high using this option, given the large number of facilities required. Facility costs are somewhat lower than for a network with retail stores but much higher than for either manufacturer storage or distributor storage with package carrier delivery. Processing costs, however, are much higher than for a network of retail stores because all customer participation is eliminated. A grocery store using last-mile delivery performs all the processing until the product is delivered to the customer's home, unlike a supermarket, where there is much more customer participation.

The information infrastructure with last-mile delivery is similar to that for distributor storage with package carrier delivery. However, it requires the additional capability of scheduling deliveries.

Response times are faster than using package carriers. Kozmo and Urbanfetch tried to provide same-day delivery, whereas online grocers typically provide next-day delivery. Product variety is generally lower than for distributor storage with carrier delivery. The cost of providing product availability is higher than for every option other than retail stores. The customer experience can be very good using this

**TABLE 4-4** Performance Characteristics of Distributor Storage with Last-Mile Delivery

<i>Cost Factor</i>	<i>Performance</i>
Inventory	Higher than distributor storage with package carrier delivery.
Transportation	Very high cost given minimal scale economies. Higher than any other distribution option.
Facilities and handling	Facility costs higher than manufacturer storage or distributor storage with package carrier delivery, but lower than a chain of retail stores.
Information	Similar to distributor storage with package carrier delivery.
<i>Service Factor</i>	<i>Performance</i>
Response time	Very quick. Same day to next-day delivery.
Product variety	Somewhat less than distributor storage with package carrier delivery but larger than retail stores.
Product availability	More expensive to provide availability than any other option except retail stores.
Customer experience	Very good, particularly for bulky items.
Time to market	Slightly higher than distributor storage with package carrier delivery.
Order traceability	Less of an issue and easier to implement than manufacturer storage or distributor storage with package carrier delivery.
Returnability	Easier to implement than other options. Harder and more expensive than a retail network.

option, particularly for bulky, hard-to-carry items. Time to market is even higher than for distributor storage with package carrier delivery because the new product has to penetrate deeper before it is available to the customer. Order visibility is less of an issue given that deliveries are made within 24 hours. The order-tracking feature does become important to handle exceptions in case of incomplete or undelivered orders. Of all the options discussed, returnability is best with last-mile delivery, because trucks making deliveries can also pick up returns from customers. Returns are still more expensive to handle than at a retail store, where a customer can bring the product back.

The performance characteristics of distributor storage with last-mile delivery are summarized in Table 4-4. In areas with high labor costs, it is very hard to justify distributor storage with last-mile delivery on the basis of efficiency or improved margin. It can only be justified if there is a large enough customer segment willing to pay for this convenience. In that case, an effort should be made to couple last-mile delivery with an existing distribution network to exploit economies of scale and improve utilization. An example is Albertsons' use of existing grocery store facilities and labor to provide home delivery. A portion of the grocery store serves as a fulfillment center for online orders as well as a replenishment center for the grocery store itself. This helps improve utilization and lower the cost of providing this service. Last-mile delivery may be justifiable if customer orders are large enough to provide some economies of scale. Peapod has changed its pricing policies to reflect this idea. Minimum order sizes are for \$50 (with a delivery charge of \$9.95), and free delivery is no longer provided for orders of any size. Peapod offers discounts for deliveries during slower periods based on what its schedule looks like. To be profitable, home delivery companies almost definitely have to eliminate free delivery.

### MANUFACTURER OR DISTRIBUTOR STORAGE WITH CUSTOMER PICKUP

In this approach, inventory is stored at the manufacturer or distributor warehouse but customers place their orders online or on the phone and then travel to designated pickup points to collect their merchandise. Orders are shipped from the storage site to the pickup points as needed. Examples include 7dream.com, operated by Seven-Eleven Japan, which allows customers to pick up online orders at a designated store. A business-to-business (B2B) example is W.W. Grainger, whose customers can pick up their orders at one of the W.W. Grainger retail outlets. In the case of 7dream.com, the order is delivered from a manufacturer or distributor warehouse to the pickup location. In the case of W.W. Grainger, some items are stored at the pickup location, whereas others may come from a central location. The information and product flows in the network for Seven-Eleven Japan are as shown in Figure 4-10.

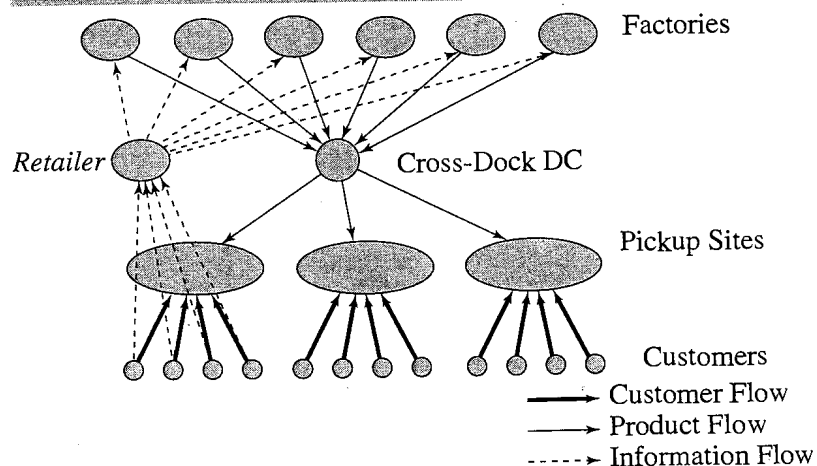
Seven-Eleven has distribution centers where product from manufacturers is cross-docked and sent to retail outlets on a daily basis. A retailer delivering an online order can be treated as one of the manufacturers, with deliveries cross-docked and sent to the appropriate Seven-Eleven outlet. Serving as an outlet for online orders allows Seven-Eleven to improve utilization of its existing logistical assets.

Inventory costs using this approach can be kept low, with either manufacturer or distributor storage to exploit aggregation. W.W. Grainger keeps its inventory of fast-moving items at pickup locations, whereas slow-moving items are stocked at a central warehouse, or in some cases at the manufacturer.

Transportation cost is lower than for any solution using package carriers because significant aggregation is possible when delivering orders to a pickup site. This allows the use of truckload or less-than-truckload carriers to transport orders to the pickup site. For a company such as Seven-Eleven Japan, the marginal increase in transportation cost is small because trucks are already making deliveries to the stores and their utilization can be improved by including online orders.

Facility costs are high if new pickup sites have to be built. A solution using existing sites can lower the additional facility costs. This, for example, is the case with 7dream.com and W.W. Grainger, for which the stores already exist. Processing costs at the manufacturer or the warehouse are comparable to those of other solutions. Processing costs at the pickup site are high because each order must be matched with a specific customer when

**FIGURE 4-10** Manufacturer or Distributor Warehouse Storage with Consumer Pickup





he or she arrives. Creating this capability can increase processing costs significantly if appropriate storage and information systems are not provided. Increased processing cost at the pickup site is the biggest hurdle to the success of this approach.

A significant information infrastructure is needed to provide visibility of the order until the customer picks it up. Very good coordination is needed among the retailer, the storage location, and the pickup location.

In this case, a response time comparable to that using package carriers can be achieved. Variety and availability comparable to any manufacturer or distributor storage option can be provided. There is some loss of customer experience, because unlike the other options discussed, customers must pick up their own orders. On the other hand, customers who do not want to pay online can pay by cash using this option. In countries like Japan, where Seven-Eleven has more than 10,000 outlets, it can be argued that the loss of customer convenience is small, because most customers are close to a pickup site and can collect an order at their convenience. In some cases, this option is considered more convenient because it does not require the customer to be at home at the time of delivery. Time to market for new products can be as short as with manufacturer storage.

Order visibility is extremely important for customer pickups. The customer must be informed when the order has arrived, and the order should be easily identified once the customer arrives to pick it up. Such a system is hard to implement because it requires integration of several stages in the supply chain. Returns can potentially be handled at the pickup site. The problem with some existing sites such as Seven-Eleven stores is that they are not equipped to accept and process returns for products not sold at the stores. From a transportation perspective, however, return flows can be handled using the delivery trucks. For customers, returning a product is easy because they have a physical location to bring it to. Overall, returnability is fairly good using this option.

The performance characteristics of manufacturer or distributor storage with consumer pickup sites are summarized in Table 4-5. The main advantages of a network

**TABLE 4-5** Performance Characteristics of Network with Consumer Pickup Sites

<i>Cost Factor</i>	<i>Performance</i>
Inventory	Can match any other option, depending on the location of inventory.
Transportation	Lower than the use of package carriers, especially if using an existing delivery network.
Facilities and handling	Facility costs can be very high if new facilities have to be built. Costs are lower if existing facilities are used. The increase in handling cost at the pickup site can be significant.
Information	Significant investment in infrastructure required
<i>Service Factor</i>	<i>Performance</i>
Response time	Similar to package carrier delivery with manufacturer or distributor storage. Same-day delivery possible for items stored locally at pickup site.
Product variety	Similar to other manufacturer or distributor storage options.
Product availability	Similar to other manufacturer or distributor storage options.
Customer experience	Lower than other options because of the lack of home delivery. In areas with high density of population, loss of convenience may be small.
Time to market	Similar to manufacturer storage options.
Order visibility	Difficult but essential.
Returnability	Somewhat easier given that pickup location can handle returns.

with consumer pickup sites is that it can lower the delivery cost and expand the set of products sold as well as customers served online. The major hurdle is the increased handling cost at the pickup site. Such a network is likely to be most effective if existing locations such as coffee shops, convenience stores, or grocery stores are used as pickup sites, because this type of network improves the economies from existing infrastructure. Unfortunately, such sites are typically designed to allow the customer to do the picking and need to develop the capability of picking a customer-specific order.

#### **RETAIL STORAGE WITH CUSTOMER PICKUP**

In this option, often viewed as the most traditional type of supply chain, inventory is stored locally at retail stores. Customers walk into the retail store or place an order online or by phone and pick it up at the retail store. Examples of companies that offer multiple options of order placement include Albertsons, which uses part of the facility as a grocery store and part of the facility as an online fulfillment center. Customers can walk into the store or order online. A B2B example is W.W. Grainger: Customers can order online, by phone, or in person and pick up their order at one of W.W. Grainger's retail outlets. Albertsons keeps its inventory at the pickup location itself. W.W. Grainger stores some items at the pickup locations whereas others may come from a central location.

Local storage increases inventory costs because of the lack of aggregation. For very fast-moving items, however, there is marginal increase in inventory even with local storage. Albertsons uses local storage because most of its products are relatively fast moving and are stocked at the supermarket in any case. Similarly, W.W. Grainger keeps its inventory of fast-moving items at pickup locations, whereas slow-moving items are stocked at a central warehouse.

Transportation cost is much lower than with other solutions because inexpensive modes of transport can be used to replenish product at the retail store. Facility costs are high because many local facilities are required. A minimal information infrastructure is needed if customers walk into the store and place orders. For online orders, however, a significant information infrastructure is needed to provide visibility of the order until the customer picks it up.

Very good response times can be achieved with this system because of local storage. For example, both Albertsons and W.W. Grainger offer same-day pickup from their retail locations. Product variety stored locally is lower than under other options. It is more expensive than with all other options to provide a high level of product availability. Customer experience depends on whether the customer likes to shop or not. Time to market is the highest with this option because the new product has to penetrate through the entire supply chain before it is available to customers. Order visibility is extremely important for customer pickups when orders are placed online or by phone. Returns can be handled at the pickup site. Overall, returnability is fairly good using this option.

The performance characteristics of a network with customer pickup sites and local storage (such as retail stores) are summarized in Table 4-6. The main advantage of a network with local storage is that it can lower delivery costs and provide a faster response than other networks. The major disadvantage is the increased inventory and facility costs. Such a network is best suited for fast-moving items or items for which customers value rapid response.

#### **SELECTING A DISTRIBUTION NETWORK DESIGN**

A network designer needs to consider product characteristics as well as network requirements when deciding on the appropriate delivery network. The various networks

**TABLE 4-6** Performance Characteristics of Local Storage at Consumer Pickup Sites

<i>Cost Factor</i>	<i>Performance</i>
Inventory	Higher than all other options.
Transportation	Lower than all other options.
Facilities and handling	Higher than other options. The increase in handling cost at the pickup site can be significant for online and phone orders.
Information	Some investment in infrastructure required for online and phone orders.
<i>Service Factor</i>	<i>Performance</i>
Response time	Same-day (immediate) pickup possible for items stored locally at pickup site.
Product variety	Lower than all other options.
Product availability	More expensive to provide than all other options.
Customer experience	Related to whether shopping is viewed as a positive or negative experience by customer.
Time to market	Highest among distribution options.
Order visibility	Trivial for in-store orders. Difficult, but essential, for online and phone orders.
Returnability	Easier than other options given that pickup location can handle returns.

considered earlier have different strengths and weaknesses. In Table 4-7, the various delivery networks are ranked relative to each other along different performance dimensions. A ranking of 1 indicates the best performance along a given dimension; as the relative performance worsens, the ranking number increases.

Only niche companies end up using a single distribution network. Most companies are best served by a combination of delivery networks. The combination used depends on product characteristics as well as the strategic position that the firm is targeting. The

**TABLE 4-7** Comparative Performance of Delivery Network Designs

	<i>Retail Storage with Customer Pickup</i>	<i>Manufacturer Storage with Direct Shipping</i>	<i>Manufacturer Storage with In-Transit Merge</i>	<i>Distributor Storage with Package Carrier Delivery</i>	<i>Distributor Storage with Last-Mile Delivery</i>	<i>Manufacturer Storage with Pickup</i>
Response time	1	4	4	3	2	4
Product variety	4	1	1	2	3	1
Product availability	4	1	1	2	3	1
Customer experience	Varies from 1 to 5	4	3	2	1	5
Time to market	4	1	1	2	3	1
Order visibility	1	5	4	3	2	6
Returnability	1	5	5	4	3	2
Inventory	4	1	1	2	3	1
Transportation	1	4	3	2	5	1
Facility and handling	6	1	2	3	4	5
Information	1	4	4	3	2	5

Key: 1 corresponds to the strongest performance and 6 the weakest performance.

**TABLE 4-8** Performance of Delivery Networks for Different Product/Customer Characteristics

	<i>Retail Storage with Customer Pickup</i>	<i>Manufacturer Storage with Direct Shipping</i>	<i>Manufacturer Storage with In-Transit Merge</i>	<i>Distributor Storage with Package Carrier Delivery</i>	<i>Distributor Storage with Last-Mile Delivery</i>	<i>Manufacturer Storage with Pickup</i>
High-demand product	+2	-2	-1	0	+1	-1
Medium-demand product	+1	-1	0	+1	0	0
Low-demand product	-1	+1	0	+1	-1	+1
Very low-demand product	-2	+2	+1	0	-2	+1
Many product sources	+1	-1	-1	+2	+1	0
High product value	-1	+2	+1	+1	0	+12
Quick desired response	+2	-2	-2	-1	+1	-2
High product variety	-1	+2	0	+1	0	+2
Low customer effort	-2	+1	+2	+2	+2	-1

Key: +2 = very suitable; +1 = somewhat suitable; 0 = neutral; -1 = somewhat unsuitable; -2 = very unsuitable.

suitability of different delivery designs (from a supply chain perspective) in various situations is shown in Table 4-8.

An excellent example of a hybrid network is that of W.W. Grainger, which combines all the aforementioned options in its distribution network. The network, however, is tailored to match the characteristics of the product and the needs of the customer. Fast-moving and emergency items are stocked locally, and customers can either pick them up or have them shipped, depending on the urgency. Slower-moving items are stocked at a national DC and shipped to the customer within a day or two. Very-slow-moving items are typically drop-shipped from the manufacturer and carry a longer lead time. Another hybrid network is used by Amazon, which stocks some items at its warehouses. Other slow-moving items may be drop-shipped from distributors or publishers.

We can now revisit the examples from the computer industry discussed at the beginning of the chapter. Gateway's decision to create a network of retail stores without exploiting any of the supply chain advantages such a network offers was flawed. To fully exploit the benefits of the retail network, Gateway should have stocked its standard configurations (likely to have high demand) at the retail stores, with all other configurations drop-shipped from the factory (perhaps with local pickup at the retail stores if it was economical). Instead, they drop-shipped all configurations from the factory. Apple has opened some retail stores and actually carries products for sale at these stores. This makes sense given the lower level of customization on most Apple products and the high demand for some of their products such as iPods. In fact, Apple has seen consistent growth in sales and profits through its retail outlets.

#### 4.4 E-BUSINESS AND THE DISTRIBUTION NETWORK

In this section we use ideas discussed earlier in the chapter to see how the advent of e-business in the late 1990s affected the structure and performance of various distribution networks. The goal is to understand what drove the successful introduction of e-business in some networks and not others, and how these networks should evolve.

Similar to our consideration with distribution networks, we build a scorecard based on how e-business affects a supply chain's ability to meet customer needs and the cost of meeting those needs. We now detail the contents of each scorecard category.

## IMPACT OF E-BUSINESS ON CUSTOMER SERVICE

As with distribution networks considered earlier, we start by studying how e-business affects customer service elements such as response time, product variety, availability, customer experience, time to market, visibility, and returnability. We also look at factors such as direct sales and the ability to offer flexible pricing that help e-business.

### Response Time to Customers

In selling physical products that cannot be downloaded, an e-business without a physical retail outlet takes longer to fulfill a customer request than a retail store because of the shipping time involved. Thus, customers who require a short response time may not use the Internet to order a product. There is no such delay, however, for products that can be downloaded. Going online may offer a time advantage in many cases. For example, a mutual fund prospectus or music can be downloaded from the Web. A physical mailing of these products or even making a trip to a music store takes much longer.

### Product Variety

An e-business finds it easier to offer a large selection of products than a bricks-and-mortar store. For example, Amazon.com offers a much larger selection of books than a typical bookstore. Offering the same selection at a retail store would require a huge location with a correspondingly large amount of inventory.

### Product Availability

An e-business can greatly increase the speed with which information on customer demand is disseminated throughout the supply chain, giving rise to more accurate forecasts. These improved forecasts and the more accurate view of customer demand leads to a better match between supply and demand. On the inventory front, this translates into having more of the inventory that customers demand and less of the inventory they do not. An e-business also allows for aggregation of inventory that improves product availability.

### Customer Experience

An e-business affects customer experience in terms of access, customization, and convenience. Unlike most retail stores that are open only during business hours, an e-business allows access to customers who may not be able to place orders during regular business hours. For example, a customer can place an order at Grainger.com even though the W.W. Grainger store where he will pick up his order is closed. In fact, W.W. Grainger has observed a surge in online orders after their bricks-and-mortar stores close. An e-business also allows a firm to access customers who are geographically distant. For example, a small specialty retail store located near Chicago can reach customers all over the United States, or even the world, by setting up an e-business. Without an e-business, only the customers located near the store are likely to shop there. Access to an e-business is limited only by the customers' access to the Internet.

The Internet offers an opportunity to create a personalized buying experience for each customer. For example, Amazon displays products that are related to what customers have recently purchased or browsed. Firms that focus on mass customization can use the Internet to help customers select a product that suits their needs. For example, Dell allows customers to customize their computers by using the options available on the Dell Web site.

For both consumers and companies, e-business can increase the ease with which one does business. For instance, customers have the convenience of not needing to leave home or work to make a purchase. An e-business can also help automate the

purchasing process, increasing the speed of conducting business as well as decreasing the costs of placing orders. For example, many e-businesses use data from past purchases to speed up the current purchase.

#### **Faster Time to Market**

A firm can use e-business to introduce new products much more quickly than a firm that uses physical channels. A firm that sells PCs through physical channels must produce enough units to stock the shelves at its distributors and retailers before it starts to see revenue from the new product. An e-business, in contrast, introduces a new product by making it available on the Web site—a distribution lag to fill the physical channels is not present. A new product can be made available as soon as the first unit is ready to be produced. This is evident in the computer industry, in which Dell often introduces new products earlier than its competitors that use traditional channels.

#### **Order Visibility**

The Internet makes it possible to provide visibility of order status. From a customer's perspective, it is crucial to provide this visibility because an online order has no physical equivalent to a customer shopping for an item at a retail store.

#### **Returnability**

Returnability is harder with online orders, which typically arrive from a centralized location. It is much easier to return a product purchased at a retail store. The proportion of returns is also likely to be much higher for online orders because customers are unable to touch and feel the product before their purchase. Going online thus increases the cost of reverse flows.

#### **Direct Sales to Customers**

An e-business allows manufacturers and other members of the supply chain that do not have direct contact with customers in traditional channels to enhance revenues by bypassing intermediaries and selling directly to customers, thereby collecting the intermediary's incremental revenue. For example, Dell sells PCs online direct to customers. As a result, Dell is able to increase revenue and enhance margins because it shares no part of the revenue with a distributor or retailer. In contrast, HP, which sells through retailers, must share some of the product revenue with the distributor and retailer, resulting in lower revenue and margins for HP.

#### **Flexible Pricing, Product Portfolio, and Promotions**

An e-business can easily alter prices by changing one entry in the database linked to its Web site. This ability allows an e-business to maximize revenues by setting prices based on current inventories and demand. The airlines provide a good example of this ability—they make last-minute, low-cost fares available on the Web on routes with unsold seats. Dell also changes prices for different PC configurations regularly, based on demand and component availability. Firms can change prices at an e-business much more easily than most traditional channels can. If Dell or L.L.Bean were to use paper catalogs to convey a discount in prices, they would have to print new catalogs and mail them to potential customers. With an e-business, however, they only have to update the price on their Web site. Similarly, an e-business can easily alter the product portfolio that it offers as well as the promotions it is running.

#### **Efficient Funds Transfer**

An e-business can enhance revenues by speeding up collection. An excellent example shows how e-business affects areas even outside the business world. Within 48 hours of John McCain's 2000 Presidential primary victory in New Hampshire, Senator

McCain's campaign collected \$1 million through his Web site. In contrast, it would have taken much more time and effort to process all the payments if the campaign was receiving checks by mail.

### IMPACT OF E-BUSINESS ON COST

On the cost side, e-business affects inventory, facilities, transportation, and information costs. It is important to observe that the impact in each case is not necessarily positive.

#### Inventory

An e-business can lower inventory levels and inventory cost by improving supply chain coordination and creating a better match between supply and demand. Additionally, e-business enables a firm to aggregate inventories far from customers if most customers are willing to wait for delivery of online orders. As a result of geographic aggregation, an e-business requires less inventory. For example, Amazon.com is able to aggregate its inventory of books and music at a few warehouses. Borders and Barnes&Noble, in contrast, need more inventory because they must carry a significant portion of their stock at retail stores. A key point to note is that the relative benefit of aggregation is small for high-demand items with low variability but large for low-demand items with high variability.

An e-business can significantly lower its inventories if it can postpone the introduction of variety until after the customer order is received. The time lag between when a customer places the order and when he expects delivery offers an e-business a window of opportunity to implement postponement. For example, Dell keeps its inventory as components and assembles its PCs after receiving the customer order. The amount of component inventory required is much lower than it would be if Dell kept its inventories in the form of assembled PCs. Its e-business thus allows Dell to hold less inventory relative to a firm carrying its inventory at retail stores in finished-goods form.

#### Facilities

Two basic types of facilities costs must be included in the analysis: costs related to the number and location of facilities in a network, and costs associated with the operations that take place in these facilities. An e-business can reduce network facility costs by centralizing operations, thereby decreasing the number of facilities required. For example, Amazon.com is able to satisfy demand from a few warehouses, whereas Borders and Barnes&Noble must incur facility costs for all the retail outlets they operate.

With regard to ongoing operating costs, customer participation in selection and order placement allows an e-business to lower its resource costs. For example, when a customer goes to the Lands' End Web site, she makes the effort to check on product availability and then place her order. When the same customer phones in an order, the firm incurs the additional cost of its employees checking product availability and placing the order. An e-business can lower its order fulfillment costs because it does not have to fill an order as soon as it arrives. A retail store or supermarket must staff its sales counters so that more cashiers are available when more customers are shopping. As a result, these stores require greater staffing during weekends and at times when people are not at work. At an e-business, if a reasonable buffer of unfilled orders is maintained, the rate of order fulfillment can be made significantly smoother than the rate at which orders arrive, which reduces the peak load for order fulfillment and thus reduces resource requirements and cost.

Additionally, operating costs can be decreased for a manufacturer using e-business to sell direct to customers because fewer supply chain stages touch the product as it makes its way to a customer, thereby reducing handling costs.

On the downside, however, for some products, such as groceries, an e-business has to perform tasks currently performed by the customer at retail stores, affecting both handling costs and transportation costs. In such situations, an e-business will incur higher handling and delivery costs than a retail store. For example, whereas a customer picks out the required items at a grocery store, an e-business such as Peapod incurs higher handling costs because its employees must pick a customer's order from the warehouse shelves and deliver it to the customer's home.

### Transportation

If a firm can put its product in a form that can be downloaded, the Internet will allow it to save on the cost and time for delivery. For example, downloadable music and software offer an opportunity to eliminate all costs associated with transporting compact discs. For nondigital products, aggregating inventories increases outbound transportation relative to inbound transportation. Compared to a business with many retail outlets, an e-business with aggregated inventories tends to have higher transportation costs (across the entire supply chain) per unit because of the increased outbound costs.

### Information

An e-business can share demand information throughout its supply chain to improve visibility. The Internet may also be used to share planning and forecasting information within the supply chain, further improving coordination. This helps reduce overall supply chain costs and better match supply and demand. Here we see that information is an enabler of many of the benefits of e-business discussed so far.

An e-business incurs additional information costs, however. The cost of software and hardware to set up an e-business can often be significant. These costs need to be weighed against the benefits that will be derived. Keep in mind that much of the information technology (IT) infrastructure for e-business may already be in place to operate the regular bricks-and-mortar business. This can greatly reduce the incremental cost needed for e-business.

The blank B2C e-business scorecard shown in Table 4-9 can be used by a firm to summarize the impact of e-business on each of the areas identified earlier.

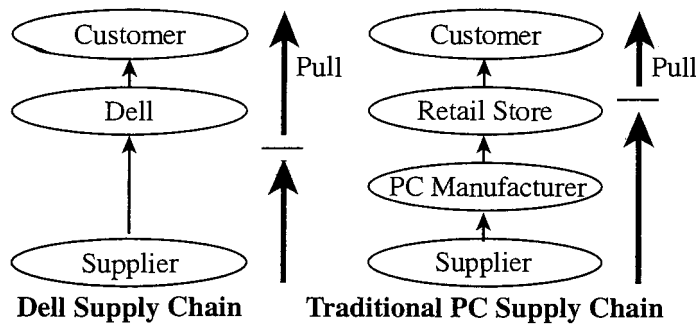
The value of setting up an e-business is not the same in every industry. Whereas Dell has seen its profits increase after going online, Webvan and many other online

**TABLE 4-9** The e-Business Scorecard

<i>Area</i>	<i>Impact</i>
Response time	
Product variety	
Product availability	
Customer experience	
Time to market	
Order visibility	
Direct sales	
Flexible pricing, portfolio, promotions	
Efficient funds transfer	
Inventory	
Facilities	
Transportation	
Information	

Key: +2 = very positive; +1 = positive; 0 = neutral;  
-1 = negative; -2 = very negative.





**FIGURE 4-11** Supply Chains for Dell and a Traditional PC Manufacturer

grocers have gone out of business. The scorecard in Table 4-9 can be used to understand how e-business affects the performance of different supply chain networks. In the next section, we apply the e-business scorecard to several examples.

#### USING E-BUSINESS TO SELL PCs: DELL

The PC industry in general—and Dell in particular—has used e-business effectively to improve performance of supply chain networks. As shown in Figure 4-11, Dell sells PCs directly to customers, both companies and consumers, and starts assembly after receiving a customer order (shown by the fact that Dell is above the push/pull boundary). Traditional PC manufacturers, in contrast, assemble the PC in the push phase of the supply chain because they must maintain assembled products available for purchase at a retail store.

#### Impact of e-Business on Customer Service in the PC Industry

The main disadvantage for Dell of selling PCs over the Internet is that customers who are unwilling to wait five to 10 days to receive their order cannot be attracted. A PC, however, is usually a planned purchase; most people are willing to wait for its delivery. Dell also does not attract customers who need a lot of help when selecting a PC. However, the segment of people who are comfortable selecting their own PC and are willing to wait for its delivery is quite large and still growing. Dell and other PC manufacturers who sell over the Internet target this group of customers.

Dell is able to exploit most of the responsiveness-enhancing opportunities offered by an e-business. The company uses the Internet to offer a very wide variety of different PC configurations. Customers are allowed to select recommended PC configurations or customize them to have the desired processor, memory, hard drive, and other components. Customization allows Dell to satisfy customers by giving them a product that is close to their specific requirements. The customization options are very easy to display over the Internet, allowing Dell to attract customers who value this choice. Dell also uses customized Web pages to enable large business customers to place orders.

The Internet allows Dell to bring new products to market more quickly than competitors who sell through retail stores. This is particularly important because products in the PC industry have short life cycles of a few months. Competing firms that sell through distributors and retailers need to fill shelves at their distributors and retailers before a product reaches the customer. Dell, in contrast, introduces a new product to customers on the Internet as soon as the first PC of that model is ready to be assembled. As a result, Dell can offer new components in its products as soon as they are available. It takes PC manufacturers who sell through distributors and retailers much longer to bring new components to market.

Although the company cannot compete with a retailer in terms of response time for a PC the retailer has in stock, Dell is one of the fastest at providing customers with customized PCs. The company has designed its products and assembly process to assemble the customized PC after a customer order arrives. Without the direct interaction between the consumer and Dell that e-business affords, Dell's reaction would be slower, and the company could not be as responsive with customized products. Decreasing the response time by a few days allows Dell to attract more time-sensitive customers.

Dell also uses the price flexibility the Internet offers to increase revenues. The salespeople at Dell change prices and delivery time daily, based on demand and supply of components, in order to maximize the revenue that can be extracted from available resources. To spur sales, the company lowers prices on configurations that contain components with excess inventory.

By using the Internet to sell PCs directly to customers, Dell is able to eliminate distributor and retailer margins and increase its own margin. The Internet allows Dell customers to place orders at any time of the day. Relative to other channels, the Internet makes it much cheaper to provide access by decreasing the workforce required. Computer stores, for example, would find it very expensive to stay open all the time.

Having an e-business allows Dell to collect payment for its PCs in a matter of days after they are sold. Dell, however, pays its suppliers according to the more traditional schedules in which payment is due in weeks (e.g., 30 days). Given its low levels of inventory, Dell is able to operate its business with negative working capital because it receives payment for its PCs about 30 days before it pays its suppliers for their components. A PC supply chain including distributors and retailers cannot achieve these results.

#### **Impact of e-Business on Cost in the PC Industry**

**Inventory Costs.** Its e-Business offers Dell the ability to reduce its inventories by aggregating them in a few geographic locations, whereas a chain of retail stores selling computers must carry inventory in each store. Dell is able to further reduce inventories by exploiting the time that elapses from the point at which an online order arrives to the point at which it must be shipped. Dell products and assembly lines are designed so that all components on which customers are offered customization can be assembled in a very short period of time. This allows Dell to postpone assembly until after the customer order has been placed. As a result, Dell holds all inventories in the form of components that are common across multiple finished products. Postponement, coupled with component commonality, allows Dell to reduce inventories significantly.

A PC manufacturer that sells through distributors and retailers finds it difficult to implement postponement. As a result, traditional PC manufacturers often find that they are stuck with PC configurations that are not selling while simultaneously being out of the configurations that are selling. Dell, in contrast, is better able to match supply and demand.

**Facility Costs.** Its e-Business allows the Dell supply chain to lower facility costs because the company has no physical distribution or retail outlets. Dell incurs only the cost of the manufacturing facility and warehousing space for components. A PC supply chain selling through retail stores must pay for the distribution warehouses and retail stores as well.

Its e-Business also allows Dell to take advantage of customer participation in order placement and thus decrease processing costs at its facility. Dell saves on the cost of call center representatives because customers do all the work when they place an order online.

**Transportation Costs.** As a result of e-business, total transportation costs in the Dell supply chain are higher than in a supply chain selling PCs through distributors and retailers. Dell sends individual PCs to customers from its factories, whereas a manufacturer selling through distributors and retailers sends large shipments on trucks to warehouses and to retailers. The Dell supply chain thus has higher outbound transportation costs. Relative to the price of a high-end PC, however, the outbound transportation cost is low (typically 2 to 3 percent) and thus it does not have a major impact on the overall cost.

**Information Costs.** Although Dell has made a significant investment in information technology to implement its build-to-order model, these costs are more than made up for by the benefits discussed earlier. Additionally, the majority of these IT costs would be incurred regardless of Dell's e-business status. Therefore, e-business does add incrementally to Dell's information costs, but this is not a significant factor given the benefits.

#### **Impact of e-Business on Performance at Dell**

As summarized in the e-business scorecard in Table 4-10, e-business allows Dell to significantly improve its performance in terms of both responsiveness and cost. As a result, customers are happier while Dell is able to reduce costs. Dell, to the delight of its shareholders, has exploited every advantage that the Internet offers to improve performance.

#### **A Supply Chain Network for PCs Using Retail Stores and the Internet**

It may seem at first glance that all PC manufacturers should structure their networks as Dell does. A careful study, however, indicates that a traditional PC manufacturer, selling through distributors and retailers, can gain a lot by incorporating the Internet into its existing network. This issue becomes more significant as hardware becomes more of a commodity. The PC manufacturer should use an e-business to sell new products or customized PC configurations whose demand is hard to forecast and let the retail channel sell standard configurations whose demand is easier to forecast. Manufacturers should introduce new models on the Internet, and as demand for some of them grows, these models should be added to the retail channel. Another option is to

**TABLE 4-10** Impact of e-Business on Performance at Dell

<i>Area</i>	<i>Impact</i>
Response time	-1
Product variety	+2
Product availability	+1
Customer experience	+2
Time to market	+2
Order visibility	+1
Direct sales	+2
Flexible pricing, portfolio, promotions	+2
Efficient funds transfer	+2
Inventory	+2
Facilities	+2
Transportation	-1
Information	0

Key: +2 = very positive; +1 = positive; 0 = neutral; -1 = negative; -2 = very negative.

introduce recommended configurations of new models at retail stores, while selling all customized configurations on the Internet. The manufacturer is thus able to decrease inventories by aggregating all high-variability production and satisfying that demand online. These models should be built to order using as many common components as is feasible. The standard models can be produced using a low-cost approach even if it involves longer lead time. Selling standardized models through distributors and retail stores allows the supply chain to save on transportation costs, which are likely to be more significant for these low-cost configurations. Retailers can be allowed to participate in the e-business by having kiosks where customers can configure models of their choice or order standardized models that are out of stock. It is important that traditional PC manufacturers give retailers a chance to participate in any e-business to avoid damaging existing channel relationships.

A traditional manufacturer can use the two-pronged approach outlined earlier to utilize both the strengths of e-business and those of traditional retail and distribution channels. Gateway failed in its effort with retail stores because it did not use any of the supply chain strengths of the bricks-and-mortar channel. Instead of just helping people with configuration at their retail stores, Gateway would have served its customers better by also carrying recommended configurations of their PCs in the stores. This would immediately satisfy customers who wanted the recommended configuration, while allowing Gateway to produce the more customized configurations efficiently.

#### **USING E-BUSINESS TO SELL BOOKS: AMAZON**

Book supply chains have been transformed with the advent of e-business and the launching of Amazon.com in July 1995. Since 1995, Amazon.com has added music, toys, electronics, software, and home improvement equipment to its product offerings. It is fair to state, however, that the growth in profitability that the Internet has brought to the book industry has been less than in the PC industry.

##### **Impact of e-Business on Customer Service in the Book Industry**

There are several reasons why e-business has not helped profits in the book industry to the same extent as in the PC industry. Unlike the PC industry, in which e-business facilitates direct sales by manufacturers, e-business has not shortened supply chains in the book industry.

As is the case with Dell, customers wanting a book quickly cannot shop at Amazon.com. Thus Amazon.com can only attract customers who are willing to wait a few days to get a book. Amazon.com also cannot attract customers who value the ability to leaf through books. The company tries to counter this problem by providing reviews and other information on books to allow customers to get a feel for the book online.

To counter these drawbacks, Amazon.com has exploited several opportunities on the Internet to attract customers and increase revenues. Amazon.com attracts many customers by offering a wide selection of millions of books. Customers can search for hard-to-find books or those of special interest. A large physical bookstore, in contrast, can carry fewer than a hundred thousand titles. Amazon.com also uses the Internet to recommend books to customers based on their purchase history. Customers are sent e-mails informing them of new titles that match their interests. Amazon.com also provides reviews and comments from other customers on the titles available. New titles are quickly introduced and made available online, whereas in a bricks-and-mortar bookstore chain, all retail stores have to be stocked.

Amazon.com uses the Internet to allow customers to order a book at any time from the comfort of their own home. If customers know the books they want, they can

place the order online and the books will be delivered to their door. There is no need to leave the house and spend an hour or two going to a physical bookstore. This fact allows Amazon.com to attract customers who value this convenience and are willing to wait for delivery.

#### **Cost Impact of e-Business on the Book Industry**

Amazon.com also uses e-business to lower its inventory and some of its facility costs. Transportation costs, however, increase as a result of selling books online.

**Inventory Costs.** Amazon.com is able to decrease inventories by aggregating inventories in a few geographical locations. A bookstore chain, in contrast, has higher inventories because titles are carried at every store. The reduction of inventories from aggregation is most significant for low-demand books with high demand uncertainty. The benefit is less significant for best-sellers with demand that is more predictable. Amazon.com carries high-demand titles in inventory, whereas it purchases low-demand titles from a distributor in response to a customer order. This allows the Amazon.com supply chain to further reduce inventories of low-demand titles because distributors are able to aggregate across other booksellers in addition to Amazon.

**Facility Costs.** Its e-business allows Amazon.com to lower facility costs because it does not need the retail infrastructure that a bookstore chain such as Borders or Barnes&Noble must have. Initially, Amazon.com did not have a warehouse, purchasing all books from distributors. When demand volumes were low, the distributor was a better location to carry inventories because it aggregated demand across other booksellers besides Amazon.com. As demand has grown, however, Amazon.com has opened its own warehouses, where it stocks high-demand books. Amazon.com now purchases high-demand books directly from publishers and goes to distributors for lower-demand books only. Thus, facility costs at Amazon.com are growing, though they are still much lower than the facility costs for a bookstore chain because Amazon.com has no retail sites.

**Transportation Costs.** The Amazon.com supply chain incurs higher transportation costs than a bookstore chain selling through retail stores. Local bookstores do not have the cost of individually shipping books to customers. Amazon.com, in contrast, incurs the cost of shipping books to its customers from warehouses. The shipping cost from an Amazon.com warehouse represents a significant fraction of the cost of a book (it can be even higher than 100 percent for an inexpensive book). As demand has grown, Amazon.com has opened several warehouses in an effort to get closer to customers, decrease its transportation costs, and improve response time.

**Information Costs.** As with Dell, setting up an e-business takes some additional investment in IT, but this is not incrementally significant compared with the IT that is required to run a bricks-and-mortar business. Therefore, IT costs for e-business are somewhat higher, but not prohibitively so.

#### **Impact of e-Business on Performance at Amazon**

Amazon's e-business scorecard is summarized in Table 4-11. A comparison of Tables 4-10 and 4-11 shows that e-business offers far greater advantages when selling PCs than when selling books. Some key differences between the two products are that (1) product differentiation in PCs can be postponed until after the customer has placed an order, whereas books are currently published well in advance of a sale; and (2) transportation cost represents a much higher portion of the cost of books and a relatively small portion of the cost of PCs. If books become downloadable, Amazon.com will be able to exploit all the advantages that Dell currently exploits, along with being able to

**TABLE 4-11** Impact of e-Business on Performance at Amazon.com

<i>Area</i>	<i>Impact</i>
Response time	-1
Product variety	+2
Product availability	+1
Customer experience	+1
Time to market	+1
Order visibility	0
Direct sales	0
Flexible pricing, portfolio, promotions	+1
Efficient funds transfer	0
Inventory	+1
Facilities	+1
Transportation	-2
Information	-1

Key: +2 = very positive; +1 = positive; 0 = neutral; -1 = negative; -2 = very negative.

ship its products over the Internet. As a result, many of Amazon's current disadvantages would disappear.

Other potentially downloadable products that Amazon.com currently sells include software and music. In both instances, Amazon.com can increase the benefit of e-business if it either creates compact discs in response to a customer order or allows customers to download these products. For other products, such as toys and hand tools, limited possibilities exist for postponement. The advantages of e-business for Amazon.com in those product categories will continue to be small compared to physical retail outlets.

#### **A Supply Chain Network for Books Using Retail Stores and the Internet**

The performance of traditional bookstore supply chains can be improved significantly by combining the strengths of the retail and online channels. It is important to realize that the benefits of aggregation are most significant for low-demand books whose demand is hard to forecast. The book supply chains should be structured so that retail outlets carry many copies of best-sellers for customer purchase and one copy of low-demand books to encourage customers to browse and make impulse purchases. Terminals or Internet kiosks should be provided so that customers wanting to order low-demand books can place their orders online. The presence of kiosks increases the variety of books that the bookstore can offer. This approach allows the supply chain to reduce inventories by aggregating low-demand books sold online while keeping transportation costs low for best-sellers sold at retail stores.

#### **USING E-BUSINESS TO SELL GROCERIES: PEAPOD**

The grocery industry saw a spurt in new e-businesses in 1998 and 1999, although virtually all have gone out of business. Peapod, one of the oldest online grocers, is one of the few left. Given this industry's poor track record, one might surmise that this is an industry not well suited for e-business. Let us take a look with our scorecard to see whether this is the case.

Peapod started by supplying orders using employees at grocery stores to pick and deliver orders. The company has now moved to supplying orders from centralized fulfillment centers and also some large supermarkets. Each fulfillment center is much larger than a supermarket and is comparable to a warehouse. The Peapod and supermarket supply chains are comparable except that for a supermarket, some products come from a warehouse whereas the rest come directly from suppliers.

#### **Impact of e-Business on Customer Service in the Grocery Industry**

Peapod and other online groceries have tried to sell convenience and the time savings they offer customers. For many people, grocery shopping is a chore that is time consuming and rarely enjoyable. Peapod allows customers to place orders at any time and have them delivered at home, eliminating a trip to the supermarket. This can be a significant convenience, especially in urban areas, where customers have to walk to a supermarket and carry all their groceries home. In a suburban area, the benefit is smaller because people can drive to supermarkets with relative ease. The convenience of saving time, however, remains quite valuable.

The convenience factor related to access is even more significant if a specialty-food provider goes online. For example, ethnic food stores are not as accessible as supermarkets and people often drive long distances to reach them. Offering ethnic foods on the Internet provides easy access to customers and saves a long drive. Ethnicgrocer.com is an e-business that specializes in, as the name suggests, ethnic groceries and products. Peapod, however, does not offer significantly more variety than a typical supermarket. Most large supermarkets offer sufficiently large variety to cover the needs of most households.

Peapod is able to increase revenues by creating a personalized shopping experience for customers and delivering customized, one-to-one advertising and promotions. This is done using extensive member profiles that Peapod creates based on online shopping behavior, purchase histories, and surveys. Unlike a supermarket, where the store does not know what customers have selected until they check out, Peapod can guide online customers based on what they purchase. For example, if a customer buys some pasta, Peapod can suggest a type of pasta sauce or some Parmesan cheese. Over longer periods, Peapod can collect shopping patterns and suggest products that match a customer's preferences. Such suggestions enhance revenues by increasing customers' impulse purchases.

Peapod also adds to its revenues by giving consumer goods companies a forum for targeted interactive advertising and electronic coupons. Peapod increases revenues by selling data on consumer choices to product manufacturers. Consumer choice data available to an online grocer is more valuable than scanner data from a supermarket because scanner data only reveals the customer's final purchases. An online grocer, in contrast, can record the customer's decision process. For example, an online grocer can record a customer's substitution patterns for items that are out of stock. With scanner data, a supermarket cannot record substitutions because it has no way of finding out if the customer looked for something that is out of stock.

#### **Impact of e-Business on Costs in the Grocery Industry**

Peapod and other online grocers use e-business to lower some facility costs and, to an extent, inventory costs. Picking costs and transportation costs, however, are much higher than for traditional supermarkets.

**Inventory Costs.** Compared to a supermarket chain, an online grocer such as Peapod can lower inventories by aggregating the inventory in a few large replenishment centers. The degree of aggregation, however, is less than that achieved by

Amazon.com or Dell, because Peapod needs fulfillment centers in every urban area it serves to get food to customers in acceptable condition.

The benefits of aggregation are further diminished by the fact that the majority of products sold at a supermarket are staple items with steady demand. Thus, aggregation provides a marginal benefit in terms of improved forecast accuracy and reduced inventories (see Chapter 11). The benefits of aggregation are higher for specialty, low-demand items with high demand uncertainty. These products constitute a small fraction of overall sales at a supermarket. Thus, aggregation allows e-grocers to lower their inventory costs only marginally compared to a typical supermarket. If online grocers focused primarily on specialty items such as ethnic foods, the inventory benefits of aggregation would be larger.

**Facility Costs.** Peapod's e-business allows it to lower facility costs because it needs only warehouse facilities and can save on the cost of retail outlets such as supermarkets. Processing costs at Peapod to fulfill an order, however, are significantly higher than those for a supermarket, and overwhelm the savings from needing fewer facilities. Peapod saves on checkout clerks compared to a supermarket but must pick the customer order, a task the customer performs at a supermarket and one that is much more time consuming than checkout. Thus, e-business results in a loss of customer participation compared to a supermarket and raises overall facility costs.

**Transportation.** An online grocer such as Peapod has significantly higher transportation costs than a supermarket. Supermarkets have the advantage of having to bear only inbound transportation cost for products, with customers providing transportation from the supermarket to their homes. Inbound transportation costs tend to be low because supermarkets have large deliveries that enable them to exploit economies of scale in transportation. Peapod, in contrast, has to bear inbound transportation cost to its fulfillment centers and then outbound delivery costs from the fulfillment centers to customer homes. Outbound delivery costs are high, because individual orders must be delivered to each customer's home. The task becomes all the more problematic given the different temperature requirements for different types of food.

Compared to computers and even books, groceries have a low value-to-weight/volume ratio. For example, paper towels and bathroom tissues have very low value but occupy a lot of space in a truck. Thus, transportation costs are a significant fraction of the cost incurred by online grocers. This makes it very difficult for an online grocer to compete with a supermarket on prices.

**Information Costs.** Again, the IT infrastructure required for an e-business increases costs. In the case of an e-grocer, this is somewhat more significant than with the other e-businesses we have been discussing, because an e-grocer takes on a wider range of functions that shoppers do themselves. Therefore, IT costs are higher for an e-grocer. As in the other examples, however, IT costs are not a deal breaker for this business model.

#### **Impact of e-Business on Performance at Peapod**

An e-business offers some revenue-enhancement opportunities in the grocery industry. Costs, however, are significantly higher for an online grocer than for a supermarket, as we can see from Table 4-12. A comparison of Tables 4-10, 4-11, and 4-12 shows that e-business offers fewer benefits when selling groceries compared to books and PCs. Supermarkets are large enough to enjoy most of the inventory benefits that aggregation offers, without having the additional delivery cost incurred by an online grocer. Online grocers cannot compete with supermarkets on price, and can succeed only if



**TABLE 4-12** Impact of e-Business on Performance at Peapod

<i>Area</i>	<i>Impact</i>
Response time	-1
Product variety	0
Product availability	0
Customer experience	+1
Time to market	0
Order visibility	-1
Direct sales	0
Flexible pricing, portfolio, promotions	+1
Efficient funds transfer	0
Inventory	0
Facilities	-1
Transportation	-2
Information	-1

Key: +2 = very positive; +1 = positive; 0 = neutral; -1 = negative; -2 = very negative.

there are enough people willing to pay a premium for the convenience of home delivery. Online grocers, however, can provide some cost advantage when selling specialty groceries, whose demand tends to be low and uncertain.

#### **Value of e-Business to a Traditional Grocery Chain**

Traditional supermarket chains can benefit by using an e-business to complement the strengths of their existing network. The e-business can be used to offer convenience to customers who are willing to pay for it. Supermarkets can be used to target customers who value lower prices.

A supermarket chain with an e-business has the opportunity to offer an entire array of services at differing prices based on the amount of work the customer does. The cheapest service involves customers walking into the supermarket and shopping for the products they want. In this case, the customer picks the order from the shelves and provides outbound transportation for it. For an additional charge, a supermarket might allow customers to place orders online to be picked up at a later time. The supermarket personnel would pick the order from the shelf, but the customer would provide outbound transportation. The most expensive service is when the customer places orders online for home delivery. In this case the supermarket chain is responsible for both picking the order from the shelf and delivering it to the customer's home. The varying services and prices would allow supermarket chains to efficiently satisfy the needs of a variety of customers.

Among the supermarket chains, Albertsons has taken the lead in combining e-business with physical supermarkets. It has renamed some of its stores Albertsons.com. Half the store remains a traditional supermarket, while the other half is used to fulfill online grocery orders. This allows the firm to exploit economies of scale on inbound transportation while keeping delivery distances to customers short on the outbound side. Customers are allowed to pick up their orders at the store or have the order delivered to their home. Based on our analysis, the Albertsons model is likely to be the most effective method for combining e-business with existing supermarkets in the grocery industry, whereas pure online grocers are likely to be less effective.

As we have mentioned earlier, the online channel is also more effective for specialty grocers. In fact, Amazon.com has set up a specialty grocery area on its Web site to go after this market.

#### **USING E-BUSINESS TO SELL MRO SUPPLIES: GRAINGER.COM**

W.W. Grainger is a B2B distributor of MRO supplies, selling more than 200,000 different products ranging from consumables such as machine lubricants to hardware items such as nuts and bolts. W.W. Grainger has traditionally sold its products using a paper catalog. Customers place orders on the phone or walk up to one of about 400 branches (similar to large retail stores) in the United States. Orders placed over the phone are either picked up at a branch or shipped to the customer using a package carrier. In 1995, W.W. Grainger established an e-business when it set up Grainger.com, allowing customers to place orders online. Such businesses have grown rapidly in the MRO supplies industry, with competitors such as McMaster-Carr having also built e-businesses.

#### **Impact of e-business on Customer Service for W.W. Grainger**

W.W. Grainger is in a position to exploit several opportunities offered by the Internet. Grainger.com gives a customer access to all the 220,000 products that W.W. Grainger sells, whereas the catalog offers only about 80,000 products. Compared to a catalog, searching for a product is simpler on the Internet using search engines that W.W. Grainger has developed. The increased variety allows W.W. Grainger to attract more customers and satisfy more needs of existing customers. The Internet allows W.W. Grainger to enhance revenues by introducing a new product as soon as it becomes available. With directmail marketing, W.W. Grainger had to wait for a new catalog to be shipped before customers were informed about new products. An e-business also allows W.W. Grainger to offer promotions and change prices easily without having to send out new catalogs.

Grainger.com allows customers to place orders and check their status at any time. This is a significant benefit to customers, who can use this ability to improve their MRO purchase process. For example, a customer's night-shift personnel can use the Internet to place and check on orders for supplies they need. They no longer have to wait for people from the day shift to place their order. This improves the accuracy of orders and reduces the time needed to process them. A study by the Aberdeen Group indicates that online purchases decrease the duration of the order and fulfillment cycle from an average of 7.3 days to an average of 2 days. The decreased order-fulfillment times allow W.W. Grainger to attract more orders through its e-business. A study by W.W. Grainger Consulting estimates that MRO distributors could see incremental sales gains of 10 to 20 percent by selling online.

Product margins, however, are likely to drop as a result of e-business in the MRO supply industry. With customers able to compare prices easily over the Internet, the growth in e-business has put pressure on MRO supply companies to lower price.

#### **Impact of e-Business on Costs at W.W. Grainger**

W.W. Grainger uses e-business to lower its order processing costs and to some extent its facility costs. Notably, W.W. Grainger customers also see a significant reduction in order processing costs as a result of e-business.

**Inventory Costs.** With an increase in Internet orders that are shipped by package carrier, W.W. Grainger is able to aggregate more of its inventories, resulting in some inventory reduction. W.W. Grainger will achieve further inventory reduction if online sales grow large enough to enable the company to close some of its branches.

The inventory benefits, however, are likely to be small, because W.W. Grainger's existing supply chain network is well suited to online sales. Customers also save on inventory costs as a result of e-business because replenishment lead times over the Internet are lower than with traditional procurement methods.

**Facility Costs.** W.W. Grainger's facility costs will come down to some extent if more Internet sales are shipped using package carriers and some branches are closed. W.W. Grainger will see a bigger reduction in processing costs from online sales. Customers placing orders over the Internet perform all order placement activities. This allows W.W. Grainger to decrease the number of customer service representatives in its call centers.

Customers also save on order processing costs as a result of e-business. An e-business is a convenient way for corporations to place content-rich catalogs in the hands of end users of MRO supplies. As a result, companies no longer require people to process MRO purchase orders. An e-business offers many companies a quick and convenient chance to get away from inefficient manual methods of procurement. The Aberdeen Group estimates that online purchase of MRO supplies saves about \$30 per order in administrative costs.

**Transportation Costs.** Transportation costs in the W.W. Grainger supply chain are unlikely to change significantly as a result of e-business. Transportation costs may increase if more Internet orders are shipped using package carriers rather than being picked up at branches. Overall, however, the costs are likely to remain unchanged, as the method of ordering should not have a large impact on how a customer wants an order delivered.

**Information Costs.** Information costs increase to fund the creation of the Grainger.com storefront, but beyond that there is little additional cost.

**Impact of e-Business on Performance at W.W. Grainger.** MRO distributors such as W.W. Grainger are likely to find e-business a somewhat attractive proposition, as summarized in Table 4-13. Most of the gains from e-business come from a

**TABLE 4-13** Impact of e-Business on W.W. Grainger Performance

<i>Area</i>	<i>Impact</i>
Response time	0
Product variety	+2
Product availability	0
Customer experience	+1
Time to market	+1
Order visibility	+1
Direct sales	0
Flexible pricing, portfolio, promotions	+1
Efficient funds transfer	0
Inventory	0
Facilities	+1
Transportation	0
Information	-1

Key: +2 = very positive; +1 = positive; 0 = neutral; -1 = negative; -2 = very negative.

decrease in order taking and processing costs. Some gains are also achieved because of the ability to display a wider variety of products and increased customer convenience in product search. The structure of the MRO supply chain, however, is not significantly different for online orders compared to phone orders. Thus, gains from an improved supply chain structure are minimal.

## 4.5 DISTRIBUTION NETWORKS IN PRACTICE

1. ***The ownership structure of the distribution network can have as big an impact as the type of distribution network.*** The bulk of this chapter deals with different types of physical networks and subsequent flows to distribute products successfully. However, equally important is who owns each stage in the distribution network. Distribution networks that have exactly the same physical flow but different ownership structures can have vastly different performance. For example, a manufacturer that owns its distribution network can control the network's actions. However, if the manufacturer does not own the distribution network, as is more often the case, a wide variety of issues need to be taken into account to optimize over the network. Obviously, an independent distributor wants to optimize its own enterprise, not necessarily the entire supply chain. Attempting to optimize over a distribution network with multiple enterprises requires great skill in coordinating the incentives of each of the players and in creating the right relationships. Be sure to consider the impact of both the physical flows and the ownership structure when designing a distribution network.

2. ***The choice of a distribution network has very long-term consequences.*** The structure of the distribution network is one of the most difficult decisions to change. The impact often lasts for decades, amplifying the importance of the choice. For example, in the United States, auto manufacturers sell virtually all of their vehicles to consumers through a network of independent dealers set up decades ago. Because dealers are the interface between the consumer and the automotive supply chain, auto manufacturers are very interested in influencing dealers to ensure that this is a positive relationship. However, given that dealers are independent, they have a somewhat different set of goals that is not necessarily consistent with the manufacturers. Further complicating this is the fact that dealers often have relationships with more than one manufacturer and have successfully encouraged legislation that makes it very difficult for manufacturers to use any other distribution channel. Although automakers have tried to implement alternative distribution channels for several years, the dealers have kept the manufacturers captive, remaining the only channel through which cars are sold.

Another example of long-term consequences is seen within the PC industry. In the early days, manufacturers sold through independent distributors and retailers. Dell's emergence was a clear example of how the direct model was often superior to the traditional model. Other PC manufacturers, such as HP, made forays into selling PCs directly. However, their existing distribution channels reacted quite negatively to this—as you might expect, given that it would cannibalize their business. Because distributors often sold other companies' PCs, manufacturers were hesitant to promote their direct efforts aggressively, for fear of their distributors retaliating by promoting competitors' products. These PC manufacturers therefore ended up with minimal direct business. The manufacturers were essentially shackled by their legacy distribution network. The only way to go direct was a clean break—a move that was

just too costly given that their distributors owned the relationship with their customers. These examples illustrate the long-term implications of choosing the right distribution network.

3. **Consider whether an exclusive distribution strategy is advantageous.** Another important choice is whether to distribute exclusively or not. For instance, a manufacturer of consumer electronics such as Sony could choose to have relationships with many distributors such as Best Buy, Circuit City, and Wal-Mart. In this case, Sony would be interested in increasing the availability of its products to customers and would certainly not mind if its distributors competed with each other to sell Sony products to customers. An alternative, which is more plausible for a manufacturer of very-high-end stereo equipment, is to form an exclusive relationship with a distributor. In this case, customers can buy this brand's products only from a single retailer. The retailer can garner higher margins, as it doesn't have to battle over price with a nearby store. But what's in it for the manufacturer? The manufacturer can often increase its sales significantly, because its exclusive distributor will be much more interested in marketing the manufacturer's goods, as there is a higher margin and less competition.

4. **Product price, commoditization, and criticality affect the type of distribution system preferred by customers.** Interactions between a buyer and a seller take time and resources. Many buyers would like to establish a relationship with a single enterprise that can deliver a full line of products. This can be accomplished by a manufacturer with a broad line of products. However, this is often accomplished more effectively by a distributor carrying products from many manufacturers. A customer's desire for a one-stop shop depends not just on the convenience of the relationship, but also on the type of product he or she is buying. The more differentiated an item is, the more likely that a customer will be willing to have a relationship solely around that particular product.

For example, a consumer may well be content to buy a PC directly from a manufacturer. However, very few consumers are willing to order pens direct from a pen manufacturer, paper directly from a paper manufacturer, and staples directly from a staple manufacturer. Most consumers much prefer a stationary store that carries a very wide range of different manufacturers' products. Even if a pen manufacturer could economically deliver individual pens to customers' homes, the hassle for the consumer of dealing with different entities for each type of office product would be prohibitive.

5. **Integrate the Internet with the existing physical network.** To extract maximum benefit from e-business, firms should integrate it with their existing supply chain networks. Separating the two networks often results in inefficiencies within the supply chain. This coupling of e-business with the existing physical network has been referred to as clicks-and-mortar.

Alberstons use of its physical assets to satisfy both online orders and people who want to shop in a supermarket is an effective integration of e-business within a supply chain network. Another example of an effective clicks-and-mortar strategy is The Gap, which allows customers to place online orders through computers placed in the stores and also return items purchased online at retail stores. The Internet is used to expand the variety available to customers at a Gap store. Gap stores stock popular items, whereas customers can order online the colors or sizes that may not be available in the store. This allows the Gap to centralize low-demand items while increasing the variety available to customers and extracting the maximum benefit from integrating its e-business with its physical network.

## 4.6 SUMMARY OF LEARNING OBJECTIVES

1. Identify factors to be considered when designing the distribution network.

A manager must consider the customer needs to be met and the cost of meeting these needs when designing the distribution network. Some key customer needs to be considered include response time, product variety/availability, convenience, order visibility, and returnability. Important costs that managers must consider include inventories, transportation, facilities and handling, and information. Increasing the number of facilities decreases the response time and transportation cost but increases inventory and facility cost.

2. Discuss the strengths and weaknesses of various distribution options.

Distribution networks that ship directly to the customer are better suited for a large variety of high-value products that have low and uncertain demand. These networks carry low levels of inventory but incur high transportation cost and provide a slow response time. Distribution networks that carry local inventory are suitable for products with high demand, especially if transportation is a large fraction of total cost. These networks incur higher inventory cost but lower transportation cost and provide a faster response time.

3. Understand how e-business has affected the design of distribution networks in various industries.

The rise of e-businesses has affected both customer service and costs in supply chains. An e-business allows a firm to offer greater product variety and improve product availability by centralizing inventories. This is especially beneficial for low-volume, high-variety products. An e-business also improves the customer experience by providing 24-hour access and allowing a more customized experience. Selling a product online, however, increases the response time relative to a retail store. An e-business reduces facility costs if there is no significant loss of customer participation. Transportation costs increase, however, and this is particularly significant for low-value products with predictable demand. An e-business has been most effective for high-value products with uncertain demand, when customers are willing to wait some time before delivery.

### Discussion Questions

1. What differences in the retail environment may justify the fact that the fast-moving consumer goods supply chain in India has far more distributors than in the United States?
2. A specialty chemical company is considering expanding its operations into Brazil, where five companies dominate the consumption of specialty chemicals. What sort of distribution network should this company utilize?
3. A distributor has heard that one of the major manufacturers from which it buys is considering going direct to the consumer. What can the distributor do about this? What advantages can it offer the manufacturer that the manufacturer is unlikely to be able to reproduce?
4. What types of distribution networks are typically best suited for commodity items?
5. What type of networks are best suited to highly differentiated products?
6. In the future, do you see the value added by distributors decreasing, increasing, or staying about the same?
7. Why has e-business been more successful in the PC industry compared to the grocery industry? In the future, how valuable is e-business likely to be in the PC industry?
8. Is e-business likely to be more beneficial in the early part or the mature part of a product's life cycle? Why?
9. Consider the sale of home improvement products at Home Depot or a chain of hardware stores such as Tru-Value. Who can extract the greatest benefit from going online? Why?
10. Amazon.com sells books, music, electronics, software, toys, and home improvement products online. In which product category does e-business offer the greatest advantage compared to

- a retail store chain? In which product category does e-business offer the smallest advantage (or a potential cost disadvantage) compared to a retail store chain? Why?
11. Why should an e-business such as Amazon.com build more warehouses as its sales volume grows?

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