CASE STUDIES

Zhou Bicycle Company

Zhou Bicycle Company (ZBC), located in Seattle, is a wholesale distributor of bicycles and bicycle parts. Formed in 1981 by University of Washington Professor Yong-Pin Zhou, the firm's primary retail outlets are located within a 400-mile radius of the distribution center. These retail outlets receive the order from ZBC within 2 days after notifying the distribution center, provided that the stock is available. However, if an order is not fulfilled by the company, no backorder is placed; the retailers arrange to get their shipment from other distributors, and ZBC loses that amount of business.

The company distributes a wide variety of bicycles. The most popular model, and the major source of revenue to the company, is the AirWing. ZBC receives all the models from a single manufacturer in China, and shipment takes as long as 4 weeks from the time an order is placed. With the cost of communication, paperwork, and customs clearance included, ZBC estimates that each time an order is placed, it incurs a cost of $65. The purchase price paid by ZBC, per bicycle, is roughly 60% of the suggested retail price for all the styles available, and the inventory carrying cost is 1% per month (12% per year) of the purchase price paid by ZBC. The retail price (paid by the customers) for the AirWing is $170 per bicycle.

ZBC is interested in making an inventory plan for 2016. The firm wants to maintain a 95% service level with its customers to minimize the losses on the lost orders. The data collected for the past 2 years are summarized in the following table. A forecast for AirWing model sales in 2016 has been developed and will be used to make an inventory plan for ZBC.

Demands For Airwing Model

MONTH	2014	2015	FORECAST FOR 2016
January	6	7	8
February	12	14	15
March	24	27	31
April	46	53	59
May	75	86	97
June	47	54	60
July	30	34	39
August	18	21	24
September	13	15	16
October	12	13	15
November	22	25	28
December	38	42	47
Total	343	391	439

Discussion Questions

1. Develop an inventory plan to help ZBC.
2. Discuss ROPs and total costs.
3. How can you address demand that is not at the level of the planning horizon?

Source: Professor Kala Chand Seal, Loyola Marymount University.

Parker Hi-Fi Systems

Parker Hi-Fi Systems, located in Wellesley, Massachusetts, a Boston suburb, assembles and sells the very finest home theater systems. The systems are assembled with components from the best manufacturers worldwide. Although most of the components are procured from wholesalers on the East Coast, some critical items, such as LCD screens, come directly from their manufacturer. For instance, the LCD screens are shipped via air from Foxy, Ltd., in Taiwan, to Boston's Logan airport, and the top-of-the-line speakers are purchased from the world-renowned U.S. manufacturer Boss.

Parker's purchasing agent, Raktim Pal, submits an order release for LCD screens once every 4 weeks. The company's annual requirements total 500 units (2 per working day), and Parker's per unit cost is $1,500. (Because of Parker's relatively low volume and the quality focus—rather than volume focus—of many of Parker's suppliers, Parker is seldom able to obtain quantity discounts.) Because Foxy promises delivery within 1 week following receipt of an order release, Parker has never had a shortage of LCDs. (Total time between date of the release and date of receipt is 1 week or 5 working days.)

Parker's activity-based costing system has generated the following inventory-related costs. Procurement costs, which amount to $500 per order, include the actual labor costs involved in ordering, customs inspection, arranging for airport pickup, delivery to the plant, maintaining inventory records, and arranging for the bank to issue a check. Parker's holding costs take into account storage, damage, insurance, taxes, and so forth on a square-foot basis. These costs equal $150 per LCD per year.

With added emphasis being placed on efficiencies in the supply chain, Parker's president has asked Raktim to seriously evaluate the purchase of the LCDs. One area to be closely scrutinized for possible cost savings is inventory procurement.

Discussion Questions

1. What is the optimal order number of LCDs that should be placed in each order?
2. What is the optimal reorder point (ROP) for LCDs?
3. What cost savings will Parker realize if it implements an order plan based on EOQ?

Managing Inventory at Frito-Lay

Video Case

Frito-Lay has flourished since its origin—the 1931 purchase of a small San Antonio firm for $100 that included a recipe, 19 retail accounts, and a hand-operated potato ricer. The multi-billion-dollar company, headquartered in Dallas, now has 41 products—15 with sales of over $100 million per year and 7 at over $1 billion in sales. Production takes place in 36 product-focused plants in the U.S. and Canada, with 48,000 employees.

Inventory is a major investment and an expensive asset in most firms. Holding costs often exceed 25% of product value, but in Frito-Lay's prepared food industry, holding cost can be much higher because the raw materials are perishable. In the food industry, inventory spoils. So poor inventory management is not only expensive but can also yield an unsatisfactory product that in the extreme can also ruin market acceptance.

Major ingredients at Frito-Lay are corn meal, corn, potatoes, oil, and seasoning. Using potato chips to illustrate rapid inventory flow: potatoes are moved via truck from farm, to regional plants for processing, to warehouse, to the retail store. This happens in a matter of hours—not days or weeks. This keeps freshness high and holding costs low.

Frequent deliveries of the main ingredients at the Florida plant, for example, take several forms:

- Potatoes are delivered in 10 truckloads per day, with 150,000 lbs consumed in one shift: the entire potato storage area will only hold 7½ hours' worth of potatoes.
- Oil inventory arrives by rail car, which lasts only 4½ days.
- Corn meal arrives from various farms in the Midwest, and inventory typically averages 4 days' production.
- Seasoning inventory averages 7 days.
- Packaging inventory averages 8 to 10 days.

Frito-Lay's product-focused facility represents a major capital investment. That investment must achieve high utilization to be efficient. The capital cost must be spread over a substantial volume to drive down total cost of the snack foods produced. This demand for high utilization requires reliable equipment and tight schedules. Reliable machinery requires an inventory of critical components: this is known as MRO, or maintenance, repair, and operating supplies. MRO inventory of motors, switches, gears, bearings, and other critical specialized components can be costly but is necessary.

Frito-Lay's non-MRO inventory moves rapidly. Raw material quickly becomes work-in-process, moving through the system and out the door as a bag of chips in about $1\frac{1}{2}$ shifts. Packaged finished products move from production to the distribution chain in less than 1.4 days.

Discussion Questions*

1. How does the mix of Frito-Lay's inventory differ from those at a machine or cabinet shop (a process-focused facility)?
2. What are the major inventory items at Frito-Lay, and how rapidly do they move through the process?
3. What are the four types of inventory? Give an example of each at Frito-Lay.
4. How would you rank the dollar investment in each of the four types (from the most investment to the least investment)?
5. Why does inventory flow so quickly through a Frito-Lay plant?
6. Why does the company keep so many plants open?
7. Why doesn't Frito-Lay make all its 41 products at each of its plants?

*You may wish to view the video that accompanies this case before addressing these questions.

Inventory Control at Wheeled Coach

Video Case 

Controlling inventory is one of Wheeled Coach's toughest problems. Operating according to a strategy of mass customization and responsiveness, management knows that success is dependent on tight inventory control. Anything else results in an inability to deliver promptly, chaos on the assembly line, and a huge inventory investment. Wheeled Coach finds that almost 50% of the cost of every ambulance it manufactures is purchased materials. A large proportion of that 50% is in chassis (purchased from Ford), aluminum (from Reynolds Metal), and plywood used for flooring and cabinetry construction (from local suppliers). Wheeled Coach tracks these A inventory items quite carefully, maintaining tight security/control and ordering carefully so as to maximize quantity discounts while minimizing on-hand stock. Because of long lead times and scheduling needs at Reynolds, aluminum must actually be ordered as much as 8 months in advance.

In a crowded ambulance industry in which it is the only giant, its 45 competitors don't have the purchasing power to draw the same discounts as Wheeled Coach. But this competitive cost advantage cannot be taken lightly, according to President Bob Collins. "Cycle counting in our stockrooms is critical. No part can leave the locked stockrooms without appearing on a bill of materials."

Accurate bills of material (BOM) are a requirement if products are going to be built on time. Additionally, because of the custom nature of each vehicle, most orders are won only after a bidding process. Accurate BOMs are critical to cost estimation and the resulting bid. For these reasons, Collins was emphatic that Wheeled Coach maintain outstanding inventory control. The *Global Company Profile* featuring Wheeled Coach (which opens Chapter 14) provides further details about the ambulance inventory control and production process.

Discussion Questions*

1. Explain how Wheeled Coach implements ABC analysis.
2. If you were to take over as inventory control manager at Wheeled Coach, what additional policies and techniques would you initiate to ensure accurate inventory records?
3. How would you go about implementing these suggestions?

*You may wish to view the video that accompanies this case before addressing these questions.

- **Additional Case Studies:** Visit MyOMLab for these free case studies:
  Southwestern University (F): The university must decide how many football day programs to order, and from whom.
  LaPlace Power and Light: This utility company is evaluating its current inventory policies.

Endnotes

1. See E. Malykhina, "Retailers Take Stock," *Information Week* (February 7, 2005): 20–22, and A. Raman, N. DeHoratius, and Z. Ton, "Execution: The Missing Link in Retail Operations," *California Management Review* 43, no. 3 (Spring 2001): 136–141.
2. This is the case when holding costs are linear and begin at the origin—that is, when inventory costs do not decline (or they increase) as inventory volume increases and all holding costs are in small increments. In addition, there is probably some learning each time a setup (or order) is executed—a fact that lowers subsequent setup costs. Consequently, the EOQ model is probably a special case. However, we abide by the conventional wisdom that this model is a reasonable approximation.
3. The formula for the economic order quantity (Q^*) can also be determined by finding where the total cost curve is at a minimum (i.e., where the slope of the total cost curve is zero). Using calculus, we set the derivative of the total cost with respect to Q^* equal to 0. The calculations for finding the minimum of

$$TC = \frac{D}{Q}S + \frac{Q}{2}H + PD$$

are

$$\frac{d(TC)}{dQ} = \left(\frac{-DS}{Q^2}\right) + \frac{H}{2} + 0 = 0$$

$$\text{Thus, } Q^* = \sqrt{\frac{2DS}{H}}$$

4. The number of units short, Demand–ROP, is true only when Demand–ROP is non-negative.
5. Equations (12-15), (12-16), and (12-17) are expressed in days; however, they could equivalently be expressed in weeks, months, or even years. Just be consistent, and use the same time units for all terms in the equations.
6. Note that Equation (12-17) can also be expressed as:

$$\text{ROP} = \text{Average daily demand} \times \text{Average lead time} + Z\sqrt{(\text{Average lead time} \times \sigma_d^2) + \bar{d}^2\sigma_{LT}^2}.$$

7. OM managers also call these *continuous review systems*.

CASE STUDIES

Darden's Global Supply Chains

Video Case 

Darden Restaurants (subject of the *Global Company Profile* at the beginning of this chapter), owner of popular brands such as Olive Garden and LongHorn Steakhouse, requires unique supply chains to serve more than 300 million meals annually. Darden's strategy is operations excellence, and Senior VP Jim Lawrence's task is to ensure competitive advantage via Darden's supply chains. For a firm with purchases exceeding $1.8 billion, managing the supply chains is a complex and challenging task.

Darden, like other casual dining restaurants, has unique supply chains that reflect its menu options. Darden's supply chains are rather shallow, often having just one tier of suppliers. But it has four distinct supply chains.

First, "smallware" is a restaurant industry term for items such as linens, dishes, tableware and kitchenware, and silverware. These are purchased, with Darden taking title as they are received at the Darden Direct Distribution (DDD) warehouse in Orlando, Florida. From this single warehouse, smallware items are shipped via common carrier (trucking companies) to Olive Garden, Bahama Breeze, and Seasons 52 restaurants.

Second, frozen, dry, and canned food products are handled economically by Darden's 11 distribution centers in North America, which are managed by major U.S. food distributors, such as MBM, Maines, and Sygma. This is Darden's second supply line.

Third, the fresh food supply chain (not frozen and not canned), where product life is measured in days, includes dairy products, produce, and meat. This supply chain is B2B, where restaurant managers directly place orders with a preselected group of independent suppliers.

Fourth, Darden's worldwide seafood supply chain is the final link. Here Darden has developed independent suppliers of salmon, shrimp, tilapia, scallops, and other fresh fish that are source inspected by Darden's overseas representatives to ensure quality. These fresh products are flown to the U.S. and shipped to 16 distributors, with 22 locations, for quick delivery to the restaurants. With suppliers in 35 countries, Darden must be on the cutting edge when it comes to collaboration, partnering, communication, and food safety. It does this with heavy travel schedules for purchasing and quality control personnel, native-speaking employees onsite, and aggressive communication. Communication is a critical element; Darden tries to develop as much forecasting transparency as possible. "Point of sale (POS) terminals," says Lawrence, "feed actual sales every night to suppliers."

Discussion Questions*

1. What are the advantages of each of Darden's four supply chains?
2. What are the complications of having four supply chains?
3. Where would you expect ownership/title to change in each of Darden's four supply chains?
4. How do Darden's four supply chains compare with those of other firms, such as Dell or an automobile manufacturer? Why do the differences exist, and how are they addressed?

*You may wish to view the video that accompanies this case before answering the questions.

Supply Chain Management at Regal Marine

Video Case 

Like most other manufacturers, Regal Marine finds that it must spend a huge portion of its revenue on purchases. Regal has also found that the better its suppliers understand its end users, the better are both the supplier's product and Regal's final product. As one of the 10 largest U.S. power boat manufacturers, Regal is trying to differentiate its products from the vast number of boats supplied by 300 other companies. Thus, the firm works closely with suppliers to ensure innovation, quality, and timely delivery.

Regal has done a number of things to drive down costs while driving up quality, responsiveness, and innovation. First, working on partnering relationships with suppliers ranging from providers of windshields to providers of instrument panel controls, Regal has brought timely innovation at reasonable cost to its product. Key vendors are so tightly linked with the company that they meet with designers to discuss material changes to be incorporated into new product designs.

Second, the company has joined about 15 other boat manufacturers in a purchasing group, known as American Boat Builders Association, to work with suppliers on reducing the costs of large purchases. Third, Regal is working with a number of local vendors to supply hardware and fasteners directly to the assembly line on a just-in-time basis. In some of these cases, Regal has worked out an arrangement with the vendor so that title does not transfer until parts are used by Regal. In other cases, title transfers when items are delivered to the property. This practice drives down total inventory and the costs associated with large-lot delivery.

Finally, Regal works with a personnel agency to outsource part of the recruiting and screening process for employees. In all these cases, Regal is demonstrating innovative approaches to supply chain management that help the firm and, ultimately, the end user. The *Global Company Profile* featuring Regal Marine (which opens Chapter 5) provides further background on Regal's operations.

Discussion Questions*

1. What other techniques might Regal use to improve supply chain management?
2. What kind of response might members of the supply chain expect from Regal because of their "partnering" in the supply chain?
3. Why is supply chain management important to Regal?

*You may wish to view the video that accompanies this case before answering the questions.

Arnold Palmer Hospital's Supply Chain

Video Case 

Arnold Palmer Hospital, one of the nation's top hospitals dedicated to serving women and children, is a large business with over 2,000 employees working in a 431-bed facility totaling 676,000 square feet in Orlando, Florida. Like many other hospitals, and other companies, Arnold Palmer Hospital had been a long-time member of a large buying group, one servicing 900 members. But the group did have a few limitations. For example, it might change suppliers for a particular product every year (based on a new lower-cost bidder) or stock only a product that was not familiar to the physicians at Arnold Palmer Hospital. The buying group was also not able to negotiate contracts with local manufacturers to secure the best pricing.

So in 2003, Arnold Palmer Hospital, together with seven other partner hospitals in central Florida, formed its own much smaller, but still powerful (with $200 million in annual purchases) Healthcare Purchasing Alliance (HPA) corporation. The new alliance saved the HPA members $7 million in its first year with two main changes. First, it was structured and staffed to ensure that the bulk of the savings associated with its contracting efforts went to its eight members. Second, it struck even better deals with vendors by guaranteeing a *committed* volume and signing not 1-year deals but 3- to 5-year contracts. "Even with a new internal cost of $400,000 to run HPA, the savings and ability to contract for what our member hospitals really want makes the deal a winner," says George DeLong, head of HPA.

Effective supply chain management in manufacturing often focuses on development of new product innovations and efficiency through buyer–vendor collaboration. However, the approach in a service industry has a slightly different emphasis. At Arnold Palmer Hospital, supply chain opportunities often manifest themselves through the Medical Economic Outcomes Committee. This committee (and its subcommittees) consists of users (including the medical and nursing staff) who evaluate purchase options with a goal of better medicine while achieving economic targets. For instance, the heart pacemaker negotiation by the cardiology subcommittee allowed for the standardization to two manufacturers, with annual savings of $2 million for just this one product.

Arnold Palmer Hospital is also able to develop custom products that require collaboration down to the third tier of the supply chain. This is the case with custom packs that are used in the operating room. The custom packs are delivered by a distributor, McKesson General Medical, but assembled by a pack company that uses materials the hospital wanted purchased from specific manufacturers. The HPA allows Arnold Palmer Hospital to be creative in this way. With major cost savings, standardization, blanket purchase orders, long-term contracts, and more control of product development, the benefits to the hospital are substantial.

Discussion Questions*

1. How does this supply chain differ from that in a manufacturing firm?
2. What are the constraints on making decisions based on economics alone at Arnold Palmer Hospital?
3. What role do doctors and nurses play in supply chain decisions in a hospital? How is this participation handled at Arnold Palmer Hospital?
4. Doctor Smith just returned from the Annual Physician's Orthopedic Conference, where she saw a new hip joint replacement demonstrated. She decides she wants to start using the replacement joint at Arnold Palmer Hospital. What process will Dr. Smith have to go through at the hospital to introduce this new product into the supply chain for future surgical use?

*You may wish to view the video that accompanies this case before answering these questions.

Endnote

1. Inventory quantities often fluctuate wildly, and various types of inventory exist (e.g., raw material; work-in-process; finished goods; and maintenance, repair, and operating supplies [MRO]). Therefore, care must be taken when using inventory values; they may reflect more than just supply chain performance.