Chapter 21
Managing Inventory and Service Costs

After studying this chapter, you should be able to:

1. Identify the different types of inventory in manufacturing, service, and merchandising organizations and understand how these inventory costs are reflected on the income statement and balance sheet.

2. Analyze the levels of raw materials, work-in-process, and finished goods inventories in a manufacturing organization.

3. Understand how merchants manage inventory in their organizations.

4. Measure profitability and personnel utilization in a service organization.

5. Describe how the concept of just-in-time (JIT) inventory systems is used to improve cost, quality, and timely performance in organizations.

6. Calculate and interpret holding costs in merchandising and service businesses.

7. Use classic quantitative tools in inventory management (economic order quantity, reorder point, and safety stock).

© 2003 Howard Kingsnorth/Getty Images
Sam Walton didn’t invent discount retailing, but the company he founded, WAL-MART, is now the undisputed giant in the field. Sam Walton started his career in retailing at a J.C. PENNEY store in Des Moines, Iowa. Sam was a good salesperson, though he disliked the bookkeeping that went along with the job: “[I] couldn’t stand to leave a new customer waiting while I fiddled with paperwork on a sale I’d already made.”

After World War II, Sam borrowed $20,000 from his father-in-law and bought a variety store in Newport, Arkansas. By 1962, Sam Walton had built a chain of 16 variety stores located in Missouri, Arkansas, and Kansas. By this time, however, Walton had become convinced that there were big opportunities in opening discount retail locations in the smaller U.S. towns and cities that were being overlooked by the traditional retailers such as SEARS. Walton pitched his idea to a couple of retail chains, but he couldn’t generate any interest. He finally had to fund the start-up of his first discount store with his own money, putting up 95% of the financing, with another 3% coming from his skeptical brother Bud and 2% from the person he hired to manage the store. On July 2, 1962, this first Wal-Mart opened its doors. Today, Wal-Mart Stores, Inc. is the world’s largest retailer ($218 billion in sales in 2002), employing approximately 1.3 million people in more than 4,300 stores. Each week, more than 100 million customers visit Wal-Mart stores worldwide.

FYI:

Two other well-known discount retailers also began operations in 1962: KMART and TARGET.

Providing the management accounting information necessary to effectively control this massive merchandising organization is no easy task. Providing merchandise at the right time, to the right place, and at the right price is how a retailer “wins” customers. Sound simple? Consider that at any given moment, a typical Wal-Mart discount store has more than 70,000 different items of inventory in stock. Every one of these items must be identified, ordered, inventoried, and replenished—all the while keeping an eye on costs. (Inventory costs at a typical Supercenter are even tougher to manage because these stores also carry more than 20,000 grocery items, many of them perishable.) The crucial idea behind discount retailing is that lower prices will lead to a large enough increase in sales volume to make up for the fact that a smaller profit is made on each inventory item. As the discount retailing industry has expanded and become more competitive, Wal-Mart has had to be ever more aggressive in cutting its profit margins in order to keep its prices low. To illustrate, in 1980 Wal-Mart’s gross profit percentage was 27%; in 2003, the percentage had dropped to 22%. For a company wrestling with tightening margins, inventory control is a crucial part of operations. Wal-Mart leased its first computer, an IBM 360, in 1969 in order to track the inventory flow at its new distribution center in Bentonville, Arkansas. Ever since, Wal-Mart has been a leader in using information technology to monitor and manage its inventory.

Today, Wal-Mart is a leader in implementing electronic data interchange (EDI), which involves the electronic transfer of invoices, purchase orders, and shipping notices, thus speeding up the communication between Wal-Mart and its suppliers. One important tool in Wal-Mart’s EDI system is small handheld computers that link by radio frequency to in-store terminals. The next time you’re in a Wal-Mart store, watch to see if you can spot an employee using one of these handheld computers to manage inventory on the shelves. These devices provide the critical link between Wal-Mart’s suppliers and customers. With this technology, Wal-Mart management is able to get faster and more accurate information to plan, control, and evaluate every aspect of inventory management. This leads to better cost control and better merchandise and service.

In addition to the use of handheld computers, Wal-Mart’s “Retail Link” system now gives vendors access to Wal-Mart’s own store-by-store sales information and inventory levels in real time, so that the vendors themselves can know when to make additional product shipments to specific Wal-Mart locations. The information partnership between Wal-Mart and PROCTER & GAMBLE, dating back to 1987, is legendary as an example of a buyer and a seller exchanging detailed transaction data in order to improve the operating efficiency of both companies.

FYI:

In its 2003 financial statements, Procter & Gamble (P&G) disclosed that Wal-Mart is its single largest customer, accounting for 18% of P&G’s sales in 2003.

ome companies, such as COCA-COLA and NIKE, have become successful through convincing potential customers that their soft drinks or sports shoes are superior to all others. Hence, we talk of the marketing genius of Coca-Cola and Nike, not their cost management techniques. In contrast, WAL-MART does not offer unique products; to a large extent, Wal-Mart sells the same products sold by every other discount retailer in the world. Wal-Mart attracts us with its low prices, and consistent low prices are possible only in an organization that meticulously and relentlessly controls its inventory costs. In this chapter, we will introduce techniques used to manage inventory in manufacturing organizations, service organizations, and merchandising organizations (like Wal-Mart).

### Inventory in Organizations

In an earlier chapter on product cost flows, we discussed the ways in which costs flow from one activity to the next in manufacturing, merchandising, and service organizations. These cost flow patterns are summarized in Exhibit 1. You can see in this exhibit that product costs first appear on the balance sheet in the form of inventory, and then flow onto the income statement as cost of goods or services sold (an expense account). Recall that the extended production process characteristic of both manufacturing and service firms means that those organizations have significant levels of work-in-process inventory—goods or services that have not yet been completed but have already resulted in work being done and costs being incurred. In addition, note that both manufacturing and merchandising firms maintain significant inventories of goods that are ready for sale (finished goods or merchandise inventory). On the other hand, it is typically not in the nature of a service business to have finished goods inventory. As soon as the service (e.g., the accountant’s audit, the doctor’s office visit, the trucking company’s transportation contract) has been completed and moves out of the work-in-process services account.

### Exhibit 1: Cost Flows in Manufacturing, Service, and Merchandising Organizations

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>Service</th>
<th>Merchandising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost Inputs</strong></td>
<td><strong>Balance Sheet Assets</strong></td>
<td><strong>Income Statement Expenses</strong></td>
</tr>
<tr>
<td>Direct Materials</td>
<td>Work-in-Process Inventory</td>
<td>Cost of Goods Sold</td>
</tr>
<tr>
<td>Direct Labor</td>
<td>Finished Goods Inventory</td>
<td></td>
</tr>
<tr>
<td>Manufacturing Overhead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplies</td>
<td>Work-in-Process Services</td>
<td>Cost of Services Sold</td>
</tr>
<tr>
<td>Wages and Salaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventory Purchases</td>
<td>Merchandise Inventory</td>
<td>Cost of Goods Sold</td>
</tr>
</tbody>
</table>
(sometimes known as the unbilled services account), it is delivered to the final customer, and the product cost is transferred to the cost of services sold expense account.

Exhibit 2 compares the income statements for three fictitious firms. The exhibit also presents selected balance sheet accounts. Carefully examine this exhibit to be sure you understand how the activities and inventories of manufacturing, service, and merchandising organizations are reported in the financial statements.

Exhibit 2: Financial Statement Comparison: Manufacturing, Service, and Merchandising Firms

### Income Statements for Different Types of Firms
**For the Year Ended December 31, 2006**

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing Firm</th>
<th>Service Firm</th>
<th>Merchandising Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales revenue</td>
<td>$4,000,000</td>
<td>$5,000,000</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>Cost of goods sold/Cost of services:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of goods manufactured/Cost of services:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning raw materials/supplies inventory</td>
<td>$24,000</td>
<td>$230</td>
<td></td>
</tr>
<tr>
<td>+ Purchases of materials/supplies</td>
<td>1,153,000</td>
<td>11,400</td>
<td></td>
</tr>
<tr>
<td>Total raw materials/supplies available</td>
<td>$1,177,000</td>
<td>$11,630</td>
<td></td>
</tr>
<tr>
<td>- Ending raw materials/supplies inventory</td>
<td>(25,000)</td>
<td>(180)</td>
<td></td>
</tr>
<tr>
<td>Raw materials/supplies used in production</td>
<td>$1,152,000</td>
<td>$11,450</td>
<td></td>
</tr>
<tr>
<td>+ Direct labor</td>
<td>445,000</td>
<td>1,890,000</td>
<td></td>
</tr>
<tr>
<td>+ Applied manufacturing/service overhead</td>
<td>1,003,000</td>
<td>798,000</td>
<td></td>
</tr>
<tr>
<td>Total manufacturing/service costs</td>
<td>$2,600,000</td>
<td>$2,699,450</td>
<td></td>
</tr>
<tr>
<td>+ Beginning work-in-process inventory/services</td>
<td>24,000</td>
<td>75,000</td>
<td></td>
</tr>
<tr>
<td>- Ending work-in-process inventory/services</td>
<td>(19,000)</td>
<td>(83,000)</td>
<td></td>
</tr>
<tr>
<td>Cost of goods manufactured/Cost of services</td>
<td>$2,605,000</td>
<td>$2,691,450</td>
<td></td>
</tr>
<tr>
<td>Merchandise purchases</td>
<td></td>
<td></td>
<td>$1,713,000</td>
</tr>
<tr>
<td>+ Beginning finished goods/merchandise inventory</td>
<td>24,000</td>
<td>37,000</td>
<td></td>
</tr>
<tr>
<td>- Ending finished goods/merchandise inventory</td>
<td>(47,000)</td>
<td>(36,000)</td>
<td></td>
</tr>
<tr>
<td>Cost of goods sold/Cost of services</td>
<td>$2,582,000</td>
<td>$2,714,000</td>
<td></td>
</tr>
<tr>
<td>+ Under/over applied manufacturing/service overhead</td>
<td>307,000</td>
<td>22,100</td>
<td></td>
</tr>
<tr>
<td>Adjusted cost of goods sold/Cost of services</td>
<td>$2,889,000</td>
<td>$2,736,500</td>
<td></td>
</tr>
<tr>
<td>Gross margin</td>
<td>$1,111,000</td>
<td>$2,286,450</td>
<td>$786,000</td>
</tr>
<tr>
<td>Selling and administrative expenses:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selling expenses</td>
<td>$256,000</td>
<td>$367,000</td>
<td>$406,000</td>
</tr>
<tr>
<td>Administrative expenses</td>
<td>474,000</td>
<td>1,003,000</td>
<td>188,000</td>
</tr>
<tr>
<td>Total selling and administrative expenses</td>
<td>$730,000</td>
<td>$1,370,000</td>
<td>$594,000</td>
</tr>
<tr>
<td>Operating income</td>
<td>$381,000</td>
<td>$916,450</td>
<td>$192,000</td>
</tr>
</tbody>
</table>

### Selected Balance Sheet Information
**December 31, 2006**

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing Firm</th>
<th>Service Firm</th>
<th>Merchandising Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts receivable</td>
<td>$74,000</td>
<td>$63,000</td>
<td>$3,900</td>
</tr>
<tr>
<td>Raw materials inventory</td>
<td>25,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-process inventory/services</td>
<td>19,000</td>
<td>83,000</td>
<td></td>
</tr>
<tr>
<td>Finished goods/Merchandise inventory</td>
<td>47,000</td>
<td>36,000</td>
<td></td>
</tr>
<tr>
<td>Supplies inventory</td>
<td>750</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Accounts payable</td>
<td>28,000</td>
<td>16,000</td>
<td>48,000</td>
</tr>
</tbody>
</table>

2 We use the term “product cost” to refer to both the cost of goods in manufacturing and merchandising organizations and to the cost of services in service organizations.
As you can see, each income statement in Exhibit 2 follows a typical income statement format:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales revenue</td>
<td>$XXX,XXX</td>
</tr>
<tr>
<td>Costs of goods sold</td>
<td>(XX,XXX)</td>
</tr>
<tr>
<td>Gross margin</td>
<td>$XXX,XXX</td>
</tr>
<tr>
<td>Selling and administrative expenses</td>
<td>(X,XXX)</td>
</tr>
<tr>
<td>Operating income</td>
<td>$XXX,XXX</td>
</tr>
</tbody>
</table>

Remember that the calculation for cost of goods sold for a manufacturing company (and for a service company) comes from the cost of goods manufactured schedule. This schedule is also included in Exhibit 2 and follows the format below:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning raw materials inventory</td>
<td>$ XXX</td>
</tr>
<tr>
<td>Add: Raw materials purchased</td>
<td>X,XXX</td>
</tr>
<tr>
<td>Total raw materials available</td>
<td>$X,XXX</td>
</tr>
<tr>
<td>Less: Ending raw materials inventory</td>
<td>(XXX)</td>
</tr>
<tr>
<td>Raw materials used in production</td>
<td>$ X,XXX</td>
</tr>
<tr>
<td>Direct labor</td>
<td>X,XXX</td>
</tr>
<tr>
<td>Applied manufacturing overhead</td>
<td>X,XXX</td>
</tr>
<tr>
<td>Total manufacturing costs</td>
<td>$XX,XXX</td>
</tr>
<tr>
<td>Add: Beginning work-in-process inventory</td>
<td>XXX</td>
</tr>
<tr>
<td>Less: Ending work-in-process inventory</td>
<td>(XXX)</td>
</tr>
<tr>
<td>Cost of goods manufactured</td>
<td>$XXX,XXX</td>
</tr>
</tbody>
</table>

You should note two important items in Mason Tool’s cost of goods manufacturing calculation versus the similar calculation for Brown Engineering. First of all, notice that Brown is using a rather insignificant amount of supplies ($11,450) to create its service product, especially when compared with Mason Tool, which is using a very significant amount of raw materials ($1,152,000) to create its tools. This difference underscores the fact that some supplies are often used in the process of creating and delivering a service product, but these costs are typically not a significant component of cost of services. Secondly, when calculating cost of services (analogous to cost of goods sold), note that Brown Engineering does not hold finished service products for later sale to its customers. Again, the very nature of a service business determines that a completed service is delivered to the customer almost instantly. In contrast, Brown Engineering does have significant work-in-process “inventory,” representing the costs of engineering contracts that have not yet been completed.

Smith Office Supply does not create the products it sells. As a result, Smith has no work-in-process inventory, and the cost of goods sold calculation only requires that Smith adjust the total amount of merchandise it purchased in 2006 by the change in its merchandise inventory account.

Balance sheet information for the three companies is presented at the bottom of Exhibit 2. As you can see, all three firms have accounts receivable, supplies inventory, and accounts payable accounts. Because Brown uses supplies directly in providing engineering services to its clients, this account is used in the calculation of cost of services. On the other hand, cost of supplies for Mason Tool and Smith Office Supply is included in the overhead and administrative expenses accounts. In addition, you can see that Mason Tool has three inventory accounts; Smith Office Supply has one inventory account to record the costs of goods until the goods are sold to customers. Brown does not have a raw materials inventory, finished goods inventory, or merchandise inventory account (though supplies inventory is analogous to raw materials inventory for many service firms). However, its work-in-process services account acts much like Mason Tool’s work-in-process inventory account and is similarly used to adjust the cost of services account in Brown’s income statement.

3 If necessary, be sure to review the earlier chapter on product cost flows, particularly Exhibit 1 on page 877 and Exhibit 5 on page 886.
Exhibit 1 reviews how product costs and inventory flow through manufacturing, merchandising, and service organizations, and Exhibit 2 illustrates how these different types of inventory are reflected in the income statement and the balance sheet. In the remainder of this chapter, we will discuss how companies can use this information to manage inventory. The extended production process of a manufacturing or service firm requires careful scrutiny of costs at each important stage of the process. For a merchandising company, cost management focuses on acquiring the right amount of inventory for the right price.

**TO SUMMARIZE:** Both manufacturing and service organizations must manage substantial production processes; an important managerial accounting function in these organizations is tracing the flow of costs through the various stages of production. Both manufacturing and merchandising organizations traditionally maintain significant levels of inventory ready for sale to customers. These differences among manufacturing, merchandising, and service organizations are reflected in differences in their income statements and balance sheets.

### Analyzing Inventory Levels

2. Analyze the levels of raw materials, work-in-process, and finished goods inventories in a manufacturing organization.

In the income statement and balance sheet figures reported in Exhibit 2 for Mason Tool Company, cost of goods sold was determined to be $2,889,000 (after the adjustment for underapplied manufacturing overhead). This is a summary number that is used in the financial statements and is the number that the company’s auditors will work hard to attest for the company’s published financial statements. However, because it is a summary number, it is not useful for detailed internal decision making. To be useful, management may want to analyze product costs on a product-by-product basis, a period-by-period basis, and a department-by-department basis. By breaking costs down by product, period, and department, management can determine which departments and products are performing well and which are performing poorly. Further, because product costs are used to measure inventory values on the balance sheet, these costs can be used to determine how effectively Mason Tool Company manages its investments in inventory. Exhibit 3 reports the monthly ending balances for the three inventories necessary to produce its products: raw materials, work-in-process, and finished goods. These inventories represent significant investments necessary to support Mason Tool Company’s production processes.

Mason maintains a raw materials inventory in order to ensure that there are materials always available for use in production. This flow of materials is represented by the cost of materials used (i.e., the materials transferred onto the factory floor). The work-in-process inventory is important to maintaining a constant flow of production through the factory and into the finished goods warehouse. This “flow” is represented by the cost of goods manufactured (i.e., the completed goods transferred off of the factory floor). Finally, the finished goods inventory is necessary to be sure that products are always available for sale to customers. The flow of product costs to customers is represented by the cost of goods sold.

The top panel of Exhibit 3 reports product cost and inventory ending balance data for table saws at Mason Tool Company (we’ll assume that table saws are this company’s only product). These data are listed by month, and the total values for the year tie back to the income statement data in Exhibit 2. As you review these data, try to put yourself in the shoes of the Mason Tool Company production manager. Ask yourself this question: how effectively is the company using inventory to support its purchasing, production, and sales processes? It is difficult to answer this question based solely on the data reported in the top panel of Exhibit 3.

4 The need to maintain inventory in order to support key business processes such as production and sales is challenged by an important new management concept known as just-in-time inventory systems or JIT. We discuss JIT later in this chapter.
By combining inventory data with its related cost flow data, management is able to create a report that helps it control how effectively raw materials, work-in-process, and finished goods inventories are being used. Two measures used to evaluate a company’s inventory management practices are inventory turnover and days in inventory. Exhibit 4 illustrates the computations of inventory turnover and days in inventory in February for table saws at Mason Tool Company.

**inventory turnover** The number of times the inventory in the organization “turns over” during a period of time. It is often easier to think of inventory turnover as the number of times a dollar invested in inventory generates output. Output for raw materials inventory is measured by the cost of raw materials used in production. Output for work-in-process inventory is measured by cost of goods manufactured. Output for finished goods (or merchandise) inventory is measured by cost of goods sold. Inventory turnover is computed as total output for the period divided by average inventory level.

**days in inventory** Average number of days of use provided by the level of inventory maintained by the organization. This definition is closely related to the “inventory turnover” concept. Days in inventory is computed as number of days in the period being assessed divided by the inventory turnover. (See related definition and computation for inventory turnover.)

By combining inventory data with its related cost flow data, management is able to create a report that helps it control how effectively raw materials, work-in-process, and finished goods inventories are being used. Two measures used to evaluate a company’s inventory management practices are inventory turnover and days in inventory. Exhibit 4 illustrates the computations of inventory turnover and days in inventory in February for table saws at Mason Tool Company.

The inventory turnover measure is based on the following formula:

\[
\text{Cost flow for the period} \div \text{Average inventory level} = \text{Inventory turnover}
\]

*where the average inventory level is generally measured as:

\[
\frac{\text{Beginning inventory} + \text{Ending inventory}}{2} = \text{Average inventory level}
\]

This turnover measure indicates how many times during the period the organization completely replenished or replaced the inventory, given the rate at which costs are flowing through the production process. For example, Exhibit 3 reports that Mason’s cost of raw materials used during February was $86,000. As shown in Exhibit 4, Mason’s average raw materials inventory level for February was approximately $22,500 ($25,000 + $20,000 + \( \div 2 \)), which means that its raw materials inventory “turned over” or was replaced 3.8 times during the month. Inventory turnover measures the intensity with which Mason is managing its raw materials inventory—low inventory turnover indicates lots of idle
inventory lying around the raw materials warehouse whereas high inventory turnover indicates extremely active management with little excess inventory.

The days in inventory measure provides an alternative measure of the inventory turnover concept. The computation of this measure is as follows:

\[
\text{Days in inventory} = \frac{\text{Number of days in the reporting period}}{\text{Inventory turnover}}
\]

For example, Exhibit 3 reports that Mason’s cost of goods manufactured (which “flows” out of the work-in-process inventory account) during February was $195,000. Using the inventory turnover formula shown above, Mason’s work-in-process inventory turnover for the month is 10.0, meaning that inventory was replaced 10 times in February. If we assume that on average there are 30 days in a month,\(^5\) then Mason maintained approximately three days’ worth of work-in-process inventory in February to support the production process. The fewer numbers of days in work-in-process inventory, the more streamlined the production process; a long, complex manufacturing process (such as the construction of a ship) could have more than a year’s worth of production costs tied up in unfinished inventory.

Mason Tool Company’s performance in terms of how well it efficiently uses finished goods inventory is indicated by the fact that this inventory turned over

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**Caution**

Days in inventory is a function of the time period used to compute the production costs used in the related inventory turnover measure. Therefore, if the cost of raw materials used (or cost of goods manufactured or cost of goods sold) is for a six-month period, then the days in raw materials inventory (or days in work-in-process inventory or days in finished goods inventory) should be computed using the numbers of days in a six-month period. The organization generally sets a policy on numbers of days to use. For example, it may choose to consistently use 30 days in a month, 90 days in a quarter, 180 days in a half year, and 360 days in a year.

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**Exhibit 4: Analysis of the Levels of Raw Materials, Work-in-Process, and Finished Goods Inventories**

<table>
<thead>
<tr>
<th>Raw Materials Inventory—February</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of raw materials used during February</td>
<td>$86,000</td>
</tr>
<tr>
<td>Beginning raw materials inventory in February(^*)</td>
<td>$25,000</td>
</tr>
<tr>
<td>Ending raw materials inventory in February</td>
<td>$20,000</td>
</tr>
<tr>
<td>Average inventory balance during the month</td>
<td>$22,500</td>
</tr>
<tr>
<td>Raw materials inventory turnover (cost flow (\div) average inventory)</td>
<td>3.8</td>
</tr>
<tr>
<td>Days in raw materials inventory (30 days (\div) inventory turnover)(^{\dagger})</td>
<td>7.8 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work-in-Process Inventory—February</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of goods manufactured during February</td>
<td>$195,000</td>
</tr>
<tr>
<td>Beginning work-in-process inventory in February(^*)</td>
<td>$19,000</td>
</tr>
<tr>
<td>Ending work-in-process inventory in February</td>
<td>$20,000</td>
</tr>
<tr>
<td>Average inventory balance during the month</td>
<td>$19,500</td>
</tr>
<tr>
<td>Work-in-process inventory turnover (cost flow (\div) average inventory)</td>
<td>10.0</td>
</tr>
<tr>
<td>Days in work-in-process inventory (30 days (\div) inventory turnover)(^{\dagger})</td>
<td>3.0 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Finished Goods Inventory—February</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of goods sold during February</td>
<td>$190,000</td>
</tr>
<tr>
<td>Beginning finished goods inventory in February(^*)</td>
<td>$48,000</td>
</tr>
<tr>
<td>Ending finished goods inventory in February</td>
<td>$46,000</td>
</tr>
<tr>
<td>Average inventory balance during the month</td>
<td>$47,000</td>
</tr>
<tr>
<td>Finished goods inventory turnover (cost flow (\div) average inventory)</td>
<td>4.0</td>
</tr>
<tr>
<td>Days in finished goods inventory (30 days (\div) inventory turnover)(^{\dagger})</td>
<td>7.4 days</td>
</tr>
</tbody>
</table>

\(^*\)Equal to the ending inventory level in January.

\(^{\dagger}\)Don’t round the turnover ratio when computing days in inventory.

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\(^5\) Although there are 28 (occasionally 29) days in the month of February, we use an average of 30 days per month in this textbook for all monthly days in inventory calculations. This is a standard number of days per month used by many organizations for similar calculations.
4.0 times during February. Alternatively, Mason reports 7.4 days in finished goods inventory for February. This means that Mason is able to sell its entire inventory of table saws to customers approximately every 7.4 days.

Mason Tool Company’s inventory turnover and days in inventory computations for the remainder of 2006 are reported in the bottom panel of Exhibit 3. Take a moment to scan these numbers. Do you see any patterns across time in the way that Mason Tool Company is able

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**That’s a Lot of Inventory!**

During your last trip to the grocery store, did you count the number of types of product on the shelves? How many different stock keeping units (SKUs) or product items would you estimate your local grocery store uses to monitor its inventory activity? 1,000? 10,000? 100,000? Keeping track of the catalog and inventory of SKUs is made easier by technology. Managers need detailed information to help keep the shelves fully stocked without having too much invested in inventory.

In 1883, when Arthur and Howard Hannaford opened their fruit and vegetable stand in Portland, Maine, life was just a bit slower. Now HANNAFORD BROS. is a supermarket chain operating 116 supermarkets and three distribution centers located throughout Maine, New Hampshire, Vermont, New York, and Massachusetts under the names of SHOP ‘N SAVE and HANNAFORD FOOD AND DRUG SUPERSTORES with an average store size of about 48,000 square feet per store. Just like every business, the grocery business is competitive; traditionally thin margins make every penny count. Store managers are under a lot of pressure to control inventory and costs and generate as much revenue as possible.

The company’s information philosophy is expressed by Bill Homa, chief information officer of Hannaford, “If we can provide managers with the information they need to reduce their out-of-stocks, we can help them increase their sales.” The company used to distribute daily printed merchandising reports to its stores via FEDERAL EXPRESS. Given the number of stores involved, this procedure cost Hannaford several hundred thousand dollars each year.

In order to provide managers with the inventory information they need to effectively operate their stores, Hannaford and CISCO developed an inventory SKU system to manage its perishable dated products to reduce costs and increase sales. This system alerts managers to early indications of inventory problems, improving their ability to make strategic merchandising and buying decisions. The system also hosts merchandising reports that are updated daily and centralizes decision-support information for corporate planners and store managers.

The Hannaford inventory SKU system eliminates the need for daily printed merchandising reports, which were costing the company hundreds of thousands of dollars in annual express delivery charges. It also gives managers Web-based access to daily merchandising reports and affords them the means to examine sales by item or by category. Thanks to the system, they are able to control “shrink” (the loss associated with products that are outdated, damaged, or stolen), look at weekly variances in sales and labor, and centralize all of this information so that corporate planners can make timely decisions based on updated knowledge of chain-wide trends.

“In the past, we printed new reports every day and shipped them out to the stores. Now store and department managers can use Web browsers to search the online reports and immediately pull off the information they need. And by eliminating paper reports, we’re also saving several hundred thousand dollars in annual FedEx charges.”

—Bill Homa, chief information officer, Hannaford Bros.

In 1999, Hannaford announced its merger with DELHAIZE AMERICA; allowing Hannaford Bros. Co. to operate as a separate business while being part of a $14 billion company with 1,400 stores from Maine to Florida.

to manage its three types of inventory? Look closely at the days in inventory numbers. You should see that Mason is able to reduce its days in finished goods inventory during the summer months by approximately two days (from more than seven days to a little more than five days). This suggests that Mason is experiencing more sales of its table saws in the summer. While Mason may or may not be able to control this seasonal cycle, it does need to anticipate these surges in market demand and plan its production process accordingly. The fact that Mason is basically holding its days in work-in-process inventory consistent at between approximately 2.5 and 3 days indicates that it is working hard to adjust its production outflow to the market demand for its table saws. One inventory problem that Mason likely needs to address is the way it controls its raw materials inventory. This inventory level fluctuates from about 5.5 days in the summer to about 8 days during the winter. Perhaps Mason needs to more aggressively tailor its volume of raw material purchases to coincide with production and sales.

As we finish this section on managing inventory levels, it is important to point out that comparing performance across periods of time is only one way that these two measures can be used to control inventory. Management may also want to compare the inventory levels of different products across the organization, or may want to “benchmark” the performance of its products with those of other companies. Further, in addition to assessing production cost and inventory levels, managers are just as interested in indicators of product and production quality. We’ll address some of these quality issues in the next chapter.

STOP & THINK
It appears in Exhibit 3 that the inventory performance measures are missing for January. Is it possible to compute these measures using the data provided? What data would you need to analyze how well Mason Tool Company managed its three inventory levels during January?

TO SUMMARIZE: Cost of goods sold is a summary number that is audited and used in the financial statements, but it is not very useful for managers to use when assessing how well the company controls inventory costs and inventory levels. Two management accounting tools can be used to support good management control of levels of raw materials, work-in-process, and finished goods inventories. These two measures are inventory turnover and days in inventory. Inventory turnover is a measure of the intensity with which the organization is using its inventory. Higher turnover numbers indicate a more efficient use of inventory. The days sales in inventory measure reports the average number of days of inventory use. A lower number of days indicates a more efficient use of inventory.

Managing Cost Information

3 Understand how merchants manage inventory in their organizations.

As discussed in the preceding section, cost data can be used in a manufacturing firm to evaluate the appropriateness of the levels of raw materials, work-in-process, and finished goods inventories. Merchants, or managers of merchandising organizations, are particularly conscious of inventory levels currently in the retail store or in the distribution center. Managing this inventory takes careful and detailed planning. The detail in these plans results from merchants having many different types of inventory items, each with its own particular supplier source and targeted customer. Merchants must also be very careful in planning their inventory levels because having either too little or too much inventory can involve critical issues. These issues are listed in Exhibit 5. If accountants are aware of these issues, they can help their organizations avoid a variety of unnecessary out-of-pocket costs or opportunity costs.

Carrying Too Much Inventory

Having inventory is certainly necessary for most merchants if they expect to do business with their customers. However, accumulating as much inventory as possible is not the purpose of merchandising (or manufacturing) companies. Good business management entails having the right assets at the right place in the right time and in the right quantity (always a challenging
endeavor!). Later in this chapter, we’ll introduce you to the concept of just-in-time (JIT) inventory management, which emphasizes the fact that too much inventory creates a lot of management problems. Managers of merchandising organizations are particularly sensitive to this fact. First of all, clearly many out-of-pocket costs are involved in having inventory on site, including costs of storage, security, and record keeping. What may not be as clear is the financial opportunity cost (sometimes called the holding cost) of the inventory investment. Every dollar that is invested in inventory cannot be used in alternative business investments, such as expanding another part of the business or simply investing in the stock market or in a bank savings account. Whatever money we could make by investing the money elsewhere is the holding cost of the current inventory investment. Accountants measure and report holding costs all the time. We will demonstrate the calculation of holding costs in the expanded material section of this chapter.

Increased overhead costs and holding costs are not the only issues involved in carrying too much inventory. The more inventory a merchant elects to carry, the more risk the merchant faces that the inventory will decrease in market value before it can be sold (of course, inventory may unexpectedly increase in market value as well). In addition, when a merchant invests in a lot of one type of inventory, it becomes difficult to shift to another inventory type that customers may suddenly want to buy. Finally, every merchant understands the tough reality that inventories “shrink” over time. Inventory shrinkage happens in a lot of ways. The type of shrinkage we hear about most often is theft (either by customers or employees). However, when inventory is being moved, stacked, stored, retrieved, and rotated, things get broken, parts get lost, and items become mislabeled. Liquid and gas stocks spill or evaporate. Cloth material becomes soiled. Grocery items spoil or become stale. As inventory is piled up around the store or distribution center, this disorder, spoilage, and theft are revealed every time the company takes an annual inventory count, resulting in additional out-of-pocket costs to replace the inventory.

**Carrying Too Much Inventory**

- Increased overhead costs
- Increased financial holding costs
- Increased risk of loss of market value
- Decreased inventory flexibility
- Increased inventory shrinkage

**Carrying Too Little Inventory**

- Increased risk of lost sales
- Increased ordering costs
- Increased risk of supplier price increases
- Increased exposure to nondelivery
- Decreased bulk order discounts

**FYI:**

In 1999, FRUIT OF THE LOOM reported that it experienced inventory shrinkage totaling $70.4 million. This represented a 25% increase in shrinkage compared to the prior year. Fruit of the Loom attributed the shrinkage increase to expansion of its network of contractors (factories where its clothing items are produced).

How important is the Christmas buying season for a toy merchant? The 2002 annual report for TOYS “R” US, INC., reports that approximately 43% of its sales occur in the months of November, December, and January.
buying in smaller quantities will generally have to make more purchases, and pay for additional employee time, to replenish their stock.

Prices for most types of inventory increase with time. Some items are particularly susceptible to sudden price increases. Have you ever awakened to hear the morning newscast report that automobile gasoline prices have suddenly surged? When you go out to your car and discover the gas tank nearly empty, don’t you wish you had filled the tank yesterday? One reason some merchants purchase large amounts of inventory is to temporarily protect themselves from sudden increases in prices. Companies without similar foresight will experience greater out-of-pocket expenses if prices do increase. Companies that keep very low levels of inventory are most likely to have to pay for every price increase. In addition, these same companies are much more dependent on their suppliers to always meet their delivery commitments. If a supplier is late in making promised shipments or delivers inventory that is damaged or of the wrong type, the merchant may miss making sales to some customers. Finally, merchants that regularly purchase large levels of inventory often enjoy price discounts from their suppliers. Merchants making smaller purchases should be aware of the opportunity cost related to missing these potential bulk purchase discounts.

**Example of Inventory Management Costs**

We’ll use the fictitious example of two large retailers of children’s toys, Kids N Toys, Inc., and Child’s Delight, Inc., to explore the issues and costs involved in inventory management for merchandising organizations. As you might expect, the Christmas buying season is a big deal for a toy retailer. Management and buyers for these companies study trend reports and catalogs all year in order to properly plan their investments for December. Both companies have limited resources that can be invested in inventory for the holiday season. Given the necessary lead time, as well as the size of the investment, these decisions are absolutely critical to both companies. Once December has arrived, it becomes very difficult to make many adjustments to preplanned inventory types and levels.

A wholesaler of children’s dolls has announced the availability of a new doll for Christmas this year, the Burzee Doll. Based on the manufacturer’s reputation, as well as the fact that the manufacturer of the doll intends to do a lot of promotional advertising, the wholesaler is confident that the Burzee Doll will sell very well this year. To help make planning decisions, each retailer has its management accountants prepare some forecasts on potential revenues and costs related to the issues listed in Exhibit 5. Based on the projections of its accountants, Kids N Toys, Inc., decides to invest very heavily in the Burzee Doll and orders 50,000 dolls for delivery on November 1. Because of the size of its order, the wholesaler offers Kids N Toys a discount of $2 per doll. On the other hand, the accountants’ projections of revenues and costs at Child’s Delight, Inc., are not as optimistic. As a result, Child’s Delight orders only 5,000 dolls and pays the full wholesale price of $12 per doll. Both retailers follow the manufacturer’s recommendation to set the customer price at $30 per doll.

Exhibit 6 outlines all the Burzee Doll events that take place during the holiday season, as well as the resulting revenues and costs for the two companies. As it turns out, the Burzee Dolls are a real hit during the holiday buying season. Child’s Delight keeps running out of inventory and must reorder dolls three times during the season. As you can see in Exhibit 6, each time Child’s Delight reorders dolls, it is not hard for the accountants to note the amount of inventory shrinkage. Occasionally, dolls are stolen, misplaced, or destroyed in the process of moving, sorting, and stacking. On the other hand, Kids N Toys has lots of dolls spread out all over the store, making it difficult to know much about shrinkage without taking a very expensive inventory count. The accountants at Kids N Toys elect to wait until all the inventory is sold before measuring inventory shrinkage.
By the end of December, Child’s Delight has sold all of its dolls and elects not to place a fifth order. On the other hand, Kids N Toys still has a large number of dolls remaining. Since the buying craze for Burzee Dolls appears to be finished, Kids N Toys puts the dolls on sale at cost ($10 per doll) in mid-January. At the end of January, the store liquidates the remaining 4,400 dolls to another retailer at $3 per doll.

**The Gross Margin Report**

When all Burzee Doll sales are totaled, Kids N Toys sold 48,400 dolls (indicating inventory shrinkage over the last three months of 1,600 dolls); Child’s Delight sold 19,850 dolls (indicating inventory shrinkage of 150 dolls). Which of the two retailers did better with the Burzee Dolls? Exhibit 7 provides a gross margin report based on what each company spent on inventory purchases and received in inventory sales. When you look at the gross margin of $793,200 for Kids N Toys, it appears that this company did a much better job selling Burzee Dolls than its competitor, Child’s Delight, based on its gross margin of only $325,500.

**Return on Inventory Investment**

The gross margin numbers presented in Exhibit 7 suggest that Kids N Toys outperformed Child’s Delight. However, if you had money to invest in these companies, you might actually like Child’s Delight’s retail work on Burzee Dolls better than the work done by Kids N Toys.
Think about the average size of the inventory investment that each company maintained. Kids N Toys initially spent $500,000 to acquire 50,000 dolls. By the end of January, this inventory had been fully liquidated back into cash. Hence, Kids N Toys had quite a bit of cash tied up in Burzee Doll inventory! On average, how much cash did it have invested in this inventory during its selling period? On November 1, Kids N Toys had $500,000 in Burzee Doll inventory. On January 30, it had no Burzee Doll inventory. On average, Kids N Toys had about a $250,000 investment in inventory during its three-month selling period ($500,000 / 2). How does Kids N Toys’ average inventory investment compare to its competitor’s investment? Rather than one large inventory purchase at the beginning of November, Child’s Delight made four smaller investments as needed during November and December. The average inventory purchase amount was $67,500 ($60,000 + $60,000 + $75,000 + $75,000) / 4. On December 31, it had no Burzee Doll inventory. On average, then, Child’s Delight had only about a $33,750 investment in inventory during its two-month selling period ($67,500 / 2).

Obviously, the difference between the two companies’ gross margins reported in Exhibit 7 is dramatic. However, the difference in Kids N Toys’ average inventory investment of $250,000 versus the $33,750 average inventory investment at Child’s Delight is also impressive. Remember from the introductory chapter that the executives in the early days at DUPONT COMPANY recognized that it is just as important to manage the money outflow for asset investment as it is to manage the money inflow from profits. This is the logic underlying Pierre du Pont and Donaldson Brown’s ROI (return on investment) formula.

\[
\text{ROI} = \frac{\text{Profit margin}}{\text{Asset turnover}} = \frac{(\text{Profit} + \text{Revenue})}{\text{Asset turnover}} = \frac{(\text{Revenue} + \text{Total assets})}{\text{ROI}}
\]

Based on ROI, which of these two companies has created the most revenue for each dollar invested in its Burzee Doll inventory asset? Answering this question is really a function of the “asset turnover” section of the ROI formula. Notice, however, that rather than total revenue and total assets, we are focusing only on Burzee Doll revenue and the value of the Burzee Doll

6 Be careful with this calculation! The fact that Kids N Toys held its doll inventory for three months (or two months, or four months) does not change the fact that average inventory for the company is $250,000. The formal calculation here is (Beginning balance + Ending balance) / 2. Instead of having no inventory, what if Kids N Toys still had $50,000 worth of Burzee Dolls on January 31? The average inventory investment would then be $275,000 ($50,000 + $50,000 + $25,000) / 2. You might also note that a more accurate measure of average inventory for Kids N Toys could involve assessing inventory levels on a month-by-month basis (we use an approach similar to this when we compute average inventory for Child’s Delight, Inc.). However, unless otherwise indicated, this textbook will use the traditional (Beg+End)/2 formula to calculate average inventory.
inventory asset. This fact really doesn’t present a problem. Rather than measuring how much total revenue is generated per dollar of total assets, we will simply measure how much specific revenue is generated per dollar of a specific inventory item. Hence, how many sales dollars does Kids N Toys generate for each dollar invested in its Burzee Doll inventory compared to Child’s Delight?

Kids N Toys: Revenue ÷ Average inventory
\[
\frac{1,293,200}{250,000} = 5.17
\]

Child’s Delight: Revenue ÷ Average inventory
\[
\frac{595,500}{33,750} = 17.64
\]

Note that organizations have a limited amount of resources to invest. Using the ROI formula, DuPont Company was able to wisely manage the task of maximizing the value of its investments by knowing where in the massive organization to invest its resources. Looking at the calculations above, you can see that Child’s Delight made the better use of limited purchasing dollars to manage the Burzee Doll inventory in order to create sales revenue.7

Combining the gross margin per sales dollar with the number of sales dollars generated per dollar of inventory yields the following return on inventory investment calculations for Kids N Toys and Child’s Delight:

\[
\text{Return on inventory investment} = \frac{(\text{Gross margin} \times \text{Revenue})}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Inventory}}
\]

Kids N Toys: \[
\frac{793,200}{1,293,200} \times \frac{1,293,200}{250,000} = 317\%
\]

Child’s Delight: \[
\frac{325,500}{595,500} \times \frac{595,500}{33,750} = 964\%
\]

These numbers suggest that although Child’s Delight generated a lower gross margin, it actually performed better than Kids N Toys because of superior inventory management. By the way, these numbers (317% and 964%) probably seem high to you. Don’t confuse these numbers with the classic ROI results you’d expect to see in most companies. (We’ve been careful to not refer to these calculations as ROI calculations.) These numbers are high because we have focused on the utilization of just one asset—inventory. In order to sell Burzee Dolls, each merchandiser must also invest in buildings, store shelving and displays, cash registers, and so forth. When we add all of these assets to the inventory, then we can calculate the traditional ROI measure. However, these calculations on Burzee Doll inventory usage give a strong indication that, regardless of what the overall ROI of each company is, it appears that Child’s Delight has been more effective at managing its acquisition and sales of Burzee Dolls.

The day-to-day effort to manage the Burzee Doll inventory involves many other important issues (as listed in Exhibit 5). Even the inventory measures above do not provide Kids N Toys and Child’s Delight management with the data necessary to address all issues as they plan for future inventory investments and control and evaluate the current inventory acquisition and selling process. This is where good management accounting can provide real value in management’s effort to improve a merchandising operation. Exhibit 8 provides a management accounting view of the two companies’ retail work with the Burzee Doll line of operations. Study both Exhibit 8 and Exhibit 5 for a moment. What information in Exhibit 8 could help a manager trying to work with some of the issues described in Exhibit 5?

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7 As you can see, we’re essentially adjusting the inventory turnover measure here by dividing the retail value of revenue by the wholesale value (or purchase cost) of inventory, and we’re very careful to label this new calculation “inventory turnover.” As illustrated in the preceding section, inventory turnover is traditionally measured using cost of goods sold rather than sales or revenue. Conceptually, comparing a wholesale number (inventory) to a wholesale number (cost of goods sold) makes more sense than comparing a wholesale number to a retail (sales revenue) number. However, as long as a consistent approach is used, the insights gained are the same. Further, the “revenue ÷ average inventory” calculation allows us to combine inventory turnover and profit margin in our analysis of these two retailers. As you can see, management accounting sometimes must adjust in order to suit the needs of the current decision-making situation.
The Management Accounting Report on Kids N Toys’ Net Operating Profit

As you can see in Exhibit 8, we are identifying some additional out-of-pocket costs on the Burzee Doll operation for each company. Note that the gross margin for each company is the same as that calculated in the gross margin report in Exhibit 7. However, we’re approaching the calculation of gross margin differently, as well as identifying some other relevant costs to calculate net operating profit for each company. Net operating profit is useful in measuring the performance of these operations. Much more important, though, are the insights gained in the management accounting numbers used to calculate gross margin and net operating profit. These numbers, presented in Exhibit 8, are extremely useful for planning, controlling, and evaluating the Burzee Doll retail operations.

Let’s work with Kids N Toys first. This company originally purchased 50,000 units with the intent of selling all of them for $30. Why didn’t it then have $1.5 million in revenue? This question cannot be answered using the gross margin report in Exhibit 7, but the answer is obvious in the management accounting report in Exhibit 8. Somehow, 1,600 dolls that Kids N Toys planned to sell were broken, misplaced, or stolen. Based on an intended $30 selling price, this cost the company $48,000 in lost revenue. In addition, the market demand changed while Kids N Toys still had dolls to sell. As a result, the store had to sell some dolls for prices lower than the planned $30. Specifically, Kids N Toys reduced expected revenue by $40,000 when it sold 2,000 dolls for $10, and reduced expected revenue by another $118,800 when it sold 4,400 dolls for $3. This loss of market value is a risk that Kids N Toys management should consider when planning for next year’s purchases. Further, management should also evaluate the information on inventory shrinkage to better control the inventory operation.

We mentioned briefly the concept of activity-based costing (ABC) in an earlier chapter on product cost flows. We’ll spend a lot of time on the ABC concept in the next chapter. Briefly, ABC is an approach to tracking the relationship between activities and costs that is generally used to better allocate manufacturing overhead costs to products. This concept can also be used to analyze overhead costs in merchandising organizations. Managing the Burzee Doll inventory

### Exhibit 8: Management Accounting Report on the Burzee Doll Inventory

<table>
<thead>
<tr>
<th></th>
<th>Kids N Toys, Inc.</th>
<th>Child’s Delight, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected revenue</td>
<td>50,000 units × $30 standard price</td>
<td>20,000 units × $30 standard price</td>
</tr>
<tr>
<td>Shrinkage loss</td>
<td>1,600 units × $30</td>
<td>48,000</td>
</tr>
<tr>
<td>Market loss</td>
<td>2,000 units × ($30 − $10) + 4,400 units × ($30 − $3)</td>
<td>150 units × $30 (4,500)</td>
</tr>
<tr>
<td>Actual revenue</td>
<td>$1,293,200</td>
<td>$595,500</td>
</tr>
<tr>
<td>Purchase costs</td>
<td>50,000 units × $10 standard cost</td>
<td>20,000 units × $10 standard cost (200,000)</td>
</tr>
<tr>
<td>Lost discount</td>
<td>(0)</td>
<td>20,000 units × $2 lost discount (40,000)</td>
</tr>
<tr>
<td>Price increase</td>
<td>(0)</td>
<td>10,000 units × $3 price increase (30,000)</td>
</tr>
<tr>
<td>Gross margin</td>
<td>$ 793,200</td>
<td>$325,500</td>
</tr>
<tr>
<td>Overhead costs</td>
<td>50,000 units ÷ 2 = 25,000 average inventory level × $1.10 × 3 months</td>
<td>5,000 units ÷ 2 = 2,500 average inventory level × $1.10 × 2 months (5,500)</td>
</tr>
<tr>
<td>Order costs</td>
<td>1 order × $1,250</td>
<td>4 orders × $1,250</td>
</tr>
<tr>
<td>Net operating profit</td>
<td>$ 709,450</td>
<td>$315,000</td>
</tr>
</tbody>
</table>

**Caution:** Note that shrinkage loss and market loss are based on expected selling prices, not purchase costs.

**The difference between normal business sales and normal business expenses.**
requires some overhead costs. In this example, let’s assume an ABC analysis reveals that the cost for storage, security, and other supervisory activities works out to be about $1.10 per doll per month. In addition, the effort to count inventory and prepare the purchase order, as well as to receive and pay for the inventory, requires about $1,250 in administrative costs each time inventory is purchased. In a standard income statement, only the direct cost of inventory purchases would be used to measure gross margin. Those overhead and purchasing costs related to managing the Burzee Doll inventory are typically combined with all other administrative costs to form Selling and Administrative Expenses on the income statement. However, the management accounting report in Exhibit 8 has specifically identified and related these costs to the Burzee Doll inventory line (this is the goal of the ABC concept). This information allows management to see exactly how the Burzee Doll product line is contributing to Kids N Toys’ overall net operating profit. Further, management can evaluate how having a lot of inventory leads to higher overhead costs. On the other hand, though, purchasing all these dolls at once saved Kids N Toys additional purchasing costs.

The Management Accounting Report on Child’s Delight’s Net Operating Profit

Now let’s evaluate operations at Child’s Delight using the management accounting report in Exhibit 8. During November and December, Child’s Delight purchased a total of 20,000 units with the intent of selling all of them for $30. Similar to Kids N Toys, the difference between expected revenue and actual revenue is explained by the inventory shrinkage of 150 units. Compared to Kids N Toys, why does Child’s Delight have a much lower percentage of dolls being broken, misplaced, or stolen? It seems reasonable to expect that Child’s Delight found it much easier to maintain and keep track of its much smaller level of inventory. Can this shrinkage be further reduced? Child’s Delight should carefully consider this question as it plans for the next buying season.

As noted in Exhibit 5, keeping the inventory levels low helps protect the organization against certain types of costs and risks. However, this can be a challenging balance because other costs occur as a result of low inventory levels; Child’s Delight incurred three of these costs. First, because Child’s Delight made small inventory purchases, bulk discounts were unavailable to the company. The effect of losing these discounts, $40,000, was to pay $2 more per doll (20,000 dolls x $2). Second, each time Child’s Delight ran out of inventory and had to reorder, it had to pay the current market rate. Given the high popularity of Burzee Dolls during the holiday buying spree, it is not surprising that the manufacturer raised the price. This cost was passed through the distributor to Child’s Delight, which had to pay an additional $3 per doll for its last two shipments. Overall, this resulted in an additional $30,000 in cost (10,000 dolls x $3).

Finally, each purchase event at Child’s Delight adds to the management activities that must take place. If we assume that both companies have similar inventory acquisition activities, then Child’s Delight must have $5,000 in purchase order costs (4 purchases x $1,250 activity costs). Again, though, low inventory levels have their advantage. Because Child’s Delight orders only 5,000 dolls at a time, its inventory will range from 0 to 5,000 dolls. On average, it will generally have 2,500 dolls on hand. Based on an average monthly overhead cost of $1.10 per doll, selling Burzee Dolls led to relatively low overhead costs of $5,500 (again, assuming similar ABC costs for storage, security, and other supervisory activities for Child’s Delight and Kids N Toys). Clearly, Child’s Delight management should pay attention to all these numbers as it evaluates this year’s operations and make plans for next year.

Remember that the format and content of financial accounting reports are standardized in order to allow external users to compare reports from many different companies. In contrast, the format and content of internal management accounting reports differ across organizations because each organization customizes the reports to fit specific needs. Hence, the format of the management accounting report in Exhibit 8 is not regulated by anyone! The accountants for
one particular retailer will customize the report to best support their own management processes of planning, controlling, and evaluating. The cost calculations displayed in Exhibit 8 are used by many, but not all, organizations in the merchandising industry. In this case, we saw that a simple comparison of gross margins does not necessarily indicate which company (Kids N Toys with a gross margin of $793,200 or Child’s Delight with a gross margin of $325,500) made better decisions. By including information on inventory management, we concluded that Child’s Delight had more successfully combined the activities of profitable sales with efficient use of its inventory assets. The more detailed profit analysis contained in Exhibit 8 enabled us to look more closely at the specific factors affecting the net operating profit of Kids N Toys and Child’s Delight.

**TO SUMMARIZE:** Because wholesalers and retailers generally do not have to deal with raw materials or work in process, the process of accounting for inventory in a merchandising business is not nearly as complicated as it is in a manufacturing business. However, managing inventory costs is both complicated and critical for a merchant. Having too much inventory creates unnecessary overhead costs, financial holding costs, costs due to loss of market value, and costs due to inventory shrinkage. Not having enough inventory may result in unnecessary ordering costs and loss of bulk order discounts, as well as opportunity costs due to lost sales and increased supplier prices. While measuring some of these costs presents a challenge to accountants, the information is very important to the processes of planning, controlling, and evaluating gross margins and net operating profits for individual product lines.

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**Managing Service Organizations**

As discussed earlier in the chapter on product cost flows, service organizations have many characteristics in common with manufacturing organizations. Both types of organizations engage in a substantial production process before delivering the final product to the customer. In a manufacturing organization, this production process involves people assembling materials using equipment located in factories. In a service organization, materials are of much smaller importance, and the production process focuses on people delivering a service within an infrastructure of tangible assets (hotels, delivery trucks, barbershops, doctors’ offices, etc.). In some service organizations, such as airline service, the focus is on the tangible asset infrastructure—while the pilots, flight attendants, and ticket agents are important, most of our interest centers around the reliability of the planes and the baggage handling equipment. In other service organizations, such as legal services, the focus is on person-to-person delivery of customized service—we don’t really care how nice the attorney’s office is, as long as the attorney gives us good legal counsel. In this section, controlling product costs will be discussed in the context of a service organization.

**Characteristics of a Service Organization**

Service organizations can be broadly categorized into three basic types: professional services, service shops, and mass services. A professional services organization is associated with people providing a highly customized service process. For example, a good family doctor tailors the treatment to the specific patient, after developing a personal rapport with the patient and carefully extracting a thorough case history. At the other end of the continuum, a mass service organization provides a standardized product with little emphasis on the person delivering the product. For example, MCDONALD’S has developed its fast-food business around the delivery of standard-quality food in a predictable atmosphere; we are pleased when the person serving us is competent and cheerful, but we are primarily interested in the taste of the food and

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the cleanliness of the restrooms. A service shop is somewhere between a professional service and a mass service. For example, in a large-scale laser eye surgery clinic, there is more emphasis on standardization and on the equipment itself than one finds in a family doctor clinic. Also, in a high-end sit-down restaurant, the taste of the food is still important, but the quality of the personal service is at least as important.

The different characteristics of professional services, service shops, and mass services are summarized in Exhibit 9. Professional services are those services that emphasize person-to-person delivery, that focus on the process of service delivery rather than the creation of some final, tangible product, and that are highly customized. Mass services are those services that rely on equipment more than people in delivering the service, that result in the customer taking away a tangible product, and that do little, if any, tailoring to individual customer needs. Service shops provide a mixture of the three dimensions of people/equipment, process/product, and high/low customization.

Cost Management in a Service Organization

As we saw earlier in the chapter in our discussion of cost management in manufacturing and merchandising organizations, it is important for an organization to evaluate the magnitude of its costs and the degree to which it is efficiently utilizing its resources. We looked at cost and profitability measures, as well as at indicators of inventory management (such as inventory turnover). The same two concepts—evaluation of profitability and efficiency—will be used in developing cost management tools for service organizations.

For a manufacturing organization, key resources used in the production process are raw materials, machine hours, factory space, and labor. For a merchandising organization, the management of the level of inventory is crucial to the efficient use of the organization’s resources. For a service organization, the management of materials inventories, building space, and equipment usage is also important. However, to emphasize the importance of people in service organizations, our illustration in this chapter will focus on how a service organization can measure the degree to which it is efficiently using its people.
Illustration: Cost Management in an Audit Firm

A large audit firm is a good example of a professional services organization. An “audit” firm is composed of CPA (certified public accountant) professionals who provide specialized accounting, tax, and information systems consulting; and conduct audits of financial statements. The illustration in this section is for the hypothetical audit firm of LeviForrester. This illustration will center on the audit services offered in one large regional office of the firm. The office employs approximately 200 professionals and another 100 support staff. We will examine the costs associated with the professionals in the office. The costs of the support staff, as well as the training, recruiting, marketing, and technical analysis costs charged to the regional office by the national headquarters of LeviForrester, are also very important to the overall profitability of the regional office. However, assigning these support costs and national charges to specific jobs is quite difficult. The task of identifying cost drivers, common costs, and other concepts important to the proper treatment of these indirect support costs will be undertaken in the next chapter where we discuss activity-based costing. For the example in this chapter, we will restrict our attention to personnel costs that can be directly traced to specific client engagements.

The regional office of LeviForrester employs five types of professionals, as listed below.

<table>
<thead>
<tr>
<th>Professional Level</th>
<th>Average Years of Service with the Firm</th>
<th>Number of Professionals in the Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner</td>
<td>More than 12 years</td>
<td>10</td>
</tr>
<tr>
<td>Senior manager</td>
<td>9 to 12 years</td>
<td>15</td>
</tr>
<tr>
<td>Manager</td>
<td>6 to 8 years</td>
<td>20</td>
</tr>
<tr>
<td>Senior</td>
<td>3 to 5 years</td>
<td>50</td>
</tr>
<tr>
<td>Staff</td>
<td>1 to 2 years</td>
<td>100</td>
</tr>
</tbody>
</table>

The partners exercise overall oversight of the audit practice. They review and approve the supporting documents (in electronic form) for each audit. They also seek to build the business by finding new clients. One of the 10 partners is designated the “managing partner” and is responsible for running the office and setting the strategic direction for the practice in that area. The senior managers and the managers are the professionals who are the primary interface between the audit firm and the clients. These managers keep the client informed about the progress of the audit and also supervise the other members of the audit team (the seniors and staff). The seniors spend much of their time at the clients’ offices supervising and performing the actual work of the audit. The staff accountants do the bulk of the routine work of the audit.

Partners are expected to spend about half of their time working on specific client jobs during the year. This works out to be 1,000 hours out of the potential 2,000 working hours (50 weeks × 40 hours per week) during the year. At other times, partners are cultivating new client relationships and making proposals in order to get new client engagements. Senior managers and managers are expected to spend 75% of their time working on specific client engagements; seniors and staff are expected to spend all of their time working on specific client engagements. In fact, an important responsibility within the audit firm is the planning of the demands of various audit engagements to make sure that all of the seniors and the staff are always scheduled for specific engagements and are not sitting around the main office because of “unassigned” time.

These expectations about how much of a professional’s time is to be spent in serving specific clients are used to develop billing rates and job cost charges. The computation of these billing rates that are used for job cost charges is shown in Exhibit 10. The job cost charges are
computed as a professional’s total annual compensation divided by the number of client hours to be worked (i.e., billable hours) during a year. For example, the average annual compensation of partners at LeviForrester is $400,000, and each partner is expected to work on specific client engagements for 1,000 hours during a year. Thus, the partner compensation cost assigned to a job is $400 per hour ($400,000 / 1,000 hours). These job cost charges are used by LeviForrester to compute the professional labor cost associated with each audit engagement.

The billing rates are used in computing how much is to be charged to a client for an audit engagement. The billing rate for professional services should be large enough to cover both the professional’s compensation and general administrative costs such as secretarial support, computers, supplies, travel, and so forth. As you can imagine, the determination of the billing rates in Exhibit 10 is an extremely important element in LeviForrester’s success. Billing rates that are too high will drive away potential customers, whereas billing rates that are too low will lead to low profitability and, perhaps, the inability to appropriately compensate the professionals.

On October 5, the managing partner for the regional office of LeviForrester received the profitability report contained in Exhibit 11. The report is generated in early October because LeviForrester’s fiscal year ends on September 30. (It is impossible for LeviForrester to analyze its own business operations at the end of the normal calendar year because January is the busiest month of the year for audit firms as they perform audit work for their clients with December 31 year-ends.) The managing partner used the data in the profitability report to compute profit percentage from personnel (PPP), which is the fundamental measure of profitability used by LeviForrester. The overall PPP for this regional office is computed as follows:

\[
PPP = \frac{Revenue - Personnel \ compensation \ cost}{Revenue} = \frac{\$60,975,000 - \$14,450,000}{\$60,975,000} = 76.3\%
\]

Exhibit 10: Billing Rates and Job Cost Charges for LeviForrester

<table>
<thead>
<tr>
<th>Compensation</th>
<th>Expected Billable Hours</th>
<th>Compensation Cost per Billable Hour</th>
<th>Client Billing Rate per Billable Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner</td>
<td>$400,000</td>
<td>1,000</td>
<td>$400</td>
</tr>
<tr>
<td>Senior manager</td>
<td>130,000</td>
<td>1,500</td>
<td>87</td>
</tr>
<tr>
<td>Manager</td>
<td>100,000</td>
<td>1,500</td>
<td>67</td>
</tr>
<tr>
<td>Senior</td>
<td>50,000</td>
<td>2,000</td>
<td>25</td>
</tr>
<tr>
<td>Staff</td>
<td>40,000</td>
<td>2,000</td>
<td>20</td>
</tr>
</tbody>
</table>

Exhibit 11: Profitability Report for LeviForrester Regional Office

<table>
<thead>
<tr>
<th>Number of Professionals</th>
<th>Actual Billable Hours</th>
<th>Billing Rate</th>
<th>Total Revenue</th>
<th>Total Compensation Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partners</td>
<td>10</td>
<td>8,200</td>
<td>$500</td>
<td>$4,100,000</td>
</tr>
<tr>
<td>Senior managers</td>
<td>15</td>
<td>20,000</td>
<td>300</td>
<td>6,000,000</td>
</tr>
<tr>
<td>Managers</td>
<td>20</td>
<td>35,000</td>
<td>225</td>
<td>7,875,000</td>
</tr>
<tr>
<td>Seniors</td>
<td>50</td>
<td>120,000</td>
<td>150</td>
<td>18,000,000</td>
</tr>
<tr>
<td>Staff</td>
<td>100</td>
<td>250,000</td>
<td>100</td>
<td>25,000,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>$60,975,000</td>
</tr>
</tbody>
</table>
The managing partner is quite pleased with this report because the firm-wide goal for PPP is just 73.0%. As the various regional offices within LeviForrester are evaluated, each region’s PPP is used to allocate a firm-wide bonus pool—the employees in regions with PPP in excess of 73.0% can expect to receive higher-than-average year-end bonuses.

The managing partner also received the personnel utilization report contained in Exhibit 12. The report contains personnel utilization rates (PUR) for each category of professionals within the firm. The contents of this report are somewhat disturbing. The managing partner sees that the partners in the office spent only 82.0% of the time that they should have on specific client engagements. Senior managers are also working with clients at less than desirable levels (88.9%). On the other hand, the hours billed by other managers, as well as seniors and staff accountants, were well in excess of 100% of the expected amount. This personnel utilization pattern suggests at least two potential future problems. First, existing clients may become concerned that the LeviForrester partners and senior managers are not spending as much time with them as they had anticipated. The clients may feel that the LeviForrester partners are now spending too much time finding new clients and not enough time attending to the needs of the existing clients. Second, the high utilization rates for the managers, seniors, and staff are a warning sign that these key professionals may be working too many hours. Hiring and training new professionals is an expensive process, and LeviForrester does not want to overwork its young professionals, resulting in abnormally high employee turnover.

The two specific measures—PPP and PUR—used to describe service process management at LeviForrester are intended only as illustrations; measures with these specific names are not in use in any real professional services firm. However, measures similar to these are very commonly used in service organizations. These two measures are representative of a broad class of measures that indicate the performance of service organizations on two important dimensions—profitability and personnel utilization. These two performance indicators connect directly with similar concepts used to manage inventory assets in manufacturing and merchandising organizations.

### Exhibit 12: Personnel Utilization Report for LeviForrester

<table>
<thead>
<tr>
<th>Category</th>
<th>Actual Billable</th>
<th>Budgeted Billable</th>
<th>Utilization Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partners</td>
<td>8,200</td>
<td>10,000</td>
<td>82.0%</td>
</tr>
<tr>
<td>Senior managers</td>
<td>20,000</td>
<td>22,500</td>
<td>88.9%</td>
</tr>
<tr>
<td>Managers</td>
<td>35,000</td>
<td>30,000</td>
<td>116.7%</td>
</tr>
<tr>
<td>Seniors</td>
<td>120,000</td>
<td>100,000</td>
<td>120.0%</td>
</tr>
<tr>
<td>Staff</td>
<td>250,000</td>
<td>200,000</td>
<td>125.0%</td>
</tr>
</tbody>
</table>

**TO SUMMARIZE:** Three broad types of service organizations are professional services, service shops, and mass services. The dimensions on which these types of organizations differ are people/equipment, process/product, and high/low customization. As with manufacturing and merchandising organizations, it is important to measure both profitability and resource utilization in a service organization. In a professional services firm, profitability is measured by comparing the service revenues with the compensation costs associated with the professionals. It is also important to monitor the degree to which the professionals are appropriately utilized within the firm.
Part 7  Control

Just-in-Time

Describe how the concept of just-in-time (JIT) inventory systems is used to improve cost, quality, and timely performance in organizations.

JIT Inventory Systems

The effort of management to compete on measures of time and to make improvements involving time is captured in the concept of just-in-time (JIT) management processes. To understand JIT, you need to first understand how JIT is used to manage inventory, including raw materials inventory, work-in-process inventory, and finished goods inventory. Let’s talk for a moment about inventory. What is the purpose of inventory in a manufacturing plant? This may seem obvious. In the past, manufacturers stockpiled inventories in order to avoid shutdowns or slowdowns and to meet customer needs if suppliers were late or if production or delivery was slow. Occasionally (sometimes more than occasionally!), suppliers deliver raw materials that contain some defects, or the production process ruins some work-in-process, or a customer returns an unacceptable product. How do we deal with these unexpected surprises? Again the answer has been to “have a little extra on hand” so that bad parts or products can be replaced without having to interrupt the manufacturing process. Not surprisingly, production managers can get a little nervous when inventory levels get too low.

Because of concerns about risks due to scheduling and quality problems, companies establish policies to keep inventory levels at or above some minimal level. This minimum level of inventory is usually called a “safety stock” (which we will discuss later in the expanded material section of this chapter). However, several years ago some cagey accountants and business owners in Japan created a new competitive view of inventory management. They (like everyone else) realized that maintaining these inventories can be very expensive because of warehousing costs, interest costs incurred to finance inventory, and the opportunity cost of money tied up in stockpiled inventory. The real insight these Japanese business professionals had was that inventories are really only “buffers” that mask inefficient operations or product quality problems. Eliminate these timing and quality problems, and you no longer need the inventory buffers. By concentrating on improving product quality and timely deliveries, many Japanese companies became much more efficient and profitable at the same time that inventories were kept to a minimum or even eliminated. The emerging inventory systems that allow for the elimination of inventory stockpiles, inefficiency, and waste are referred to as just-in-time inventory systems. The competitive value of these new management systems eventually caught on and came to America.

JIT began as a management tool for manufacturing. So, when first learning about JIT, it’s probably best to think of it in this context. In a manufacturing setting, JIT is a process by which only enough materials to satisfy immediate production are shipped to the job site. When JIT is functioning perfectly, companies take delivery from suppliers only as raw materials are needed.
The Japanese Focus on Inventory

Henry Ford, the famous automotive production industrialist, lifted the FORD MOTOR COMPANY to great success during the early and mid-1900s by achieving tremendous cost efficiencies in producing cars. He believed in long production runs where low-skilled workers could build the same car part over and over again. As a result, high manufacturing costs per automobile plummeted, and he was able to offer cars to the public at extremely competitive prices. However, this production approach required high levels of raw materials, work-in-process, and finished goods inventories.

Meanwhile, across the ocean in Japan, Taiichi Ohno, an industrial scientist, and Eiji Toyoda, an executive vice president at TOYOTA MOTOR CORPORATION (and the son of the founder of Toyota), were experimenting with a different approach to large-scale production. While other Toyota executives thought that Toyoda’s ideas were impractical, in 1949, in a machine shop in Koromo, Eiji Toyoda began experimenting with a new production control approach using the concepts of a just-in-time (JIT) inventory system. By 1953, the Koromo machine shop had a fully implemented Kanban system, which was based on the concept that supplies should be “pulled” through the production process as they are needed. (Kanban is essentially a signaling system that pulls parts forward through the production system.) Interestingly, Toyota copied this idea from the sales methods of U.S. supermarkets. He was able to demonstrate that Kanban eliminated waste due to the overproduction of parts, reduced or eliminated the need for buffer inventories in the plant, and dramatically reduced production defects. In 1963, top management decided on the full application of Kanban as a means of transforming the production control system. Cost accountants were charged with developing and maintaining performance measures that tracked defects, excess inventory, and throughput time. Eiji Toyoda became chairman of Toyota in 1983. The rest, as they say, is history.


JIT and Value-Added Activities

Benefits such as those experienced by AT&T occur because companies that have adopted JIT have been able to avoid buildups of parts and materials and still ensure a smooth and orderly flow of goods to customers. JIT-based environments manage the flow of goods using a “pull” process. Essentially, this means that the final assembly stage for a product sends a signal (a Kanban; see the Business Environment on The Japanese Focus on Inventory) to the preceding workstation indicating what parts and materials will be needed during the next few hours.

The preceding workstation then sends similar signals all the way back through the manufacturing cycle, ensuring an orderly flow of products. Thus, the demand at the final assembly stage “pulls” the inventory through the production process only as it is needed. Using this system, nothing is produced unless customers demand it. At all stages, inventories are eliminated or reduced to the lowest possible level. Obviously, then, progress toward successful implementation of JIT is inventory-related. Inventory reduction is not the primary purpose of JIT, but it generally is a consequence of JIT efforts to eliminate waste. The goal is to add value to the product or service and reduce or eliminate activities that do not. To be specific, value-added activities are essentially defined as those activities for which the customer is willing to pay. On the other hand, non-value-added activities are those for which the customer is not willing to pay. For example, clients in a law office are not interested in paying for the time spent running the payroll, organizing the file room, or computing billable hours. These are non-value-added activities. However, these clients should be willing to pay for court time and consultation time. These are clearly value-added activities that the law firm should emphasize. Under JIT, waste is considered to be anything other than the minimum amount of equipment, materials, parts, space, and workers’ time that is essential to add desired value to a product. This results in careful management of time spent on value-added activities such as machining and assembly operations (for a manufacturer) and customer service and contact activities (for a service firm). More importantly, the JIT focus on eliminating waste emphasizes removing as much as possible the time spent on non-value-added activities such as setup work, materials handling, and inspection.

**JIT and Time**

It is important to understand that JIT encourages accountants to emphasize providing time-based performance measures to management. Critical success factors for many JIT manufacturing, service, and merchandising firms include improving timeliness of customer delivery and increasing the product or service provider’s flexibility in handling customers’ needs. Exhibit 13 provides a sample of appropriate performance measures that support these factors of success, which are particularly important in today’s dynamic, customer-oriented environment.

**TO SUMMARIZE:** Fundamentally, just-in-time (JIT) is an inventory management method that focuses on removing all waste from a production or service process. Originally a Japanese management system, JIT has made a significant impact on the way manufacturing, service, and merchandising companies in the United States and other nations are managed. JIT has a strong emphasis on costs and quality. However, JIT adds an important third dimension to the management process—management of timeliness and flexibility. In a manufacturing setting, demand at the final assembly stage “pulls” the inventory through the production process only as it is needed. Using this system, nothing is produced until customers demand it.

The main goal of JIT is to add value to the product or service and to reduce or eliminate activities that do not. By focusing on removing non-value-added activities and managing time spent on value-added activities, inventories and costs are reduced, while quality and timeliness are improved. Timeliness issues include emphasis on reducing customer delivery times and increasing flexibility within the production, service, or merchandising process.
### Exhibit 13: Time-Based Performance Measures in a JIT Firm

**Customer Delivery Success Factor**  
(On-time delivery to customers can be affected by suppliers, product design time, and the production process and distribution time.)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Computation Method</th>
<th>Measure</th>
<th>Computation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer on-time delivery</td>
<td>Number of on-time deliveries divided by total deliveries. Goal: higher</td>
<td>Lead time for new product introduction</td>
<td>Amount of time from idea to readiness for sale. Goal: lower</td>
</tr>
<tr>
<td>Supplier on-time delivery</td>
<td>Number of on-time deliveries divided by total deliveries. Goal: higher</td>
<td>Parts and product availability</td>
<td>Number of times a part or product is unavailable when requested. Goal: lower</td>
</tr>
<tr>
<td>Design cycle time</td>
<td>Amount of time from initial idea to readied plans. Goal: lower</td>
<td>Number of common parts common to other products. Goal: higher</td>
<td></td>
</tr>
<tr>
<td>Number of schedule changes</td>
<td>Number of times a contract is changed. Goal: lower</td>
<td>Inventory level</td>
<td>Average level of inventory. Goal: lower</td>
</tr>
<tr>
<td>Schedule attainment</td>
<td>Number of unchanged schedules divided by total schedules. Goal: lower</td>
<td>Capacity</td>
<td>Percentage of process capacity used in current operations. Goal: higher</td>
</tr>
<tr>
<td>Lead time</td>
<td>Amount of time from customer’s initial request to final product or service delivery. Goal: lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setup time*</td>
<td>Amount of time required to set up a production run. Goal: lower</td>
<td>Downtime</td>
<td>Amount of time a manufacturing or service process was unavailable. Goal: lower</td>
</tr>
<tr>
<td>Throughput time*</td>
<td>Amount of time from beginning of production or service process until process conclusion. Goal: lower</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note that some performance measures are important to both customer delivery and flexibility success factors.

**Provider Flexibility Success Factor**  
(Manufacturing, service, and merchandising flexibility includes the ability to respond quickly to changes in customer demand and product design changes.)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Computation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity utilization</td>
<td>Percentage of process capacity used in current operations. Goal: higher</td>
</tr>
<tr>
<td>Downtime</td>
<td>Amount of time a manufacturing or service process was unavailable. Goal: lower</td>
</tr>
<tr>
<td>Setup time*</td>
<td>Amount of time required to set up a production run. Goal: lower</td>
</tr>
<tr>
<td>Throughput time*</td>
<td>Amount of time from beginning of production or service process until process conclusion. Goal: lower</td>
</tr>
</tbody>
</table>


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**Expanded Material**

As mentioned earlier in the chapter, an important element of cost management is the evaluation of whether an organization is utilizing its resources efficiently. In the expanded material section of this chapter, you will learn further details about inventory management. In particular, the expanded material discusses ways to determine the appropriate level of inventory that should be maintained by an organization.

### Opportunity Costs in Managing Inventory and Work-in-Process Services

1. Calculate and interpret holding costs in merchandising and service businesses.

Let’s return to our Burzee Doll example to discuss opportunity costs involved in managing inventory. As discussed in the introductory management chapter, there are many types of costs involved in managing an organization. All the costs that we discussed in the management accounting report for Kids N Toys and Child’s Delight involved out-of-pocket costs (see Exhibit 8). However, there are several cost issues listed in Exhibit 5 that we did not include in...
the earlier analysis for these two companies. For example, inventory flexibility involves potential opportunity costs related to investing in a lot of inventory. Kids N Toys tied up a lot of money in securing 50,000 Burzee Dolls for the Christmas season—a shopping season that is particularly critical for retailers in the United States. Kids N Toys may have been fortunate that the Burzee Doll line sold as well as it did. If fickle shopper tastes had turned instead to another toy, it would have been difficult for Kids N Toys to shift this part of its inventory investment out of Burzee Dolls and into an alternative item in time to take advantage of the Christmas shopping rush. Kids N Toys may not have had any real problems in this area, but it needs to pay attention to this issue in planning for next year.

Child’s Delight was also exposed to some opportunity costs. For example, because it kept its inventory of Burzee Dolls much lower than its competitor, Child’s Delight was much more at risk of losing sales due to problems with supplier delivery and other logistics beyond its control. We’ll assume in this case that all its deliveries were on time and without problems. However, another opportunity cost that Child’s Delight was clearly not so fortunate in avoiding was lost sales due to lack of inventory. During the same period of time that Child’s Delight sold 19,850 dolls, Kids N Toys sold 41,500 dolls (see Exhibit 6 on page 1162). If these retailers were at all similar in terms of competitive factors such as location and advertising, then it appears certain that Child’s Delight could have sold more dolls if it had had more dolls! How many more dolls could have been sold? Frankly, this is a very difficult number to measure—even for a good accountant. You won’t see it measured on any of the management accounting reports in this chapter. How many more dolls could have been sold? Frankly, this is a very difficult number to measure—even for a good accountant. You won’t see it measured on any of the management accounting reports in this chapter. That does not at all imply that this number is less important than the others. There is a lot of discussion (and disagreement) on how to measure this number. The important thing is to somehow make decision makers aware of this cost. However, there is so much disagreement in practice as to how to specifically calculate this number that it is best in a textbook such as this to simply make you aware of this particular opportunity cost issue.

Holding Costs and Economic Profit in Merchandising Organizations

Another opportunity cost that both companies in our example experienced is financial holding costs. Financial holding costs are very well defined in practice. We’ll use this cost to calculate for these two merchants a third income number called economic profit. As we calculated before, during the three-month period of November, December, and January, Kids N Toys had an average of $250,000 invested in Burzee Doll inventory. (See page 1163 if you need help remembering how to calculate average inventory levels.) This money could alternatively have been earning money in a financial investment, or it could have been used to pay off loans or retire stock that Kids N Toys currently has outstanding. Every business has a cost of capital that relates to its cost of using money. In fact, you likely have your own individual cost of capital. Do you have any loans? What is the average interest rate on those loans? Let’s assume it is 15%. Hopefully, you understand that as long as you have loans, every dollar you use for anything besides paying down your loan(s) costs you 15%. This 15% rate is your cost of capital. To be specific, for every dollar you spend buying a new stereo system, your loan(s) will increase by $0.15 at the end of the year. Hence, buying the stereo had better be worth this implicit financial holding cost. Even if you don’t have any loans, you probably (hopefully!) have a savings account. Your cost of capital would then be the interest rate on your investment in the savings account. Let’s assume you get a 4% return on your account. In this case, for every dollar you delay putting into the account (such as money spent on your new stereo), at the end of the year, your account will be $0.04 less than it could have been. Obviously, this cost information is important to all decisions involving the investment of limited resources. The formula to calculate a financial holding cost is the same approach traditionally used to calculate interest costs. We’ll assume that the cost of capital for both Kids N Toys and Child’s Delight is 20%. The financial holding cost of the average Burzee Doll inventory investment for Kids N Toys can be calculated in the following manner:
Financial holding cost = Average investment × Annual rate × Number of years

\[ \frac{\text{Financial holding cost}}{\text{H11005}} = \frac{250,000 \times 20\% \times 3/12}{\text{year}} = 12,500 \]

The financial holding cost for Child’s Delight can also be calculated. Remember, we calculated earlier that Child’s Delight had a much lower average investment in inventory. In addition, this company’s investment in Burzee Dolls lasted for only two months—November and December. As a result, its financial holding cost was much lower than Kids N Toys and is calculated as follows:

\[ \frac{\text{Financial holding cost}}{\text{H11005}} = \frac{33,750 \times 20\% \times 2/12}{\text{year}} = 1,125 \]

The financial holding cost is as much a cost of being in the business of selling Burzee Dolls as any other cost we calculated and listed earlier in Exhibit 8. Most accountants recognize that measuring financial holding costs is important to managing the economic well-being of the organization. Hence, in Exhibit 14 we have expanded the original management accounting report on the Burzee Doll inventory to include financial holding costs in order to calculate the organization’s economic profit.

Before we leave this example and move on to discuss holding costs in service organizations, take one more opportunity to compare the gross margin report in Exhibit 7 and the management accounting report in Exhibit 14. These two merchandising reports would look basically the same regardless of whether Child’s Delight and Kids N Toys were retailers or wholesalers of toys. You should now have a pretty clear understanding of how dramatically management

---

**Exhibit 14: Expanded Management Accounting Report on the Burzee Doll Inventory**

In addition to cost of purchases, note the following additional inventory costs:

- Average inventory overhead costs are $1.10 per unit per month.
- Average costs to initiate and receive a purchase order are $1,250 per event.
- Average costs of capital are 20%.

<table>
<thead>
<tr>
<th></th>
<th>Kids N Toys, Inc.</th>
<th>Child’s Delight, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected revenue</strong></td>
<td>50,000 units × $30 standard price</td>
<td>20,000 units × $30 standard price</td>
</tr>
<tr>
<td><strong>Shrinkage loss</strong></td>
<td>1,600 units × $30</td>
<td>(48,000)</td>
</tr>
<tr>
<td><strong>Market loss</strong></td>
<td>2,000 units × ($30 − $10) + 4,400 units × ($30 − $3)</td>
<td>(158,800)</td>
</tr>
<tr>
<td><strong>Actual revenue</strong></td>
<td>$1,293,200</td>
<td>$595,500</td>
</tr>
<tr>
<td><strong>Purchase costs</strong></td>
<td>50,000 units × $10 standard cost</td>
<td>20,000 units × $10 standard cost</td>
</tr>
<tr>
<td><strong>Lost discount</strong></td>
<td>(0)</td>
<td>(40,000)</td>
</tr>
<tr>
<td><strong>Price increase</strong></td>
<td>(0)</td>
<td>(30,000)</td>
</tr>
<tr>
<td><strong>Gross margin</strong></td>
<td>$793,200</td>
<td>$325,500</td>
</tr>
<tr>
<td><strong>Overhead costs</strong></td>
<td>50,000 units ÷ 2 = 25,000 average inventory level × $1.10 × 3 months</td>
<td>5,000 units ÷ 2 = 2,500 average inventory level × $1.10 × 2 months</td>
</tr>
<tr>
<td><strong>Order costs</strong></td>
<td>1 order × $1,250</td>
<td>(1,250)</td>
</tr>
<tr>
<td><strong>Net operating profit</strong></td>
<td>$709,450</td>
<td>$315,000</td>
</tr>
<tr>
<td><strong>Holding costs</strong></td>
<td>$500,000 in purchases ÷ 2 = $250,000 average inventory investment × 20% × 3/12 year</td>
<td>($60,000 ÷ 4 + $60,000 ÷ 4 + $75,000 ÷ 4 + $75,000 ÷ 4) × 20% × 3/12 year</td>
</tr>
<tr>
<td></td>
<td>(12,500)</td>
<td>(1,125)</td>
</tr>
<tr>
<td><strong>Economic profit</strong></td>
<td>$696,950</td>
<td>$313,875</td>
</tr>
</tbody>
</table>
accounting can differ from financial accounting in analyzing results of merchandising organizations. It is also important to point out that the reports in Exhibits 7 and 14 are both segment reports that are specific to inventory lines in these companies. A complete net operating profit analysis of all operations at either company should obviously include revenues and costs that are specific to all other inventory lines and overhead costs that are common across the organization (for example, the salaries for company executives). A complete economic profit analysis (sometimes called an Economic Value Added or EVA™ analysis) would include a “holding cost” on all assets belonging to the company (cash, investments, equipment, buildings, land, etc.).

Service Organizations and Holding Costs

Something you should realize about GAAP and the service industry is that there typically has not been nearly as much emphasis on measuring and reporting work-in-process costs as compared to the manufacturing industry. However, it is important that the accountants support the management process by reporting on the costs and processes involved in work-in-process services. Think about the economic facts of work-in-process services for a moment. What do these costs represent? They represent significant investments in services provided to a client that typically have yet to provide any kind of a return in terms of cash receipts. Work in process is obviously necessary in many service companies. However, service companies cannot allow work-in-process services to build up in their organizations without restraint. Otherwise, resources are tied up that could otherwise be used to provide additional salable services. These opportunity costs eventually reduce profits in the company. Doesn’t this sound a lot like the same risk of holding costs we described for merchandising companies earlier in this section? Accountants can and should measure holding costs on large service projects. Such measures provide decision makers with the insight to assess the effects of not properly planning and controlling large service projects. For example, consider a large accounting firm that is planning an audit which is expected to take three months to complete. Suppose that by the end of the three months, this large accounting firm has invested $400,000 in supplies, labor, and overhead for the audit project. Because most service companies have outstanding debts that are accruing interest costs or investment opportunities that have a measurable rate of return, these companies will incur a cost of capital just like merchants and manufacturers. If the accounting firm’s cost of capital is 20%, the holding costs on this project are:

Average investment during the three-month period—($0 + $400,000) ÷ 2 = $200,000
Holding cost—$200,000 × 20% × 3/12 month = $10,000

What if the accounting firm has not completed the audit at the end of three months? At this point, it appears that the audit will require another month and another $40,000 in costs to complete. What are the additional holding costs of this extra month?

Average investment during the fourth month—($400,000 + $440,000) ÷ 2 = $420,000
Additional holding cost—$420,000 × 20% × 1/12 month = $7,000

Computing and understanding these cost data provide a lot of incentive for the audit manager to complete the job and collect fees as quickly as possible. In providing these data, the accountant is supporting good planning and control of work in process in the audit service process.

FYI:
A study on cost accounting in the service industry reported that 65% of service companies have significant levels of work in process at the end of their reporting periods.

10 Note that ($440,000 ÷ 2) × 20% × (4/12) < $10,000 + $7,000. This is because the costs on this audit contract are building much faster in the first three months ($400,000 in three months) than in the last month ($40,000 in one month). Similarly, using $400,000 ÷ 2 assumes that the $400,000 in costs is growing evenly over the three-month period ($133,333 per month). A more accurate method of computing the total holding costs for the four-month period would involve calculating and summing the holding costs for each individual month.
**Chapter 21**

**Managing Inventory and Service Costs**

Measuring holding costs requires that the company’s cost of capital first be identified. The holding cost formula is

\[
\text{Holding Cost} = \frac{\text{Average Investment in Inventory or Work-in-process Services}}{\text{Annual Rate}} \times \text{Number of Years}
\]

Financial holding costs can be deducted from net operating profit to measure economic profit for a particular product line.

**T O S U M M A R I Z E:**
Both merchandising and service firms often experience several types of opportunity costs, such as lost sales due to not having enough inventory or delays in completing work in process for customers. These costs are extremely difficult to measure. One important category of opportunity costs that accountants can measure is financial holding costs, which is a measure of the costs of having money tied up in inventory (for merchants) or in work-in-process services (for service companies).

**Quantitative Inventory Management Methods**

We have spent a lot of time in this chapter discussing the many types of costs involved in managing inventory for merchants (once again, refer to Exhibit 5 to see a list of these issues). Generally, service companies do not carry significant levels of inventory and do not need to pay as much attention to inventory management costs. However, many manufacturing companies carry significant inventory levels of raw materials, work in process, and finished goods. These companies need to pay attention to issues involved in managing costs of carrying too much versus too little inventory. The primary question here is, “How much inventory should a company have?” This section will describe some quantitative methods that can be useful to accountants working to answer this question. We will use the example of a merchandising company to illustrate these methods; however, these inventory management calculations are equally applicable to manufacturing companies.

**Economic Order Quantity**

It is a significant challenge to balance the costs of carrying too much inventory against the costs of carrying too little inventory. Determining how much inventory a company should have involves two important issues: (1) knowing *how much* inventory to order and (2) knowing *when* to place the inventory order. One well-known method used to handle the first issue is the [economic order quantity (EOQ)](#). In calculating the optimal size of an inventory order, the EOQ attempts to balance the costs of placing an order against the costs of carrying inventory in the organization.

**Caution**

It is important that you understand that the purchase costs used to calculate the EOQ are not the inventory purchase prices, but the overhead costs involved in handling a purchase order (e.g., preparing purchase orders, receiving and inspecting shipments, initiating payment for purchases, etc.).

We’ll return once more to the Burzee Doll example to demonstrate how to balance carrying costs and purchasing costs to calculate EOQ. First, we need to determine a cost per doll that includes all the costs of carrying Burzee Dolls during the two-month holiday buying season (November and December). Look back at Exhibit 14. Carrying costs should include the cost due to shrinkage loss, cost due to market loss, overhead costs, and holding costs. You should realize that combining all these carrying costs into a single cost per unit requires a great deal of analysis and intuition on the part of the accountant. However, let’s assume that carrying costs are approximately $5 per doll. In addition, purchase order costs are $1,250 per order. Finally, we’ll assume that a merchant can sell as many as 40,000 dolls during the holiday buying season. Exhibit 15 demonstrates one method of calculating EOQ using a cost schedule approach. As you can see, as the order quantity gets higher, the average inventory level in the store increases, and total carrying costs increase; in addition, the total purchase orders for the buying season are reduced, resulting in lower total ordering costs. By calculating the total of both carrying and ordering costs, the accountant can get a general idea of the optimal (i.e., economic) order quantity. According to the numbers in Exhibit 15, it appears that the store should request approximately 4,500 dolls for each of its nine orders during the buying season.
There is an alternative, and more precise, approach to calculating the EOQ using a formula (derived by calculus). Without working through the calculus derivation, the EOQ formula is:

$$EOQ = \sqrt{\frac{2OP}{C}}$$

- $Q$ - The market demand in units for the period
- $P$ - The overhead cost of placing one order
- $C$ - The total carrying cost for one unit for the period

By inserting our Burzee Doll data into the EOQ formula, we can calculate the precise EOQ as follows:

$$EOQ = \sqrt{\frac{2(40,000)(125)}{5}} = \sqrt{\frac{100,000,000}{5}} = \sqrt{20,000,000} = 4,472 \text{ dolls}$$

Now that we have the EOQ, we can calculate the following exact costs:

- Total carrying costs = $4,472 \times 2 = 2,236$ average inventory $\times 5 = 11,180$
- Total ordering costs = $40,000 \times 9 = 360,000$ average overhead $\times 1250 = 11,250$
- Total inventory management costs = $11,180 + 11,250 = 22,430$

Using the EOQ formula is much faster and more precise than working through an EOQ cost schedule. With the EOQ, we can resolve the first of two important issues involved in determining how much inventory a company should have—knowing how much inventory to order. Now we will turn our attention to the second issue—knowing when to place the inventory order.

**Reorder Point and Safety Stock**

Knowing when to place the inventory order involves the reorder point and the desired safety stock. Assume for a moment that you are the manager of the Kids N Toys store. Now that you have calculated the EOQ, you need to know exactly when to place your order. You don’t want to reorder Burzee Dolls too soon, or you’ll end up with more inventory on hand than you need.
This will result in unnecessary overhead costs, holding costs, and possibly increased inventory shrinkage. On the other hand, if you wait until you’re nearly out of dolls before you place the order, you’ll probably run out of inventory before the next shipment arrives. This will result in lost sales—a serious opportunity cost. Walking through your store, you watch the levels of dolls on your shelves and in your storeroom decline as customers make purchases. In terms of level of Burzee Doll inventory, at what point do you place your next order? Essentially, you need to calculate a reorder point. The calculation is quite simple:

$$\text{Reorder point} = \text{Average lead time in days} \times \text{Average daily sales}$$

Lead time, in this case, is the time between when store management initiates a purchase order and when the inventory is finally delivered and ready for sale. Lead time for Burzee Dolls would include the time it takes for Kids N Toys to process any necessary paperwork to initiate the purchase order, for the distributor to process the purchase order and deliver the goods, and for Kids N Toys to receive and prepare the dolls for aisle display. Let’s assume that lead time for the Burzee Doll is three days. Further, Kids N Toys sells, on average, 800 dolls per day. The reorder point calculation is:

$$\text{Reorder point} = 3 \text{ days} \times 800 \text{ dolls} = 2,400 \text{ dolls}$$

When the inventory falls to 2,400 dolls, you need to initiate a new purchase order. By the time the order arrives, the store should be selling its last doll.

At this point, a couple of things about this reorder point number may be bothering you. One possible problem is that the reorder point calculation is assuming a perfect world. In other words, the reorder point calculation shown assumes that sales are always 800 dolls per day and that the lead time is always three days. A sudden surge in customer demand or any problems in order processing or shipping could result in empty shelves. As manager for Kids N Toys, you may think you should build a little cushion into your reorder point calculation to allow for any unexpected problems. This is the purpose of safety stock. The calculation of the amount of safety stock has two parts: (1) to handle possible problems in the reorder process and (2) to handle an unexpected spike in sales demand. Let’s assume that problems in the reorder process could result in a maximum lead time of four days. Further, as many as 875 dolls could sell in one day. The safety stock calculation would be as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum lead time</td>
<td>4 days</td>
</tr>
<tr>
<td>Average lead time in days</td>
<td>3 days</td>
</tr>
<tr>
<td>Surplus</td>
<td>1 day</td>
</tr>
<tr>
<td>Average expected sales per day</td>
<td>800 dolls</td>
</tr>
<tr>
<td>Safety stock for reorder problem</td>
<td>800 dolls</td>
</tr>
<tr>
<td>Maximum expected sales per day</td>
<td>875 dolls</td>
</tr>
<tr>
<td>Average expected sales per day</td>
<td>800 dolls</td>
</tr>
<tr>
<td>Surplus</td>
<td>75 dolls</td>
</tr>
<tr>
<td>Maximum lead time</td>
<td>4 days</td>
</tr>
<tr>
<td>Safety stock for demand changes</td>
<td>300 dolls</td>
</tr>
<tr>
<td>Total safety stock</td>
<td>1,100 dolls</td>
</tr>
</tbody>
</table>

Based on these numbers, Kids N Toys will always want to keep at least 1,100 dolls on hand to handle unexpected situations involving either its suppliers or its customers. Hence, this safety stock number should be added to the original reorder point calculation, resulting in a new reorder point calculation that includes a cushion for safety stock:

$$\text{Reorder point with safety stock} = (\text{Average lead time in days} \times \text{Average daily sales}) + \text{Safety stock}$$

$$= (3 \text{ days} \times 800 \text{ dolls}) + 1,100 \text{ dolls} = 3,500 \text{ dolls}$$

**reorder point** The point at which the inventory level in the organization drops low enough to trigger a new purchase order.

**safety stock** The minimal level of inventory required to insure against the organization running out of inventory in the case of unforeseen problems in receiving its next purchase order.
You’ve likely noticed that the reorder point calculation that includes safety stock can be directly calculated as:

\[
\text{Reorder point with safety stock} = \frac{\text{Maximum lead time in days} \times \text{Maximum daily sales}}{\text{Maximum lead time in days} + \text{Safety stock inventory level}}
\]

Combining these two calculations into one simple calculation is acceptable, assuming that management is not interested in knowing the specific level for safety stock. Usually, though, store management wants to know when sales are eating into the safety stock. Such a situation signals that special attention is needed to ensure that the store does not run out of stock and miss some customer sales. Exhibit 16 graphically depicts these relationships.

**Caution**

Perhaps you’ve heard of the saying “Garbage in, garbage out!” The quality of these three quantitative inventory management models (like all decision models and systems in business) is only as good as the quality of the information that is used in the calculations. Before using the EOQ, reorder point, or safety stock calculations, the accountant needs to be sure that all costs and risks of carrying and ordering inventory are understood. Current JIT thinking suggests that accountants in the past may have severely understated the costs of carrying inventory, resulting in unnecessarily large inventory orders and high levels of inventory in the organization.

**TO SUMMARIZE:** Balancing costs of carrying too much inventory against the costs of carrying too little inventory is a significant challenge for accountants in both merchandising and manufacturing organizations. The economic order quantity, reorder point, and safety stock calculations can help. Exhibit 16 graphically summarizes the relationship between EOQ, reorder points, and safety stock inventory levels. Consider Exhibit 16 in light of the inventory management issues in Exhibit 5. The EOQ model is a useful tool for managing carrying costs (e.g., overhead costs, holding costs, losses due to decreased market value, and the cost of inventory shrinkage). The EOQ model balances these carrying costs against ordering costs. In addition, the EOQ should be combined with intelligent calculations of reorder points and safety stock in order to guard against excessive risk of lost sales due to delivery problems and fluctuating market demand.

Exhibit 16: Graphical Display of EOQ, Reorder Points, and Safety Stock Inventory Levels
r e v i e w  o f  l e a r n i n g  o b j e c t i v e s

1 Identify the different types of inventory in manufacturing, service, and merchandising organizations and understand how these inventory costs are reflected in the income statement and balance sheet. Both manufacturing and service organizations maintain substantial production processes. As a result, both types of organizations report work-in-process inventory in the balance sheet. In addition, the computation of cost of goods sold can be quite complex for these types of organizations because the computation involves combining information about materials, labor, and overhead costs. The computation of cost of goods sold in a merchandising organization is relatively simple because inventory is purchased in its final form and substantial additional costs are generally not incurred in getting it ready to sell. Both manufacturing and merchandising organizations maintain significant levels of ending inventory that are reported in the balance sheet.

2 Analyze the levels of raw materials, work-in-process, and finished goods inventories in a manufacturing organization. Inventory turnover measures can be used to evaluate effective use of raw materials, work-in-process, and finished goods inventories. The average level of raw materials inventory is used to support the cost of materials used during the period. Work-in-process inventory is used to support the cost of goods manufactured. Finished goods inventory is used to support the cost of goods sold during the period. Two measures of inventory management performance are used to report on and control inventory levels: inventory turnover and days in inventory.

3 Understand how merchants manage inventory in their organizations. Because merchants basically purchase inventory in a finished state, the process of accounting for inventory in a merchandising business is not nearly as complicated as it is in a manufacturing business. However, there are a number of important issues associated with managing the inventory in order to maximize sales and minimize a variety of inventory costs. For example, having too much inventory creates unnecessary overhead costs, financial holding costs, costs due to loss of market value, and costs due to inventory shrinkage. Not having enough inventory may result in unnecessary ordering costs and loss of bulk order discounts, as well as opportunity costs due to lost sales and increased supplier prices. Measuring these costs allows management accountants to prepare detailed cost reports that support effective management of gross margins and net operating profits for individual product lines.

4 Measure profitability and personnel utilization in a service organization. Like a manufacturing organization, a service organization involves a substantial process before delivering a final product to the customer. Three types of service organizations are professional services, service shops, and mass services. Professional service firms emphasize people-to-people service over automation, the delivery of a process rather than a final tangible product, and high customization. A mass service organization emphasizes the standardized, automated delivery of a tangible product. Service organizations, similar to manufacturing and merchandising organizations, must measure profitability and resource utilization. A professional services firm uses profitability measures based on a comparison of revenues to the compensation cost of the professionals. This textbook reports this performance using a measure called profit percentage from personnel (PPP). Personnel utilization can be measured by comparing the number of billable hours actually worked to the number that was expected. This measure is referred to in this textbook as personnel utilization rates (PUR).

5 Describe how the concept of just-in-time (JIT) inventory systems is used to improve cost, quality, and timely performance in organizations. Just-in-time (JIT) has become an important tool for managing manufacturing, service, and merchandising companies across the world. In a manufacturing setting, demand at the final assembly stage “pulls” the inventory through the production process only as it is needed. Using this system, nothing is produced until customers demand it. JIT puts a strong emphasis on costs and quality. However, JIT also focuses on management of timeliness and flexibility. The main goal of JIT is to add value to the product or service and reduce or eliminate activities that do not. By focusing on removing non-value-added activities and reducing time spent on value-added activities, inventories and other costs are reduced, while quality and timeliness are improved.

6 Calculate and interpret holding costs in merchandising and service businesses. Although opportunity costs can be extremely difficult to measure, one important type of opportunity cost that accountants can measure is financial holding costs. Financial holding costs measure the costs of having money tied up in inventory (for merchants) or
tied up in work-in-process services (for service companies). Measuring holding costs requires that the company’s cost of capital first be identified. The holding cost formula is Average investment in inventory or work-in-process services × Annual rate × Number of years. Financial holding costs can be deducted from net operating profit to measure economic profit for a particular product line. Measuring economic profit for an entire company is sometimes called Economic Value Added (EVA™).

Use classic quantitative tools in inventory management (economic order quantity, reorder point, and safety stock). Both merchandising and manufacturing organizations have significant investments in inventory costs. Accountants can balance the costs of carrying too much inventory against the costs of carrying too little inventory by calculating the economic order quantity (EOQ), reorder point, and safety stock. The EOQ model is a useful tool for managing carrying costs (e.g., overhead costs, holding costs, losses due to decreased market value, and the costs of inventory shrinkage). The EOQ model balances these carrying costs against ordering costs. The EOQ is combined with reorder point and safety stock calculations in order to guard against excessive risk of lost sales due to delivery problems and fluctuating market demand.

**Key terms & concepts**

<table>
<thead>
<tr>
<th>Days in inventory, 1156</th>
<th>Holding costs, 1160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory shrinkage, 1160</td>
<td>Inventory turnover, 1156</td>
</tr>
<tr>
<td>Just-in-time (JIT), 1172</td>
<td>Lead time, 1161</td>
</tr>
<tr>
<td>Net operating profit, 1165</td>
<td>Non-value-added activities, 1174</td>
</tr>
<tr>
<td><strong>Value-added activities, 1174</strong></td>
<td><strong>Cost of capital, 1176</strong></td>
</tr>
<tr>
<td><strong>Economic profit, 1176</strong></td>
<td><strong>Economic Value Added (EVA™), 1178</strong></td>
</tr>
<tr>
<td><strong>Reorder point, 1181</strong></td>
<td><strong>Safety stock, 1181</strong></td>
</tr>
<tr>
<td><strong>Segment, 1178</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Review problem**

**Inventory Performance Measures**

**Part 1**

Sparky Manufacturing, Inc. manufactures cell phones. A comprehensive income statement and a partial balance sheet for Sparky Manufacturing, Inc. follow:

<table>
<thead>
<tr>
<th><strong>Income Statement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sales revenues</strong></td>
</tr>
<tr>
<td><strong>Cost of goods sold/Cost of goods manufactured:</strong></td>
</tr>
<tr>
<td>Cost of goods manufactured:</td>
</tr>
<tr>
<td>Beginning raw materials</td>
</tr>
<tr>
<td>+ Purchases of materials</td>
</tr>
<tr>
<td>Total raw materials available</td>
</tr>
<tr>
<td>− Ending raw materials</td>
</tr>
<tr>
<td>Raw materials used</td>
</tr>
<tr>
<td>+ Direct labor</td>
</tr>
<tr>
<td>+ Applied manufacturing overhead</td>
</tr>
<tr>
<td>Total manufacturing costs</td>
</tr>
</tbody>
</table>
Total manufacturing costs ................................................. $1,453,300
+ Beginning work-in-process inventory .................................. 12,400
− Ending work-in-process inventory ...................................... (15,200)
Cost of goods manufactured ............................................. $1,450,500
+ Beginning finished goods inventory .................................... 40,700
− Ending finished goods inventory ...................................... (37,600)
Cost of goods sold ......................................................... $1,453,600
− Overapplied manufacturing overhead .................................. (12,000)
Adjusted cost of goods sold ........................................... $1,441,600

Gross margin ................................................................. $1,198,400

Selling and general administrative expenses:
Selling expenses .......................................................... $ 128,000
Administrative expenses .................................................. 237,000
Total selling and general administrative expenses .................. $ 365,000
Net operating income ..................................................... $ 833,400

Selected Balance Sheet Information

Accounts receivable ......................................................... $59,200
Raw materials inventory ................................................... 20,000
Work-in-process inventory .................................................. 15,200
Finished goods inventory .................................................. 37,600
Supplies inventory ..........................................................  600
Accounts payable ............................................................ 22,400

Required:
Use Sparky Manufacturing, Inc.’s income statement and partial balance sheet to answer the following question.

1. Compute the turnover ratio and days in inventory ratio for all three inventories (use 365 days in a year).

Part 2

Toadstool Wireless is a cell phone retailer that purchases its cell phones from Sparky Manufacturing, Inc. To support sales in the months April through June, Toadstool Wireless bought 890 phones in one order that were received in multiple shipments. Of those 890 phones, 815 were sold at the suggested retail price of $250. The other 75 cell phones were lost due to poor controls in the shipping process. The average cost to initiate and receive each purchase order was $550 per order. Toadstool Wireless expected to pay $110 per phone but due to unexpected tariffs that affected some of Sparky’s competitors, the cost per phone was raised to $125. Overhead costs for the three months were initially expected to be $60,000, but were actually only $49,000.

Required:
2. Create a management accounting report that helps management to understand the impact of these changes on net operating profit.
3. Compute the return on inventory investment for Toadstool Wireless.
4. Assume that the company’s cost of capital is 12%. Compute the holding costs and economic profit for the company.
Solution

Part 1

1. **Raw materials inventory turnover:**
   \[ \frac{953,300}{23,300} \times 2 = 44.0 \text{ times} \]
   **Raw materials days in inventory:** \( \frac{365}{44.0} = 8.3 \text{ days} \)

2. **Work-in-process inventory turnover:**
   \[ \frac{1,450,500}{12,400} \times 2 = 105.1 \text{ times} \]
   **Work-in-process days in inventory:** \( \frac{365}{105.1} = 3.5 \text{ days} \)

3. **Finished goods inventory turnover:**
   \[ \frac{1,441,600}{40,700} \times 2 = 36.8 \text{ times} \]
   **Finished goods days in inventory:** \( \frac{365}{36.8} = 9.9 \text{ days} \)

Part 2

2. **Expected revenue** ................................................................. $250 \times 890 \text{ units} = $222,500
   **Shrinkage loss** ................................................................. $250 \times 75 \text{ units} = (18,750)
   **Actual revenue** ................................................................. $203,750
   **Expected product costs** ....................................................... $110 \times 890 \text{ units} = (97,900)
   **Cost increase** ................................................................. $15 \times 890 \text{ units} = (13,350)
   **Gross margin** ................................................................. $92,500
   **Expected overhead costs** ................................................... (60,000)
   **Decrease in overhead costs** ............................................... $60,000 - $49,000 = 11,000
   **Order costs** ................................................................. $550 \times 3 \text{ orders} = (1,650)
   **Net operating profit** ......................................................... $41,850

3. **Return on inventory investment:**
   \[ \frac{(97,900 + 13,350)}{2} = 55,625 \text{ average inventory level} \]
   \[ \frac{92,500}{55,625} \times 100 = 166.3\% \]

4. **Holding costs:**
   \[ 55,625 \times 12\% \times \frac{3}{12} = 1,669\% \]
   **Economic profit:** $23,100 - 1,669 = $21,431
   *(Rounded.)*

Discussion Questions

1. What similarities are there in the inventories of a manufacturing and a merchandising organization? What are the differences?
2. What similarities are there in the inventories of a manufacturing and a service organization? What are the differences?
3. How does the work-in-process inventory in a manufacturing organization differ from that in a service organization?
4. What is represented by total cost of goods manufactured?
5. Why is the total cost of goods sold number of limited usefulness for detailed internal decision making?
6. What amount is compared to the level of raw materials inventory in computing a useful measure of raw materials inventory turnover? Of work-in-process inventory turnover? Of finished goods inventory turnover?
7. Name three problems associated with carrying too much inventory.
8. Name three problems associated with carrying too little inventory.
9. What is inventory shrinkage? Name three things that can cause inventory shrinkage.
10. What can a company do to evaluate the management of its inventory investment?
11. What are the three basic types of service organizations?
12. The different types of service organizations vary in the emphasis they place on three dimensions. What are these three dimensions?
13. The same two concepts that underlie cost management in manufacturing and merchandising organizations are also used in developing cost management tools for service organizations. What are these two concepts?
14. How did the concept of just-in-time (JIT) change most companies' view that maintaining a minimum level of inventory was desirable? Use the measures of cost, quality, and time as you prepare your answer.

15. “The purpose of just-in-time (JIT) is to reduce inventory.” Do you agree or disagree? Explain.

16. What causes holding costs to exist? How is it that holding costs exist in the service industry, which typically does not have inventories?

**Practice exercises**

**Practice 21-1**  
**Inventory Turnover**  
Using the following annual information, calculate inventory turnover for (1) raw materials inventory, (2) work-in-process inventory, and (3) finished goods inventory.

- Cost of raw materials used: $100,000
- Ending raw materials inventory: 20,000
- Ending work-in-process inventory: 50,000
- Cost of goods sold: 250,000
- Beginning finished goods inventory: 60,000
- Cost of goods manufactured: 200,000
- Beginning work-in-process inventory: 40,000
- Beginning raw materials inventory: 15,000
- Ending finished goods inventory: 70,000

**Practice 21-2**  
**Days in Inventory**  
Refer to the data in Practice 21-1. Compute the number of days in inventory for (1) raw materials inventory, (2) work-in-process inventory, and (3) finished goods inventory. (Assume 365 days in the year.)

**Practice 21-3**  
**Carrying Too Much Inventory versus Carrying Too Little Inventory**  
Which one of the following statements is false?

a. Companies that carry too much inventory face increased overhead costs.

b. Companies that carry too little inventory face increased bulk order discounts.

c. Companies that carry too little inventory face increased exposure of suppliers not delivering inventory on time.

d. Companies that carry too much inventory face increased inventory shrinkage.

e. Companies that carry too much inventory face increased financial holding costs.

**Practice 21-4**  
**Gross Margin Comparison**  
Which of the following companies performed better during the period based on gross margin alone?

(continued)
**Practice 21-5**

**Return on Investment Comparison**

Refer to the data in Practice 21-4. Based on DuPont’s return on investment (ROI) formula, which company performed better during the period?

**Practice 21-6**

**Reports and Decision Making**

Which one of the following reports provides management with the most valuable information related to sales of products?

a. Master budget  

b. Management accounting report  

c. Gross margin report  

d. Balance sheet

**Practice 21-7**

**Cost Management in Service Organizations**

Which one of the following statements is false?

a. Service firms place no emphasis on the cost of materials.  

b. Cost management in service organizations measures how efficiently the company uses its people.  

c. Professional service organizations implement a high degree of customization.  

d. Mass service firms place more emphasis on equipment than on people.

**Practice 21-8**

**Measuring Profitability in Service Organizations**

The company is a service organization and has the following numbers of professionals:

<table>
<thead>
<tr>
<th></th>
<th>Company A</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning total assets</td>
<td>$183,000</td>
<td>$92,000</td>
</tr>
<tr>
<td>Ending total assets</td>
<td>192,000</td>
<td>95,000</td>
</tr>
<tr>
<td>Cost of goods sold</td>
<td>1,360,000</td>
<td>420,000</td>
</tr>
<tr>
<td>Revenue</td>
<td>1,840,000</td>
<td>870,000</td>
</tr>
</tbody>
</table>

**Practice 21-9**

**Measuring Personnel Utilization in Service Organizations**

Refer to the data in Practice 21-8. For each class of professional, compute the total actual billable hours during the year as a percentage of total expected billable hours.
**Practice 21-10**  
**Just-in-Time Inventory**  
Which one of the following statements is false?  
a. Carrying large amounts of inventory can be very costly for a company.  
b. JIT environments are usually “push” systems.  
c. JIT inventory systems started in Japan.  
d. JIT emphasizes reduction of non-value-added activities.  
e. Under a JIT system, accountants are encouraged to provide time-based performance measures to management.

**Practice 21-11**  
**Opportunity Costs**  
Which one of the following statements is false?  
a. Economic profit is less than or equal to net operating profit.  
b. A company that has a high quantity of one type of inventory may incur opportunity costs related to other inventory items in lower quantity.  
c. Both service and manufacturing firms often experience opportunity costs.  
d. Opportunity costs include a number of out-of-pocket costs.  
e. Opportunity costs are difficult to measure.

**Practice 21-12**  
**Financial Holding Costs**  
The company had an average of $160,000 worth of a certain product in inventory from September 1 to December 31. If the company’s cost of capital is 16%, what is the financial holding cost of this inventory?

**Practice 21-13**  
**Economic Order Quantity**  
Using the following data, compute the company’s economic order quantity.  

- Total units demanded annually: 150,000  
- Cost to place one order: $3,200  
- Total carrying cost for one unit for the year: $4

**Practice 21-14**  
**Reorder Point**  
The company sells 130 units daily; each time the company orders more units, it takes the supplier four days to deliver the inventory. What is the company’s reorder point (in number of units)?

**Practice 21-15**  
**Safety Stock**  
Refer to the data in Practice 21-14. The supplier may take five days to deliver the inventory if any unexpected event occurs, and the daily demand for inventory may also spike to 160 units. Compute the amount of safety stock the company should keep on hand in case both of these events should happen.

**Practice 21-16**  
**Reorder Point and Safety Stock**  
Refer to the data in Practice 21-14. If the company never wants inventory to drop below 200 units, what is the company’s reorder point (in number of units)?
Inventory Turnover in a Manufacturing Company

The following information is the end of year data for Pecos Yo Company:

- Raw materials purchased during the year: $203,000
- Beginning raw materials inventory: $20,000
- Ending raw materials inventory: $25,000
- Applied manufacturing overhead: $350,000
- Direct labor costs: $100,000
- Beginning work-in-process inventory: $64,000
- Ending work-in-process inventory: $60,000
- Beginning finished goods inventory: $37,000
- Ending finished goods inventory: $40,000

Compute the following:

1. Inventory turnover for raw materials inventory.
2. Days in raw materials inventory. Assume 360 days in a year.
3. Inventory turnover for work-in-process inventory.
5. Inventory turnover for finished goods inventory.
6. Days in finished goods inventory. Assume 360 days in a year.

Inventory Turnover in a Merchandising Company

Beanie Company is a merchandising company. Beanie had the following financial data for the years 2005 and 2006:

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues</td>
<td>$200,000</td>
<td>$180,000</td>
</tr>
<tr>
<td>Cost of goods sold</td>
<td>$110,000</td>
<td>$109,000</td>
</tr>
<tr>
<td>Gross margin</td>
<td>$90,000</td>
<td>$71,000</td>
</tr>
<tr>
<td>Inventory</td>
<td>$40,000</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

2. Calculate Beanie Company’s days in inventory for 2006, assuming 365 days in a year, and explain what it means.

Inventory Turnover in a Merchandising Company

Both Dave and Kelly own auto parts stores. The following information is available for 2005 and 2006:

<table>
<thead>
<tr>
<th></th>
<th>Dave</th>
<th>Kelly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of goods sold:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>$150,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>2006</td>
<td>$130,000</td>
<td>$350,000</td>
</tr>
<tr>
<td>Ending inventory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>75,000</td>
<td>225,000</td>
</tr>
<tr>
<td>2006</td>
<td>55,000</td>
<td>255,000</td>
</tr>
</tbody>
</table>
1. Calculate each company’s turnover for inventory for 2006.
2. Calculate each company’s days in inventory for 2006 (assume 365 days in a year).
3. Which owner manages inventory better? Explain your answer.

**Analyzing a Management Accounting Report**

You have just finished preparing the management accounting report for your division. You show the following report to your division president, Karen, and tell her that you are very pleased with the performance of your division.

<table>
<thead>
<tr>
<th>Division Management Accounting Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected revenue</td>
</tr>
<tr>
<td>Shrinkage loss</td>
</tr>
<tr>
<td>Market loss</td>
</tr>
<tr>
<td>Actual revenue</td>
</tr>
<tr>
<td>Expected purchase costs</td>
</tr>
<tr>
<td>Lost discount</td>
</tr>
<tr>
<td>Gross margin</td>
</tr>
<tr>
<td>Overhead costs</td>
</tr>
<tr>
<td>Order costs</td>
</tr>
<tr>
<td>Net operating profit</td>
</tr>
</tbody>
</table>

After reviewing the report, Karen does not understand what some of the costs are and why they are in the report. Respond to her questions listed below.

1. What does the $38,400 shrinkage signify?
2. What does it mean to have a $127,040 market loss?
3. Just because we didn’t take advantage of a discount on a purchase, why is this a cost when there was no outflow of dollars directly related to the discount?

**Analysis of Return on Inventory Investment**

Plaids & Stripes and Audrey’s Apparel are clothes retailers. August and September are busy months for these two stores because many people are buying new clothes for the start of school. This year these stores expect the largest demand to be in children’s clothing. The following information has been given for both stores’ children’s departments during the months of August and September:

<table>
<thead>
<tr>
<th>Plaids &amp; Stripes</th>
<th>Audrey’s Apparel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$565,000</td>
</tr>
<tr>
<td>Gross margin</td>
<td>296,100</td>
</tr>
<tr>
<td>Average investment in inventory</td>
<td>29,000</td>
</tr>
<tr>
<td></td>
<td>$1,115,000</td>
</tr>
<tr>
<td></td>
<td>527,300</td>
</tr>
<tr>
<td></td>
<td>165,000</td>
</tr>
</tbody>
</table>

Using the above information, answer the following questions about Plaids & Stripes and Audrey’s Apparel.

1. Using the information given, which store generated the most total profit from inventory sales?
2. Calculate the return on inventory investment for both stores’ children’s departments. (Use both the profit margin and inventory turnover ratios.)
3. Using the calculations from part (2), which store actually manages its inventory more effectively? Explain your answer.

**Profitability in a Service Organization**

Lorien Company is an engineering firm composed of five engineers. It is expected that each engineer will work 2,000 hours during a year on client jobs. The following additional information has been given for each of the five engineers:
<table>
<thead>
<tr>
<th></th>
<th>Annual Compensation</th>
<th>Billing Rate per Engineering Hour</th>
<th>Actual Billable Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penny</td>
<td>$270,000</td>
<td>$300</td>
<td>1,900</td>
</tr>
<tr>
<td>Jacob</td>
<td>$250,000</td>
<td>250</td>
<td>1,900</td>
</tr>
<tr>
<td>Mandy</td>
<td>$230,000</td>
<td>225</td>
<td>1,800</td>
</tr>
<tr>
<td>Edwin</td>
<td>$200,000</td>
<td>200</td>
<td>1,800</td>
</tr>
<tr>
<td>Jackie</td>
<td>$180,000</td>
<td>175</td>
<td>1,800</td>
</tr>
</tbody>
</table>

1. Calculate each engineer’s profit percentage from personnel (PPP).
2. Calculate the profit percentage from personnel (PPP) for the entire firm.
3. Which engineer is bringing the most value to the company?

**Personnel Utilization in a Service Organization**

Magily Company is a mathematical model consulting firm. Magily’s services are sought by oil exploration companies for interpreting seismic data, by NASA for deciphering signals from deep space probes, and by Wall Street derivatives speculators who want to predict the weather in order to know whether to buy or sell soybean futures. Magily maintains the following mathematician staff:

<table>
<thead>
<tr>
<th>Number of Individuals</th>
<th>Client Billable Hours Expected to Be Worked per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full mathematician consultants</td>
<td>5</td>
</tr>
<tr>
<td>Associate mathematician consultants</td>
<td>10</td>
</tr>
<tr>
<td>Assistant mathematician consultants</td>
<td>40</td>
</tr>
</tbody>
</table>

During the most recent year, full mathematician consultants worked a total of 3,000 hours; associate mathematician consultants worked a total of 25,000 hours; and assistant mathematician consultants worked a total of 140,000 hours. Compute personnel utilization ratios for each class of mathematician.

**Value-Added and Non-Value-Added Activities**

Below is a list of activities performed by the Ibapah Bijou, a movie theater. Indicate whether each activity is a value-added activity (VA) or a non-value-added activity (NVA).

a. Redesigning the staff uniforms.
b. Cooking popcorn.
c. Counting the ticket stubs at night to make sure no one got in free.
d. Servicing the quadraphonic speaker system.
e. Paying for the rights to show the next movie starring Julia Roberts.
f. Paying a management fee for the employee pension fund.
g. Renting a storage facility to store the excess inventory of candy, uncooked popcorn, and soft drinks.
h. Paying the accounts payable.
i. Cleaning the white movie screens.
j. Scrubbing the theater floor to remove the sticky residue of spilled soft drinks.
Financial Holding Costs
On January 1, 2006, Owen Corporation has $350,000 in inventory. On May 1, 2006, Owen’s inventory is at $400,000. Owen’s cost of capital is 13%. What were Owen’s financial holding costs for January through April?

Brady’s Holding Costs
Brady Company sells imported goods made in India. One product it sells is a wooden music box. The music boxes cost Brady $65, and Brady charges its customers a price of $250. Brady’s cost of capital is 12%. On average, an entire year elapses between the time Brady pays for a music box and the time Brady collects the cash from the sale of the music box. What are Brady’s annual financial holding costs per unit for the wooden music boxes?

Economic Order Quantity
Pace Retailers’ best-selling item is its reinforced bicycle tires. Pace sells 4,745 of these tires each year. It costs approximately $200 for Pace to place a purchase order, and it costs on average about $2.50 per tire per year for inventory overhead costs. The retail price of the tires is $12.50. What is the economic order quantity of tires Pace should order at one time?

Reorder Point
Refer to Exercise 21-11. Suppose the lead time to receive a purchase order of reinforced bicycle tires is 13 days. To ensure adequate inventories at all times, Pace maintains a safety stock of 80 tires. Assuming Pace sells the 4,745 bicycle tires uniformly over the 365 days of the year, what is Pace’s reorder point?

Economic Order Quantity
For the past three years, Hawkeye Army Surplus Store has had excessive inventory holding costs. Management believes the excessive costs are due to the large inventory purchase orders the company places. The company hires a consultant, Brad Miles, to analyze the problem and suggest a solution. Information about two products, combat boots and backpacks, is as follows:

<table>
<thead>
<tr>
<th>Product</th>
<th>Combat Boots</th>
<th>Backpacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual market demand</td>
<td>20,000 pairs</td>
<td>5,000 packs</td>
</tr>
<tr>
<td>Cost per unit</td>
<td>$20</td>
<td>$55</td>
</tr>
<tr>
<td>Annual carrying cost per unit</td>
<td>$7</td>
<td>$16</td>
</tr>
<tr>
<td>Ordering cost</td>
<td>$500</td>
<td>$500</td>
</tr>
</tbody>
</table>

In order to balance the cost of placing a purchase order against the overhead cost of controlling inventory, how many pairs of combat boots should Brad suggest Hawkeye purchase at a time? How many backpacks?

Reorder Point
Avery Grocery Store is the only grocery store in Rayville, a small town populated mostly by college students. Students have been complaining lately because Avery always runs out of macaroni and cheese, the students’ favorite food. Avery management decides it needs to calculate a more suitable reorder point. Information about the macaroni and cheese is as follows:

(continued)
Average daily sales ...................................................... 500 boxes
Average lead time to receive an order .............................. 5 days
Avery’s cost per unit ..................................................... $0.30
Price charged to customers ............................................ $0.75

1. What should be the reorder point if Avery does not want to maintain any safety stock?
2. What should be the reorder point if Avery wants to maintain a safety stock of 1,000 boxes of macaroni and cheese?

### Inventory Turnover in a Manufacturing Company

The following information is for Bun MaScare Company:

- Beginning raw materials inventory ................................ $25,000
- Raw materials purchased ............................................. 110,000
- Ending raw materials inventory ....................................... 15,000
- Manufacturing overhead (actual) ................................. 300,000
- Beginning work-in-process inventory ............................... 50,000
- Ending work-in-process inventory ................................... 40,000
- Direct labor costs .......................................................... 90,000
- Beginning finished goods inventory ............................... 200,000
- Ending finished goods inventory ..................................... 270,000
- Overapplied manufacturing overhead ............................. 15,000

**Required:**

Compute the following (assume 365 days in a year):

1. Inventory turnover for raw materials inventory.
2. Days' supply of raw materials inventory.
3. Inventory turnover for work-in-process inventory.
5. Inventory turnover for finished goods inventory.
6. Days' sales in finished goods inventory.
7. **Interpretive Question:** What conclusions can you draw from your inventory turnover calculations?

### Management Accounting Reports in a Merchandising Company

Ride EZ and Happy Trails are mountain bike retailers. This season a new bike, the Coaster, was introduced in the market. It was believed that the Coaster would be the most popular mountain bike sold during the season. Both companies sold the bike at the suggested retail price. At the end of each month during the season (May through September), store managers made notes of how many bikes were sold or purchased during the month. The following is a list of these notes:

<table>
<thead>
<tr>
<th>Date</th>
<th>Ride EZ</th>
<th>Happy Trails</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>30 bikes purchased</td>
<td>150 bikes purchased</td>
</tr>
<tr>
<td>May 31</td>
<td>27 bikes sold, out of stock; 30 more bikes are purchased</td>
<td>30 bikes sold</td>
</tr>
</tbody>
</table>
June 30  29 bikes sold, out of stock; 35 bikes sold
30 more bikes are purchased

July 31  28 bikes sold, out of stock; 37 bikes sold
30 more bikes are purchased

Aug. 31  24 bikes sold; 24 bikes sold

Sept. 30  4 bikes sold at cost; out of stock, 13 bikes sold at cost; out of stock,
no bikes purchased
no bikes purchased

The following information is also known:
• Suggested retail price is $600.
• The manufacturer sells the Coaster for a normal price of $275.
• Discounts of $25 off the normal price are given on purchases of 100 bikes or more.
• Average overhead costs used to purchase and initiate a purchase order for both retailers are $450 per event.
• Purchases are always made on the last day of the month.
• On June 15, the manufacturer raised the price of the Coaster to $290.
• Average inventory overhead costs for both retailers are $15 per unit per month.
• Both Ride EZ and Happy Trails account for inventory using FIFO.

Required:
Prepare a management accounting report for both Ride EZ and Happy Trails using the information given in the problem.

Personnel Utilization in a Service Business
Columbus & Hercules offers the following annual estimates (based on a 50-week work year) regarding the salaries and estimated hours associated with the professionals employed by the firm:

<table>
<thead>
<tr>
<th>Position</th>
<th>Total Estimated Salaries</th>
<th>Total Estimated Billable Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partners (2 × $100,000)</td>
<td>$200,000</td>
<td>4,400</td>
</tr>
<tr>
<td>Managers (3 × $70,000)</td>
<td>210,000</td>
<td>6,600</td>
</tr>
<tr>
<td>Seniors (6 × $50,000)</td>
<td>300,000</td>
<td>13,200</td>
</tr>
<tr>
<td>Staff accountants (10 × $25,000)</td>
<td>250,000</td>
<td>22,000</td>
</tr>
</tbody>
</table>

During February, Managers 1 and 2 were assigned three staff accountants each; Manager 3 was assigned four staff accountants. At the end of February, the following staff utilization report was generated:

<table>
<thead>
<tr>
<th>Staff Working for:</th>
<th>Budgeted Billable Hours</th>
<th>Actual Billable Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager 1</td>
<td>528</td>
<td>690</td>
</tr>
<tr>
<td>Manager 2</td>
<td>528</td>
<td>530</td>
</tr>
<tr>
<td>Manager 3</td>
<td>704</td>
<td>630</td>
</tr>
<tr>
<td>Total</td>
<td>1,760</td>
<td>1,850</td>
</tr>
</tbody>
</table>

Required:
Use the staff utilization numbers to evaluate the staff usage practices by the three managers.
Problem 21-4

Profitability and Personnel Utilization in a Service Company
Diggy Company specializes in caring for the pets of the rich and famous. Diggy gives personal care to each and every pet, and its professional animal “consultants” are on call 24 hours per day. Some details about Diggy’s business are given below.

<table>
<thead>
<tr>
<th></th>
<th>Number of Individuals</th>
<th>Client Billable Hours</th>
<th>Annual Compensation</th>
<th>Billing Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Expected to Be Worked per Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partners</td>
<td>5</td>
<td>500</td>
<td>$500,000</td>
<td>$400</td>
</tr>
<tr>
<td>Consultants</td>
<td>40</td>
<td>2,500</td>
<td>$35,000</td>
<td>$250</td>
</tr>
</tbody>
</table>

During the most recent year, the five partners billed a total of 3,000 hours, and the 40 consultants billed a total of 56,000 hours.

**Required:**
1. Compute personnel utilization ratios for each of the two classes of professionals within the firm.
2. Compute the firm’s profit percentage from personnel (PPP).
3. Compute the PPP for each of the two classes of professionals within the firm.
4. **Interpretive Question:** Speculate on why the 40 consultants worked the number of billable hours that they did.

Problem 21-5

JIT Inventory
The president of Penman Corporation, John Burton, has asked you, the company’s controller, to advise him on whether Penman should develop a just-in-time (JIT) inventory system. Your research concludes that there is a high cost associated with inventory storage facilities; that inventories use a large portion of the company’s cash flow; and that because of the nature of the inventory, there is a significant amount of shrinkage. Research also shows that neither of Penman’s two competitors uses a JIT inventory system. Most of Penman’s employees are trained to do only one job and belong to a local union. The union is strong and, in the past, has opposed major production changes. The union believes major changes will result in the loss of union employees’ jobs. Your research indicates that Penman’s major production item (a fairly new product in the market) should continue to have strong sales growth.

**Required:**
1. Using the information provided, advise John Burton to either continue the present system or work to develop a JIT inventory system.
2. Assume John decides to develop an inventory management system. He plans to evaluate the system after one year. List at least four possible performance measures John could use to evaluate the effectiveness of the system. Describe what information these measures would provide John.

Problem 21-6

Economic Profit
Larsen Company has two divisions. The following is information about these two divisions over the past six months:
Division L Division M

<table>
<thead>
<tr>
<th></th>
<th>Division L</th>
<th>Division M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net operating profit</td>
<td>$390,000</td>
<td>$400,000</td>
</tr>
<tr>
<td>Average investment</td>
<td>$35,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>Annual cost of capital</td>
<td>12%</td>
<td>18%</td>
</tr>
</tbody>
</table>

**Required:**
1. Use the above information to calculate the economic profit for the two divisions.
2. **Interpretive Question:** The division manager for Division M asks you why it is appropriate to include holding costs in the calculation of economic profit. Since holding costs are not included in the audited income statements that are reported by the company to its shareholders, then why would it be appropriate to use this cost in the internal reports that are used to evaluate managers and divisions? How would you respond?

**Inventory Management**
Watersports, Inc., sells high-performance water skis. Because its sales are seasonal, Watersports calculates and uses different reorder points for summer and winter months. The following information is available:

<table>
<thead>
<tr>
<th></th>
<th>April–October</th>
<th>November–March</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead time (days)</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Total customer demand for the period</td>
<td>1,600</td>
<td>400</td>
</tr>
</tbody>
</table>

The water skis cost $150 each, and Watersports sells them to its customers for $300. Watersports’ supplier charges $500 for each order placed. Watersports incurs an annual carrying cost of $17 per set of skis. Watersports has noticed in the past that sometimes the deliveries can be up to two days later than average and that the customer demand can be as much as 1,800 skis during April through October and 500 skis during the rest of the year.

**Required:**
1. Calculate the appropriate economic order quantities for the two seasons.
2. Calculate the safety stock for the two seasons that are necessary to accommodate potential delays in inventory deliveries and potential spikes in sales demand.
3. Calculate reorder point (with safety stock) for the two seasons.
4. **Interpretive Question:** What are the value and the cost of having safety stock?
Case 21-1
Buying Inventory for the Holiday Selling Season
Ryan Baird owns a small retail shop. Historically, her annual sales have been about $250,000, with 60% of that coming in the holiday selling season of November and December. This year on a buying trip to southern China, Ryan discovered an item that she is certain will be in huge demand. The item is a mechanical cricket powered by a photovoltaic cell—the cricket automatically silences at night when it gets dark and then starts chirping in the morning when the sun’s rays hit it. Ryan can buy the crickets from her Guangdong supplier for $1.00 each; she plans to sell them for $9.95 each.

Ryan is trying to decide how many of the crickets she should order. If she orders 30,000 or more, she can get a volume discount and pay just $0.80 each. However, she does not have room to store that many crickets, and she will have to rent storage space for $3,000 per month (three-month minimum). Also, the Guangdong supplier will only accept cash, and, because Ryan does not have very good credit, she will have to pay 17% annual interest on any money she borrows. She expects any loan to be outstanding for about two months.

Ryan has come to you for advice about whether she should buy a large quantity of crickets or play it safe and order just 10,000. What advice would you give her?

Case 21-2
Financial Holding Costs
You work in the accounting department of Cox Company. You are having a debate with one of your co-workers about holding costs. Your co-worker insists that holding costs should not be considered in making decisions because they do not involve any cash flows. He believes that cash flows are all that the business really cares about. How do you respond to him?

Judgment 21-1
You Decide: Can inventory management tools, such as turnover and days in inventory, be used in a service company that doesn’t have significant levels of tangible inventory? Why is it important to manage costs in a service organization?
You have just been hired as an accountant for a large law firm. Your first project is to look at some financial information and determine why net income is declining. The senior partner tells you that total revenues for the company have increased each of the last five years. As a result, a proposal to substantially increase salaries for senior associates is being strongly considered. “A number of partners are preparing to retire, and we need to retain our best associates for future partnership,” he said. “No one else in the company has done any research as to why net income has gone down, so we are excited to see what you come up with!” How should you perform the analysis?

Judgment 21-2
You Decide: Can a just-in-time inventory system help companies minimize inventory costs, or is JIT too expensive and cumbersome to implement?
Lately, you have heard a lot of talk about just-in-time inventory systems and how they help companies, like WAL-MART, keep track of inventory. You know that a JIT system can help track and keep inventory costs at a minimum, but is JIT really a viable option for all companies? For example, your neighbor works at a local automobile repair shop and he is always complaining about not having the right parts on hand, which causes him to get behind on his work. He can frequently be heard saying, “We always seem to run out of parts at the wrong time. Jan does a good job at trying to keep inventory in stock, but sometimes that job can get too big. Something else needs to be done or we are going to start losing customers!” How large does a company have to be and how much inventory must it have before JIT makes sense?
Managing Inventory and Service Costs  |  CEO  |  Chapter 21  |  1199

**Competency Enhancement Opportunities**

- Analyzing Real Company Information
- International Case
- Ethics Case
- Writing Assignment
- The Debate
- Internet Search

The following additional assignments provide opportunities for students to develop critical thinking, ethical perspectives, oral and written communication skills, experience with electronic research, and teamwork through group and business activities.

**Analyzing Real Company Information**

**Analyzing 21-1 (Microsoft)**

1. For the year ended June 30, 2002, Microsoft’s total cost of revenue was $5.191 billion. Can you compute Microsoft’s total manufacturing costs for the year? Cost of goods manufactured for the year? Explain.

2. As of June 30, 2002, Microsoft reported the following about the number of its employees:

   - Employees engaged in research and development: 20,800
   - Employees in sales and marketing: 23,500
   - Employees in administration: 4,000
   - Other employees: 2,200
   - Total: 50,500

Refer to Microsoft’s income statement in Appendix A and compute the following:

a. Total revenue per employee.
b. Total R&D cost per R&D employee.
c. Total sales and marketing cost per sales and marketing employee.
d. Total administrative cost per administrative employee.

**Analyzing 21-2 (Wal-Mart)**

1. Through its Retail Link™ system, Wal-Mart gives its suppliers access to detailed sales information “store by store, item by item, day by day.” What advantages are there to Wal-Mart in sharing this kind of detailed data with suppliers? What disadvantages?

2. Wal-Mart reports (in its 2003 10-K report filed with the Securities and Exchange Commission) that 83% of the goods sold in Wal-Mart stores and Supercenters are first shipped to one of Wal-Mart’s 84 regional distribution centers and then shipped to the individual stores. On the other hand, Sam’s Clubs receive 63% of their goods directly from the supplier. Why is there a difference in the distribution procedure for these two groups of stores?

3. In recent years, Sam’s Clubs sales, as a percentage of total Wal-Mart sales, have decreased, from 15% of sales in fiscal 2000 to 13% of sales in fiscal 2003. What impact do you think this change in sales mix has had on Wal-Mart’s overall gross margin percentage? Explain.
International Case

Deloitte & Touche

DELOITTE & TOUCHE is one of the largest professional services firms in the world. In 2003, the company reported revenues of $15.1 billion generated from its various business units—accounting, assurance and advisory, tax, legal, and management, financial and human capital consulting. Deloitte & Touche has 698 offices in 144 countries, and it employs almost 120,000 people.

1. What does Deloitte & Touche sell?
2. Deloitte & Touche has an office in Quito, Ecuador. What type of company operating in Ecuador would hire Deloitte & Touche instead of a local Ecuadorian professional services firm?
3. Review the chapter discussion of cost information for service companies. What costs would be important to Deloitte & Touche in deciding how much to bid on a consulting contract for a potential new client?

Ethics Case

Performance Evaluation: The Illusion of Objectivity?

You are a store manager for a large, regional department store chain. You have been asked by company headquarters to submit an evaluation of the performance of two of your assistant managers. The company is considering promoting one of them to be the manager of another store in the chain.

One of the assistant managers heads the Electronics Department in your store. She is a long-time friend of yours and you would like her to get the promotion. The other candidate heads the Home and Garden Department; she is a good assistant manager but you just don't know her well. You decide to recommend your friend, the head of the Electronics Department, for the promotion.

In order to support your recommendation with objective evidence, you include the following departmental profit numbers for the most recent year:

<table>
<thead>
<tr>
<th></th>
<th>Electronics</th>
<th>Home and Garden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$500,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>Net profit</td>
<td>$100,000</td>
<td>$40,000</td>
</tr>
<tr>
<td>Profit percentage</td>
<td>20%</td>
<td>13%</td>
</tr>
</tbody>
</table>

On this basis, arguing that the Electronics Department has generated higher sales, higher net profit, and a higher profit margin percentage, you recommend that the promotion be given to your friend. However, you are a little troubled by the following two additional pieces of information:

1. The average value of inventory held in the Electronics Department at any given time is $1.2 million. The comparable number for the Home and Garden Department is $250,000.
2. The profit percentage in the Electronics Department has been fairly stable over the last five years. On the other hand, the profit percentage in the Home and Garden Department is at a 10-year high; the increase coincides with the hiring of the current head of the Home and Garden Department.

Is it ethical for you to recommend the promotion for your friend, the head of the Electronics Department? How should you use the numerical evidence in support of your recommendation?
Writing Assignment

Consultant’s Report for a Small-Town Supermarket

You have been hired as a financial consultant by a small-town supermarket. The supermarket is considering building a new, larger store and requests your expertise in evaluating the feasibility of the project. You know that the construction of the store will cost $3 million. You also know that the average gross margin percentage in supermarkets is 27%.

Draft a one-page memo to the owner of the supermarket requesting additional cost information to be used in your analysis. The store owner is a clever businessperson but has no experience in using quantitative data in making decisions. Therefore, your memo must be very specific in identifying the information that you will need to perform a useful analysis.

The Debate

Overutilization of Young Professionals

As seen in this chapter, an important dimension of performance for a manufacturing, merchandising, or service organization is the efficient utilization of resources. The more intensively resources are used, the greater a company’s return on investment. However, when talking about a service organization, this “resource” is often the time of young professionals who are just starting their careers. Competitive pressures on companies can translate into 70- and 80-hour work weeks for college graduates in the first few years of their careers. These work pressures make it difficult for young professionals to develop their lives outside work.

Divide your group into two teams and prepare a two-minute oral presentation supporting the following views.

- One team supports “Work/Life Balance.” This group believes that young professionals should not be viewed as “resources” to be utilized but as human beings to be respected.
- The other team supports “Survival of the Fittest.” This group believes that it is a dog-eat-dog world out there, and that those young professionals who can’t stand the long hours should get out of the way of those who can.

Internet Search

Toyota Motor Corporation

Go to TOYOTA’s North America Web site at http://www.toyota.com. Sometimes Web addresses change, so if this Toyota address doesn’t work, access the Web site for this textbook (http://albrecht.swlearning.com) for an updated link to Toyota. Once you have gained access to Toyota’s Web site, answer the following questions:

1. Access Toyota’s Operations section (you can find it within the “About Toyota” menu selection). Find the timeline for Toyota’s sales and service. When did Toyota begin selling in North America? When did Toyota begin manufacturing cars in North America?

2. Next, move to Toyota’s corporate Web site in Japan at http://www.toyota.co.jp and learn about how the just-in-time (JIT) concept works at Toyota. You can do this by finding a news release dated October 9, 2003, titled “The Essence of TPS (the Toyota Production System).” In this article, Teruyuki Minoura, former CEO of Toyota Motor Manufacturing North America, talks about his experiences with TPS, which represents how his company implements a JIT management system. Minoura describes nine concepts that capture the concept of JIT. What are these concepts? (Hint: They’re listed as subtopic headings in his presentation.)