CHAPTER 12

# THE PURCHASING PROCESS

## LEARNING OBJECTIVES

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO:

- DESCRIBE THE RELATIONSHIP BETWEEN THE PURCHASING PROCESS AND ITS BUSINESS ENVIRONMENT, INCLUDING THE ORGANIZATION'S SUPPLY CHAIN.
- SUMMARIZE HOW ENTERPRISE SYSTEMS, E-BUSINESS, AND OTHER TECHNOLOGIES CAN IMPROVE THE EFFECTIVENESS OF THE PURCHASING PROCESS.
- ASSESS THE IMPLICATIONS OF IMPLEMENTING A SUPPLY CHAIN MANAGEMENT SYSTEM IN A GLOBAL BUSINESS ENVIRONMENT.
- DEPICT THE LOGICAL AND PHYSICAL CHARACTERISTICS OF A TYPICAL PURCHASING PROCESS.
- PREPARE A CONTROL MATRIX FOR A TYPICAL PURCHASING PROCESS, INCLUDING AN EXPLANATION OF HOW BUSINESS PROCESS CONTROL PLANS CAN ACCOMPLISH OPERATIONS AND INFORMATION PROCESS CONTROL GOALS.

This is a classic story. In the 1980s, Wal-Mart® and Procter & Gamble™ (P&G™) built a software system that linked P&G to Wal-Mart's distribution centers. When a P&G product ran low in a Wal-Mart distribution center, the system sent a message to P&G. Then, P&G initiated a shipment to the Wal-Mart distribution center or perhaps to a Wal-Mart store. Enhancements to the system have allowed P&G to know when any P&G product is scanned at the checkout at any Wal-Mart store. Purchase orders, shipments, invoices, and payments are all automatic. As a result, P&G knows when to make and ship products to Wal-Mart, without maintaining excessive inventory. Wal-Mart has less inventory on hand, lower costs (savings passed on from P&G), and higher product availability. P&G, Wal-Mart, and, most importantly, Wal-Mart customers are happier with this system. In this chapter, we will explore the processes, systems, and controls that should be in place to ensure that the purchasing process operates efficiently (i.e., low cost) and effectively (i.e., high customer value). Particular attention will be paid to processes that are used to determine when and how much to purchase.

## Synopsis

This chapter presents our third business process, the purchasing process. The purchasing process includes the first three steps, requirements determination, purchase order processing, and goods receipt, in the purchase-to-pay process (see Figure 2.10 on pg. 55 in Chapter 2). After we introduce the players involved in the purchasing process, we describe an organization's connections to its suppliers and customers (i.e., its supply chain) to set the stage for the complexities of the purchasing process. In addition, we call your attention to the "Physical Process Description" and the "Application of the Control Framework" sections. These sections cover state-of-the-art material on current and evolving technology and provide reading that we hope you will find both interesting and informative.

## Introduction

As previously noted, the purchasing process comprises the first three steps in the purchase-to-pay process (Figure 2.10, pg. 55). Let's take a closer look at the purchasing process.

## Process Definition and Functions

The **purchasing process** is an interacting structure of people, equipment, methods, and controls that is designed to accomplish the following primary functions:

- Handle the repetitive work routines of the purchasing department and the receiving department.[1]
- Support the decision needs of those who manage the purchasing and receiving departments.
- Assist in the preparation of internal and external reports.

First, the purchasing process handles the repetitive work routines of the purchasing and receiving departments by capturing and recording data related to the day-to-day operations of the departments. The recorded data then may be used to generate source documents (such as purchase orders and receiving reports) and to produce internal and external reports.

The purchasing process prepares a number of reports that personnel at various levels of management use. For example, the manager of the purchasing department might use an open purchase order report to ascertain which orders have yet to be filled.

Before leaving this section, we need to clarify two terms that we will be using throughout the chapter: *goods* and *services*. *Goods* are raw materials, merchandise, supplies, fixed assets, or intangible assets. *Services* cover work performed by outside vendors, including contractors, catering firms, towel services, consultants, auditors, and the like.

1 To focus our discussion, we have assumed that these two departments are the primary operating units related to the purchasing process. For a given organization, however, the departments associated with the process may differ.

# Organizational Setting

The purchasing process is closely linked to functions and processes inside and outside the organization. Let's take a look at those links and the impact that they have on the operation of the purchasing process.

## An Internal Perspective

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Figure 12.1 and Table 12.1 (pg. 422) present an internal view of the relationship between the purchasing process and its organizational environment. They show the various information flows generated or captured by the process. Take some time now to study the figure to get acquainted with the entities with which the process interacts.

Figure 12.1 and Table 12.1 reveal five information flows that function as vital communication links among various departments, business processes, and external entities. We briefly explain each flow here to give you a quick introduction to the purchasing process. Although Figure 12.1 depicts the flows using the document symbol, most of them can be implemented using electronic communications (e.g., workflow) and data stored in the enterprise database.

- Flow 1 is sent to purchasing from the inventory control department (or process), or various departments in the organization, to request that a purchase of goods or services be prepared. The requests might be routed to purchasing electronically (e.g., *workflow*).
- Flow 2a is a purchase order to a vendor. This could be a mailed, paper PO, or it could be sent electronically (e.g., *EDI*). Flows 2b, 2c, and 2d "inform" (via documents or electronic notices) the original requestor (e.g., inventory control, various departments), receiving, and accounts payable that a purchase order has been sent.
- Flow 3 represents the goods and accompanying packing slip from the vendor to receiving.
- After matching the goods and packing slip to the purchase order (flow 2c), receiving sends the goods to the warehouse via flow 4.
- Flows 5a, 5b, and 5c "inform" (via documents or electronic notices) accounts payable, general ledger, and purchasing that the goods have been received. Accounts payable will match flows 2d and 5a with the vendor invoice when it is received to determine that the invoice is valid and accurate. The general ledger uses flow 5b to update the general ledger account for inventory to reflect the increase in inventory on hand. Because we do not have a vendor invoice, we cannot make an entry to the general ledger account for accounts payable. To balance this entry to inventory, the general ledger process will make an entry to a clearing account. We'll discuss this entry later in the chapter and in Chapter 13. Upon receipt of flow 5c, purchasing will "close" the purchase order.

Let's examine the important control implicit in the assignment of responsibilities in Figure 12.1 (pg. 422). First, we see that purchasing receives *authorization* to *execute* and *record* the purchase. The open purchase order (i.e., flow 2c) *authorizes* receiving to accept the goods. Receiving *executes* the receipts and, along with the warehouse, has *custody* of the goods. The controller/general ledger *records* the increase in inventory.

## Organizational Setting and Possible Goal Conflicts

The chief purchasing executive in an organization assumes various titles such as manager of purchasing, director of purchasing, or purchasing agent. We use the term *purchasing manager*. The purchasing manager usually performs major buying activities as

**FIGURE 12.1** An Internal Perspective of the Purchasing Process

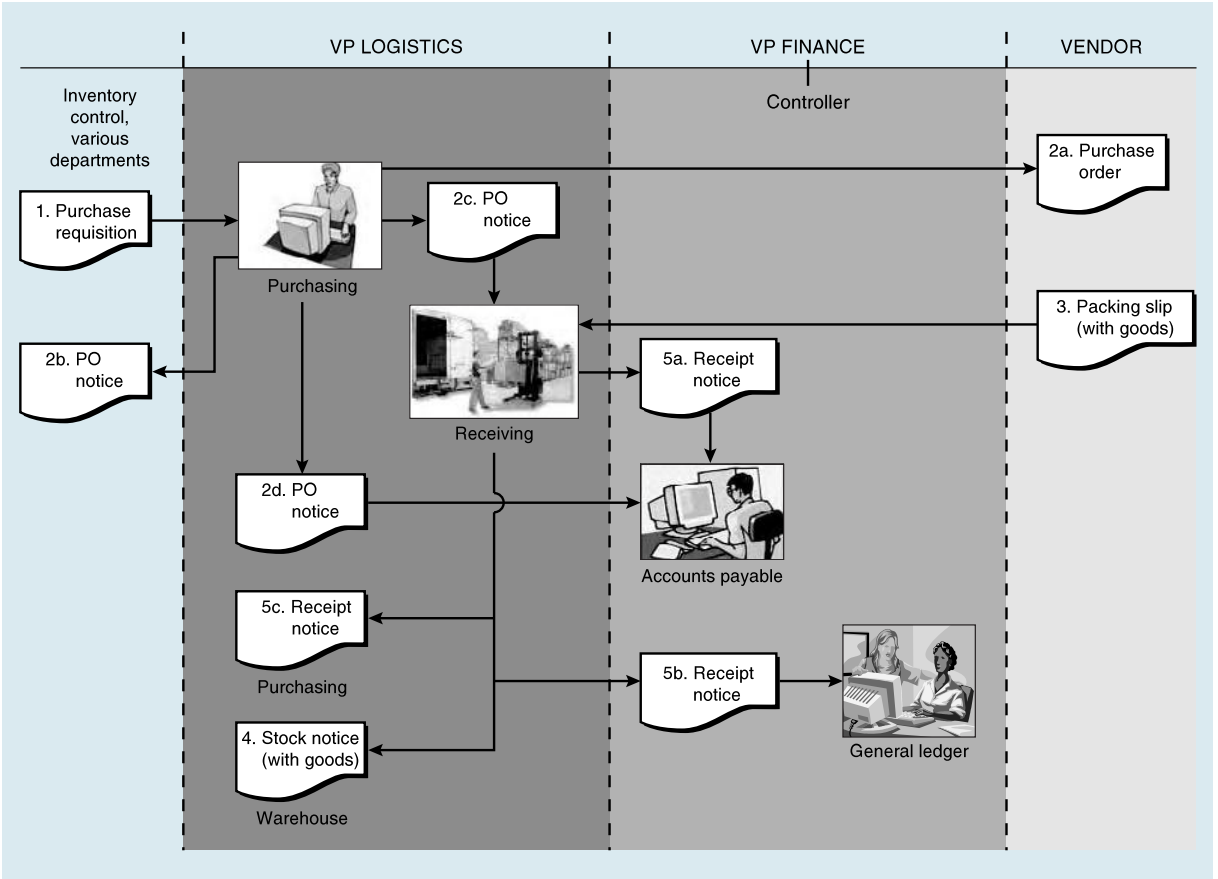



**TABLE 12.1** Description of Information Flows

| Flow No. | Description |
|---|---|
| 1 | Purchase requisition sent from inventory control (or various departments) to purchasing |
| 2 | Purchase order sent to vendor (2a), inventory control (or various departments) (2b), receiving (2c), and accounts payable (2d) |
| 3 | Packing slip (with goods) received from vendor |
| 4 | Stock notice (with goods) sent to warehouse |
| 5 | Notice of receipt sent to accounts payable (5a), general ledger (5b), and purchasing (5c) |

well as the required administrative duties of running a department. In many organizations, professional *buyers* do the actual buying. The *receiving supervisor* is responsible for receiving incoming goods, signing the *bill of lading* presented by the carrier or the supplier in connection with the shipment, reporting the receipt of goods,[2] and making prompt transfer of goods to the appropriate warehouse or department.

2 In this section and the section describing the logical purchasing process, we assume that the receiving supervisor also is responsible for indicating that services have been received. In practice, the receipt of services might well be reported by various operating departments that have received the service.

The goals of individual managers in this setting may conflict with (i.e., are not in *congruence* with) overall organizational objectives. For instance, some of the managers and supervisors shown in the organization chart (Figure 12.1 might be "marching to different drummers." For example, the purchasing manager probably will want to buy in large quantities to take advantage of quantity discounts and to reduce ordering costs. Receiving, inspecting, and storing large quantities of inventory, however, will more than likely present problems for the receiving department supervisor and the warehouse manager.

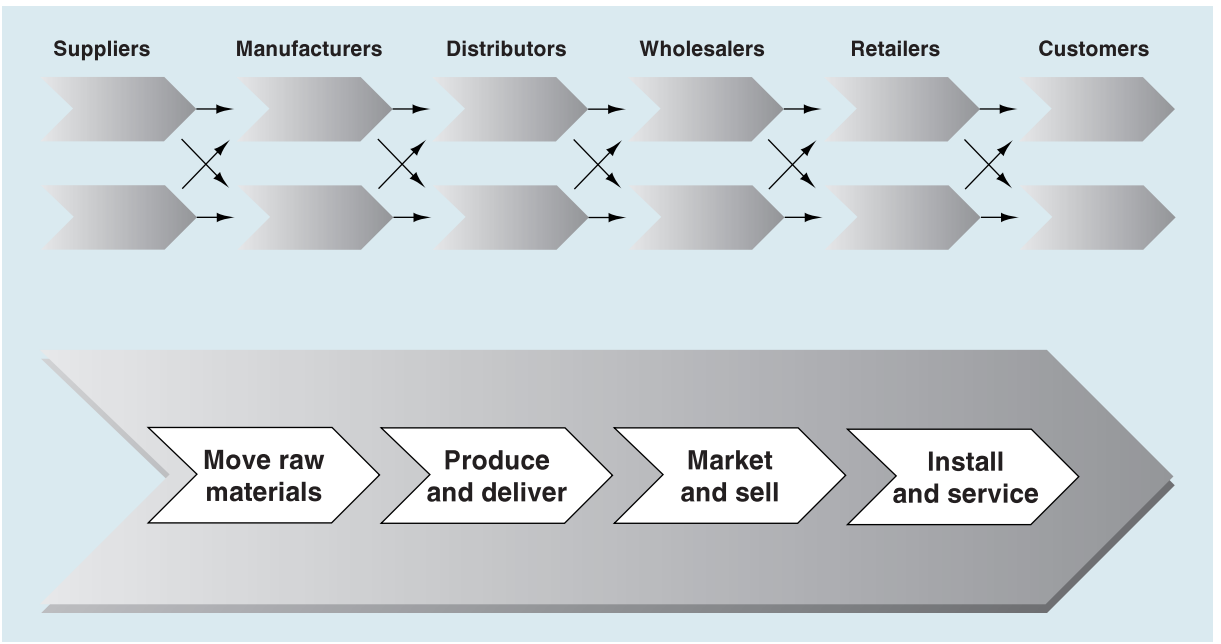
In addition to goal conflicts between managers, ambiguity often exists in defining goals and success in meeting goals. For instance, one of the purchasing goals might be *to select a vendor who will provide the best quality at the lowest price by the promised delivery date.* But what does this goal mean precisely? Does it mean that a particular vendor must satisfy all three conditions of best quality, lowest price, and timely delivery? Realistically, one vendor probably will not satisfy all three conditions.

Prioritization of goals is often necessary in choosing the *best* solution given the various conflicts and constraints placed on the process. This implies that trade-offs must be made in prioritizing among the goals that conflict. For example, if a company operates in an industry that is extremely sensitive to satisfying customer needs, it may be willing to incur an excessive price to ensure that it is procuring the best quality goods and obtaining them when needed.

## An External Perspective

Figure 12.2 presents an external view of the relationship between the purchasing process and its environment. The connections between an organization, including the flow of information, materials, and services, from suppliers of merchandise and raw materials through to the organization's customers, are its **supply chain**. We depict the supply chain as a value system (see Figure 2.2 on pg. 42 of Chapter 2) because each player in the

**FIGURE 12.2** An External Perspective of the Purchasing Process: The Organization's Supply Chain (A Value System)



## Technology Summary 12.1

### SUPPLY-CHAIN OPERATIONS REFERENCE-MODEL (SCOR)

The SCOR-model is a process reference tool that allows companies to benchmark their supply chain processes and to identify how to make improvements in the processes and relationships that it has with partners, suppliers, and customers. The model defines five basic components for supply chain management:

1. *Plan:* Measure customer demand for a product or service and develop a course of action to source, produce, deliver, and, if necessary, return the product or service.
2. *Source:* Select supply sources and procure the goods and services to meet the planned or actual demand, receive product, and authorize payments to suppliers.
3. *Make:* Transform a product to a finished state to meet planned or actual demand.
4. *Deliver:* This is the order fulfillment step. Receive customer orders, provide goods or services to customers, and invoice customers.
5. *Return:* Perform post-delivery customer support and receive defective or excess products back from customers.

**Source:** *Supply-Chain Operations Reference-Model: SCOR Version 8.0*, Supply Chain Council, Inc., http://www.supply-chain.org, 2006.

supply chain is performing a set of activities to transform inputs into outputs valued by its customers (i.e., a *value chain*). As discussed in Chapter 2, the value chain within an organization is facilitated by its *enterprise system*. And, you should notice that the links between the organizations in the supply chain are normally global, *e-business* connections.

In our discussion here, we will assume the role of the retailer in Figure 12.2 and not consider the manufacturer. In Chapter 14, we will discuss the role of the manufacturing process in the supply chain. For now, assume we are a retailer, such as Wal-Mart, Target®, or Staples®, and we need to manage the links in our supply chain so that we can get the right goods on our shelves, in the right amount, at the right time, and at minimal cost (i.e., *efficiency*) to create maximum value for our customers (i.e., *effectiveness*). How we do that is discussed next.

## Supply Chain Management

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**Supply chain management (SCM)** is the combination of processes and procedures used to ensure the delivery of goods and services to customers at the lowest cost while providing the highest value to the customers. As previously noted, the goal of SCM is to increase product availability while reducing inventory across the supply chain. To do this, supply chain partners must coordinate the flow of information and physical goods among members of the supply chain. Technology Summary 12.1 describes a model for SCM developed by the Supply-Chain Council and adopted by more than 500 companies worldwide.[3]

**Supply chain management software** helps an organization execute the steps in the supply chain. Software products are available to perform individual functions within each of the five steps in *SCM* (i.e., steps in Technology Summary 12.1) and products are available to perform complete steps or several of the steps. The products can be divided

3 "Companies Worldwide Turn to Supply-Chain Council's SCOR-model for Efficient Supply Chain Management," *Supply-Chain Newsletter*, http://www.supply-chain.org, June 2003.

into two categories. The first, *supply chain planning* software accumulates data about orders from retail customers, sales from retail outlets, and data about manufacturing and delivery capability of assisting in planning for each of the SCM steps. The most valuable, and problematic, of these products is demand planning software used to determine how much product is needed to satisfy customer demand.

The second category of supply chain software, *supply chain execution* software, automates the *SCM* steps. ERP software is assigned to this category as it receives customer orders, routes orders to an appropriate warehouse, and executes the invoice for the sale. As previously noted, many of the connections between players in the supply chain are B2B automated interfaces. For example, the sourcing step may be implemented through an automatic order sent to a supplier via the Internet or *EDI*.

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At the beginning of this chapter, we briefly described the advantages that P&G and Wal-Mart achieved by managing their supply chain. In general, management of the supply chain leads to some or all of the following benefits:

- Lower costs to the customer
- Higher availability of the product (for the customer, for production, etc.)
- Higher availability leading to lower backorder costs
- Higher response to customer request for product customization and other specifications
- Reduced inventories along the supply chain
- Improved relationships between buyers and sellers
- Smooth workloads due to planned goods arrivals and departures, leading to reduced overtime costs
- Reduced item costs as a result of planned purchases through contracts and other arrangements
- Increased customer orders due to improved customer responsiveness
- Reduced product defects through specifying quality during planning and sharing defect information with suppliers during execution

Are all SCM initiatives successful? No. Here are some things that can go wrong and, in some cases, how to avoid those problems:

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- Data is not collected or is not shared across functional boundaries. For example:
  - Up-to-date real-time sales data must be fed to the SCM demand forecasting system. An *enterprise system* and Internet (i.e., B2B) connection typically facilitate this process.

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  - Supply chain performance is not fed back to the planning system. Again, an enterprise system can relay purchasing, receiving, transportation, and other logistics data.
  - Data such as customer, location, warranty, and service contracts, needed for post-customer support is not available. This data must be collected during sales processing and made available to the appropriate functions.
- Data starts at retailers and must be shared across the supply chain, but confused lines of responsibility and lack of trust can lead to a lack of information sharing between supply chain partners. These issues must be worked out in the SCM planning phase.
- Inaccurate data within the supply chain can negatively affect the entire chain. Implementation of the controls, such as those introduced in Chapters 8 and 9 and discussed throughout the business process chapters, should reduce this problem.

- Over reliance on demand forecasting software can lead to inaccurate forecasts. Good demand forecasting requires an intelligent combination of software tools and human experience.
- Competing objectives can lead to unrealistic forecasts. For example, marketing may want a high target to ensure a successful product (i.e., promotion and production budgets will be based on the forecast). Sales, on the other hand, will be evaluated on its ability to meet sales quotas and wants a lower demand forecast. Deference to the modeling tools and to objective arbitration should reduce this conflict.

Several methods have been developed for managing the supply chain and implementing the SCOR-model described in Technology Summary 12.1 (pg. 424). Technology Summary 12.2 describes an evolution of those techniques, and Technology Summary 12.3 (pg. 428) details the most recent, CPFR.

How does the supply chain operate without using some of the techniques described in Technology Summary 12.2? Not well. Here are some things that can happen:

- An organization in the chain can relay a false demand signal. For example, a retailer could misread retail demand and double its normal order. Assume further that the wholesaler in response doubles its normal order (now four times the retail order) and so on up the chain to the manufacturer and its supplier. The multiplication of these orders up the supply chain can cause wild demand and supply fluctuations known as the **bullwhip effect**.
- Any member of the supply chain can increase its orders for reasons other than an expected increase in demand. For example, a wholesaler might plan a promotion, a retailer might order extra product one month to take advantage of a sales price, or a distributor could increase its order in anticipation of rationing, hoping to lower the reduction that it will receive from its supplier.
- A sales forecast—what a retailer will sell and when they will sell it—is not easily converted into a demand forecast, which is what the retailer will order from its supplier and when. One problem is that the calculations can be staggering. For example, Payless ShoeSource® Worldwide, Inc. must forecast sales and demand for more than 4,600 stores and 2,000 unique brands of footwear in 13 sizes acquired from 200 factories in 7 countries. Payless uses *supply chain management software* such as i2®'s Merchandise Planner software to crunch the 22 billion variables that are involved.[4]

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- Global supply chains, such as those at Payless ShoeSource® Worldwide, can add additional stress to supply chain planning and coordination. For example, NCH Corp., an Irving Texas-based supplier of industrial maintenance products, has 26 sales offices in Europe, each with its own separate, stand-alone system making sales and demand planning, as well as order generation and order fulfillment, time-consuming and expensive. The company's solution is to integrate these systems using ERP modules from Oracle®.[5]

CONTROLS

- Supply chain planning and execution requires that worldwide systems and databases remain available, and the integrity of the data maintained, at all locations at all times. Controls, such as *business continuity planning*, *continuous data protection (CDP)*, and *hot sites*, are essential for preventing systems failures.

4 Marc L. Songini, "Supply Chains Put to the Test of Global Reach," *Computerworld*, (May 16, 2005), p. 16.

5 Gary H. Anthes, "Blind Spots: Uncovering the Holes in Your Global Supply Chain," *Computerworld*, (February 20, 2006), pp. 38, 40.

## Technology Summary 12.2

### Selected Methods for Information Sharing (Collaboration) in the Supply Chain

| Collaboration Type | Features | Discussion |
|---|---|---|
| Continuous Replenishment (CRP) (also known as Vendor Managed Inventory [VMI] and Supplier Managed Inventory [SMI]). | A vendor (i.e., the seller/supplier) obtains a buyer's current sales, demand, and inventory data in real time and replenishes the buyer's inventory. Sales and demand data may be warehouse withdrawal, production control (for manufacturing), or retail point-of-sale (POS). Data may be sent via EDI or accessed by vendor via a Web interface into the buyer's system (e.g., extranet, actual system) or a hosted hub (e.g., SAP™'s Inventory Collaboration Hub). | CRP was started in 1987 with P&G shipping Pampers to Wal-Mart. Benefits:<br>• Vendor has less uncertainty and can provide a specified level of service with minimum cost (e.g., inventory, production, freight [expediting]).<br>• Buyer has better balance of inventory cost and customer service (e.g., fewer stock-outs/ higher fill rates).<br>• Lower costs are passed on to the partner/customer. |
| Co-Managed Inventory (a form of CRP). | The vendor replenishes standard merchandise, and the buyer manages the replenishment of promotion merchandise. | In 1992, Wal-Mart added retailer-provided sales forecasts to CRP. The buyer manages exceptions. |
| Collaborative Forecasting and Replenishment (CFAR) (was a precursor of CPFR). | Retailer and manufacturer forecast demand and schedule production jointly. | Starting in 1995/1996, Warner-Lambert and Wal-Mart forecasted the demand for Listerine. Introduces sales forecast collaboration. |
| Collaborative Planning Forecasting and Replenishment (CPFR). | Collaborative processes across the supply chain using a set of processes and technology models.<br>Trading partners share plans, forecasts, and other data over the Internet.<br>During planning and execution, partners negotiate resolution to exception such as:<br>• Dramatic change in plans.<br>• Plans do not match.<br>• Forecasts accuracy is out of tolerance.<br>• Overstock and understock conditions. | An initiative of the Voluntary Interindustry Commerce Standards (VICS) Association, 1998.<br>Adds planning (joint business plan) to CFAR. |

As noted in Technology Summaries 12.2 and 12.3, supply chain management solutions can reduce the impact of the *bullwhip effect* and other negative effects of a dysfunctional supply chain by:

- Sharing information such as sales and demand forecasts, sales data, and planned promotions. This allows each member of the supply chain to plan its orders and production.

TECHNOLOGY SUMMARY 12.3

### CPFR PROCESS

#### Strategy & Planning

- *Collaboration Arrangement:* Set the business goals for the relationship, define the scope of the collaboration, and assign roles, responsibilities, checkpoints, and escalation procedures
- *Joint Business Plan:* Identify significant events that affect supply and demand, such as planned promotions, inventory policy changes, store openings/closing, and product introductions.

#### Demand & Supply Management

- *Sales Forecasting:* Project consumer demand at the point of sale.
- *Order Planning/forecasting:* Determine future product ordering and delivery requirements based upon the sales forecast, inventory positions, transit lead times, and other factors.

#### Execution

- *Order Generation:* Transition forecasts into firm demands.
- *Order Fulfillment:* Produce, ship, deliver, and stock products for consumer purchase.

#### Analysis

- *Exception Management:* Monitor planning operations for out-of-bound conditions.
- *Performance Assessment:* Calculate key metrics to evaluate the achievement of business goals, uncover trends, or develop alternative strategies

**Source:** Collaborative Planning, Forecasting and Replenishment (CPFR®): An Overview, 18 May 2004, http://www.cpfr.org, accessed August 2006.

- Coordinating pricing, transportation, and product ownership.
- Obtaining operational efficiencies by reducing ordering and carrying costs.
- Using technologies such as *Bar Codes*, *RFID*, and *Global Positioning Systems (GPS)* to track the location of products in production, in warehouses, and in transit, worldwide.

Technology Application 12.1 describes some successful supply-chain collaborations.

## Logical Process Description

This section expands on the purchasing process. Once again, logical DFDs are used to present the basic composition of a typical process. We also discuss the relationship between certain goals of the process and the process's logical design. The section includes brief discussions of the interfaces between the purchasing and inventory processes. We also describe and illustrate the process's major data stores.[6]

### Discussion and Illustration

Figure 12.3 (pg. 430) is the context diagram for our purchasing process. Notice that the process responds to requests for goods and services (i.e., purchase requisitions) received from the inventory process and from various departments and sends a

6 As we have in several earlier chapters, we remind you once again that the data stores in the logical DFDs might well be the purchasing process's view of an *enterprise database*.

TECHNOLOGY APPLICATION 12.1

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## SUPPLY CHAIN COLLABORATION SUCCESS STORIES

### Case 1

Diageo North America, part of London-based Diageo plc, manufacturer of Guinness, Johnnie Walker, Bailey's, and Captain Morgan, implemented *enterprise* software from SAP®, *supply chain management software* from Manugistics, and a CPFR program with its distributors starting in 2003. Weekly data from sales, on-hand inventory, and distributors' receipts with promotional information are combined to generate detailed forecasts that are sent automatically to distributors. Diageo and its distributors then collaborate on the forecast that is loaded into a replenishment system to establish inventory levels and sales. When fully rolled out to all 120 distributors, Diageo expects to save $1.1 million in inventory costs and $600,000 in logistics costs, and increase sales by 1.1 percent or $3.3 million. Distributors also should cut inventory costs. The project has freed the sales force from inventory and order-management duties and allowed them more time to sell, improved customer satisfaction by providing distributors with collaboration processes, and improved product availability and freshness.

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### Case 2

Over the years, United Parcel Services™ Inc. (UPS™) has expanded from its delivery business into providing logistics for a variety of clients to help them solve their supply chain problems. UPS will schedule planes, trains, and ships, own and manage distribution centers and warehouses, and make the final delivery in its fleet of brown trucks. For example, UPS designed and deployed a tracking system for the delivery of 4 million cars from the Ford Motor Co.'s 19 North American plants to 6,500 dealers. UPS cut the time of delivery to the dealers by 40 percent to 10 days. UPS also moves the shoes from Germany to retailers in the U.S. for Birkenstock Footprint Sandals®, Inc. cutting the delivery time in half to 3 weeks.

### Case 3

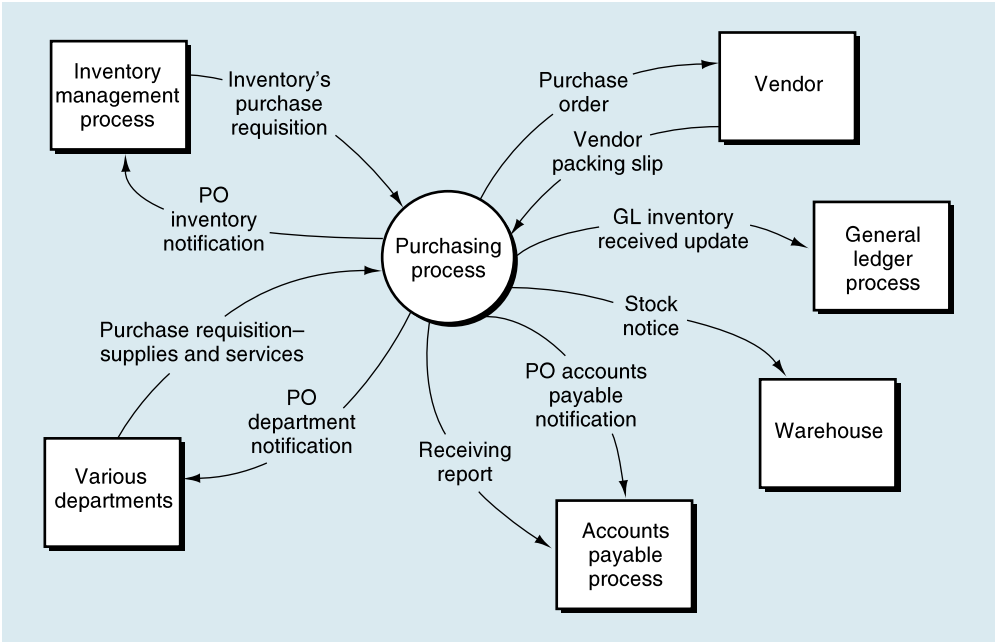
VF Corp., the $6 billion a year company that owns the Lee®, North Face®, and Wrangler® brands, uses a variety of *middleware* tools to link its worldwide systems. For example, VF uses i2's Master Data Management application to consolidate information about global manufacturing and supply chain operations. The system takes data from mainframe, ERP, and other systems, such as forecasting applications. Another application, e-SPS from New Generation Computing, tracks and traces orders over the Web. Using this application, suppliers and manufacturers can confirm that orders were received and give status reports on actual production. Using VF-designed middleware, e-SPS exchanges data with the i2 *supply chain management software*.

**Sources:** Brian Albright, "Diageo Toasts CPFR," *Frontline Solutions* (January 2004); pp. 32–35; Dean Foust, "Big Brown's New Bag," *BusinessWeek*, (July 19, 2004), pp. 54–56; Marc L. Songini, "Global Strain," *Computerworld* (July 18, 2005), pp. 21–22.

purchase order to the vendor and various notices to other departments and processes. Vendors respond by sending goods and services (i.e., vendor packing slip), which results in additional notices being sent out. As depicted, we do not see supply chain techniques such as *Vendor Managed Inventory* (*VMI*, see Technology Summary 12.2 [pg. 427]) by which the vendor would receive inventory and sales data and respond with automatic shipments.

Figure 12.4 (pg. 431) reflects the level 0 data flow diagram for our purchasing process. Take some time to study the figure. To focus our discussion, we have assumed that the purchasing process performs three major processes, represented by the three bubbles in the DFD. The next three sections describe each of those bubbles.

**FIGURE 12.3** Purchasing Process—Context Diagram




## Determine Requirements

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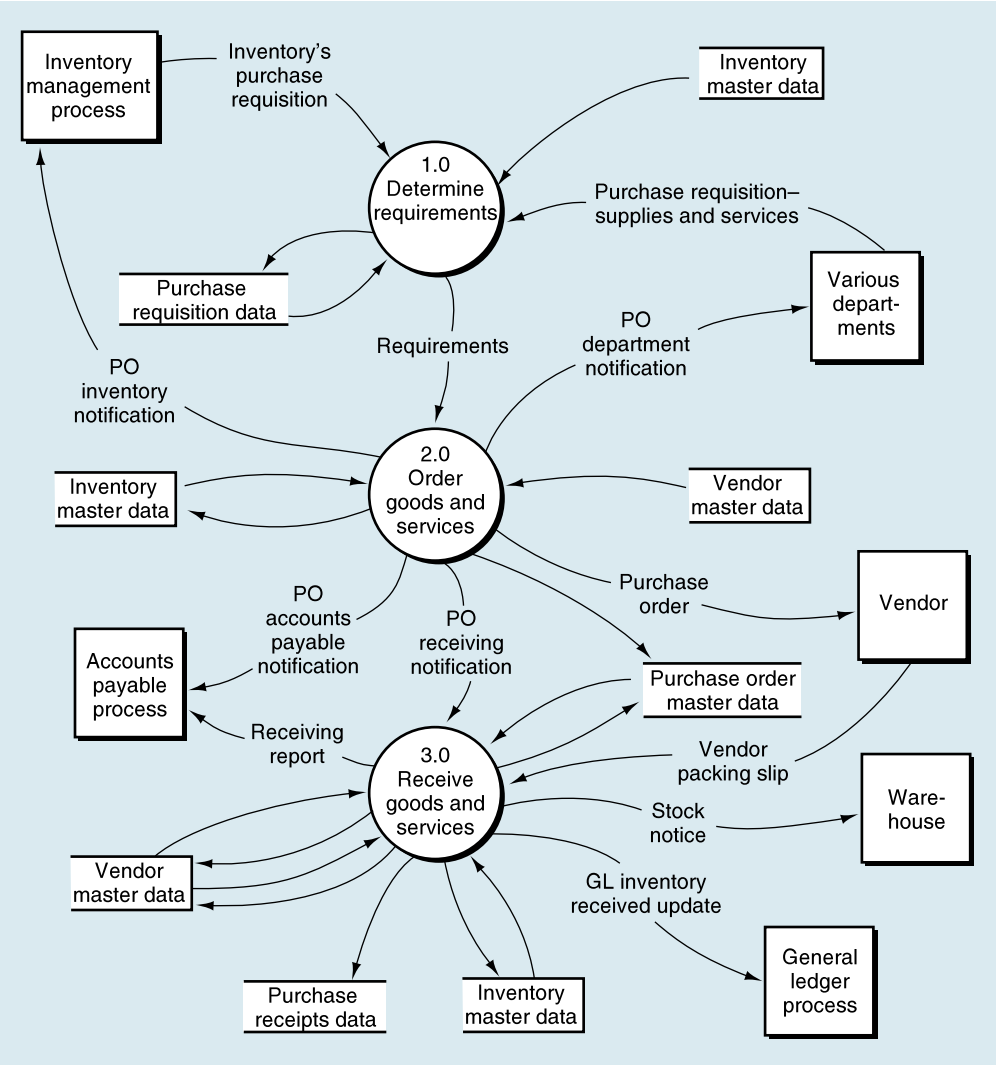
The purchasing process begins with each department identifying its need for goods and services. These needs are depicted by one of two data flows entering bubble 1.0: *inventory's purchase requisition* or *purchase requisition—supplies and services*. Figure 12.5 (pg. 432) is an example screen for a **purchase requisition**, which is an internal request to acquire goods and services from authorized personnel within an organization and for inventory replenishment from automated inventory replenishment systems, such as *supply chain-management* processes. Take some time to examine the figure, observing the various items included in the requisition such as the material and quantity requested, required delivery date, and location (plant) to which the items are to be shipped. Should the requester have a suggested or preferred vendor, that would be indicated in the section at the bottom of the screen. The requisition is usually routed by *workflow* for approval by the requisitioning department supervisor.

Figure 12.6 (pg. 432) is a lower-level view of bubble 1.0 in Figure 12.4. At first glance, the processes involved in determining an organization's requirements for goods and services may appear to be quite simple and straightforward. However, the earlier section about *supply chain management* should make it clear that the techniques and methods involved in determining *what* inventory to order, *when* to order it, and *how much* to order are considerably more intricate and complex than we might first imagine. Many of these determinations are out of our view because they occur in the inventory-management process.

The processes associated with reordering inventory involve several important concepts and techniques, such as reorder point analysis, economic order quantity

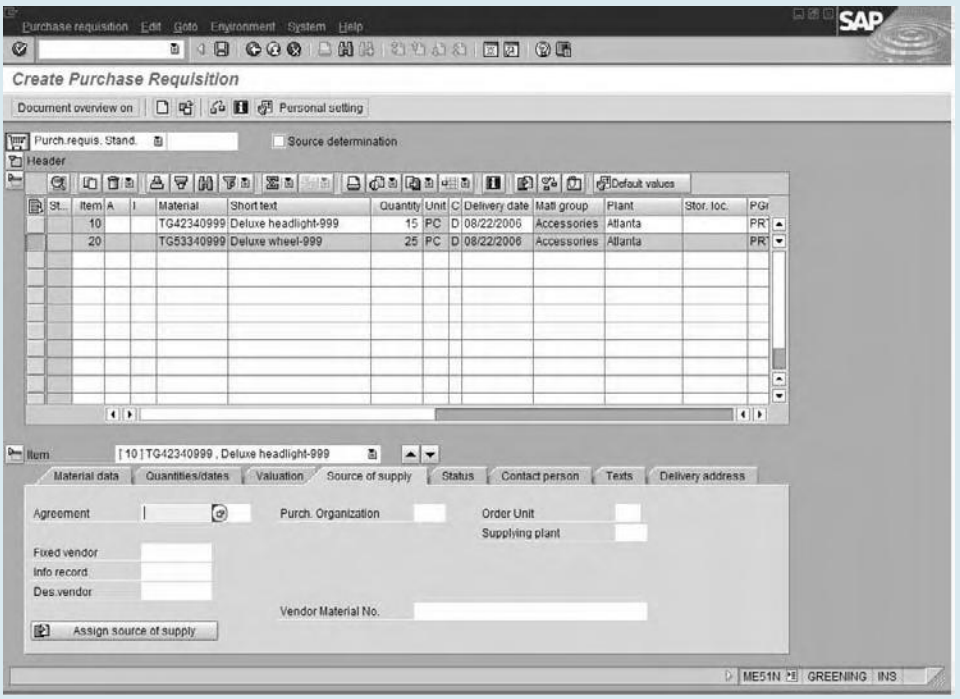
**FIGURE 12.4** Purchasing Process—Level 0 Diagram




(EOQ) analysis, and ABC analysis. We discuss each of these methods briefly before going on:

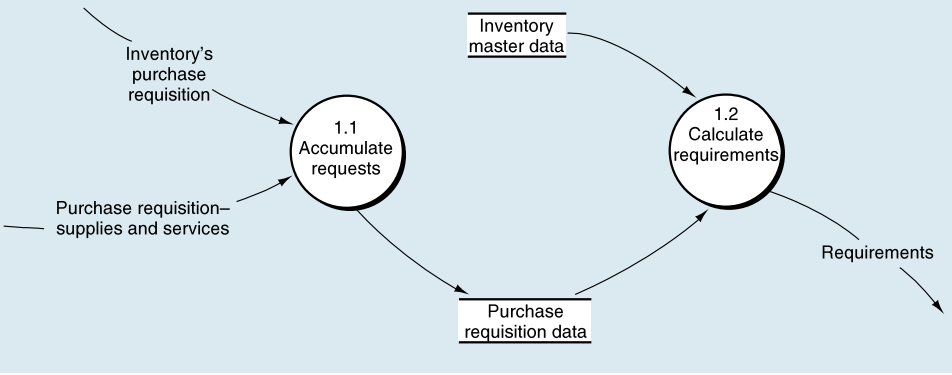
- **Reorder point (ROP) analysis** recognizes that each item of inventory is unique with respect to the rate at which it is sold. Based on each inventory item's sales rate, a reorder point is determined. Thus, when the on-hand level for an item falls to its specified reorder point, the item is reordered. The flow "inventory's purchase requisition" might originate from such an analysis in the inventory-management process. Alternatively, the on-hand level for items might be sent to a vendor managing the inventory (i.e., *VMI*), and the vendor might respond by shipping inventory without a request being made.
- **Economic order quantity (EOQ)** is a technique of analyzing all incremental costs associated with acquiring and carrying particular items of inventory. *Inventory carrying costs* are composed of five cost elements: (1) opportunity cost of investment funds, (2) insurance costs, (3) property taxes, (4) storage costs, and (5) cost

**FIGURE 12.5** Sample Purchase Requisition Screen (SAP®)




**Source:** Reprinted with permission from SAP. Copyright SAP® AG.

**FIGURE 12.6** Purchasing Process—Diagram 1




of obsolescence and deterioration. The EOQ might be used in bubble 1.2 in Figure 12.6 to adjust the quantities received from the inventory-management process to determine how much inventory to order.

- **ABC analysis** is a technique for ranking items in a group based on the output of the items. ABC analysis can be used to categorize inventory items according to their importance. A given organization, for example, may have a situation where 15 percent of its inventory items accounts for 70 percent of its sales. Let's call this portion group A. Furthermore, an organization may find that an additional 10 percent of its inventory items accounts for an additional 20 percent of its sales.

Let's call this portion group B. From this assessment, we can now deduce that the remaining 75 percent of the organization's inventory items constitutes only 10 percent of its sales. With this information, the supervisor of inventory control can decide which items of inventory are relatively more important to an organization and, consequently, require more attention and control. For instance, category C items might be ordered only when there is a specific request from a customer (i.e., no stock is kept on hand), whereas categories A and B might be ordered using *reorder point analysis*.

Now let's describe the process depicted in Figure 12.6. Bubble 1.1 receives and stores the requests received from the inventory-management process (inventory's purchase requisition) and various departments (purchase requisition—goods and services). In this way, an organization can consolidate requests, submit larger orders to vendors, and presumably receive concessions in price and payment terms for these larger purchases. Obviously, this benefit must be traded off with the costs associated with delaying a purchase and suffering the consequences of not having inventory available when needed.

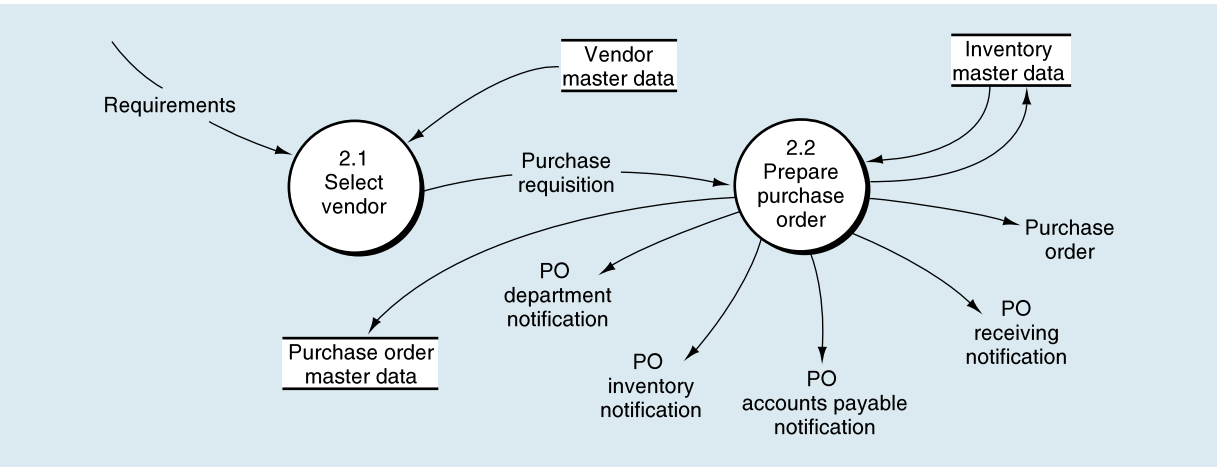
At predetermined intervals, bubble 1.2 accesses the accumulated requests held in the purchase requisition data, sorts the requests, perhaps by vendor or product type, and combines that data with the inventory master data to determine what purchases need to be made. For example, data about sales forecasts and scheduled promotions stored in the inventory master data might give bubble 1.2 the latitude to adjust requested amounts that have come from the inventory-management process or the various departments.

## Order Goods and Services

E-BUSINESS

Figure 12.7, a lower-level view of bubble 2.0 in Figure 12.4 (pg. 431), provides a look at the logical functions involved in ordering goods and services. The first process involves vendor selection (bubble 2.1). A buyer generally consults the vendor master data to identify potential suppliers that have been approved for use by the organization and then evaluates each prospective vendor for a particular purchase. The requestor may have indicated a preferred vendor, and the buyer would need to determine the appropriateness of this choice. Finally, there may not be a preferred or approved vendor for this purchase, in which case, the buyer will need to conduct research to find one. Perhaps an *intelligent agent* will be employed to scan the Web for vendors. *Web services* and *B2B marketplaces* may be used.

**FIGURE 12.7** Purchasing Process—Diagram 2



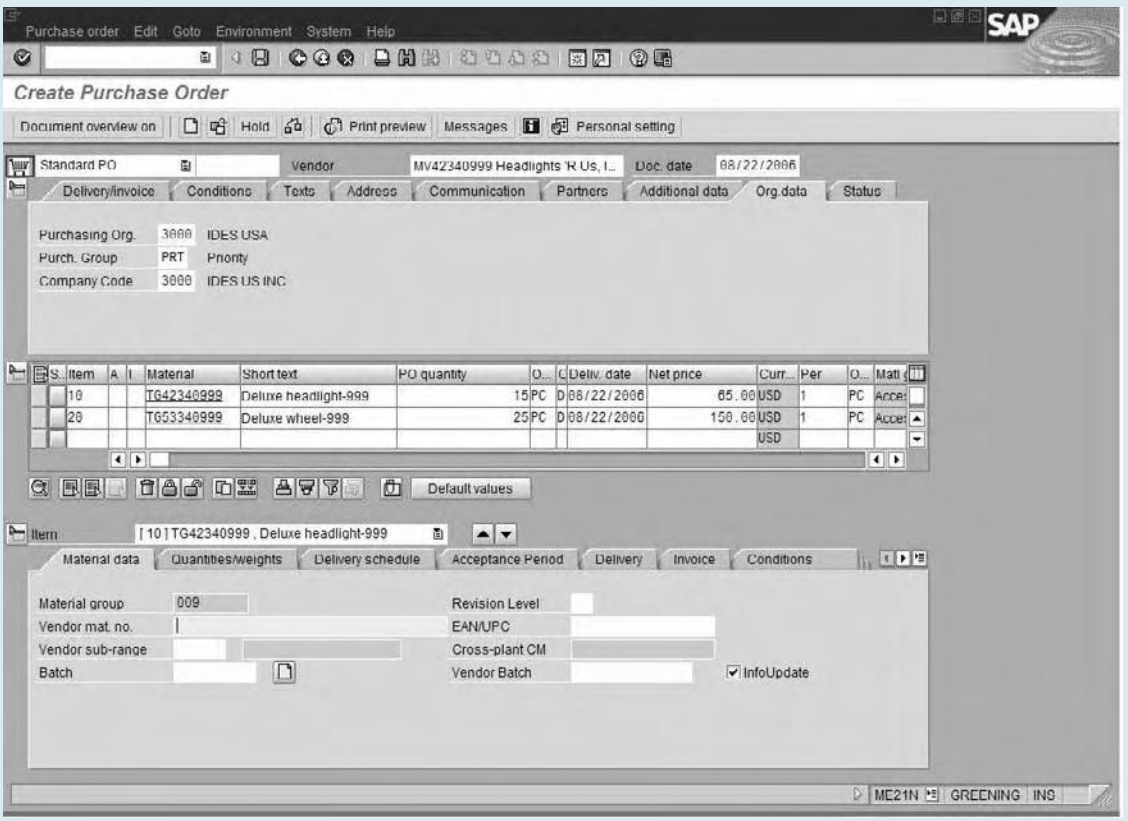
Buyers often attempt to combine as many orders as possible with the same vendor by using *blanket orders* and/or *annual agreements* (SAP calls these "outline agreements"). In such cases, the vendor has been chosen in advance of a particular purchase, and the only determination is the quantity to order at this time. If large expenditures for new or specially made parts are involved, the buyer may need to obtain *competitive bids* by sending a *request for quotation (RFQ)* to prospective vendors. Finally, an organization's merchandising function may have determined that certain brands, such as printers from Hewlett-Packard and Brother®, or computers from Apple® and Lenovo™, would be carried in the stores. In this case, as with annual agreements, the only determination to be made is the quantity of each model to be purchased at this time.

Vendor selection can have a significant impact on the success of an organization's inventory control and manufacturing functions. In Chapter 15, we describe manufacturing processes and just-in-time (JIT) inventory management. With JIT inventory management, parts arrive when needed, thus saving the interest costs associated with storing "excess" inventory and reducing the possibility of inventory becoming obsolete. To use JIT systems effectively, organizations must find and retain reliable vendors.

ENTERPRISE SYSTEMS

After the vendor has been selected, the buyer prepares a **purchase order**, which is a request for the purchase of goods or services from a vendor. Typically, a purchase order contains data regarding the needed quantities, expected unit prices, required delivery

**FIGURE 12.8** Sample Purchase Order Screen (SAP®)

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date, terms, and other conditions. Figure 12.8 displays a purchase order for the purchase requisition in Figure 12.5 (pg. 432). Notice that the vendor and price have been added.

Process bubble 2.2 of Figure 12.7 (pg. 433) depicts the process of preparing a purchase order. The "purchase order" data flowing out of process 2.2 is sent to the vendor. At the same time, the inventory master data is updated to reflect the goods on order. A record of the purchase is stored on the purchase order master data, and purchase order information is distributed to several departments and processes as shown by the four other data flows out of process 2.2. All of these flows and updates could be via paper documents or electronic notifications.

CONTROLS

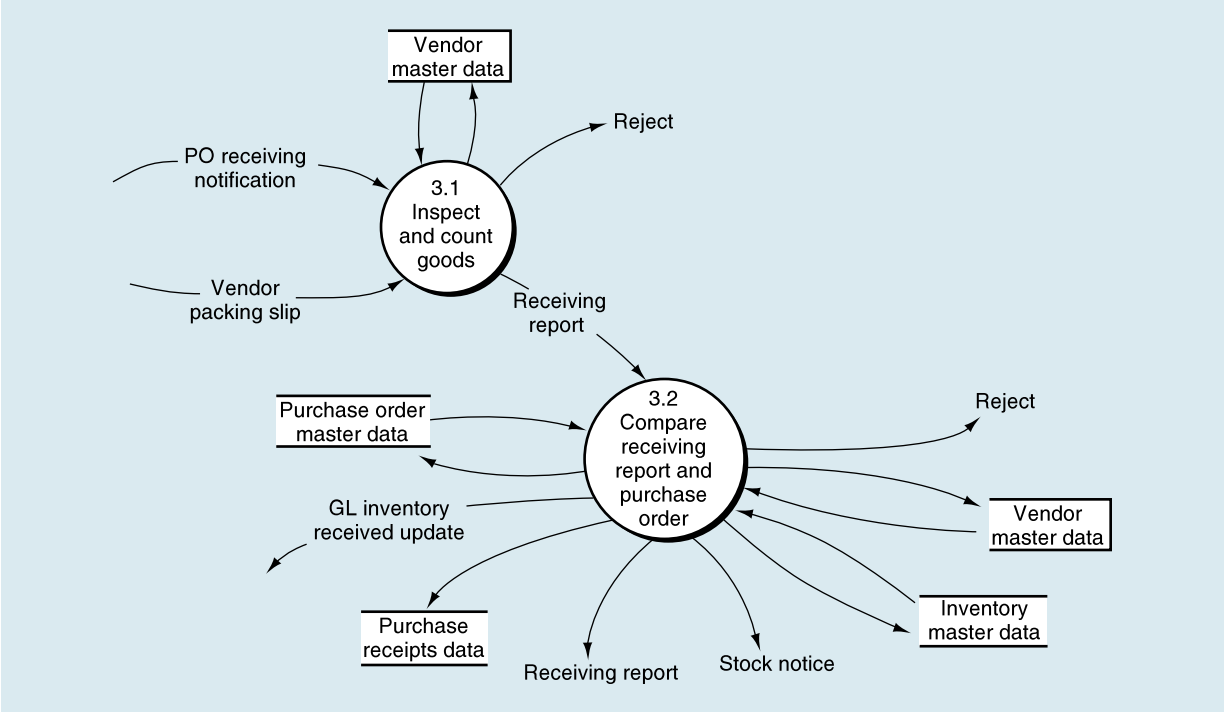
It is not uncommon for the copy of the PO available for the receiving department to be a **blind copy**, meaning that certain data is blanked out (i.e., blinded). For instance, the quantities ordered might be blanked out so that the receiving personnel will not be influenced by this information when counting the goods. Price data may also be blinded because receiving personnel have no need to know that information.

## Receive Goods and Services

CONTROLS

Figure 12.9 is the lower-level diagram for process 3.0 in Figure 12.4 (pg. 431). In the case of inventory, the **vendor packing slip**, which accompanies the purchased inventory from the vendor and identifies the shipment, triggers the receiving process. As indicated by bubble 3.1 of the figure, goods arriving at the receiving department are inspected and counted, and these data are matched against the vendor packing slip and the "PO receiving notification" (i.e., the blind copy of the PO). Nonconforming goods are denoted by the *reject* stub out of process 3.1. Notation of rejected goods is added to the vendor service record in the vendor master data. After the count and condition of the goods has been obtained, process 3.1 completes the receiving report by noting the quantity received. Once annotated with the quantity received, the PO receiving

**FIGURE 12.9** Purchasing Process—Diagram 3



notification becomes a **receiving report**, which is the document used to record merchandise receipts.

Process 3.2 compares the receiving report data to the information stored in the purchase order master data—a process that often is automatically completed by the information system. Bubble 3.2 also reflects the following activities:

- Data about vendor compliance with the order terms (product quality, meeting promised delivery dates, etc., data found on the purchase order master data) is added to the vendor service record on the vendor master data.
- The receiving report data is stored as a copy of the receiving report document or electronically (see the data store "Purchase receipts data").
- Receiving report data is sent to the accounts payable process (i.e., "Receiving report"). Alternatively, the accounts payable process could access the purchase receipts data or the updated purchase order data to obtain receiving report data.
- A copy of the receiving report is sent to the warehouse (i.e., "Stock notice") with the goods.
- The inventory master data are updated to reflect the additional inventory on hand.
- The cost of the inventory received is relayed to the general ledger process (see the data flow "GL inventory received update"). To balance the debit that is made to the general ledger account for inventory, a credit is made to a clearing account. A debit will be made to this clearing account, and the account "cleared" when the invoice is recorded. We will discuss that entry in Chapter 13.
- Finally, the purchase order master data are updated to reflect the receipt of the goods.

As in the case of the receipt of goods, services received also should be documented properly. Some organizations use an **acceptance report** (SAP calls this a "Service entry sheet") to acknowledge formally the satisfactory completion of a service contract. The acceptance report data supports the payment due to the vendor in the same way as the receiving report.[7]

## Logical Data Descriptions

The purchasing process entails several data stores as shown earlier in Figure 12.4 (pg. 431). The *inventory master data* was introduced in Chapter 10. The **vendor master data** contains a record of each vendor that is approved for use by the organization. In addition to storing identification data, such as name, address, telephone numbers, e-mail addresses, bank information, and payment terms and methods, the vendor data is used by management to evaluate vendor performance and to make various ordering decisions.

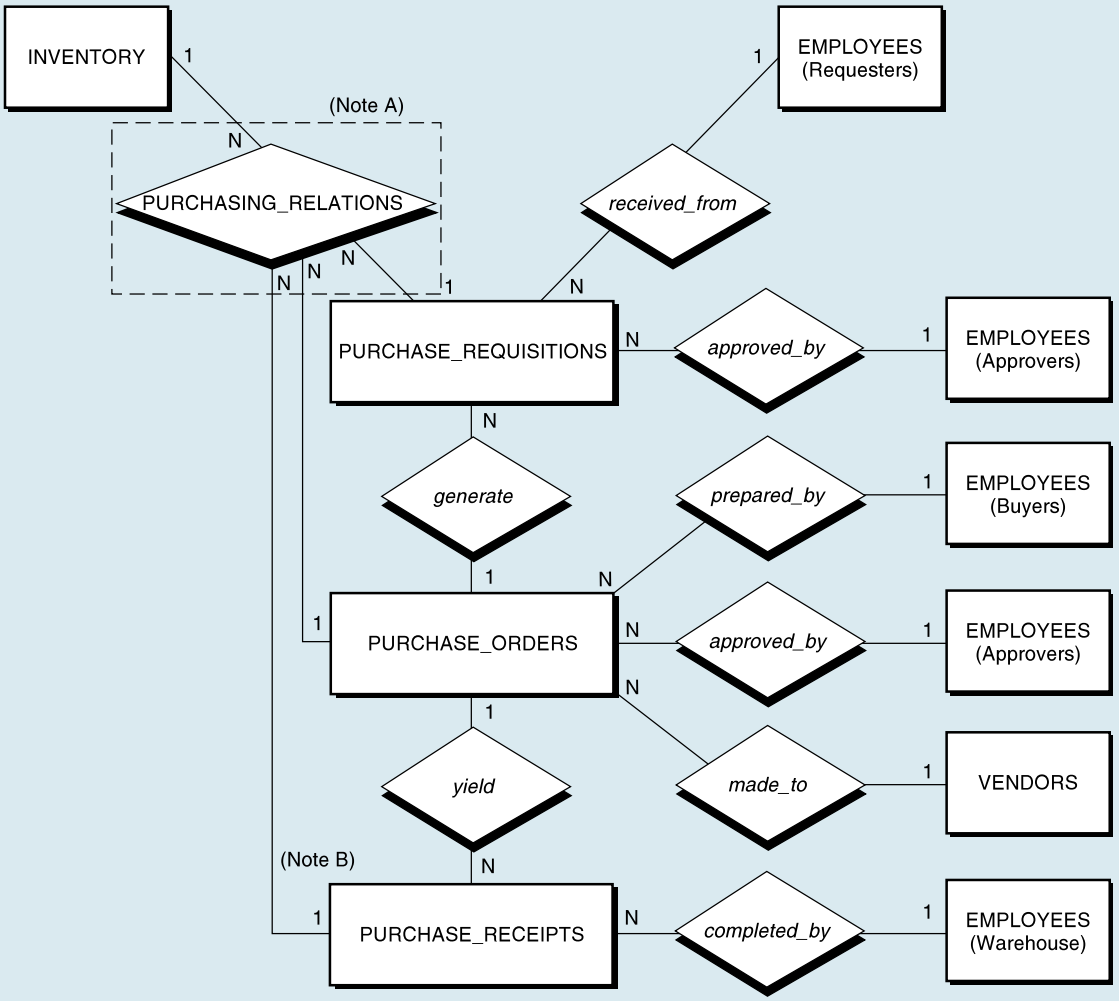
As noted earlier, *purchase requisitions* are internal requests for goods and services. These are compiled in the **purchase requisitions data** store. The **purchase order master data** is a compilation of open purchase orders and includes the status of each item on order. Finally, the **purchase receipts data** is an event data store with each record reflecting a receipt of goods and services.

## Logical Database Design

The entity-relationship diagram applicable to the purchasing process is shown on Figure 12.10. The INVENTORY, VENDORS, PURCHASE_REQUISITIONS, PURCHASE_ORDERS, and PURCHASE_RECEIPTS entities were described in the previous section. The EMPLOYEES entity contains specific information about each employee, including his/her authorization levels regarding generating purchase

7 For simplicity in drawing the DFDs, we intend that the single data flow labeled *receiving report* represents either a receiving report (goods) or acceptance report (services).

**FIGURE 12.10** Entity-Relationship (E-R) Diagram (*Partial*) for the Purchasing Process




NOTES, for simplicity, we assume that:
A—See below for an explanation of the box around PURCHASING_RELATIONS and why the model is not fully normalized.
B—There are no partial receipts of any line item on a PO.

requisitions, preparing purchase orders, receiving goods, and so on. This entity will be discussed more fully in Chapter 14.

The PURCHASING_RELATIONS relationship accumulates a record of purchasing-related events—PURCHASE_REQUISITIONS, PURCHASE_ORDERS, and PURCHASE_RECEIPTS—as they progress. The box around this relationship indicates that we will have a relation in our database for this relationship, whereas the other relationships will not have a corresponding relation.

As with Figure 10.9 (pg. 348) and Figure 11.9 (pg. 392), Figure 12.10 is not fully normalized yet. We include the "extra" relationships and redundant attributes to help you see the logical sequence of events. Also, note B on Figure 12.10 indicates that this is a simplified model. Certainly, realistic models must deal with partial receipts.

**FIGURE 12.11** Selected Relational Tables (*Partial*) for the Purchasing Process

Shaded_Attribute(s) = Primary Key

INVENTORY

| Item_No | Item_Name | Price | Location | Qty_on_Hand | Reorder_Pt |
|---|---|---|---|---|---|
| 936 | Machine Plates | 39.50 | Macomb | 1,500 | 950 |
| 1001 | Gaskets | 9.50 | Macomb | 10,002 | 3,500 |
| 1010 | Crank Shafts | 115.00 | Tampa | 952 | 500 |
| 1025 | Manifolds | 45.00 | Tampa | 402 | 400 |

EMPLOYEES

| Emp_No | Emp_First_Name | Emp_Last_Name | Soc_Sec_No | Emp_Dept |
|---|---|---|---|---|
| B432 | Carl | Mast | 125-87-8090 | 492-01 |
| A491 | Janet | Kopp | 127-93-3453 | 639-04 |
| A632 | Greg | Bazie | 350-97-9030 | 538-22 |
| B011 | Christy | Kinman | 123-78-0097 | 298-12 |

VENDORS

| Vend_No | Vend_Name | Vend_Street | Vend_City | Vend_State | Vend_ZIP | Vend_Tel | Vend_Contact | Credit_Terms | FOB_Terms |
|---|---|---|---|---|---|---|---|---|---|
| 539 | Ace Widget Co. | 190 Shore Dr. | Charleston | SC | 29915 | 803-995-3764 | S. Emerson | 2/10,n/30 | Ship Pt |
| 540 | Babcock Supply Co. | 22 Ribaut Rd. | Beaufort | SC | 29902 | 803-552-4788 | Frank Roy | n/60 | Destin |
| 541 | Webster Steel Corp. | 49 Abercorn St. | Savannah | GA | 30901 | 912-433-1750 | Wilbur Cox | 2/10,n/30 | Ship Pt |

PURCHASE_REQUISITIONS

| PR_No | PR_Date | Emp_No (PR_Requestor)[a] | Emp_No (PR_Approver)[b] | PO_No |
|---|---|---|---|---|
| 53948 | 20071215 | A491 | E745 | 4346 |
| 53949 | 20071215 | C457 | A632 | 4350 |
| 53950 | 20071216 | 9999 | 540-32 | 4347 |
| 53951 | 20071216 | F494 | D548 | 4352 |

PURCHASE_ORDERS

| PO_No | PO_Date | Vend_No | Ship_Via | Emp_No (Buyer) | Emp_No (PO_Approver) | PO_Status |
|---|---|---|---|---|---|---|
| 4345 | 20071218 | 539 | Best Way | F395 | F349 | Open |
| 4346 | 20071220 | 541 | FedEx | C932 | F349 | Sent |
| 4347 | 20071222 | 562 | UPS | E049 | D932 | Acknowledged |

PURCHASE_RECEIPTS

| Rec_No | Rec_Date | Emp_No (Receiving) | PO_No | Invoice_No |
|---|---|---|---|---|
| 42944 | 20071216 | B260 | 4322 | 7-945 |
| 42945 | 20071216 | B260 | 4339 | 9542-4 |
| 42946 | 20071216 | B260 | 4345 | 535 |

PURCHASE_RELATIONS

| PR_No | Item_No | Qty_Requested | PO_No | Qty_Ordered | Rec_No | Qty_Received |
|---|---|---|---|---|---|---|
| 53947 | 1005 | 200 | 4345 | 200 | 42946 | 200 |
| 53947 | 1006 | 50 | 4345 | 50 | 42946 | 50 |
| 53947 | 1015 | 25 | 4345 | 25 | 42946 | 25 |

[a] If automatic purchase requisition, then 9999; if employee, then employee number.
[b] If automatic purchase requisition, then contract number of trading partner; if employee, then employee number.

The relational tables for the purchasing process are shown in Figure 12.11. Notice that each table includes a primary key. In some tables, such as INVENTORY, a single primary key is included. One table, PURCHASE_RELATIONS, has a primary key from the PURCHASE_REQUISITIONS and INVENTORY tables to form a composite (multiple) key. Each relation (row) in this table records the details of each requested item from requisition (the first three columns) to purchase order (the fourth and fifth columns), to receipt (the last two columns).

## Technology Trends and Developments

CONTROLS
E-BUSINESS

You may also recall in Chapter 3 that we discussed the emergence of *Internet auction markets* and *Internet market exchanges* that create a more competitive purchasing market. These markets and exchanges are key elements of **e-procurement**, which is the use of information technology to automate significant portions of the procurement process. E-procurement can improve *supply chain management* by lowering administrative costs associated with procurement by reducing the people and time required for the procurement process. For example, a purchasing organization can use *intelligent agents*, *Web Services*, and *B2B exchanges* to locate vendors and products. Then, the purchase process is completed using *paperless systems*. By reducing manual processes, e-procurement can reduce errors. The use of marketplaces should increase the sources for items and reduce their costs. Electronic purchasing data can be shared across functions and organizations to optimize inventory levels across the supply chain and provide real-time data for supply chain management. Next, we will describe two elements of e-procurement: paperless systems and B2B marketplaces.

ENTERPRISE SYSTEMS

**Paperless systems** eliminate documents and forms as the medium for conducting business. In a truly paperless system, printed reports disappear and are replaced with computer screen displays. With the increasing use of *Web services*, *RFID*, *EDI*, *electronic funds transfer (ETF)*, *digital image processing*, *e-mail*, *workflow software*, *enterprise systems*, and similar technologies, is the "paperless office" at hand? We are certainly close in many contemporary environments. In fact, a growing number of organizations arguably operate the bulk of their business processes using *paperless systems*. The major roadblocks are more organizational and behavioral/psychological than technological in nature. Over time, these cultural barriers to the paperless office continue to disintegrate as a new generation of managers—who have grown up with the computer as a fact of their daily lives—emerges.

Technology Application 12.2 (pg. 440) describes some **B2B marketplaces**, which are particular Web sites or portals that may be used as sources of supply in the procurement process. Recall from Chapter 3, however, that many risks are involved in the move toward electronic marketplaces, and these may limit their success in the short term.

Another technology development that has had a significant effect on *supply chain management* and the purchasing process is Radio-Frequency Identification (RFID) technology described in Technology Summary 12.4 (pg. 441). Technology Application 12.3 (pg. 442) describes some early RFID uses.

## Physical Process Description

The physical model of the purchasing process presented in this section employs much of the technology mentioned previously. Although the process is not completely *paperless*, hard copy documents are held to a minimum.

TECHNOLOGY APPLICATION 12.2

## BUSINESS-TO-BUSINESS (B2B) MARKETPLACES FOR THE PURCHASING PROCESS

### Case 1

E-procurement systems at FedEx®, Corp. have resulted in the online purchasing of more than half of the company's goods. For example, all 120,000 employees can go online to buy, mostly from authorized vendors. Having failed for many years to get their small suppliers to use *EDI*, FedEx® began to use Aeroxchange, Ltd. (http://www.aeroxchange.com), an airline industry exchange, to pay lower prices for airplane parts than if FedEx® purchased directly from suppliers. Aeroxchange can facilitate data messaging between trading partners in a variety of formats, including *EDI*. The site can also be used to manage airline maintenance, repair, and overhaul.

### Case 2

Tejari (http://www.tejari.com) is a B2B marketplace in the Middle East used by companies in the region to buy and sell goods and services online. In addition to finding, comparing, and procuring products and services, buyers can conduct reverse auctions in which sellers bid to supply products and services. Sellers can also list their products and services and sell them through catalogs and auctions.

### Case 3

In July 2006, the U.S. Business Council announced the establishment of a B2B marketplace (http://www.gousbc.com) that will connect 250,000 businesses with select vendors. Vendor participation will be limited to 2 per state from each of 60 business categories. To become a "Preferred Vendor of Choice," a vendor submits a vendor profile and, if selected, pays a fee of $375 for a term of 48 months. Businesses pay a monthly subscription fee of $19.95 to participate in the network.

**Sources:** Matt Hamblen, "After the Hype," *Computerworld* (December 23, 2002): 33–34; http://www.aeroxchange.com; http://www.tejari.com; "US Business Council Establishes New B2B Marketplace," *Telecomworldwire; Coventry* (July 24, 2006): 1; http://www.gousbc.com.

## Discussion and Illustration

Figure 12.12 (pgs. 443–444) presents a systems flowchart of the purchasing process. We assume for this illustration that one or more approved vendors are on the vendor database that can be used for the purchase. At several points in the flowchart, you will see notations that *exception routines* are not flowcharted. They also are omitted from the discussion in the following paragraphs.

### Requisition and Order Merchandise

ENTERPRISE SYSTEMS

As shown in the first column, the purchasing process begins when a cost center employee establishes a need. The *enterprise system* displays a screen similar to the one depicted in Figure 12.5 (pg. 432), and the requisitioner keys in the material number and quantity of the items desired, as well as information about the required delivery date and location (plant) to which the items are to be delivered.

CONTROLS

The completed requisition is recorded and then routed via the *workflow* routine to a cost center supervisor for approval. Depending on the amount and nature of the requisition, several approvals may be required. Approval is granted in the system by forwarding the requisition to the next person on the list; approval codes are attached to the record along the way and are displayed in the appropriate boxes on the requisition form. When all approvals have been obtained, the requisition is updated to indicate final approval and is routed to the purchasing department.

ENTERPRISE SYSTEMS

Periodically (or immediately, depending on priority), the *enterprise system* displays requisitions—including those from various departments, orders from inventory

## Technology Summary 12.4

### RADIO-FREQUENCY IDENTIFICATION TECHNOLOGY (RFID)

**Radio-Frequency Identification (RFID)** is a system for sending and receiving data, using wireless technology, between an RFID tag and an RFID transceiver. RFID tags are computer chips with an antenna that contains information about the object to which it is attached. Active RFID tags store information using a power source within the tag, and passive tags obtain their power from a transceiver. Transceivers transmit, receive, and decode data from RFID tags.

RFID tags can be attached to objects much like *bar codes* have been attached to groceries, FedEx® and UPS parcels, and clothing, just to name a few. However, unlike bar codes, RFID tags identify an instance of an item, not just an item type (i.e., *this* box of Mach3 razors, not *any* box of Mach3 razors). RFID tags can be attached to groups of items, such as pallets of groceries, or to individual items, such as shaving razors or pieces of clothing. To read RFID tags, transceivers do not require line-of-sight or proximity to a tag (a requirement for scanning a bar code) to be able to send and receive data from the tag. A reader can obtain data from chips attached to items packed within boxes as the boxes pass near the reader.

RFID's most useful application to date is to track items through the supply chain. For example, a manufacturer, such as Gillette®, would attach an RFID tag to each razor destined for Wal-Mart. RFID readers at the Gillette shipping dock would record the movement of the razors and send data to Gillette's *enterprise system* to record the shipment/sale. At Wal-Mart's warehouse, an RFID reader would read the chips and record the receipt of the razors. Readers throughout the warehouse and retail stores can keep track of the location of the razors. When the razors are sold, RFID readers will read the data and record the retail sale of each razor, in a manner similar to that used for many years with *scanners*, UPC codes, and point of sale (POS) systems. In fact, an electronic product code (EPC) has been developed for use with RFID technology, much like the UPC is used with bar codes.

Systems similar to the Wal-Mart/Gillette® example are tracking Kimberly-Clark products at Wal-Mart and Target® Corp. RFID can also be used to track in-process inventory (raw materials through finished products), animal identification (embedded in pets so they can be returned to their owners if lost), automobile key and lock antitheft systems, tracking books from libraries and book stores, building access control, airline baggage tracking, and asset and inventory tracking.

Because RFID does not require a line-of-sight between the chip and the reader, and the reading step is passive (e.g., the reader will locate every chip that passes by), this technology can help to reduce theft. At the same time, this feature has caused some privacy concerns because the chips are not necessarily turned off when the item is sold. Left activated, the chip can track the location of the person carrying the item.

Data on the chips can record the manufacturing date, color, and size of an item. Expiration dates, if any, can be stored and relayed to monitoring systems to move product into sales, price reduction, or disposal, as appropriate. At a cost of 20 cents each, it is presently more feasible to tag groups of items. The price is expected to soon reach 5 cents each and probably needs to reach 1 to 2 cents each before the technology can be widely adopted.

Advantages, then, of the RFID technology include increased data accuracy, reduced product theft, quicker retail checkout (or self-service checkout), reduced stockouts, more timely deliveries, and better customer service.

**Sources:** Harold E. Davis and Michael S. Leuhlfing, "Radio Frequency Identification: The Wave of the Future," *Journal of Accountancy* (November 2004): 43–49; Beth Serepca and Bob Moody, "Radio Frequency Identification: What Does It Mean for Auditors?," *Information Systems Control Journal* (Volume IV, 2005): 33–35.

control, and requests based on forecast data—on the screen of the appropriate buyer. The system also displays a list of approved vendors who can provide the required items. The buyer compares vendors for quality, price, terms, delivery date, and so on, and then selects a vendor. Final vendor selection and price determination may require contact with the potential vendor. When the vendor choice is settled, the buyer

TECHNOLOGY APPLICATION 12.3

## USES OF RADIO-FREQUENCY IDENTIFICATION (RFID) FOR THE PURCHASING PROCESS

### Case 1

RFID tags are attached to parts and supplies as they are received at the loading docks of AM General LLC's manufacturing plant in Mishawaka, Indiana. Data from the tags are read as the items move around the facility. Employees can track a customer order vehicle, check to see that items are where they are supposed to be, and check that actions on the customer order are carried out as required. The wireless technology has reduced the labor intervention that is required for bar codes and has improved inventory management. Hummer® reports that it earned back its investment in nine months.

### Case 2

Bosch Tool Corp. sells tools with embedded RFID tags and asset-tracking software to help businesses protect tools from theft. Bosch calls the system Safe & Sound™. Customers who opt for it pay a little more for their tools but reduce the possibility that tools will be lost or stolen at work sites. Estimated job-site equipment theft costs the construction industry between $300 million and $1 billion annually. The EPC on each tool is used to create an asset-tracking record with photograph, specifications, and description of the tool that can be used to track the tool and job sites equipped with RFID readers.

### Case 3

DHL International GmbH reports that by 2015, they will affix an RFID tag to every package that it ships. The goal is to gain tighter control of shipments, cut costs, and improve operating performance by reducing paperwork and data collection. For example, RFID tags can direct U.S. Customs officials to information contained within shipping company databases that is needed for customs declarations. DHL also plans to have RFID tags send alerts via e-mail or mobile phones to alert managers if a package is misrouted.

### Case 4

Many of you may be using RFID and not know it. RFID is the technology behind ExxonMobil's Speedpass™ used for gas purchases and E-ZPass™ used for paying highway tolls. In each case, the consumer carries the RFID chip (in the Speedpass™ fob or in the windshield-mounted E-ZPass™) that is read at the gas pump or at the toll booth. The individual (and car or truck) is then charged for the gas or toll.

**Source:** Samuel Greengard, "The New Frontier in Supply Chain management" *Business Finance* (Vol. 10, Iss. 9, September 2004): 55; Laurie Sullivan, "RFID Helps Stop Power Tools From 'Walking Off' Job Sites," *InformationWeek* (June 13, 2005); Laurie Sullivan, "DHL Plans RFID Tags for Every Package it Ships," *InformationWeek* (June 10, 2005).

converts the requisition to a purchase order and adds any necessary details, such as vendor, price, and terms.

E-BUSINESS

Next, the system routes the purchase order via *workflow* to the purchasing manager for approval. The manager approves and releases the purchase order. The system

CONTROLS

records the approval, updates the inventory master data to reflect the quantity on order, and confirms the order to the requisitioner. The purchasing process releases the PO to the EDI translator where it is converted to the appropriate EDI format. The translation software also *encrypts* the EDI message and appends a *digital signature* to it.

### Receive Merchandise

ENTERPRISE SYSTEMS

On the second page of the flowchart, we see that the receiving department personnel receive the merchandise sent by the vendor. They enter the purchase order number into the system, and an *RFID* reader reads the item numbers and quantities from the RFID chips attached to each item in the shipment. The *enterprise system* compares the items and quantities received to those on the open purchase order master data.[8] If the

8 The database controls prevent receiving personnel from accessing quantity and price data in the purchase order master data. In this way, the process implements the *blind copy* concept explained earlier.

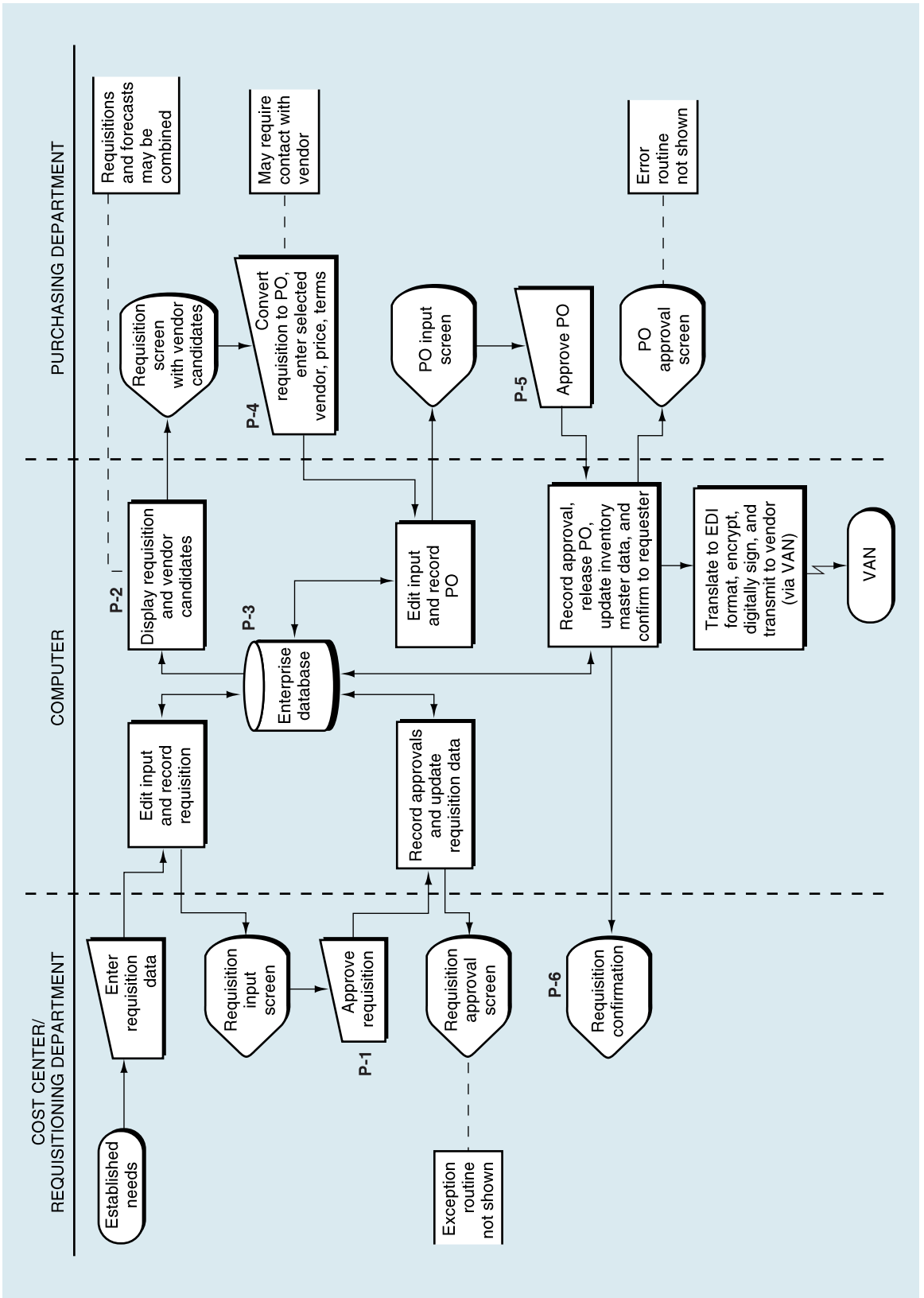



**FIGURE 12.12** Purchasing Process—Systems Flowchart

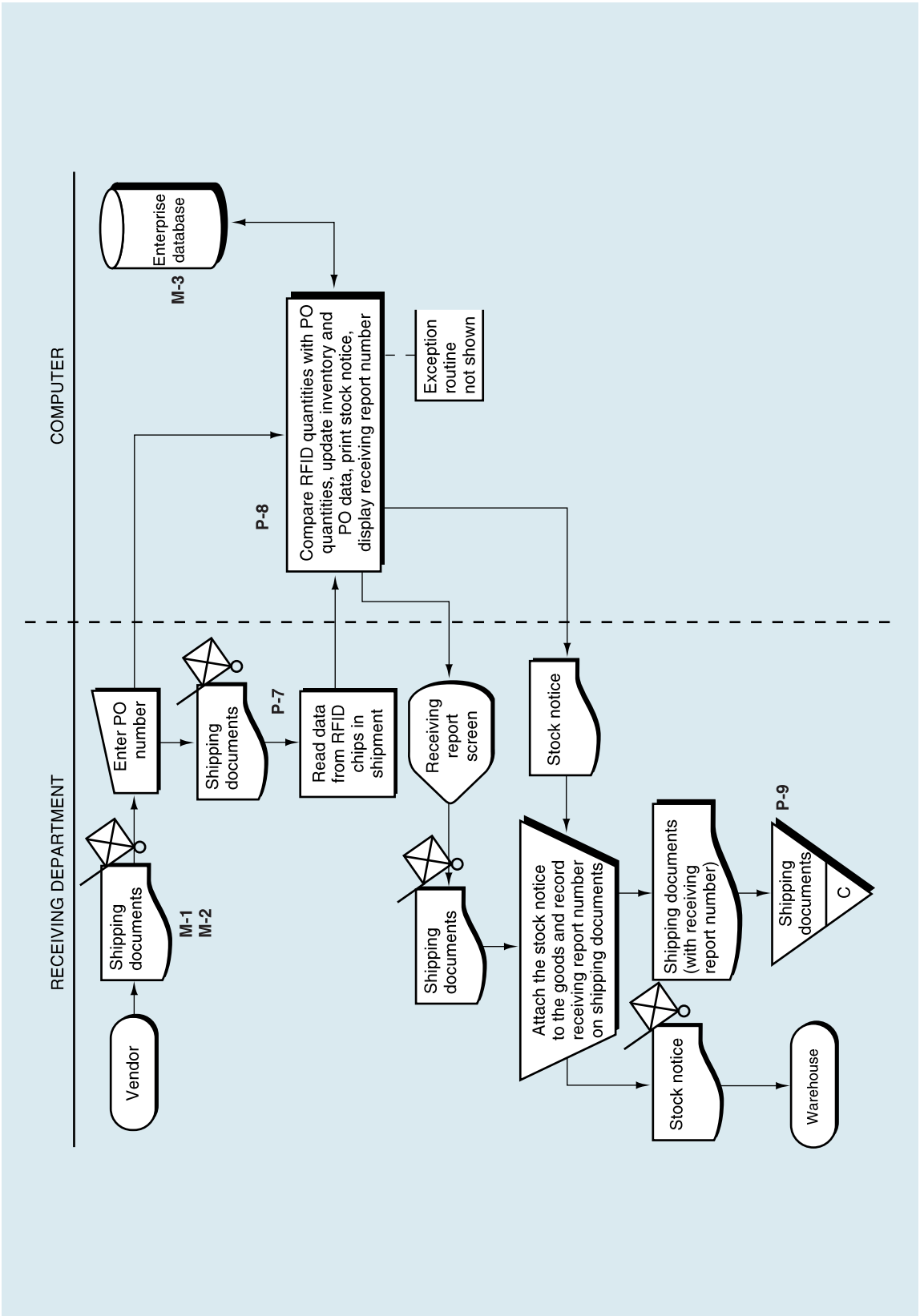



**FIGURE 12.12** Purchasing Process—Systems Flowchart *(continued)*

shipment is correct, the system accepts the shipment, creates a record in the purchase receipts data, updates the status field in the purchase order data to indicate that the items have been received, updates for the quantity received in the inventory master data, updates the general ledger to reflect the receipt, prints a stock notice, and displays the receiving report number. (Vendor performance data, such as timeliness and accuracy of the receipt, could also be recorded at this time.) The receiving clerk attaches the stock notice to the goods and sends them to the warehouse. The clerk also records the receiving report number on the shipping documents and files them in chronological sequence for *audit trail* purposes. Alternatively, a *digital image* of the shipping documents might be stored on the computer.

## The Fraud Connection

Because the *purchase-to-pay process* begins with the purchasing process and culminates with the payment of cash—a firm's most liquid asset—it should not surprise you that this process is rife with potential for exposing an organization to fraud and embezzlement. Indeed, many of the most serious cases of abuse have involved the manipulation of the purchasing process. In this section, we present some of the ways in which the process has been manipulated.

### Fraud and the Purchasing Function

The typical cases included in this category of process exploitation are instances in which the following scenarios occur:

- An employee (e.g., a buyer, purchasing manager, or other person) places purchase orders with a particular vendor(s) in exchange for a kickback, secret commission, or other form of inducement from the vendor(s).
- An employee has a *conflict of interest* between his responsibilities to his employer and his financial interest—direct or indirect—in a company with whom the employer does business.

As we mentioned in Chapter 7, these kinds of quasi-legal/ethical scenarios are often addressed by an organization as part of a *code of conduct*, which all employees are asked to acknowledge periodically by attesting that they have not engaged in activities that violate the code.

Cases of bribery, kickbacks, and the like present an interesting dilemma. It is accepted business practice for a salesperson to treat a buyer to lunch, to send the buyer promotional "gifts" (e.g., a sleeve of golf balls imprinted with the selling company's logo), or to extend other small favors to make sales. When do such actions stop being "acceptable" and cross the line into being improper, either in substance or appearance? We can't answer that ethical question here except to offer one case example that was clearly fraud. This case involved a company (customer) that made purchases from foreign suppliers. The company's president made it clear to the suppliers that if they wanted to do business with the company, they must agree to pay 2 percent of any business they transacted to the president's personal bank account. In turn, the suppliers inflated their invoices to the company by the amount of the secret commission they paid. To ensure that the higher cost would not be detected by anyone in the purchasing department, the president approved all such invoices for payment.

In purchasing activities, conflicts of interest often arise in situations where an employee with the authority to make (or approve) purchases for an organization has some kind of financial stake in a company that sells to the organization. For instance, the employee might be an owner or principal of the vendor-company, either directly or

through a relative, and therefore stands to benefit by placing business with that vendor. This condition presents one of the knottier control problems confronting business today.

Here is a brief example of a *conflict of interest* fraud:

> Over an 8-year period, Frick (a fictitious name), a director of buying for toys and related products at a major retailer (Wombat, Inc.), placed some $3 million of business with 12 companies operated by Frack. Although Frick signed annual conflict of interest statements, he did not disclose his significant ownership interest in those 12 companies. When other toy suppliers reported to one of Wombat's directors that they had trouble obtaining sales to Wombat, an investigation ensued. It was discovered that Frick had received over $500,000 in cash and benefits from the 12 companies.

# Application of the Control Framework to Purchasing

In this section, we apply the control framework from Chapter 7 to the purchasing process. Figure 12.13 presents a completed *control matrix* for the annotated systems flowchart in Figure 12.12 (pgs. 443–444). Figure 12.12 is annotated to show the location of the control plans keyed to the control matrix.

## Control Goals

The control goal listed across the top of the matrix are similar to those presented in Chapters 7 and 9 through 11 except that they have been tailored to the specifics of the purchasing process.

The *operations process control goals* that are typical of the purchasing process are the following:

- *Effectiveness of operations:* Goals A and B in Figure 12.13 identify *effectiveness goals* that are typical of the purchasing (goal A) and receiving (goal B) processes. In Goal C, we include one for complying with the organization's code of conduct concerning conflicts of interest, accepting illegal or improper payments, and like matters. Recall from Chapter 7 that one of the three categories of control objectives recommended by the COSO report on internal control is compliance with applicable laws, regulations, and contractual agreements. For each process to which it applies, we have elected to include COSO's "compliance" objective under our *effectiveness goals*. As you saw in Chapter 7 and earlier in this chapter in the "Fraud Connection" section, many organizations are addressing some of the thorny ethical issues that they face by adopting a corporate code of conduct, giving that code wide publicity throughout the organization, and having employees subscribe to that code by periodically attesting that they have abided by its provisions. In that sense, then, the code of conduct becomes a type of contractual agreement between the company and its employees.
- *Efficient employment of resources:* As noted in Chapter 9 and reinforced in Chapters 10 and 11, people and computers are the resources found in most business processes.
- *Resource security*: As mentioned in Chapter 9, the resource security column should identify assets that are at risk. The resources of interest here are inventory and the vendor and purchase order master data. Controls should protect the inventory as it is received and sent to the warehouse. Controls should also prevent the unauthorized accessing, copying, changing, selling, or destruction of the vendor and purchasing master data.

The *information process control goals* comprise the second category of control goals in Figure 12.13. The goals are divided into two sections—one section for purchase order inputs (i.e., purchase requisitions) and a second section for vendor packing slip inputs. To focus our discussion, we have not included other process inputs, such as purchase requisition and purchase order approvals. The information process control goals are the following:

- *Input validity (IV): Valid* purchase order inputs (i.e., purchase requisitions) begin with a requisition that is *approved* by the appropriate cost center authorities, and result in purchase orders that are themselves *approved* and issued to an *authorized* vendor. To be added to the vendor master data, a vendor should be investigated for quality of its processes and products. By adding a vendor to the vendor master data, management has provided *authorization* to do business with that vendor. *Valid* vendor packing slip inputs are supported by an approved purchase order and an *actual* receipt of goods. Failure to achieve these goals may result in overstocking inventory and, if the inventory cannot be used, an overstatement of the inventory asset.
- *Input completeness (IC)* of purchase requisitions: Failure to achieve this goal may result in lost customer sales or suspension of production operations due to lack of inventory.
- *Input completeness (IC)* of vendor packing slips: Failure to achieve this goal may result in the loss of accountability for the inventory and an understatement of inventory and liabilities.
- *Input accuracy (IA)* of purchase requisitions: Inaccurate purchase requisition processing may cause the wrong goods or wrong quantities to be purchased (or ordered for the wrong plant, etc.). As with invalid or incomplete inputs, this may cause overstocking or disruption of the sales or manufacturing operations.
- *Input accuracy (IA)* of vendor packing slips: Inaccurate vendor packing slip inputs may cause a lack of accountability and a misstatement of inventory. Also, if we overstate the receipt and rely on the inventory data for replenishment decisions, we may not be aware when reordering is needed.
- *Update completeness (UC) and update accuracy (UA)* of the purchase order and inventory master data:[9] The purchase order and inventory master data are updated to reflect that a purchase has been made and then that the goods have been received (and that the purchase order has been filled). Failure to update correctly when the purchase order has been issued may result in duplicate orders and an inability to follow up on open orders. Failure to update when the goods are received may result in unauthorized receipts and inaccurate inventory records.

## Recommended Control Plans

Recall that application control plans include both those that are characteristic of a particular AIS business process and those that relate to the technology used to implement the application. We introduce you here to those new plans that are particular to the purchasing business process. We first define and explain these controls and then summarize, in Exhibit 12.1, (pgs. 450–451) each cell entry in Figure 12.13, the control matrix:

- **Approve purchase requisition** (see Exhibit 12.1 and Figure 12.13, P-1): An authorized individual, or several individuals, such as cost center or department

9 These update goals will not apply in this analysis because the updates are simultaneous with the inputs, and the input controls will address any update completeness and update accuracy issues.

**FIGURE 12.13** Control Matrix for the Purchasing Process

| | Control Goals of the Purchasing Business Process | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control Goals of the Operations Process | | | | | Control Goals of the Information Process | | | | | | | | | |
| Recommended control plans | Ensure effectiveness of operations: | | | Ensure efficient employment of resources (people, computers) | Ensure security of resources (inventory, and vendor and purchase order master data) | For purchase order inputs (i.e., requisitions), ensure: | | | For purchase order and inventory master data, ensure: | | For vendor packing slip inputs, ensure: | | | For purchase order and inventory master data, ensure: | |
| | A | B | C | | | IV | IC | IA | UC | UA | IV | IC | IA | UC | UA |
| **Present Controls** | | | | | | | | | | | | | | | |
| P-1: Approve purchase requisition | | | | | | P-1 | | | | | | | | | |
| P-2: Use authorized vendor data | P-2 | | P-2 | P-2 | | P-2 | | | | | | | | | |
| P-3: Independent vendor master data maintenance | P-3 | | P-3 | | P-3 | P-3 | | | | | | | | | |
| P-4: Compare vendors for favorable price, terms, quality, and product availability | P-4 | | | | | | | | | | | | | | |
| P-5: Approve purchase order | P-5 | | P-5 | | | P-5 | | | | | | | | | |
| P-6: Confirm purchase order to requesting department | | | | | | | P-6 | | | | | | | | |
| P-7: Automated data entry | | | | P-7 | P-7 | | | | | | P-7 | | P-7 | | |

**FIGURE 12.13** Control Matrix for the Purchasing Process (*continued*)

| | Control Goals of the Purchasing Business Process | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control Goals of the Operations Process | | | | | Control Goals of the Information Process | | | | | | | | | |
| Recommended control plans | Ensure effectiveness of operations: | | | Ensure efficient employment of resources (people, computers) | Ensure security of resources (inventory, and vendor and purchase order master data) | For purchase order inputs (i.e., requisitions), ensure: | | | For purchase order and inventory master data, ensure: | | For vendor packing slip inputs, ensure: | | | For purchase order and inventory master data, ensure: | |
| | A | B | C | | | IV | IC | IA | UC | UA | IV | IC | IA | UC | UA |
| P-8: Independent authorization to record receipt | | P-8 | | | | | | | | | P-8 | | P-8 | | |
| P-9: Create audit trail for receipts | | P-9 | | | P-9 | | | | | | P-9 | | P-9 | | |
| **Missing Controls** | | | | | | | | | | | | | | | |
| M-1: Count goods and compare to vendor packing slip | | M-1 | | M-1 | M-1 | | | | | | | | M-1 | | |
| M-2: Inspect goods | | M-2 | | | M-2 | | | | | | M-2 | | M-2 | | |
| M-3: Monitor open purchase orders | | M-3 | | | | | | | | | | M-3 | | | |

Possible effectiveness goals include the following:

A—Select a vendor who will provide the best quality at the lowest price by the required delivery date

B—Ensure that the right goods in the correct amount are received in acceptable condition in a timely manner

C—Comply with the corporate code of conduct

**See Exhibit 12.1 (pgs. 450–451) for a complete explanation of control plans and cell entries.**

IV = input validity

IC = input completeness

IA = input accuracy

UC = update completeness

UA = update accuracy

management, should approve purchase requisitions to ensure that the purchase is within an applicable budget and that the purchase is desirable.

- **Use authorized vendor data** (see Exhibit 12.1 and Figure 12.13, P-2): Vendors should be vetted to determine their suitability to provide the organization with goods and services. The screening process might include vendor financial viability and performance record. The vendor data would include payment terms, address, and bank account.
- **Independent vendor master data maintenance** (see Exhibit 12.1 and Figure 12.13, P-3): Assumes that there is a separation of duties between the personnel who create vendor records (to authorize purchases and payments) and those that create and approve purchase orders, record accounts payable, and approve payments. Without this separation, a buyer could execute a purchase with a vendor with which there is some arrangement (e.g., kickback) or conflict of interest (e.g., ownership). Also, without this separation, accounts payable personnel could create a vendor account to facilitate the creation of an invalid/fraudulent invoice that would subsequently be paid, perhaps to an address or bank account that they created on the vendor record. One-time accounts might be created by accounts payable for one-time payments.
- **Compare vendors for favorable prices, terms, quality, and product availability** (see Exhibit 12.1 and Figure 12.13, P-4): Before executing a purchase, prospective vendors should be compared to determine that they are the optimal choice for the purchase.
- **Approve purchase order** (see Exhibit 12.1 and Figure 12.13, P-5): Before being issued, the appropriate personnel should approve purchase orders to ensure that an appropriate supplier has been selected and that the correct goods and services, for the correct amounts, are being purchased. Failure of this control will lead to financial loss if the goods are not needed and cannot be returned.
- **Confirm purchase order to requesting department** (see Exhibit 12.1 and Figure 12.13, P-6): To prevent duplicate purchase requests and to allow the requesting department to ensure that a purchase order is created, the requesting department should be informed when a purchase order has been issued in response to a purchase requisition.
- **Independent authorization to record receipt** (see Exhibit 12.1 and Figure 12.13, P-8): Before a receipt can be accepted and recorded, the receipt data should be compared with the purchase order master data to determine that an approved purchase order is on file and that the correct goods have been received. Receipts that are not authorized may be paid for and not be needed.
- **Inspect goods** (see Exhibit 12.1 and Figure 12.13, M-2): To ensure that the correct goods are received in acceptable condition.

Each of the recommended control plans listed in the matrix in Figure 12.13 (pgs. 448–449) is discussed in Exhibit 12.1 (pgs. 451–452). We have intentionally limited the number of plans to avoid redundancy. For example, we do not include several plans from Chapter 9 such as *preformatted screens*, *online prompting*, *programmed edits* (e.g., a reasonableness test on the purchase quantity), *procedures for rejected inputs*, *confirm input acceptance*, *digital signature*, and *populate inputs with master data*. We could also include *enter receipts data in receiving*. Study the explanations of the cell entries appearing in the control matrix in Exhibit 12.1. As you know from your studies in prior chapters, understanding how the recommended control plans relate to specific control goals is the most important aspect of applying the control framework.

**EXHIBIT 12.1** Explanation of Cell Entries for the Control Matrix in Figure 12.13

**P-1:** *Approve purchase requisition.*

- *Purchase requisition input validity:* By obtaining approvals for all purchase requisitions, we reduce the possibility that invalid (unauthorized) requisitions will be input.

**P-2:** *Use authorized vendor data.*

- *Effectiveness goal A:* Buyers in the purchasing department are presented with a list of vendor candidates that have been approved by management. The screening of vendors that preceded their being added to the authorized data should help ensure the *selection of a vendor that will provide the best quality at the lowest price by the promised delivery date.*
- *Effectiveness goal C:* Screening of vendors helps to ensure that company employees do not have financial interests in a vendor that would jeopardize their ability to be impartial in selecting a vendor with whom to place an order.
- *Efficient employment of resources:* People resources (buyers' time) are used efficiently because time is not wasted in searching for vendors that might not even supply the required goods or services.
- *Purchase requisition input validity:* The *blanket* approval accorded to vendors who are placed on the authorized vendor data also helps ensure the validity of the purchase orders issued.

**P-3:** *Independent vendor master data maintenance.*
Note: We are assuming that this is a present control.

- *Effectiveness goals A and C, security of resources:* By having someone other than the buyers add vendors to the vendor master, data we can obtain independent support for the quality of their products and processes (goal A), ensure that there will be no conflict of interest for the buyer (goal C), and ensure the integrity of the vendor master data (security of resources).
- *Purchase requisition input validity:* Valid purchase requisitions are those that result in purchase orders to vendors that have received prior *authorization.*

**P-4:** *Compare vendors for favorable prices, terms, quality, and product availability.*

- *Effectiveness goal A:* The comparison of vendors should help ensure the selection of a vendor who will provide the best quality at the lowest price by the promised delivery date.

**P-5:** *Approve purchase order.*

- *Effectiveness goal A:* After the purchase order is checked against the requisition details, it is approved by the purchasing manager—by adding an approval code to the purchase order record. The manager's approval includes the vendor chosen by the buyer and the items and quantities purchased.
- *Effectiveness goal C:* This control plan could flag situations in which certain vendors appear to be favored in the vendor-selection process.
- *Purchase requisition input validity:* Approval by the purchasing manager helps to ensure validity of the purchase order.

**P-6:** *Confirm purchase order to requesting department.*

- *Purchase requisition input completeness:* After the purchase order has been released by the purchasing manager, a confirmation of the requisition is sent to the requesting department. Should the confirmation not be received in a timely manner, the requester will follow up to see that the request is processed.

**P-7:** *Automated data entry.*

- *Efficiency employment of resources:* By reducing the amount of data that must be keyed into the system, we improve the speed and productivity of the receiving personnel.
- *Security of resources:* The accurate and valid recording of the receipt data will ensure that there is accountability for the goods, reducing the possibility that they will be lost or stolen.
- *Vendor packing slip input validity* and *input accuracy:* By reading RFID tags to record the receipt, we ensure that the goods are actually there (validity) and we reduce the possibility of input errors that might occur from key entering the items and quantities received.

**EXHIBIT 12.1** Explanation of Cell Entries for the Control Matrix in Figure 12.13 (*continued*)

**P-8:** *Independent authorization to record receipt.*

- *Effectiveness goal B, vendor packing slip input validity:* By comparing the open purchase order to the data on the RFID tags, we can ensure that we have received the goods that were ordered.
- *Vendor packing slip input accuracy:* The comparison identifies erroneous or suspect data and reduces input errors.

**P-9:** *Create audit trail for receipts.*

- *Effectiveness goal B, security of resources, vendor packing slip input validity:* The audit trail may be examined to ensure that the correct goods have been received, recorded, and sent to the warehouse.
- *Vendor packing slip input accuracy:* The audit trail may be examined to ensure that the receipts were accurately recorded.

**M-1:** *Count goods and compare to vendor packing slip.*

- *Effectiveness goal B, security of resources, packing slip input accuracy:* By comparing the goods received to the packing slip that indicates what the vendor shipped, we ensure that we have received the correct goods, that there will be accountability for the goods, and that the packing slip will be input correctly.
- *Efficient employment of resources:* By detecting early in the process that the count of the goods received does not agree with the goods shipped by the vendor, we can correct errors more easily, and in less time, than would be possible later in process (e.g., in the warehouse).

**M-2:** *Inspect goods.*

- *Effectiveness goal B:* By inspecting the goods received, we ensure that we have received the correct goods in acceptable condition.
- *Security of resources, packing slip input validity, packing slip input accuracy:* The inspection ensures that what was actually received will be recorded (validity), that there will be accountability for the actual goods received (security), and that the packing slip will be input correctly (accuracy).

**M-3:** *Monitor open purchase orders.*

- *Effectiveness goal B, packing slip input completeness:* By regularly reviewing open purchase orders, an organization could ensure that goods are received and packing slips input in a timely manner.

## Summary

This chapter has covered the purchasing process, which is the backbone of the *purchase-to-pay process* introduced in Chapter 2. Like the OE/S process in the *order-to-cash process*, the purchasing component of the purchase-to-pay process fills a central coordinating role as it supports the supplies and inventory components of an organization's operations.

The physical process implementation presented in this chapter evidences many attributes of the paperless office of the future. Are these visions of a paperless society that far-fetched? Hardly. The technology exists today, and many companies have availed themselves of some, if not all, of that technology.

As we did at the end of Chapters 10 and 11, we include here, in Technology Summary 12.5, a review of the company-level controls (i.e., control environment, pervasive controls, and general/IT general controls) that may have an impact on the effectiveness of the purchasing business process controls.

## Technology Summary 12.5

### CONSIDERING THE EFFECT OF COMPANY-LEVEL CONTROLS ON PURCHASING BUSINESS PROCESS CONTROLS

The effectiveness of purchasing process controls can depend on the operation of several controls described in Chapter 8. In this summary, we examine some of those relationships.

#### Segregation of Duties

Several functions in the purchasing process must be segregated for the business process controls to be effective, including the following:

- Authorization to create vendor records, as well as payment terms, should be assigned to someone other than those completing the purchasing and accounts payable processes. For example, vendor records might be maintained by a separate function within the purchasing or accounts payable departments.
- The receiving process assumes that there has been an authorized purchase order. This presumes the segregation between purchasing and receiving functions.
- A warehouse function, separate from receiving, can count the goods sent to the warehouse, compare that to the stock notice, and thus ensure that receipts are valid and accurate.

#### Additional Manual Controls

There are several manual, pervasive, and general controls that can affect the performance of the business process controls:

- The inspection and counting of goods upon receipt are important controls that must be performed well. Perhaps, for example, the count of two receiving clerks might be compared before that count is input.
- We might consider *rotation of duties* for buyers (e.g., change the types of products that they buy) to reduce the possibility that they are in collusion with assigned vendors.
- As noted in Technology Summary 9.1 (pg. 303), the performance of these manual controls depends on the quality of the people performing the control activities. Therefore, we expect controls such as *selection and hiring, training and education, job descriptions*, and *supervision* to be in place.

#### Automated Controls

All of the purchasing controls performed by the computer depend on the general controls (also known as IT general controls or ITGCs) in Chapter 8. Those controls include *approve purchase requisitions, use authorized vendor data, approve purchase orders,* and *independent authorization to record receipt* (e.g., compare input packing slip to purchase orders). We need to know that the programs will perform the controls as designed (e.g., *program change controls*). Also, we need to know that the stored data used by the computer when executing these controls is valid and accurate (e.g., physical and logical access controls). For the purchasing process, we are particularly concerned, for example, with controlled access to the following:

- Vendor master records so that one cannot be added without authorization.
- Purchase order master data so that bogus purchase orders cannot be created to record an unauthorized receipt.

## Key Terms

purchasing process
supply chain
supply chain management (SCM)
bullwhip effect
supply chain management software
purchase requisition
reorder point (ROP) analysis
economic order quantity (EOQ)
ABC analysis
purchase order
blind copy
vendor packing slip
receiving report
acceptance report
vendor master data
purchase requisitions data
purchase order master data
purchase receipts data
B2B marketplaces
Radio-Frequency Identification (RFID)
paperless systems
approve purchase requisition
use authorized vendor data
independent vendor master data maintenance
compare vendors for favorable prices, terms, quality, and product availability
approve purchase orders
confirm purchase order to requesting department
independent authorization to record receipt
inspect goods

## Review Questions

RQ 12-1 What is the purchasing process?

RQ 12-2 What primary functions does the purchasing process perform? Explain each function.

RQ 12-3 With what internal and external entities does the purchasing process interact?

RQ 12-4 What are the fundamental responsibilities of each position: purchasing manager, buyer, and receiving supervisor?

RQ 12-5 Describe supply chain management.

RQ 12-6 Describe the five basic components of the Supply Chain Operations Reference (SCOR) Model.

RQ 12-7 How does supply chain management software support supply chain management?

RQ 12-8 Describe Vendor Managed Inventory (VMI), Co-Managed inventory, Collaborative Forecasting and Replenishment (CFAR), and Collaborative Planning Forecasting and Replenishment (CPFR).

RQ 12-9 What is the bullwhip effect?

RQ 12-10 What three major *logical* processes does the purchasing process perform? Describe each process.

RQ 12-11 Describe how Radio-Frequency Identification (RFID) works.

RQ 12-12 What types of frauds are typically found in the purchasing process?

RQ 12-13 What are the typical effectiveness goals of the purchasing process? Provide an example illustrating each goal.

RQ 12-14 What characterizes a valid purchase order input? What characterizes a valid vendor packing slip input?

RQ 12-15 What are the key control plans associated with the purchasing process? Describe how each works and what it accomplishes.

RQ 12-16 Describe the impact that company level controls (i.e., control environment, pervasive controls, and general/IT general controls) can have on the effectiveness of purchasing business process controls.

## Discussion Questions

DQ 12-1 Refer to the operations process (effectiveness) goals shown in the control matrix (goals A and B in Figure 12.13, pgs. 447-448). For the two activities (purchasing and receiving), describe an operations goal other than the one discussed in the chapter.

DQ 12-2 Explain why ambiguities and conflicts exist among operations process goals, and discuss potential ambiguities and conflicts relative to the effectiveness goals you described in DQ 12-1.

DQ 12-3 In designing vendor records, what specific data elements would you include to help you select the best vendor for a particular purchase? Be specific as to the nature of the data to be stored, where it would come from, and how it would be used in the selection process.

DQ 12-4 Without redrawing the figures, discuss how Figures 12.3 (pg. 430), 12.4(pg. 431), 12.6(pg. 432), 12.7(pg. 433), and 12.9 (pg. 435) would change as a result of purchasing a technical product that could not be inspected in the receiving department but had to undergo quality control testing before being accepted.

DQ 12-5 Figure 12.9 on pg. 435 (the DFD depicting the receipt of goods and services) shows an update to the vendor master data from bubble 3.1 and another update to that same data from bubble 3.2. Discuss the *difference(s)* between these two updates. Be specific as to the nature of the data being updated in each case. How would your answer to this question be affected by your assumption about whether the purchase order receiving notification entering bubble 3.1 was ''blind'' as to quantities? Explain.

DQ 12-6 In terms of effectiveness and efficiency of operations, as well as of meeting the generic information system control goals of validity, completeness, and accuracy, what are the arguments for and against each of the following?

a. Sending a copy of the purchase order from the purchasing department to the receiving department.

b. Having the quantity ordered field ''blinded'' on the receiving department copy of the purchase order.

DQ 12-7 ''Auditors will never allow an organization to adopt a paperless system, so why do we waste our time bothering to study them?'' Discuss fully.

## Problems

*Note:* As mentioned in Chapters 10 and 11, the first few problems in the business process chapters are based on the processes of specific companies. Therefore, the problem material starts with case narratives of those processes.

## Case Studies

### CASE A: Stockbridge Company (Purchasing and Receiving Processes)

The Stockbridge Company sells medical supplies to hospitals, clinics, and doctor's offices. Stockbridge uses an ERP system for all of its business processes. These supplies are maintained on a real-time basis in an inventory database in an enterprise system. The inventory records include reorder points for all regularly used items and one or two preferred vendors for each item. Vendors are researched and approved by the purchasing manager before being added to the vendor database by a clerk designated to maintain the database. Stockbridge employs the following procedures for purchasing and receiving.

Throughout the day, the supplies clerk receives from the enterprise system an online report listing those items that have reached their reorder point. The clerk reviews the report and creates a requisition by filling out a requisition form in the company's enterprise system. Each requisition has a unique identifier and after creation, the purchasing and inventory databases are updated to reflect the purchase requisition. Inventory manager approval is required for purchases over $1000 and not covered by a blanket order. The inventory manager can log on to the enterprise system anytime to look at open requisitions that require approval and to approve those requisitions by checking the acceptance box.

Throughout the day, buyers in the purchasing department receive from the enterprise system online approved requisitions. They select a vendor from the vendor database and prepare a prenumbered purchase order on the enterprise system. After the purchase order is saved, the purchase and inventory databases are updated. The completed purchase order is then printed in the purchasing department and mailed to the vendor.

The receiving department inspects and counts the goods when they are received, compares the count to the packing slip, pulls up the purchase order in the enterprise system, and enters the quantity received. The purchase order and inventory databases are updated after the receiving record is saved. The general ledger is also updated to reflect the increase in the inventory balance.

### CASE B: Internet Payment Platform (Purchasing and Receiving Processes)

The following describes the purchasing and receiving processes at the U.S. Department of the Treasury's Bureau of Engraving and Printing (BEP) during a pilot of the Internet Payment Platform (IPP). Components of the IPP include a server with an "appreciating database" located at Xign, Inc. and an Intel server at BEP called the "Enterprise Adapter." BEP's mainframe, legacy enterprise system is called BEPMIS, which has an IDMS network database.

Contracting Officers (CO) in BEP's Office of Procurement enter purchase orders (POs) into the BEPMIS purchasing module, where they are stored on the IDMS database. (COs are assisted by buyers—who shop for products and services, negotiate prices, delivery schedules, etc. and prepare POs—and by contract specialists who help negotiate, prepare statements of work, and also prepare POs. Duties overlap, and all may do data entry). Because the IPP does not accommodate a digitally signed PO and does not include sufficient text to comply with the Federal Acquisition Regulation (FAR), POs are printed by the BEPMIS system, signed by the CO, and mailed to the supplier. A routine on the BEPMIS system, written for the IPP pilot, is manually initiated each

evening to extract and format POs for suppliers participating in the pilot. The core PO data (vendor, items, amounts, quantities, etc., but not including additional descriptive and contractual text) are extracted by this routine, as a batch, directly from the IDMS (BEPMIS) database and sent to the enterprise adapter, which converts the PO data from IDMS format into XML. Once translated and encrypted, the batch is sent to the IPP server at Xign and stored on the IPP appreciating database. Now a PO record exists on both the IDMS (BEPMIS) database and the IPP appreciating database. After a PO is posted to the IPP database, IPP notified suppliers via e-mail.

Having been notified that a PO has been issued, an employee at a BEP supplier logs on to IPP, reads POs onscreen, and responds by providing the requested goods or services. (Note: Suppliers might also enter the PO data manually into their own sales systems [if so, their sales order record duplicated the PO in BEPMIS and the IPP appreciating database]). Depending on the nature of the PO and a supplier's policies, its employees might be required to wait for the paper PO before beginning the process of providing goods or services, or they might be permitted to act on the electronic PO. After goods or services are received at BEP, the receiving personnel record the receipt into BEPMIS (no record of the receipt was recorded on the IPP appreciating database).

P 12-1 For the company assigned by your instructor, complete the following requirements:

a. Prepare a table of entities and activities.
b. Draw a context diagram.
c. Draw a *physical* data flow diagram (DFD).
d. Prepare an annotated table of entities and activities. Indicate on this table the groupings, bubble numbers, and bubble titles to be used in preparing a level 0 logical DFD.
e. Draw a level 0 logical DFD.

P 12-2 For the company assigned by your instructor, complete the following requirements:

a. Draw a systems flowchart.
b. Prepare a control matrix, including explanations of how each recommended existing control plan helps to accomplish—or would accomplish in the case of missing plans—each related control goal. Your choice of recommended control plans could come from this chapter plus any controls from Chapters 9 through 11 that are germane to your company's process.
c. Annotate the flowchart prepared in part a to indicate the points where the control plans are being applied (codes P-1 . . . P-*n*) or the points where they could be applied but are not (codes M-1 . . . M-*n*).

P 12-3 The following describes a purchasing process at Mountain Bay Company, a manufacturer of skis, snowshoes, and other winter recreational gear. The description here is limited to the process for ordering *and* receiving parts for repairing and maintaining manufacturing equipment. Please read the narrative and answer the questions that follow.

A small inventory of parts is located in the plant maintenance office. When that inventory needs to be replenished, the maintenance manager fills out a

purchase requisition and brings it to the purchasing department. A similar process is used when parts are not available in inventory and are needed immediately to repair or service a machine.

Once received in purchasing, the buyer responsible for plant maintenance purchase requisitions looks up any approved supplier in the corporate book of approved vendors. If an appropriate vendor is not found, the buyer looks in a card file of local suppliers. When a vendor is chosen, the buyer enters the requisition into the purchasing computer system and prints the purchase order.

The purchasing manager at Mountain Bay must sign all purchase orders, about 75 each day. This is a tedious process. There is no review, just a signature. The PO is a two-part carbon, so each PO must be signed by hand. Several POs to the same vendor may be prepared each day. The purchasing manager gives the POs to a secretary who mails the original to the vendor and files the copy in a paper file by vendor number.

When goods are received from the vendor, a receiving clerk calls up the purchase order on the computer screen, does a quick visual inspection and count, and labels the shipment ''on hold.'' The clerk notifies the Quality Control (QC) department of the shipment. QC performs the required quality tests and, if appropriate, changes the ''on hold'' label to ''released.'' At that point the goods are moved to the warehouse, and the receipt is entered into the computer to clear the PO and update the inventory balance.

a. Comment on the efficiency and effectiveness of the purchasing process at Mountain Bay.

b. Draw a systems flowchart of a revised process that would solve the problems identified in part a.

P 12-4 The following is a list of 12 control plans from this chapter or from Chapters 8, 9, 10, and 11.

**Control Plans**

A. Digital signature

B. Independent authorization to record receipt (match receipt data with PO data)

C. Approve purchase orders

D. Compare vendors for price, terms, quality, availability

E. Monitor open purchase orders

F. Logical and physical access controls

G. Count goods and compare to vendor packing slip

H. Firewall

I. Independent vendor master data maintenance

J. Personnel management controls (supervision)

K. Perimeter and building controls

L. Segregate warehouse and receiving

The following are 10 system failures that have control implications.

**System Failures**

1. Fred, a buyer at Welke Company, ordered unneeded inventory items from a vendor of which he is an owner.
2. Sydney worked in the receiving department at Rochester, Inc. One day, goods were received from Hemlock Corp for which no open purchase order could be found. To get the items received, Sydney figured out a way to create a purchase order. As it turns out, the goods had never been ordered but now Rochester is stuck with them and had to pay the bill that came from Hemlock.
3. Betty, a buyer at Winton, Inc., was in a hurry to buy a part needed to get the Winton factory back in operation. She found ProtoParts Company, a local vendor that could supply the part that day but for a premium price. Because it was an emergency, she created a vendor record for ProtoParts and issued the purchase order. Subsequently, other buyers began to use ProtoParts for other purchases.
4. Julie, who works in the warehouse at Worthington, Inc., has gotten into some financial difficulties and has figured out a way to make some extra cash by working with the folks at Chester Company. She creates orders for purchases from Chester and records a receipt, but no goods are ever received. Subsequently Chester sends a bill to Worthington, which gets paid, and Julie gets paid 20 percent of the take.
5. At Darcy, Inc., there are often discrepancies between what is ordered and what is recorded as received. Discrepancies include wrong items and wrong quantities.
6. Brady Company is often running out of inventory of certain key items. When research is conducted to find out the reason for the stockouts, they find that a purchase order had been issued, but the goods had not yet been received.
7. Warehouse managers at Troy, Inc. have been discovering inventory shortages. When they investigate the paperwork transferring the goods from receiving to the warehouse, the evidence indicates that the goods had arrived in the warehouse.
8. The accounts payable clerks at Bangor Company have difficulty reconciling the quantities recorded as received and the quantities on vendor invoices. Usually, the vendors claim that they are billing for the amounts that they had shipped.
9. Helms Corp. uses the Internet to send purchase orders to its vendors. The vendors for Helms Corp. have been receiving purchase orders that seem to be from Helms but are actually bogus.
10. The internal audits at Natick Company have found several discrepancies on the inventory data; the inventory is on the shelf, but the records do not reflect those balances. When they investigate further, they find that the goods were received but never recorded.

Match the 10 system failures with a control plan that would *best* prevent the system failure from occurring. Also, give a brief (one- to two-sentence)

explanation of your choice. A letter should be used only once, with two letters left over.

P 12-5 Conduct research on Generation 2 RFID tags (called Gen2). What will be the additional costs over first-generation RFID tags? What will be the benefits?

P 12-6 As we noted when presenting the recommended control plans in the matrix in Figure 12.13 that are discussed in Exhibit 12.1, we intentionally limited the number of plans to avoid redundancy. For example, we did not include several plans from Chapter 9 such as *preformatted screens, online prompting, programmed edits* (e.g., a reasonableness test on the purchase quantity), *procedures for rejected inputs, confirm input acceptance, digital signature,* and *populate input screens with master data.* We could also include *enter receipts data in receiving.*

Prepare a control matrix for just these controls. Include explanations of how each recommended existing control plan helps to accomplish—or would accomplish in the case of missing plans—each related control goal.

Annotate the flowchart in Figure 12.12 (pgs. 443–444) to indicate the points where the control plans are being applied (codes P-1 . . . P-*n*) or the points where they could be applied but are not (codes M-1 . . . M-*n*).

P 12-7 Note: If you were assigned DQ 12-4, consult your solution to it. Modify the DFDs in Figures 12.3 (pg. 430), 12.4 (pg. 431), 12.6 (pg. 432), 12.7 (pg. 433), and 12.9 (pg. 435), as appropriate, to reflect the purchasing of a technical product that could not be inspected in the receiving department but had to undergo quality control testing before being accepted.

P 12-8 Modify the DFDs in Figures 12.3 (pg. 430), 12.4 (pg. 431), 12.6 (pg. 432), 12.7 (pg. 433), and 12.9 (pg. 435), as appropriate, to reflect that the purchase from our vendor was ''drop-shipped'' to one of our customers instead of being shipped to us.

P 12-9 The following are five process failures that indicate weaknesses in control.

**Process Failures**

1. A purchasing agent ordered unneeded inventory items from a supplier company of which he is one of the officers.
2. The vendor shipped goods that were never ordered. The invoice for those goods was paid.
3. Goods were stolen by storeroom personnel. When the shortage was discovered, the storeroom personnel claimed that the goods had never been delivered to them from the receiving department.
4. An organization seems to regularly run out of inventory for some of its most popular items.
5. The materials going into production do not meet quality standards.

For each of the five process failures described, provide a two- to three-sentence description of the control plan that you believe would *best* address that deficiency. Obviously, there could be more than one plan that is germane to a particular situation. However, select *only one* plan for each of the five process failures, and include in your description a justification of why you believe it is *best.* When in doubt, opt for the plan that is *preventive* in nature, as opposed to plans that are *detective* or *corrective.*

P 12-10 Using the following table as a guide, describe for each function (see Figure 12.1 on pg. 422):

a. A risk (an event or action that will cause the organization to fail to meet its goals/objectives)

b. A control/process or use of technology that will address the risk.

| Function | Risks | Controls and Technology |
|---|---|---|
| Logistics | | |
| Purchasing | | |
| Receiving<br><br>Inventory (Debit)<br>??? (Credit) | | |

P 12-11 Use the DFDs in Figures 12.4 (pg. 431), 12.6 (pg. 432), 12.7 (pg. 433), and 12.9 (pg. 435), to solve this problem.

Prepare a four-column table that summarizes the purchasing processes, inputs, and outputs. In the first column, list the three processes shown in the level 0 diagram (Figure 12.4). In the second column, list the subsidiary functions shown in the three lower-level diagrams (Figures 12.6, 12.7, and 12.9). For each subsidiary process listed in column 2, list the data flow names or the data stores that are inputs to that process (column 3) or outputs of that process (column 4). (See Note.) The following table has been started for you to indicate the format for your solution.

*Note:* To simplify the solution, do not show any reject stubs in column 4.

Solution Format

Summary of the Purchasing Processes, Inputs, Outputs, and Data Stores

| Process | Subsidiary Functions | Inputs | Outputs |
|---|---|---|---|
| 1.0 Determine requirements | 1.1 Accumulate requests | Inventory's purchase requisition<br>Purchase requisition—supplies and services | Purchase requisition data |
| | 1.2 Calculate requirements | Purchase requisition data<br>Inventory master data | . . . Continue solution . . . |