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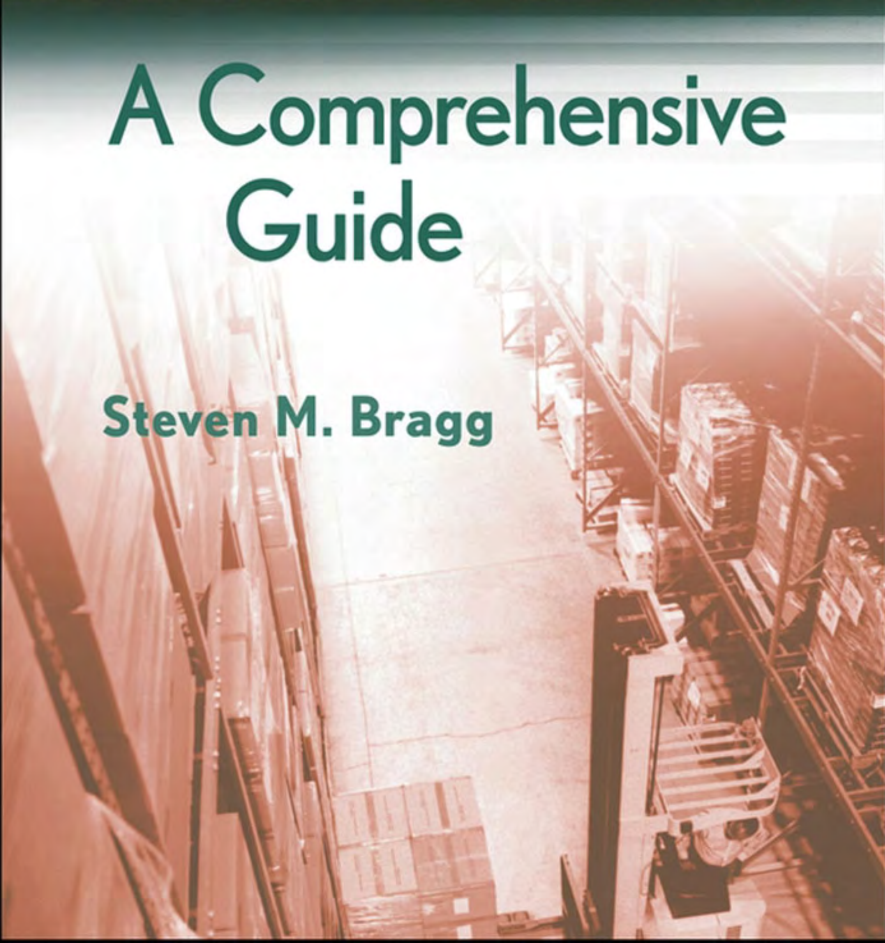
INVENTORY ACCOUNTING

A Comprehensive Guide

Steven M. Bragg



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Dedication

*Once again, to Victoria. If a warehouse looked like your room,
the fire marshall would shut it down.*

Contents

Preface

The accountant can find answers to almost any inventory-related question in this book. Within the general area of inventory accounting systems, it addresses data entry for inventory transactions, tracking inventory through different types of manufacturing environments, key control points and related fraud problems, several dozen inventory-related measurements, several inventory report formats, and budgeting for inventory. A large part of the book also covers inventory valuation, including many cost layering systems, the lower of cost or market rule, overhead calculations, joint and by-product costing, and the management of obsolete inventory issues. There are also several chapters devoted to special topics, including IRS inventory rules, counting procedures, best practices related to inventory, transfer pricing, and inventory terminology. Thus, *Inventory Accounting* not only includes answers to the basic inventory valuation questions, but also provides the accountant with a great deal of additional information related to controls, budgeting, data collection, fraud, and inventory management.

The first six chapters cover the general subject area of inventory accounting systems. Chapter 1 describes the application of bar coding, wireless data transmission, radio frequency identification, document imaging, and electronic data interchange to the collection of inventory data. Chapter 2 addresses the flow of inventory through a basic manufacturing system, as well as through a manufacturing resources planning system and a just-in-time system. Chapter 3 describes 68 possible inventory controls in such areas as in-transit inventory, inventory storage, obsolete inventory, and inventory transactions. As a logical follow-up to Chapter 3, Chapter 4 discusses 18 types of fraud that involve inventory in some manner. Chapter 5 includes 32 measurements, 3 forms, and 7 reports that can be used to determine the status of inventory levels and related systems. Chapter 6 discusses the budgeting process to be used for the raw materials, work-in-process, and finished goods inventories.

The next six chapters cover the general subject area of inventory valuation. Chapter 7 describes how to use several inventory cost layering systems: the first-in, first-out (FIFO), last-in, first-out (LIFO), dollar value LIFO, link-chain, and weighted average methods. Chapter 8 describes the lower of cost or market rule and how to apply it. Chapter 9 addresses the contents of overhead cost pools and how to apply those costs to inventory (including the use of activity-based costing). Chapter 10 covers various cost allocation and pricing methodologies for inventory designated as joint products or by-products, while Chapter 11 reveals how to locate, dispose of, and account for obsolete inventory. Chapter 12 contains a summary of those journal entries that are most commonly used by the inventory accountant.

The final four chapters and an appendix address special inventory topics. Chapter 13 is a direct extract of that portion of the Internal Revenue Code related to inventory, with integrated commentary by the author. Chapter 14 discusses how to create an inventory tracking system and conduct both periodic physical counts and cycle counts. Chapter 15 lists best practices clustered into the general areas of inventory purchasing, receiving and shipping, storage, picking, production, transactions, and quantity management. Chapter 16 describes the need for transfer pricing and compares the applicability of six transfer pricing methods. Finally, Appendix A contains definitions for more than 150 inventory-related terms.

Inventory Accounting is intended to be an expansive compendium of inventory-related information for the accountant. It is extremely useful not only for handling basic inventory transactions, but also as a source of information for improving inventory control systems, measuring inventory performance, and reducing a company's investment in inventory. Enjoy!

Steven M. Bragg
Centennial, Colorado
August 2004

About the Author

Steven Bragg, CPA, CMA, CIA, CPIM, has been the chief financial officer or controller of four companies, as well as a consulting manager at Ernst & Young and auditor at Deloitte & Touche. He received a master's degree in finance from Bentley College, an MBA from Babson College, and a Bachelor's degree in Economics from the University of Maine. He has been the two-time president of the 10,000-member Colorado Mountain Club, is an avid alpine skier and mountain biker, and is a certified master diver. Mr. Bragg resides in Centennial, Colorado. He has published the following books through John Wiley & Sons:

Accounting and Finance for Your Small Business
Accounting Best Practices
Accounting Reference Desktop
Billing and Collections Best Practices
Business Ratios and Formulas
Controller's Guide to Costing
Controller's Guide to Planning and Controlling Operations
Controller's Guide: Roles and Responsibilities for the New Controller
Controllership
Cost Accounting
Design and Maintenance of Accounting Manuals
Essentials of Payroll
Financial Analysis
GAAP Implementation Guide
Inventory Best Practices
Just-in-Time Accounting
Managing Explosive Corporate Growth
Outsourcing
Payroll Accounting
Sales and Operations for Your Small Business
The Controller's Function
The New CFO Financial Leadership Manual
The Ultimate Accountants' Reference

Also:

Advanced Accounting Systems (Institute of Internal Auditors)
Run the Rockies (CMC Press)

1

Inventory Data Collection[1]

1-1 Introduction

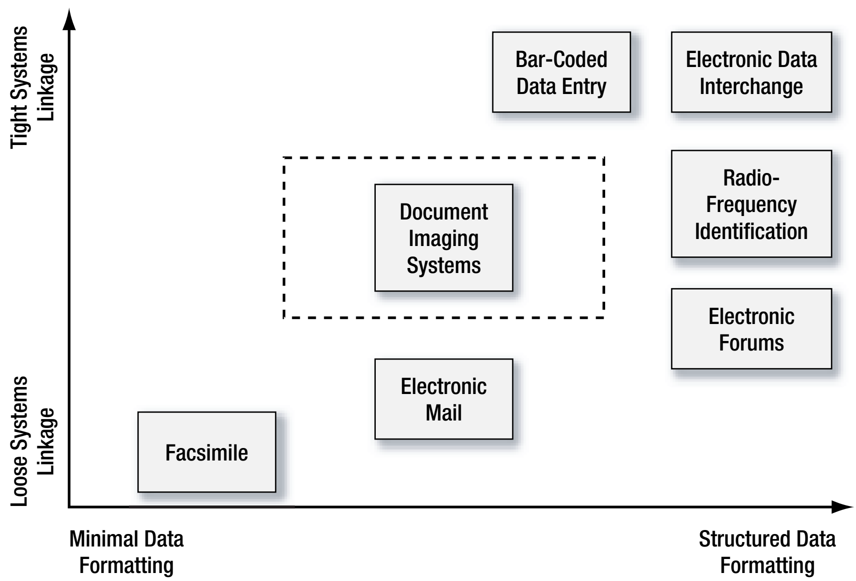
The classical view of inventory data collection is that of employees filling out forms of various kinds throughout the warehouse and production areas, which are then forwarded to a central data entry location, where hordes of clerks keypunch the data into a central computer database. Although this was a reasonably accurate view of the situation in the past, the types of systems available for collecting information are now more efficient and effective. These systems were developed because of a growing recognition that traditional data collection methods require a great deal of employee time that could be better spent on value-added tasks. Also, having a secondary data entry step increases the likelihood of keypunching errors, which can be completely avoided by some of the data collection methods discussed in this chapter.

Some of the data systems that can be used to collect inventory information are shown in Exhibit 1-1. They lie along a continuum that begins with loosely formatted data, such as that found on a faxed document, and ends with perfectly formatted data that can be directly entered into a computer system without alteration, such as electronic data interchange (EDI) transactions or transactions entered through an electronic form. A special case is document imaging, which can be tightly coupled to a company's computer systems or maintained as a freestanding system with no linkages at all. Accordingly, it is surrounded by a larger box in the exhibit, indicating the range within the exhibit that it can occupy. Based on the information in the exhibit, it is evident that an inventory accountant should recommend installation of the systems noted in the upper right-hand corner because they provide the best means for collecting the highest-quality costing information that can be injected directly into a company's central database of costing information.

This chapter discusses the more advanced data collection techniques noted in Exhibit 1-1, as well as a pair of more specialized methods that apply only to the

[1]Several sections of this chapter were adapted with permission from Chapter 4 of Bragg, *Cost Accounting: A Comprehensive Guide*, John Wiley & Sons, 2001.

Exhibit 1-1 ***Characteristics of Data Collection Systems***



picking function: voice picking and pick-to-light. It also notes how to use back-flushing to avoid most inventory transactions.

1-2 Bar Coding

Let us say that Company Alpha wants to track the progress of a product through every step of its production process. Being a technologically advanced organization, it has installed data entry keypads at each of its workstations. One of these products is assigned the part number AD-546-798. The operator of each workstation is required to enter the part number using a keypad, followed by the number of units completed. The inventory accountant uses this information to determine the progress of work-in-process batches as they move through the plant. However, the part number is so meaningless that 3 of the 10 workstation operators enter the information incorrectly by transposing numbers. The 546 part of the number is in the same row on the keypad as the 798 portion of the number, so transpositions are difficult to avoid. This error results in unreadable reports that the inventory accountant must manually correct by going to the shop floor and tracking each job by hand.

Obviously, data entry inaccuracy is a big problem in this instance. In the real world, it is an enormous issue because employees are asked to enter data into computer systems even if they are not properly trained in data entry. The author recently observed a situation where a workforce whose primary language was not English, and which also experienced an annual turnover rate of greater than 200%, was asked to enter production data into a warehouse database; the results were continuing inventory record inaccuracy levels of 50% or greater despite weekly cycle counts. In short, the human element of data entry can cause considerable difficulty in ensuring that accurate data is entered into a computer database. This problem can be resolved through the use of bar codes.

A bar code is a set of alternating parallel bars and spaces of different widths that signify letters, numbers, and other characters. When scanned by a laser beam attached to a computer chip containing a decoding algorithm, this cluster of bars and spaces is converted to an alphanumeric character. Several algorithms result in different types of bar codes. One of the most popular is Code 39, which contains both letters and numbers (i.e., is alphanumeric) and is heavily used in manufacturing. Another is Interleaved 2 of 5, which contains only numeric characters; this bar code is most commonly found in the automotive, warehousing, and baggage handling industries. Yet another variation is the universal product code (UPC), which is primarily found in supermarkets and in the retailing industry. Whatever the method used, all of these bar codes can be generated within a company by entering the required characters into a computer, which converts them to the needed bar code format and sends them to a printer. A laser printer is recommended because it yields a higher-resolution bar code, although inkjet printers are close in comparative levels of resolution. Dot-matrix printers are not recommended for bar code printing because of their much lower resolution levels.

Whatever the type of bar code used, the subsequent processing steps are the same. A bar code is manufactured at the point of use, typically by a special application printer that only produces bar codes. The bar code is typically a self-adhesive one that is affixed to the item to be tracked; this procedure can be automated if the volume of activity warrants investment in such machinery. Then the item being tracked moves through whatever process is occurring and is scanned at fixed points in the process. This scanning can be conducted by a person with a handheld scanner or by an automated scanning station. The scanner extracts information for the bar code and feeds it directly into the computer database.

There are several types of scanners, and the choice of model depends on the application. The main categories of scanners are as follows:

- *Light pen.* This is the least expensive type, requiring a user to manually drag the scanning device across the bar code. It has a low success rate and may require several scans before an accurate scan is completed. It is most commonly used for low-volume applications where the speed of scanning is not important and where low cost is the determining factor of use.
- *Handheld scanner.* This device contains a motor that rapidly sends a series of laser scans across a bar code, resulting in a much faster scan. It can also be used with bar codes printed with relatively poor resolution. This scanner can be used with a direct wire linkage to a computer or through radio transmission to a local radio receiver, thereby allowing roving use of the device. A handheld scanner is several times more expensive than a light pen, and radio-frequency scanners usually cost several thousand dollars each.

- *Stationary fixed-beam scanner.* This device is not intended for manual use. Instead, it is fixed in place at a point past which items are moved, such as on a conveyor belt. The scanner must achieve success on a single scan of any passing bar code or no read will result. To handle this situation, the conveyor belt must be equipped with a shunting gate so that the unscanned items are pushed to one side, allowing machine operators to move them back through the scanning station for a second attempt.
- *Stationary moving-beam scanner.* This device is the same as a stationary fixed-beam scanner except that it is equipped with a motor that sends a series of scans over each bar code, ensuring a high percentage of successful scans. This type of scanner is more expensive than the fixed-beam variety, but its added cost can be offset against the reduced (or eliminated) need for a shunting gate and the manual labor associated with it.

Bar coding is tailor-made for inventory transactions. For example, an inventory identification number is often randomly assigned to a component or product and so has no meaning to the person entering it into the computer system for a transaction. This situation leads to inaccurate data entry. To avoid this problem, bar codes can be attached to all inventory items, which are then scanned as part of any inventory move transaction.

Another inventory-related use of bar codes is shop floor control. As a job works its way through the production area, some companies require the production staff to extract information from a routing sheet attached to the job and enter it into a local data entry terminal. This information tells the production control staff where the job is located in the production process and can also be used by the accounting staff to determine the costs that each job has compiled thus far. It is possible for the data entry person to enter this identification incorrectly, so bar codes can be added to the routing sheet in place of written identification information. The data entry person then scans the bar codes into the local data entry terminal instead of making a typed entry.

Clearly, there are many uses for bar coding. It is ideal for situations where the risk of data entry error is high and is also useful when a company wants to use automation to avoid manual data entry. However, there is a cost associated with the purchase and implementation of bar code printing and scanning equipment, so the inventory accountant should first calculate the costs and benefits associated with the use of this equipment before proceeding to an actual installation.

1-3 Wireless Data Transmission

When a transaction is entered into a computer terminal, it travels through a wire or fiber-optic cable to a database for storage. Unfortunately, this data entry method requires one to walk to a fixed terminal location in order to enter data, which is not always possible for employees who collect data as they travel through a facility.

The answer to this problem is to obtain a terminal that sends wireless transmissions to a receiver that in turn is directly linked to a database. This allows data entry to take place virtually anywhere. This mode of data entry has improved rapidly, and several types of portable terminals have been developed. One is the radio-frequency bar code scanner, which is an integrated liquid crystal display, keyboard, and scanner. It is frequently used in warehouses, where cycle counters can enter quantity changes on the spot rather than write them down, walk to a terminal, enter the data, and then walk back to the counting area. Another terminal is the wireless Palm computer (and several knockoff versions thereof), which one can enter information into with a stylus and then send it to a Web site, from which it is sent as an electronic message to a company's database. Yet another variation is a portable computer linked to a cellular phone; a modem connection is made through the phone, which transmits data over a phone line to the company, where it is converted to a digital signal and sent to the corporate database.

Wireless applications are directly applicable to inventory transactions. For example, a major problem with any inventory system is that the warehouse staff conducts a transaction and then must find a computer terminal in which to enter the information. This may involve a long walk, so there is some risk that the worker will forget some of the information to be entered or entirely miss making the entry. Radio-frequency bar code scanners avoid this problem because they are readily available for use no matter where the worker travels within a facility. The information is scanned or punched into the portable unit, and the transaction is immediately sent to the central computer database for updating.

Also, any manager who wants to ensure a high level of inventory accuracy must send an employee into the warehouse to confirm that the inventory quantities listed in the computer are the same as those on the shelves. The trouble is that the cycle counter must plod through the warehouse with a thick sheaf of inventory reports, locate the item to be counted in the report, find it on the shelf, write down any corrections, go back to the terminal, and enter any changes. Clearly, this is a time-consuming process. A better approach is to use a radio-frequency bar code scanner to scan the part number of the item on the shelf, scan the bar code for the item's warehouse location, have the scanner immediately reveal whether there is a counting discrepancy by accessing the central database, and then making a correction on the spot.

Assuming a high level of staff training, the adoption of a wireless system combined with bar-coded transactions can push a company's inventory transaction error rate to well under 1%. Also, given the reduced amount of time required to enter transactions, one can count on the labor capacity of the warehouse staff to increase substantially.

1-4 Radio Frequency Identification (RFID)

A major problem with any manually operated inventory system is the vast number of transactions required to track receipts into the warehouse, moves between bins, issuances to the shop floor, returns from the floor, scrap, and so on. Every time someone creates a transaction, there is a chance of incorrect data being entered, resulting in a cumulative variance that can be quite large by the time a stock item has wended its way through all possible transactions. Incorrect inventory information leads to a host of other problems, such as stockouts, incorrect purchasing quantities, and a seriously inaccurate cost of goods sold. Although bar coding applications can resolve these problems, bar codes can be destroyed in some environments, are too difficult to read, or require too much staff time to locate for scanning purposes.

One way to avoid these transactional errors is to use the new RFID technology. Although only recently formulated,[2] the technology has already been adopted by Wal-Mart, which should ensure a rapid rollout in at least the retail industry. The basic RFID concept has been around for years—attach a tiny transmitter to each product, which then sends a unique encoded product identification number to a reader device. The cost of these transmitter tags has dropped to about 10 cents (depending on their level of complexity and power source), which begins to make it a cost-effective alternative for some applications. Growing use of the technology will likely reduce the cost further.

When a tagged inventory item is passed near a reader device, the reader emits a signal, which powers up the tag, allowing it to emit its unique product identification number. In order to read a large number of tags, the reader turns on each tag in sequence, reads it, and turns off the tag, thereby preventing confusion with repetitive reads. The tag information is then logged into the inventory tracking system, indicating an inventory move past the point where the reader was located.

The most likely implementation scenario for RFID is to first roll it out within the warehouse and manufacturing areas of a company, using it to track entire pallet loads (good for receiving and inventory control transactions) and then implementing it for smaller tracking units, such as cases (good for picking, cycle counts, and shipment transactions) or even individual items (most applicable for work-in-process inventory or retail applications). This implementation approach allows for a progressively increasing investment in the technology as a company gradually learns about its applicability.

A major advantage of RFID is its ability to provide inventory count information without any manual transaction keypunching. This eliminates the need for manual receiving, inventory move, and issuance transactions. It can also provide real-time information about the precise location of all inventory, which can assist with locating missing inventory, arranging cycle counts, and auditing stock. If issued to suppliers, this information tells them precisely how much inventory is currently on hand, so they can more accurately determine when to deliver more stock to the company.

An additional capability of RFID is the activation of an alarm if a tagged item is shifted off the company premises. Another possibility is the use of a more expensive self-powered tag (currently costing about $15 each) that can actively relay its precise location in relation to a fixed overhead positioning unit. The latest tag technology also allows one to rewrite the information stored on a tag many times, which

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[2]The RFID standards can be found at *www.epcglobalinc.org*.

brings up the possibility of adding data regarding the progress of a unit through various workstations in the production area. Yet another option is to track trailers in a storage area by affixing a single self-powered unit to each one, thereby solving the problem of where specific inventory batches are located. Finally, RFID can be used as an error-prevention device to ensure that goods intended for a specific customer are not loaded onto the wrong truck.

One problem with RFID is the possibility of radio interference, which can be a major problem in heavy manufacturing environments. As a general rule, if wiring in the warehouse and shop area must already be shielded in order to ensure proper data transmission, then RFID may not work. If this potential exists, then be sure to conduct extensive transmission testing in all areas where inventory may be tracked to ensure that radio interference will not be an issue. Another problem is that certain products, such as steel or fluids, obviously cannot be tagged. Yet another issue is that no suppliers have yet developed a complete turnkey RFID solution, so companies are still forced to use consultants to cobble together a disparate set of components into a working system. Given the difficulty of setting up these systems and the introductory level of much of the technology, it is impossible to install even a simple system for under $100,000, with large multisite installations costing well into the millions.

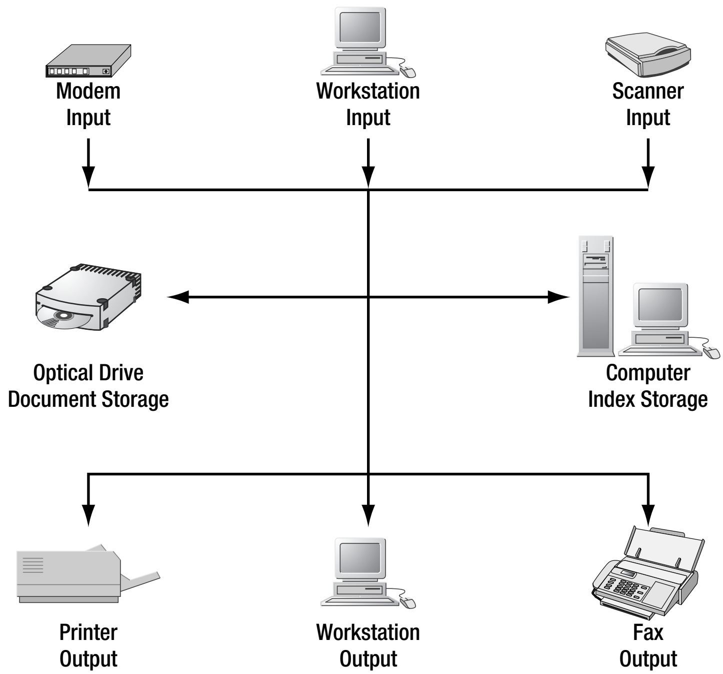
1-5 Document Imaging

The assumption in most organizations is that a paper document must be manually transcribed into a computer database. However, an alternative to this labor-intensive approach is to simply insert the document into a scanner and punch an indexing number into an attached computer terminal, thereby converting the document directly into a digitized form and making it easily accessible from any linked computer terminal throughout the company.

The basic structure of this document imaging system is shown in Exhibit 1-2, which illustrates several ways to input documents into a computer, the most common being the use of a scanner. When a document has been converted to a digital format by this means, it still cannot be stored in the computer database because there would be no way to retrieve it. Consequently, one or more indexing numbers must be punched in. For example, these could be the unique number assigned to the scanned document, the name of the customer, the date, or any other information allowing a user to readily access the document again. The key issue is to ensure that the document is not lost in the database.

The digitized document is then stored in a high-capacity storage device, usually a compact disc (CD) jukebox. This is a device containing a large number of CDs that allows rapid access to the data in each one (as opposed to tape storage systems). The jukebox format can store several terabytes of data, and it needs to because a single document stored at a high image-quality level can require up to 1/2 megabyte of storage capacity. However, it is more common to choose a lower level of document resolution when scanning into a database, which results in much lower stor-

Exhibit 1-2 *Overview of the Document Imaging Process Flow*



age requirements, usually in the range of 1/10 megabyte. The indexing file system is stored separately in a high-speed storage device that can rapidly sort through a large indexing file to find the correct document. This index is then used to extract a file from the CD jukebox and send it to a user on demand.

There are several ways to output the data from a document imaging system. The most common one is direct output to a user terminal, which has the dual advantages of saving paper and of allowing users to see a document on their screens side-by-side with other pertinent information. Other types of output include printing, facsimile, and modem transmission. The most common output is straight to a terminal.

The use of document imaging by an inventory accountant is primarily for drill-down analysis. It makes research efforts much easier by allowing the accountant to find all of the materials relevant to an information search without ever having to leave the terminal. For example, if he is looking for the reason for a specific purchase, he can drill down into the accounting system from the general ledger account to the purchasing journal, which shows the date and amount of the purchase as well as the purchase order number. If the system is linked to a materials management system, he may even be able to drill down to a copy of the purchase order, but he cannot reference the purchase requisition used to derive the purchase order. Now, with document imaging, he can use the requisition number noted on the purchase order to index the scanned requisition, which shows precisely what was ordered and who ordered it. There is no need to conduct research in a paper file, which makes this a much faster way to conduct inventory accounting research.

An added benefit of document imaging is that more than one person can access the same document at the same time. With a paper-based system, there is always the problem of files being missing because they are being used by someone (and the added problem of their not being returned to the appropriate location), resulting in a delay in research efforts until the files are returned. With document imaging, the file remains in the same storage location in the CD jukebox, no matter how many users are reviewing it at the same time. Thus, research is never delayed by missing documents.

The document imaging solution is a good one, but its costs must be considered. For a small organization, the cost of the computer hardware and software may be too high in relation to the cost savings anticipated from converting a small volume of documents to a digitized format. However, large-volume organizations dealing with tens or hundreds of thousands of documents find that the cost of such a system is negligible in comparison to the benefits gained. Prices are constantly dropping in this area, so it is difficult to itemize imaging system prices that will be valid for any length of time. In general, a low-end imaging system can be obtained for a price in the low five-figure range, while the cost of a high-volume transaction solution can easily exceed $1 million. When preparing a cost-benefit transaction solution for a document imaging system, one should consider the benefits not only of reducing research time but also of eliminating rent on document storage space, staff positions for filing work, and the cost of locating misfiled documents.

1-6 Electronic Data Interchange

Data collection is particularly painful when data is received from a company's trading partner and must then be reentered into the company's database. The problem is that the information sent to the company may not be the same as that required by the internal system, so someone must contact the trading partner for the missing information. In addition, there is always the risk of data entry errors, which can be caused by simple retyping mistakes or a misreading of the received document (as may be caused by a blurry fax). All of these costs are non-value-added because they contribute nothing to the underlying value of the product or service the company provides. These issues can be eliminated through the use of electronic data interchange.

For a few hundred dollars, one can purchase an elementary EDI software package that reveals an electronic form on the computer screen. One enters all of the data needed into a set of required fields for whatever standard transaction is required—more than 100 have been carefully defined by an international standard organization. Once all of the transactions have been entered, the computer sends the information to the business partner by modem or broadband connection. The recipient then accesses the data through its modem, prints it, and manually transfers the information to its computer system. Although very simple, this approach is not much better than