Electronic Imaging 101 Part VI–Systems, Hardware, Systems Integration and Workflow

This is the sixth in a series of articles providing a primer on electronic imaging. This installment covers systems and the hardware components that comprise the system as well as systems integration and workflow. As you read this article you may want to consult the Glossary provided with Part I of this series of articles which appeared in the *Records Management Quarterly* Volume 28, Number 2, April 1994.

By DON M. AVEDON

Many types and quantities of system and hardware components are available, making possible an infinite number of configurations. Electronic imaging systems, however, generally fall into one of two categories: **semi-automatic** (electronic file cabinets) and **distributed-processing automatic** (enterprise-wide) systems. Table 1 shows typical system sizes for various applications in terms of users, images and initial cost.

It is important to distinguish between strictly file-and-retrieval imaging systems (electronic file cabinets) and fully integrated workflow imaging (enterprise-wide) systems. A file-and-retrieval system uses imaging only to store, view and retrieve documents. It basically replaces or supplements paper and microfilm records and provides more rapid access, better use of electronic technology and more efficient storage. Although beneficial, file-and-retrieval imaging is only the beginning of what imaging can do. It is best viewed as a starting point for the full use of electronic imaging technology.

SYSTEMS AND HARDWARE COMPONENTS

In an electronic imaging system, a document is scanned, digitized and sent to the computer for temporary storage in magnetic memory. A newly scanned image can be displayed on a monitor to check for legibility, skewing and folded pages. If the image is unsatisfactory, the digitized image (still only in magnetic memory) is erased and the original

System Sizing

	USERS	IMAGES	COST*
Single User	1-2	100-50k	$30k-75k
Work Group	3-10	50k-1m	75k-300k
Departmental	11-50	1m-5m	300k-750k
Business Unit	51-100	5m-10m	750k-2m
Enterprise	100+	10m+	2m-10m+

k = 000 m = 000,000

* Initial cost including hardware, software, communications, and installation, but not including backfile conversion.

Source: Dataquest.

Table 1.

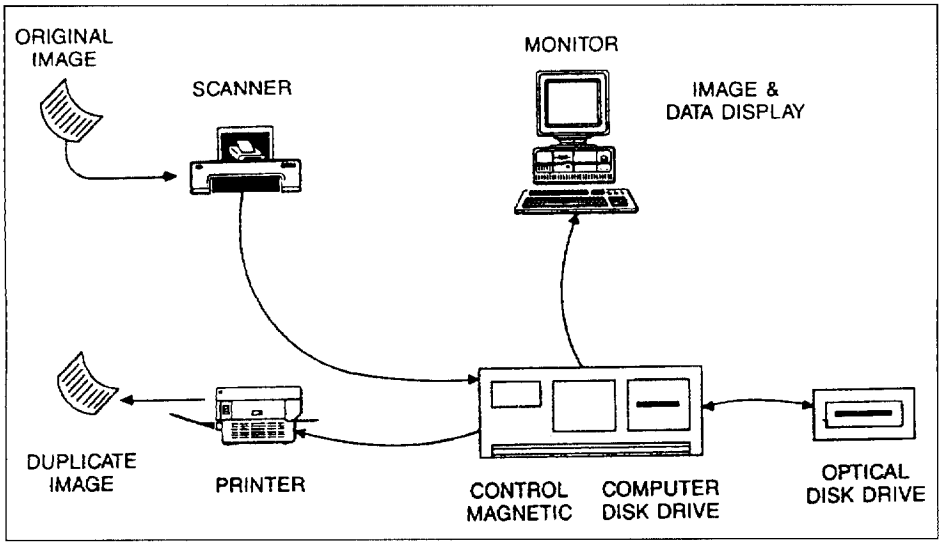


Figure 1. Diagram of semi-automatic system (electronic file cabinet).

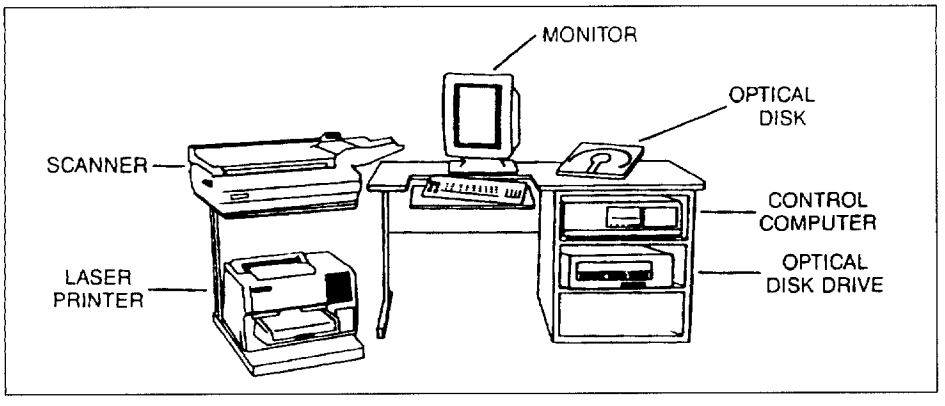


Figure 2. Line drawing of semi-automatic system (electronic file cabinet).

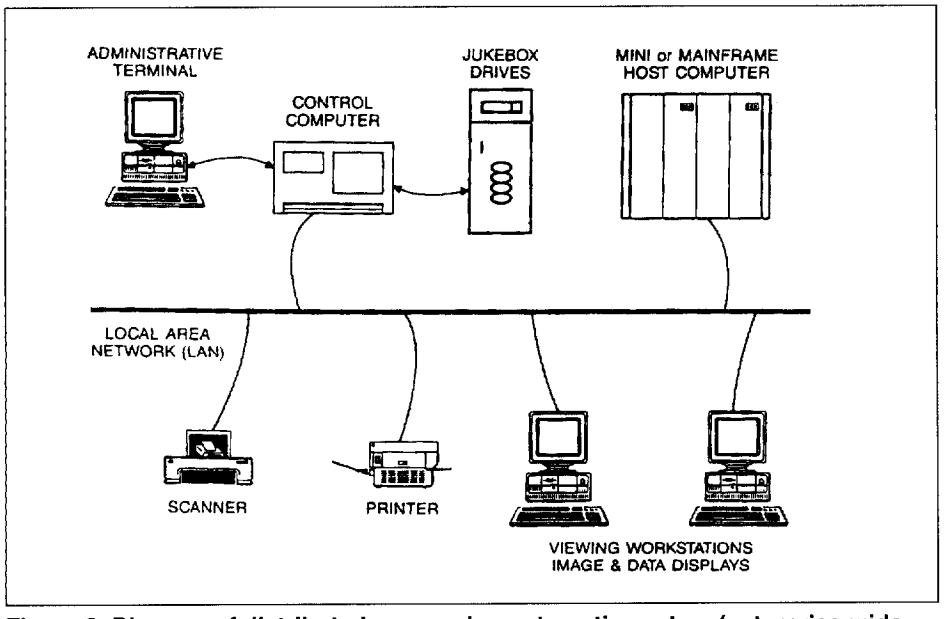


Figure 3. Diagram of distributed-processing automatic system (enterprise-wide system).

is rescanned, perhaps at a higher resolution. A satisfactory image is usually indexed at this point. Through software, the computer will provide operator prompts to assist the indexing function. The entire topic of indexing was covered in Part IV of this series [*RMQ* Volume 29, Number 1, January 1995]. The indexing information is stored in magnetic memory and may also be recorded on an optical disk. The digitized image of the document, which the computer now compresses, is transferred to an optical disk. The optical disk is in a disk drive.

Semi-Automatic Systems

A standalone semi-automatic system may have the scanner, control computer, monitor, disk drive and software all built into a single box or they may be separate units. The printer is always a separate unit. Diagrams of a semi-automatic system are shown in Figures 1 and 2. Following are the functions of the components.

Scanner. Converts human-readable images (alphanumerics and graphics) on a page (paper or microfilm) to a binary digital representation in 0.5 to 3 seconds. This process was described in Part III of this series [*RMQ* Volume 28, Number 4, October 1994]. The process is called digitizing, raster scanning, or bit-mapping. The digitized image is sent to the control computer over dedicated cables.

Control Computer. Manages the system, directing the actions of all components. This computer must have system and application software, as discussed in Part IV of this series [*RMQ* Volume 29, Number 1, January 1995]. With the appropriate software, this computer provides the interface between the system and the operators who perform scanning, inspection, indexing and retrieval tasks.

Monitor. Permits an image to be viewed for inspection or retrieval. A monitor usually displays an entire 8-1/2 by 11 inch page, although large monitors can display two pages. The monitor can display information from magnetic memory or from optical disks. In selecting monitors, consider screen size, display mode (horizontal or vertical), resolution, the need to display multiple

images, zooming, rotation, ergonomics and price (particularly when many devices are required).

Disk Drive. Uses a laser to write information on an optical disk (laser at high power) or to read from the disk (laser at lower power). The drive must match the disk size, type and format. The operator selects the appropriate disk and manually inserts it into the drive.

Printer. Produces a hard copy of an image, usually on plain paper. In selecting printers, the main considerations are resolution, speed and price. In the printing process, the computer receives the digital information from the disk drive, decompresses it, and sends the image to the printer.

Distributed-Processing Systems

A diagram of a distributed-processing automatic system (enterprise-wide system) is shown in Figure 3. This system differs from the semi-automatic system in that it includes a jukebox, a local area network (LAN), and many retrieval/viewing workstations. The system is connected to a minicomputer or mainframe host computer. Following are descriptions of the additional components.

Jukebox. Stores many optical disks and adds an automatic capability for retrieving optical disks and images. As shown in Figure 4, one or more disk drives are internal to the jukebox. This unit is also regulated by the control computer. In selecting a jukebox, consider the number of disks to be handled, disk size, average exchange time, expandability and price.

Local Area Network (LAN). Ties all the components together and allows viewing workstations to be located in user's, areas anywhere in a building or on a campus. Multiple scanners and printers can also be interconnected by the LAN. Part V of this series [*RMQ* Volume 29, Number 2, April 1995] provided information on networks.

Multiple Workstations. These types of electronic imaging systems permit hundreds of workstations,

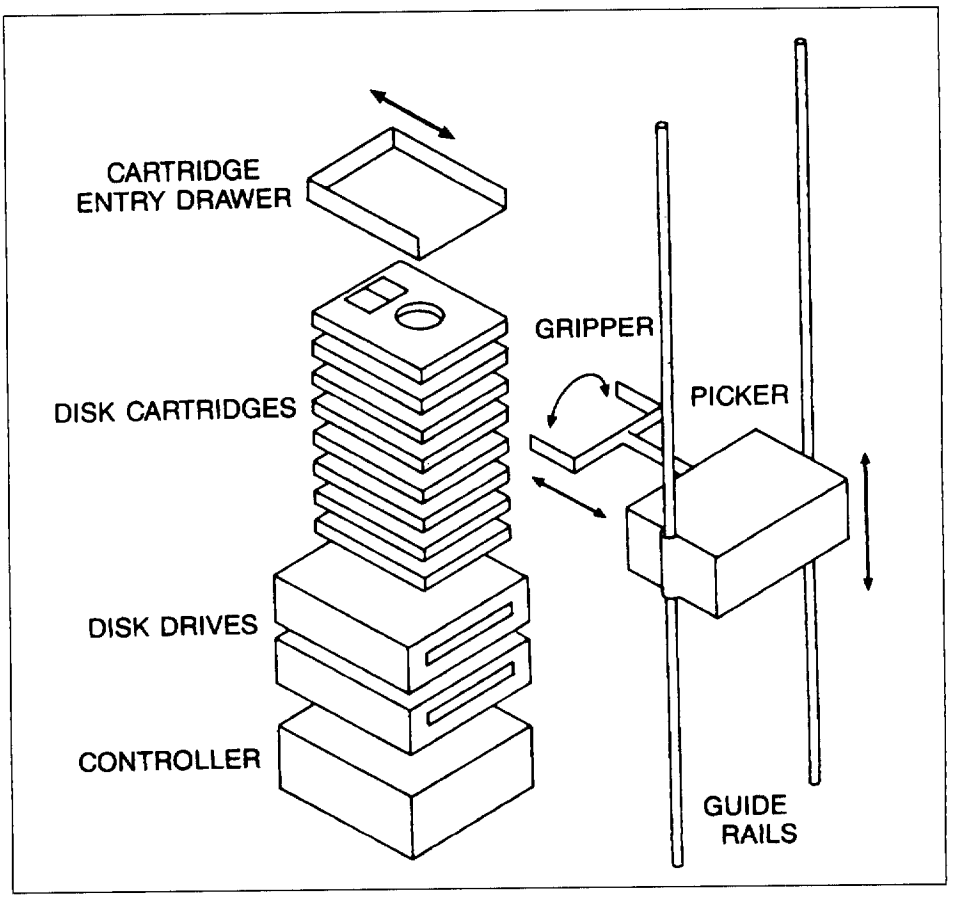


Figure 4. Jukebox schematic.

facsimile devices and microcomputers to operate online.

Host Computer Connection. Allows user workstations to retrieve data from the mainframe; to perform word processing, electronic mail and other data processing functions; and to retrieve images **all on the same display.** Once this integration is made, the functional spectrum of a **total information system** is possible. The concept of workflow (covered later in this article) can also be incorporated.

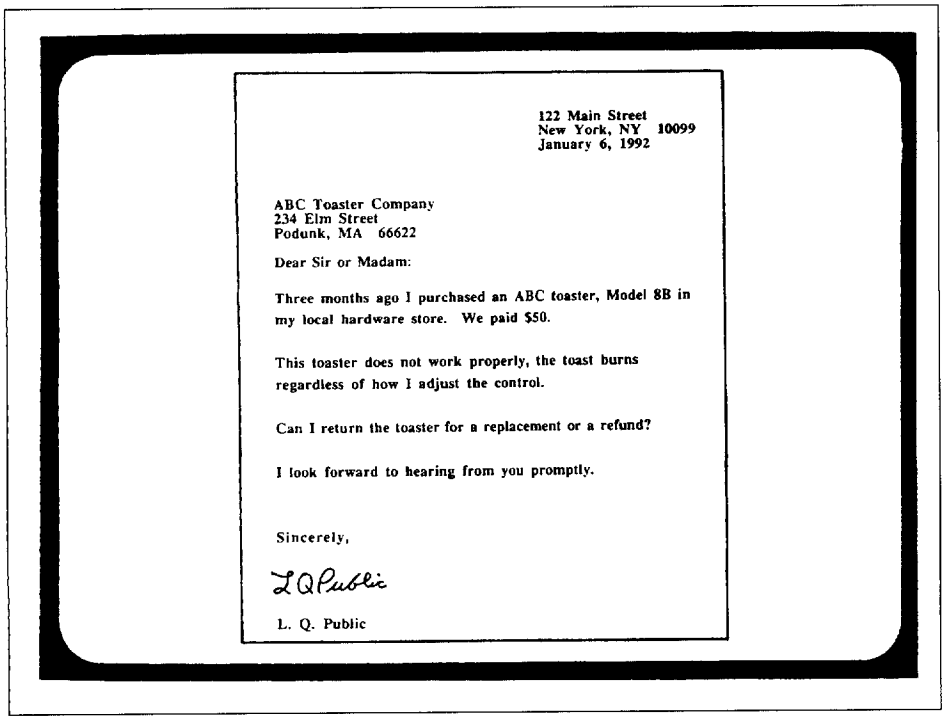
SYSTEMS INTEGRATION

Before discussing integration, it is important to define a few terms. **Standalone** describes a machine or device (such as an office copier) that performs a function by itself. A **system** or **subsystem** is a set of machines, devices (cameras, processors, readers) and sometimes software in one technology (micrographics) that performs a function. **Integration** brings together several technologies and subsystems (such as data processing, micrographics and facsimile) into one **total information system**. This total system performs many functions, allowing documents and data to flow from one subsystem to another, transcending technologies. Integration of subsystems and technologies to form a total system is made possible through software and communications.

A successful organization is the sum of its parts. But each part—an individual, work group or department—must work with the other parts, including outside organizations such as customers and suppliers. A well-run organization has an integrated environment in which sharing resources and information is a normal practice.

Where are the resources? With individuals and groups located in offices inside and outside the company. Some are connected by computer systems; some are isolated.

Where is the information (data and documents)? Some of it is in



122 Main Street
New York, NY 10099
January 6, 1992

ABC Toaster Company
234 Elm Street
Podunk, MA 66622

Dear Sir or Madam:

Three months ago I purchased an ABC toaster, Model 8B in my local hardware store. We paid $50.

This toaster does not work properly, the toast burns regardless of how I adjust the control.

Can I return the toaster for a replacement or a refund?

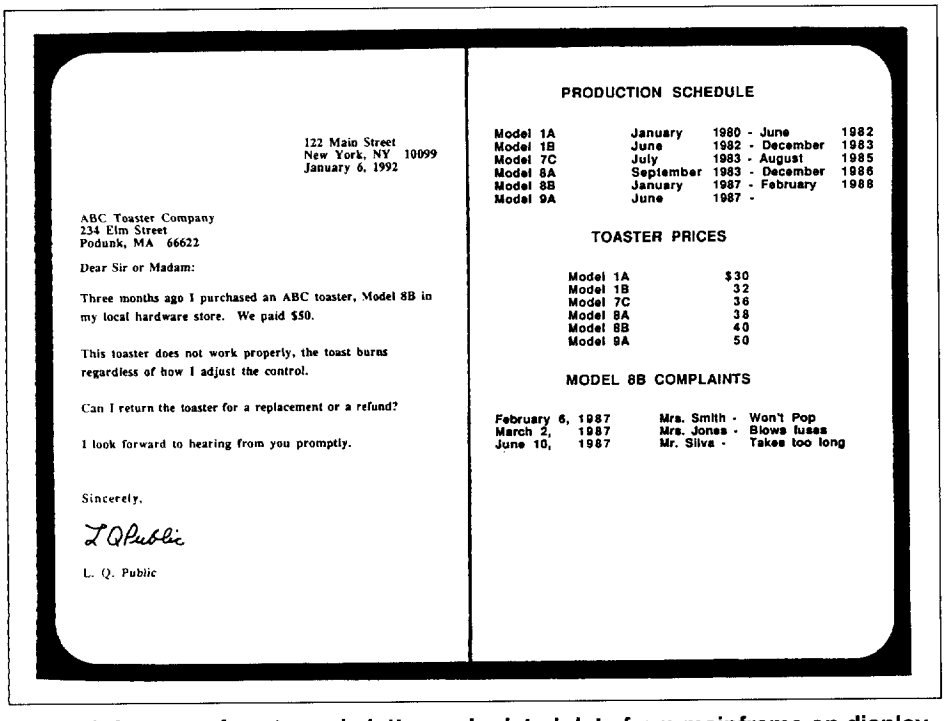
I look forward to hearing from you promptly.

Sincerely,

L Q Public

L. Q. Public

Figure 5. Image of customer's letter on display.



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PRODUCTION SCHEDULE

Model 1A	January	1980 -	June	1982
Model 1B	June	1982 -	December	1983
Model 7C	July	1983 -	August	1985
Model 8A	September	1983 -	December	1986
Model 8B	January	1987 -	February	1988
Model 9A	June	1987 -		

TOASTER PRICES

Model 1A	$30
Model 1B	32
Model 7C	36
Model 8A	38
Model 8B	40
Model 9A	50

MODEL 8B COMPLAINTS

February 6, 1987	Mrs. Smith - Won't Pop
March 2, 1987	Mrs. Jones - Blows fuses
June 10, 1987	Mr. Silva - Takes too long

Figure 6. Images of customer's letter and related data from mainframe on display.

electronic form in online data files; some is on magnetic media; some is on microfilm. A great deal of it, however, is on paper stored in folders, file cabinets and off-site facilities.

Integration means that four basic forms of information—data, text, image and voice—can be exchanged among applications running on a variety of systems or subsystems. From another point of view, integration means combining subsystems—data processing, word processing, electronic mail, electronic imaging, facsimile and voice annotation—to provide information in any form, instantly, from any subsystem, **on a single workstation.**

Example

A toaster manufacturer has an integrated electronic imaging system with correspondence from customers scanned as it arrives in the mailroom. Today, the company received a letter from a customer complaining about a Model 8B toaster. The customer says the toaster was purchased three months ago and cost $50. The problem with the toaster is that, regardless of setting, the toast burns. The letter was scanned in the mailroom and electronically routed to a customer service clerk to investigate and prepare a reply. Figure 5 shows the letter on the screen of the customer service clerk's, workstation.

After reading the letter, the customer service clerk needs some basic facts about this model toaster:

- When was it manufactured and is it still in production?
- What was its list price?
- Have there been other complaints about this model?

This type of information is maintained in the company's mainframe computer. The customer service clerk, using the same workstation displaying the electronic image of the customer's letter, interrogates the data files in the mainframe. The electronic imaging system and the data processing system are connected by software and communications, and the system has a windowing capability. Figure 6 shows the workstation screen with both the image of the letter and the related data. The customer service clerk can now see that the Model 8B toaster has not been manufactured in more than two years, and the list price was $40. There has never been a complaint about toast burning in this model. Again, using the same workstation, in a third window, the clerk uses word-processing techniques to prepare a reply to the customer. Figure 7 shows the workstation screen with the customer's letter, the data from the mainframe and the reply.

In this integrated electronic information system, electronic imaging

converted the paper letter to electronic form in the mailroom and routed and delivered it to the customer service clerk using electronic mail. The clerk used electronic imaging to view the letter, data processing to investigate the complaint and word processing to prepare the reply to the customer. The customer service clerk, on a single workstation, used electronic imaging, data processing and word processing. This type of integrated system gets the letter to the customer service clerk faster and takes the customer service clerk much less time to research the complaint and prepare a reply. The customer gets an earlier reply, and it probably cost the company less money to prepare that reply.

WORKFLOW

The long-term goal of every organization should be to develop a *total information system* by integrating all of today's separate information systems, such as data processing, electronic imaging, OCR and electronic mail. When the systems, subsystems, and technologies have been integrated, you can then begin to look toward improving your entire business process (workflow).

Most businesses and government agencies today are going through *business process reengineering,* also called *business process redesign* (BPR)—a major look at how an entire organization does business, with an aim toward substantially improving quality and productivity. Workflow techniques play a major role.

Workflow refers to how documents are processed. An electronic imaging system automatically integrates and routes the flow of documents, in electronic form, from workstation to workstation throughout an organization. Documents and files are not simply stored and retrieved, but are used to conduct actual business transactions. Work gets processed faster on a LAN, where everyone can share documents and files. Workflow thus redefines the flow of documents and tasks to improve overall quality and productivity at all levels within your organization. Indeed, several people can work with the same document or file at the same time.

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Mr. Avedon was Executive Director of the International Information Management Congress (IMC) and is its Chief Administrative Officer with responsibility for implementing all the Association's programs and activities. He was Vice President of Micronet, Inc., Vice President, Research and Development, Microfilming Corporation of America, and Technical Director of the Association for Information and Image Management (AIIM). He began his career as Project Engineer at Bell Telephone Laboratories in the Engineering Standards Department.

Mr. Avedon is a Fellow of both AIIM and IMC and a former member of the AIIM Board of Directors. In 1985 he received the Emmett Leahy Award from the Institute of Certified Records Managers for his outstanding contribution to the Information and Records Management profession and in 1987 was awarded AIIM's Award of Merit, the highest award the Association gives. He was chairman of the AIIM Standards Board and the Secretary of the American National Standards Institute PH5 Committee on Micrographic Reproduction. He is one of the delegates to the International Standards Organization and is a Certified Standards Engineer. He is author of the books *Computer Output Microfilm* and Introduction to *Electronic Imaging* and co-author of *All About Micrographics* and the *Glossary of Imaging Technology.*

Mr. Avedon has presented numerous talks in the United States and internationally and is the author of over two hundred papers in the areas of office automation, micrographics, electronic imaging, standards and engineering documentation.

Document Processing

In a traditional paper system, a document passes from person to person in serial fashion, often with long delays between reviews. If the document is related to closing a sale or servicing a customer, the delay can be quite costly.

But suppose (as shown in Figure 8) you substitute an electronic image for the paper document, scan it when it arrives (or when and where it originates), and forward it electronically to all sites simultaneously and instantly. The sale is closed much sooner, the customer is satisfied immediately and your organization may have gained a valuable competitive edge.

Workflow software allows users to write programs (**scripts**) that detail where each document should go in an organization. These scripts chart and control all documents that enter the system. The scripts can specify on which workstation(s) a document-image must appear and what other images should appear on the screen with it. And the script can do this for each category of document. Document processing is thus reduced into a shorter period of time, so work gets done faster and more efficiently.

Workflow software eliminates **information float**, that common condition when vital documents are buried in in-baskets, and other people wait for specific papers to appear. Instead, workflow software's easy-to-understand menus help users sequence and schedule documents to be processed so that the system automatically collects and distributes document-images to electronic in-boxes in the proper order.

As each person finishes processing a document-image, it is automatically sent to the next workstation, then the next. When processing is completed, however, the last user doesn't have to walk to a file cabinet. Filing was accomplished when the document was first scanned and indexed. All documents are subsequently generated by workflow software—all additions, annotations, and the like—are automatically placed in the proper file.

Management Functions Enhanced

Besides electronically controlling document-images, workflow soft-

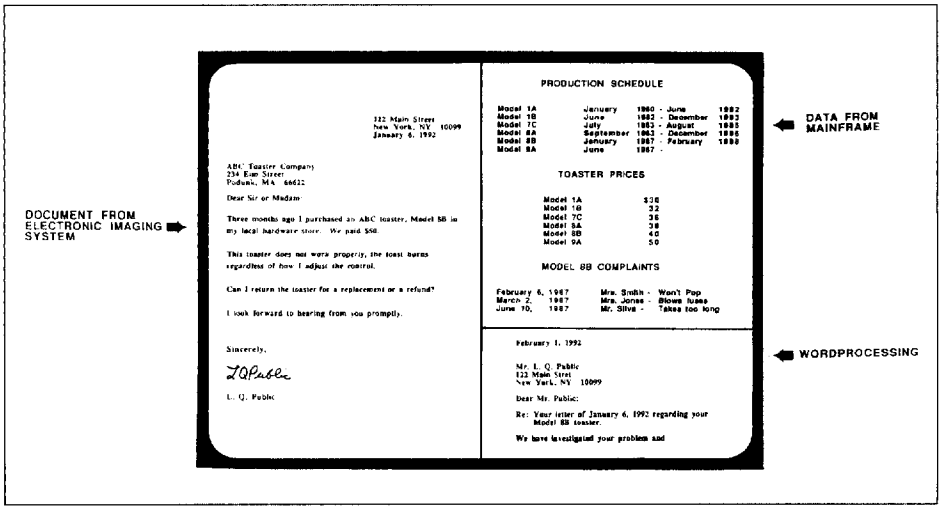

Figure 7. Images of customer's letter, data from mainframe and word-processing letter in reply, on display.

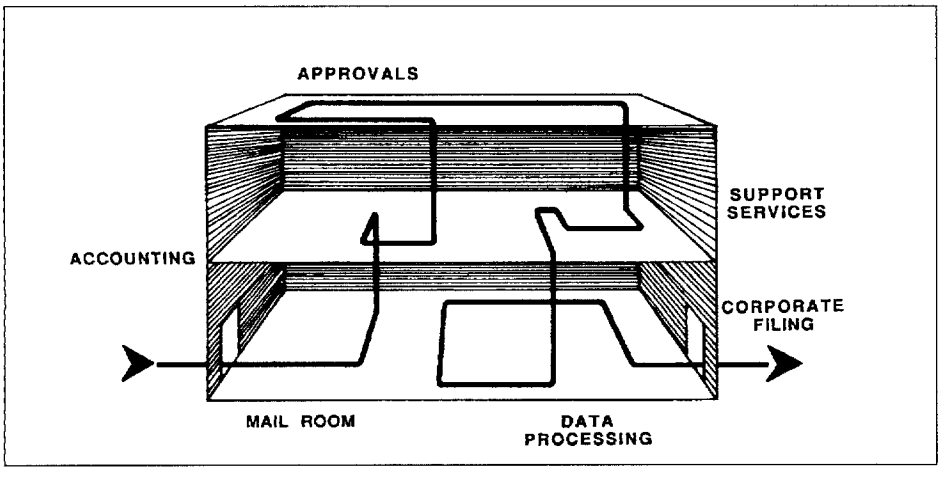

Figure 8. Workflow diagram.

ware automates a number of other management tasks—productivity of measurements, report generation and adjustments to employee work loads and schedules.

For time-sensitive documents, workflow scripts can be designed so that each document-image has a specific timeframe for being processed at each workstation. If the document-image doesn't progress past a particular workstation within its assigned timeframe, it's automatically routed to a supervisor for attention. This technique helps eliminate bottlenecks. It can also alert the supervisor that a particular user may need help, either because the employee is new or has too heavy a work load. Such information can be invaluable when creating workflow charts.

Suppose an invoice can't be processed until the product arrives. No problem. Workflow, with its rendezvous feature, suspends the document-image until the system is informed that the product has arrived. Then the system software melds the document-image with the new information and automatically dispatches the now-completed file to the accounts payable workstation. The entire process is fast, efficient and simple.

Customized to Match Organization

Workflow provides customized flexibility. No single program can fit every business need and environment, so workflow scripts can be created to match your needs and operating procedures—for work files, menued procedures, image processing, mainframe interface, word processing, routing and much more. Because workflow scripts can be quickly changed to reflect new ideas, new procedures and new needs, businesses are assured of continuing efficiency and productivity.

Additional Benefits

Workflow accelerates and simplifies all document-image processing, which helps new employees become productive earlier and experienced employees become more efficient. Productivity improvements of 50% or greater are not uncommon.

Management benefits, too. By defining exact processing steps that are both possible and required, management gains increased control over procedures. A methodology is created that employees can easily follow. The result: improved quality and increased consistency.

In addition, workflow provides many more benefits:

- Automatic prompts to operator so that procedures are not overlooked.
- Automatic appearance on screen of other information required for processing.
- Multiwindow processing, allowing operators to suspend operations and handle interruptions.
- Elimination of duplicate keystrokes, by exchange of information between a mainframe and an integrated electronic imaging system.
- Management checks of operator efficiency, for example, the date and time paperwork enters and is processed, as well as an operator's or department's current work load.

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