Document Imaging and Workflow Technology in Healthcare Today

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What Is Document Imaging Technology?

Document imaging systems (DIS) are information systems that typically capture information stored on paper documents and provide immediate, simultaneous access to the information contained in the patient or business record. Data stored on paper documents are digitized by scanning the documents into digital scanning devices (much like facsimile machines), which create bit-mapped images of the paper documents. Images of the paper documents or business records are indexed and organized, then etched onto optical disks for permanent archival storage. The optical disk drives contain a high-powered laser to record the information and a low-powered laser to later read the information.

The scanned documents are accessed through file servers that accept and prioritize requests for the archived images, retrieve the images, and send them to the appropriate workstation for online viewing, transmission via facsimile, or printing to hard copy. When a document is reproduced, the PC network retrieves the data and directs the output to a laser printer, resulting in a virtually identical copy of the original. In healthcare, document images are stored on optical disks, typically WORM (write once, read many) disks, which serve as an efficient long-term mass storage medium, complementing magnetic storage.

Components of a Document Imaging System

Scanning
One of the ways information is captured in document imaging systems is through scanning devices. Scanners convert information on a piece of paper into a digitized format that can be accessed and reviewed via computer terminals. Most systems support standard file formats and compression techniques and allow document interchange with other systems through support of document standards such as the Tagged Image File Format, CCITT Group III and Group IV. Based on the scanning needs of the organization, flatbed devices, low, medium or high-volume scanners are available, as well as single-sided or double-sided devices. The goal of today's document imaging systems is to minimize the amount of scanning required and maximize the electronic capture of information through COLD (computer output to laser disk). Even as COLD capture increases with time, scanning will continue to be a critical component of any healthcare DIS.

Indexing
Once an image is scanned, an index (document name or tag) must be associated with the document for subsequent access and retrieval. An index can be assigned manually by entering the information through the keyboard or through the use of auto-indexing techniques currently available. A master patient index (MPI) interface is recommended for automated patient-level indexing. Likewise, an interface to the admission, discharge, and transfer (ADT) system is also implemented to capture visit information for automated encounter-level indexing. Through available hardware and/or software, optical character recognition (OCR) and bar coding are frequently used to automate the process of assigning document indices.

Image Storage and Archival
Documents captured in a DIS are typically stored on either magnetic or optical media. Magnetic storage, though more costly than optical, is often used for active records that are expected to have a higher retrieval rate. Typically, healthcare records are stored on magnetic media for 30 to 60 days to improve the response time for the period of greatest activity of the records. Response time for records stored on magnetic media is usually 3 to 5 seconds. WORM optical storage is used for less active records. Both 5.25-inch or 12-inch platters are used frequently in healthcare implementations. Response times for records stored on optical media may vary considerably based on the volume of activity and the number of optical drives; however, average response time is 20 to 30 seconds.

Image Display and Manipulation
Most DIS workstations display images at 200 dots per inch (dpi). Image data decompression is usually performed at the workstation to minimize the impact on the network. Most applications provide full image manipulation features such as zoom, reduction, rotation, redaction, annotation, highlighting, and electronic signature capabilities.

Printing and Facsimile
Most commercial printers connected to the LAN can be used to print both data and images. Image data decompression is usually performed at the printer to minimize the impact on the network. The printing of images require approximately 10 times the number of pixels per page than displaying images; therefore, printers are often attached to dedicated PCs that function as print servers to increase printing efficiency. Most systems also contain facsimile management software to control the routing of faxes in and out of the DIS. Many systems recommend the use of a dedicated server for controlling inbound and outbound faxes.

COLD (Computer Output to Laser Disk)
COLD technology is software that will compress and store computer-generated reports as data on optical disk. Since reports are stored as data, not images, there is a great deal of flexibility in indexing, for example, the capability to cross-reference reports based on data in the report as well as automated indexing by downloading data from the mainframe. Reports imported into the DIS through a COLD feed require approximately one-tenth of the storage space compared to a scanned image of the same document. Transcribed medical reports, laboratory results, and radiology reports typically represent 8 to 15 percent of the medical record. A medical record in a hospital with full results reporting and clinical documentation may be comprised of 60 to 75 percent electronic documents that could be imported through a COLD subsystem.

Enabling Technologies

Much of the productivity benefits to be gained from the implementation of a document imaging system come from the enabling technologies that may be offered either by a third-party vendor or integrated into the document imaging application. These features should be considered in selecting a document imaging vendor and are described in the following sections.

Automatic Indexing
Optical character recognition (OCR) is a method of creating computer data from the pattern of a character. It was developed to allow text to be scanned and converted to machine-readable data (ASCII data). Intelligent character recognition (ICR) is a term that usually refers to handwriting recognition. Document imaging systems use OCR/ICR technology to automate indexing. Likewise, by printing bar codes on documents and using image scanners that can read bar codes, hospitals are experiencing faster data-entry throughput and reduced errors. OCR and bar coding are used to automate and reduce the human intervention required in the indexing process. With proper forms redesign, all of the information required for the index can be contained in the scanned document. OCR and bar code programs extract the information and automatically index documents to the appropriate patient encounter. Several vendors have incorporated automated indexing for remittance processing in their patient account applications. Automatic indexing can work well with structured documents like remittances, in which information is located in the same place on each document. Using the technology in this capacity requires the ability to identify specific information zones on a particular document. Accurately identifying these information zones is a task that is often more demanding than recognizing the text.

Although OCR technology continues to improve, it is anticipated that bar code technology will continue to remain the leader in data entry accuracy for the next several years. Bar codes were developed to be read by machines and have been constructed to minimize misinterpretation. The bar code is either successfully read and interpreted or rejected, resulting in an extremely high accuracy rate. OCR, on the other hand, can misread data but still accept the code. Strengths of OCR technology are speed and the ability to minimize forms redesign that may be required with bar coding. There are still those in the industry who are skeptical about OCR because of the time required to manually reconcile and correct errors, even with an accuracy rate of 98 percent; however, recent advances in OCR technology continue to improve its speed, accuracy, and cost effectiveness.

Workflow Management
The premise of workflow is that a business process can be defined as a series of tasks performed in a prescribed manner and order supported by information from various sources. Workflow management has focused on managing the flow of information as it is processed through many steps and potentially many individuals. The traditional implementation of workflow management has focused on automating existing operations. The goal of workflow management today is to reengineer

processes to become more market-driven. Healthcare organizations are searching for ways to apply workflow management tools to improve the way they currently do business. This may equate to increased efficiency and better customer service.

Components of most workflow management software include the following:

- Work queue list and prioritization
- Transaction scheduling as serial or parallel
- Tools for user-defined graphical scripts
- Workflow routing slips
- Routing to multiple queues/worklists simultaneously
- Management reporting

Workflow technology will support the following business goals:

- Streamlining business operations
- Managing events that achieve business objectives
- Routing and tracking work objects
- Managing status of business process
- Automating business process
- Processing high volume of transactions with maximum throughput

Full-text Retrieval
Full-text retrieval capabilities address the need to access information contained in images and text documents in greater detail than is provided in the document index. When full-text retrieval technology is used in combination with document image management technology, it enables users to automate image keyword entry and searching, shorten document conversion time, lower implementation costs, and gain faster access to documents. A healthcare example of this technology would be the ability to search the contents of a discharge summary from another institution to identify a final diagnosis without manually reviewing and keying the information.

Object Linking and Embedding (OLE)
Microsoft's Object Linking and Embedding (OLE) is the technology most frequently used for integrating imaging with existing Windows applications (e.g., word processors, spreadsheets, databases). It allows images to be treated as objects that can be embedded in other Windows applications and permits the addition of scan, view, and print functions to those applications. With OLE, images are viewed as objects that can be copied, manipulated, stored, and distributed by any OLE-compliant application. Many of the image-enabling software tool kits currently available use this technology.

Forms Processing
Recently, software has been developed to allow systems to recognize forms and associated index data locations to automate the indexing process. Some forms processing programs support the location and recognition of only specific sections of a document. Using zone-oriented character recognition, the system could be trained to locate and recognize the form number (document type) and patient encounter number. The system must first identify the form in question, then pick out the correct zones. Data is then extracted and forwarded to a "recognition engine." In certain environments, this technology could be employed to eliminate the tedious and expensive task of forms redesign to facilitate the placement of a bar code for automated indexing.

Click here for Document Imaging and Workflow Systems: Vendor Benchmark Data Table

CD-ROM and CD-R
Traditionally, document images have been stored on a combination of magnetic media and on optical media. The use of CD-ROM for storage and distribution has become more popular. In healthcare, CD-ROM has become popular for off-line distribution of images. Not only does the CD contain the requested images, it may also contain a look-up database and the necessary retrieval tools to view the documents. This technology may be attractive to academic medical centers with frequent requests for research access to medical records. This feature, if available, would allow researchers off-line access to the necessary medical records at their own workstations. Some of the vendors support CD-Recordable (CD-R), a subset of CD-ROM. CD-R can be used for backup and distribution of files or data within an organization.

Market Perspective

There are a number of document imaging system vendors in the marketplace today with applications that have been developed specifically for healthcare. Table 1 summarizes several of the key vendors that focus their products solely in the healthcare market or have recognized vertical market presence. These eight vendors represent nearly 200 hospitals that are in some phase of implementation of a document imaging system.

Future Directions

Document imaging and workflow management systems have not become pervasive in healthcare quite as quickly as anticipated several years ago. Many organizations have identified the technology as part of their overall strategic information technology plan and anticipate its introduction within the next one to three years. Continued emergence is anticipated for the coming years with increased emphasis on linking document image management systems with other applications and technologies. Continued movement away from document storage and retrieval systems to knowledge systems is expected. Document management software will continue to change to meet the needs of the changing healthcare and business environment.

Important Aspects of a Successful DIS Implementation

Select the best application for your environment
Organizations considering document and workflow management solutions should understand the needs of their current and future environment and then select the vendor that best helps solve their unique business problems.

Redesign the workflow and business process to take advantage of the technology
Don't use the technology to automate current processes; otherwise productivity improvements will not be maximized. Envision a future state and then allow technology to enable the organization to reach its goals.

Address the human aspects of organizational change management
Implementing a document imaging system is a major change for all individuals in the organization who come in contact with the medical record. Even though a document imaging system may not change the fundamental way information is generated and captured, how the information and the medical record are accessed changes dramatically. Sponsor commitment, change agent and advocacy skills, response to change, and organizational alignment are just a few aspects of facilitating a successful implementation.

Align DIS project with strategic information technology (IT) plan
The acquisition of a DIS must support the strategic IT plan in order for the project to be a success. People, process, and technology requirements of the future state need to be defined at both a tactical and strategic level.

Lessons Learned from Previous Implementations

Phase installations and carefully consider strategies for pilot selection
A phased approach is strongly recommended to minimize the risks to the organization. Starting small allows everyone involved to become educated and comfortable with the technology and reengineered processes before exposure to the entire organization. The choice of a pilot site should be manageable and reflective of subsequent implementation sites. Sufficient time should be allocated in the roll-out plan to make adjustments in the plan as a result of the lessons learned in the pilot phase.

Involve staff early
Staff commitment will make or break an implementation plan. Involving staff as early as possible will help address their natural resistance to change and facilitate their support of the project.

Incorporate the use of enabling technologies as much as possible
As described earlier in this article, the use of technologies such as OCR, auto-indexing, and workflow software will dramatically increase efficiencies in the redesigned processes.

Deploy an adequate number of workstations
Most users accept that we are in the midst of the information age. Document imaging systems should not be implemented so that the majority of requests require printing the information to meet the information needs of the end user. A sure way to frustrate physicians is to take away the paper chart and then not provide them with sufficient and convenient access to information.

Identify appropriate staff to support project
Individuals with the right skill set to support the DIS will be critical to the success of the project. Some of the required skills include project coordination, business/systems analysis, database administration, and LAN administration. The systems analyst is likely to develop functional specifications, act as an intermediary between the users and the development staff (internal or vendor), and provide technical support staff during the implementation process. The database administrator will perform periodic tuning of the system's databases to ensure that they are optimally configured. Local area network/system administration is required for day-to-day administration of the LAN-based document management systems. LAN/system administration includes proficiency in aspects of document management technology.

Prepare for ongoing funding needs
Approximately 10 percent of the initial capital investment should be budgeted annually for equipment obsolescence and the acquisition of new technology. Anticipation of required funds will allow an organization to take advantage of new enabling technologies as soon as they are tested and proven.

Help users maintain realistic expectations and educate everyone on the project's goals and objectives
A communication plan should be developed prior to implementation and updated regularly. This is important in organizations in which users may change frequently either because of employee turnover or rotating residents. If users know what the system is capable of doing and not doing, they are less likely to be disappointed by perceived performance issues. Response time on a DIS is not equal to other hospital information systems. As a result, users may be frustrated with a 15-second response time for a record optically archived when the reality is that the hard copy chart previously may have taken 15 minutes or longer to retrieve.

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