Payoff

Hypertext is an emerging technology that, if selected and used properly, can add tremendous efficiency and power to an organization's computing environment, especially its online documentation systems. This article describes the design, selection, and implementation considerations involved in developing a hypertext system. It is intended to help IS managers better evaluate hypertext's application potential and the related costs and benefits.

Introduction

Hypertext has been a buzzword in the computing industry ever since HyperCard was first introduced by Apple Computer, Inc. Numerous products now claim to offer hypertext or hypermedia capabilities, contributing to the misconceptions about the nature and appropriate application of these software tools.

Essentially, a hypertext system allows writers (i.e., either the original software developers or users who add functions later to build specific applications) to link words, phrases, and graphics with any other information in a data base. In other words, it is a network of cross-references between related pieces of information that need not bear any formal similarity.

In a typical hypertext application, users enter the data base by accessing a table of contents, searching through the index for an entry point, or starting to read at a designated beginning. As users read through the text, various words or graphics appear as buttons—that is, highlighted or otherwise visibly connected to links with other material. By pointing with the cursor and either clicking a mouse or pressing a key, users move instantly to other material by way of predetermined links. Repeated selection of buttons or links creates a hypertext trail, which reflects the users' specific interests or information needs and the writer's foresight in creating links.

This capacity for nonlinear, associative connection between nodes of information distinguishes hypertext from other forms of information management. Some hypertext systems allow users to interact with the system both by reading hypertext and by creating their own text links. Other systems are read-only, allowing users to access information through developer-defined links but not to add or alter the data base.

Designing a Hypertext System

A range of issues is involved in software design and writing specific applications for hypertext, some more esoteric than others. The design considerations that directly affect user performance in read-only applications of hypertext systems include:

- The use of graphics.
- Navigation through hypertext.
- Modularity and structured writing.
Combining search and associative systems.

The decision to link or not to link.

The layers and views in hypertext.

The Use of Graphics
Although there are many applications in which graphics and hypermedia (i.e., video or audio as well as text) content are useful and necessary, many others require minimal, if any, graphics capabilities. Perhaps the largest single business use for hypertext is to put corporate policies and procedures online, and virtually none of these policies and procedures requires drawings or diagrams.

In addition, no graphics standards exist for microcomputers. Especially at the high end of graphics resolution (e.g., technical drawings on Computer-Aided Design systems), hypertext programs that allow links to outside graphics hardware and software might be preferable to those that incorporate one or more current microcomputer graphics drivers.

Line drawings or graphics requiring only current hardware and software capabilities are all that a hypertext system is likely to need, so IS managers should consider selecting programs with graphics support. If graphics are unnecessary or if there is a need to incorporate existing graphics in incompatible formats, programs that support links to external devices should be considered. Graphics require greater storage capacity and processing speed for efficient use. The millions of installed 8088-based microcomputers will easily support efficient text-only applications but not-high-resolution graphics. The choice of a hypertext development system depends on whether the applications require graphics and if so, what kind.

Navigation Through Hypertext
Becoming lost is the principal danger of ineffectively designed hypertext systems. Users should be able to navigate their way through a hypertext system—that is, they need to see where they have been and where they can go. Even moderate ambiguity can confuse users and discourage them from accessing the system.

Although structured writing and design techniques can compensate for a lack of built-in navigational features, hypertext programs without strong navigational features will ultimately fail. At least three basic navigational functions are required in an effective hypertext tool. First, the system must automatically provide maps or tables of contents to which users may refer to determine their location within the system. Second, there must be simple viewing options for upcoming paths and the ability to return rapidly if particular paths are unprofitable. Third, users must be able to see where they have been—for example, a list or set of icons representing previously chosen paths should be available.

Modularity and Structured Writing
Another important value of hypertext is the structure it adds to information and the knowledge engineering it represents as an intelligently organized network of information. Although some hypertext programs allow users to create single, long documents with links among the parts, such a nonmodular approach is not usually desirable.

Breaking information into meaningful modules is a key step in the hypertext design process at the outline stage of the project or as an ongoing activity as the hypertext data base grows over time. Effective systems allow writers to assign titles or names to each information module. Systems that combine search with hypertext capabilities allow users to assign keywords to each information module.
Writing information in modules that contain only a few screens of text or graphics imposes organization on and provides navigational assistance through hypertext. Creating an outline or hierarchical structure of links and nodes is an effective step toward overall organization. Nonhierarchical links can be added as needed. Improved organization within modules and between them adds more value to the hypertext system. As with any online creation, readability (e.g., use of white space) and screen design principles apply.

**Combining Search and Associative Systems**
Although some large hypertext systems (i.e., those that have more than a few hundred nodes) have well-designed navigational aids and effective overall tables of contents or maps, users sometimes have difficulty knowing where to start reading. By combining search capabilities with hypertext, developers provide a method for users to find initial entry points. Searching by keyword for likely places to begin reading about a particular topic and then traversing through hypertext to the precise location is an effective method for navigating through large hypertext systems.

**The Decision to Link or Not to Link**
Although first-time designers of hypertext tools often create as many links as possible between nodes, too many links can confuse the user, especially in systems that have weak navigational assistance. One hypertext developer's conservative view is that designers should carefully justify every link in a hypertext system to ensure that all links will be valuable to the users.

**Layers and Views in Hypertext**
Hypertext provides a means to tailor a single document or hypertext data base for multiple audiences. The process includes creating a core of information in hypertext with appropriate links, nodes, and organization. Designers must then determine what information each audience may need and which language or verbal context they would use to ask for this information. Designers must create additional hypertext nodes that function as views into the central data base for each audience, summarizing important topics from each perspective and linking them into the central hypertext.

For example, an organizationwide policy and procedures manual can be useful to employees in several departments. By adding nodes with such titles as For Personnel and Purchasing Department Information and then linking them into the core hypertext manual, writers can accommodate the needs of each different department. Similarly, adding layers of nodes to represent different levels of detail or multiple types of information (e.g., procedures, regulations, and legal precedents) is key to making hypertext multidimensional—that is, capable of addressing different information needs within the same system.

**Justifying Hypertext Applications**
Although the ability to automate document cross-referencing is an important benefit of hypertext and alone may justify its use in many cases, systems designers and users can benefit from hypertext capabilities in more fundamental ways. In conventional text retrieval systems, for example, even when subject experts search for information, their success rates are seldom higher than 80% (i.e., they are likely to find, at most, only 80% of the information needed) and can be as low as 20%. One major drawback of traditional search systems is that when they do not respond to a query with the desired information, the user cannot tell whether it is because the data base does not contain the desired information or
because the user does not know the correct words with which to query. Most users of online systems of this type have been frustrated by such ambiguity.

Hypertext systems enable users to move from known information to needed information. Once an entry point into the hypertext has been located, the information the user view remains in a known or at least seen context. If more information about a given topic, word, or phrase is needed, users can jump to additional information by way of hypertext links. Unlike the blind search required by a conventional data base, hypertext allows for conscious decision making at each link along the way.

**Online Documentation**

A basic reason for using hypertext is that it can provide improved access to voluminous textual and pictorial data. Several major accounting firms have used HyperCard to create online reference materials for auditors and other financial professionals. Ford Motor Co. has created maintenance manuals with hypertext, and numerous hardware and software companies have built hypertext help systems into their products.

**Context-Sensitive Help**

Some hypertext help systems are context sensitive—that is, initial operation of a HELP key provides entry into an appropriate section of a reference manual, from which users can link to other parts of the full reference. Several electronic publishers have released hypertext reference sets designed to provide decision support for various professional markets.

**Online Job Aids and Just-in-Time Training**

Beyond the use of hypertext for standalone or context-sensitive documentation, some applications link hardware and software tools. Integrating hypertext with computer-based training has become a widely used strategy among instructional designers.

Hypertext can provide easily accessible task-related information, offering just-in-time training whereby users access material only when they actually need it to perform tasks. Such an approach can potentially reduce training costs and time away from the job. Systems that allow users to jump from hypertext documentation to computer-based tutorials or interactive video can provide workers with flexible training systems to be used as needed.

**Multimedia and Applications Links**

More advanced applications use hypertext to link documentation, multimedia content, tutorials, expert system, application programs, and even diagnostic hardware and software. Hypertext provides a powerful strategy for developing various types of computing environments that are structured as associative networks of information and tools. Some systems allow users to add to the hypertext, especially for supporting communications and creative work by project team members (e.g., software engineers). The ability to add notes, commentaries, and revisions to a group document base through hypertext links can offer significant performance improvements in some fields.

**Cost/Benefit Considerations in Developing a Hypertext System**

Time and cost estimates for hypertext development are difficult to provide. The cost for paper-based and screen-based technical documentation can vary from as little as $50 per page to as much as $500. The average cost for quality documentation is about $300 per page. Creating intelligently structured hypertext is more time-consuming and expert
intensive than simply dumping text into a hypertext system. In other words, an organization gets what it pays for.

In addition, hypertext costs vary tremendously. A version of HyperCard (Claris Corp., Santa Clara CA) comes free with every Macintosh computer. Guide (Owl International, Inc., Bellevue WA) costs about the same as a word processing program. Powerful products such as BOX Co.'s (Cambridge MA) Window Book technology or Owl's IDEX may require site licenses that initially cost from $50,000 to $100,000. The cost of a site license in the context of a large organization's budget is relatively minor compared to the value of the information the system is designed to make accessible.

Additional considerations that affect cost are graphics requirements (if any) and whether an organization is beginning with existing text or creating it as it goes. Utilities for transforming existing American Standard Code for Information Interchange text into various hypertext formats are becoming more widely available, though the ultimate decisions about links must rest with a human intellect.

Hypertext development software with built-in navigational features can reduce the costs of developing specific hypertext documents. Window Book, Inc. (a subsidiary of BOX Co.), converts preexisting ASCII text files into hypertext documents for as little as $25 per page. It is able to do so because the Window Book system already incorporates key features, which therefore need not be built into the process of creating each hypertext document.

On the positive side of the cost/benefit ratio, hypertext may require as much as one-third less actual text than a comparable paper publication. The reason is that in hypertext the designer writes about a given topic only once, linking back to that information whenever other parts of the materials refer to it. On paper, designers must often mention that the same topic has already been discussed many times. A well-organized hypertext may require less written material than comparable paper publications.

**Development Strategy**

Developing an effective hypertext system requires instructional design and structured documentation development skills. In general, a methodical approach to initial systems development can involve the following steps:

- Analyzing the information needs and tasks of the audience.
- Designing the system by outlining and organizing content, graphics, and screen formats.
- Developing the system by composing or importing text and graphics from other sources and creating links.
- Implementing the system, which may involve initial testing with a restricted audience (i.e., beta testing) followed by full implementation.
- Evaluating the system, ideally according to both qualitative and quantitative performance measures.
- Revising the system on the basis of evaluation results.
An important implication of hypertext modularity is that systems can evolve over time, beginning with a core of content and organization and growing with revisions and additions. As with any system, hypertext applications that can affect the entire organization usually require an administrator who tracks distribution and revision, manages the project, and maintains the system.

Selecting a Hypertext Product

Although many new hypertext and hypermedia systems are emerging, three major products that have been available for some time on microcomputers are Window Book technology, Guide, and HyperCard.

Window Book Technology

Window Book technology from BOX Co. was the first commercially available hypertext development system for IBM and compatible microcomputers. Designed to run efficiently and at high speed on even 8088-based microcomputers, the system's original objective was to produce thoroughly cross-referenced diskette-based publications. Examples of commercially published Window Books include a series of diskette-based guides to popular software programs called Boston Docs and the diskette-based users' manuals currently shipped with Toshiba laptop computers.

Two large French insurance companies asked to license the authoring system to provide online policies, procedures, and product knowledge documentation for their employees. Subsequently, a major reference book publisher commissioned BOX to expand the system's capabilities for navigating through hypertext documents published in multivolume CD-ROM—perhaps tens of thousands of pages in length.

Among the strengths of Window Book technology is its set of built-in navigational aids. These aids are powerful tools for systematically designing accessible hypertext documentation and include:

- An automatically created table of contents.
- A trail that records what articles the user has accessed while traveling through hyperspace.
- A feature allowing for multiple levels or dimensions of cross-references among articles.

Guide

Guide is a hypertext system originally released by Owl International for the Macintosh and subsequently for IBM PC/AT and compatible systems operating under Microsoft Windows. Guide is much like a standard word processor with features that enable writers to create links between documents and add references, footnotes, and other associative information.

Because it operates in a bit-mapped graphics environment, Guide is capable of including complex diagrams and technical drawings along with textual materials. The system employs features common to high-end hypertext systems, including a user interface with a mouse, icons, and pull-down menus. Among the larger demonstration projects that have used Guide (or its more powerful version, IDEX) is a data base of technical manuals developed for Ford Motor Co.
Guide lacks efficient built-in navigational aids—a weakness that can cause users to become lost. If an organization's designers create tables of contents, appropriate decision tables, and other forms of structured text, they could compensate to some extent for the system's lack of built-in navigation. When designers must create navigational aids, updating and editing present more complex problems because each substantial change in the data base may require redesigning the navigational framework.

**HyperCard**
HyperCard has created the most extensive public awareness of hypertext and hypermedia. HyperCard includes a linking feature for creating hyperpaths through textual, graphic, and multimedia information. Therefore, it can function as a text retrieval tool. Many of HyperCard's commercial applications have been textual publications that usually include substantial amounts of graphics as well (e.g., an electronic version of the Whole Earth Catalog). HyperCard also includes a basic but slow search system, and third-party developers have built faster add-on search engines.

HyperCard functions effectively as a front-end to complex networks of other computer programs, multimedia data bases, and systems software. It is a multifunction tool with a linking facility that programmers can expand in various directions to suit their specific needs (e.g., by creating additional functions using HyperCard's own programming language, HyperTalk, or numerous other standard programming languages). Several major corporations have developed user-friendly data access and information retrieval systems using HyperCard. The program has recently spawned a number of work-alike programs with broader and more powerful functions on both the Macintosh and IBM PC and compatible systems.

**Conclusion**
Hypertext's associative data base technology is an emerging tool for creating various online documentation systems and computing environments. Compared with, or as an adjunct to, conventional search data base technology, hypertext provides a powerful method for making online information and tools accessible to enhance user job performance. IS managers should look beyond the hype about hypertext and hypermedia. They should undertake a thorough needs analysis and evaluate the design issues, as described in this article, before embarking on any hypertext or hypermedia development project.

IS managers must be wary not to jump on this technology bandwagon before determining whether their organizations are ready to use it effectively. The decision to use hypertext should be business driven rather than technology driven. IS managers can begin to evaluate hypertext technology concepts and applications by:

- Distinguishing between the associative or linking strategy of hypertext and the search-and-index capabilities of conventional data base technologies. For example, conventional systems require specific querying methods that will target needed information, whereas hypertext allows users to query in a broader context using links that enable them to access more information more efficiently.

- Recognizing the strengths and limitations of hypertext. Although the search functions in a hypertext system are associative and may therefore help users to access needed information that they previously might not have thought to look for, the free-form design may confuse users about where entry points are and the actual location of information within the system.
Evaluating whether or not the organization would benefit from such hypertext applications as:

- Online policy and procedure documents and technical reference material
- Context-sensitive help for applications programs.
- Online job aids and user just-in-time training.
- Multimedia and applications program links through a single hypertext front-end.

Evaluating whether or not hypertext can improve the organization's overall computing environment performance.

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