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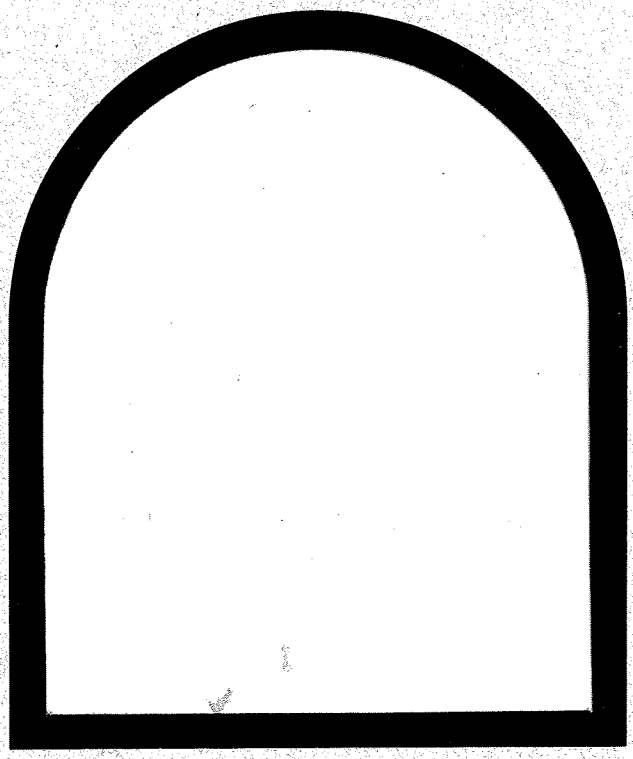

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THE ELECTRONIC DOCUMENT IN THE INFORMATED ORGANIZATION

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The Electronic Document in the Informated Organization[1]

by

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For the past 450 years, ever since Gutenberg automated the printing process, the standard technology for recording and communicating information has been the printed page. As technologies go, it's been enormously successful. A book is inexpensive, easy to produce, rugged, relatively portable, it supports high resolution text and graphics and can be read under a wide variety of circumstances. No wonder it's been a successful technology. Books have given me a great deal of pleasure over the years and I am certain they will be with us for many years to come.

Books, however, are not without limitations. For example, while the individual book is reasonably portable, *en mass*, they get quite heavy. Electronic media are far more compact. You can store half a million pages of text on a single compact disk which you can slip into your pocket or mail in an envelope. In the electronic form you can also transmit those pages electronically to the user. This is a great advance over making the user come to the library. Delivering information to the user rather than the user to the information is efficient. Electronic documents can also be searched by computer and reformatted on presentation.

Another limitation of the printed book is that it is linear. You can't jump around easily from idea to idea in the way that you want; instead you have to view the information as the author organized it. Printed books are organized into volumes. You cannot easily link to information contained in other volumes.

And although books may have beautiful typography and illustrations, they cannot contain audio and video which have become important media in this century.

Finally, the printed book does not protect the reader from information overload. It cannot selectively present pertinent information at precisely the correct level of detail needed. This task is left to the reader.

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[1]*This paper is based on a keynote address presented at the University of Waterloo's Second Conference on Quality in Documentation, May 14-16 1992.*

Electronic Books

In the past decade, electronic documentation has offered an alternative to the printed page.

There may be a temptation to look at the electronic document as a trivial extension of the printed page, a simple matter of placing text on screen rather than on paper. I think that this view is wrong, and it has caused some problem for those who attempt it. The electronic document is qualitatively different from the printed document in both structure and use.

What is the relationship between electronic and printed documentation? For some time, but with mixed feelings, I have been using the term *electronic book* to describe this new information medium. My concern has been that thinking of electronic documents as a form of "book" may hold us back and restrict our creativity. But the book is a powerful metaphor. Its structure has evolved over centuries, parts of which translate well into the electronic medium.

Books are collections of information. So are electronic knowledge bases. Books have all sorts of structural elements such as tables of contents, indexes, headings, and chapters which help organize the information in them. Such aids are desirable in electronic knowledge bases. Books may be skimmed, read thoroughly or used for reference. These are all desirable attributes of an electronic knowledge base. Books mix text and graphics, electronic knowledge bases mix text, graphics, audio and video.

Finally, books are organized into volumes. Surprisingly, this can also be an important element of electronic knowledge bases. In electronic knowledge bases we would like volume boundaries to be flexible but we also need structures to limit searches and help users navigate within a bounded domain.

The analogy between books and electronic knowledge bases falls apart when we consider the static nature of books. Electronic books can be dynamic. Their text can be created from databases and newswires. It can change depending upon the reader. And it can be reorganized to permit multiple views of its content.

Ultimately, the electronic book will evolve into a new medium which may incorporate the major media we use today: print, graphics, video, and audio. All delivered to the reader by high-speed communications lines and searched and managed by computer. For today, however, I continue to hold on to the metaphor of the electronic book.

The Informated Organization

The title of this paper suggests that the electronic document will be used in "the informated organization". The phrase was coined by Shoshana Zuboff of the Harvard Business School in

her 1988 book, *In the Age of the Smart Machine*[2]. In comparing "informated production" to automated production she says:

> The distinction between *automate* and *informate* provides one way to understand how [information processing technology] represents both continuities and discontinuities in the traditions of industrial history (p.10).

Automation is the replacement of human labor by machine-assisted labor. Replacing a shovel with a backhoe or a hand drill with a power drill is automation. When computers are applied to the automation process they simply continue an effort which has been on-going since the start of the industrial revolution. The replacement of a factory worker by a computer-controlled robot is perhaps the extreme example of automation. However, Zuboff notes, when computer technology is used to informate processes...

> it increases the explicit information content of tasks and sets into motion a series of dynamics that will ultimately reconfigure the nature of work and the social relationships that organize productive activity (p.10).

I interpret Zuboff as suggesting that when information is distributed in the corporation, there is a qualitative shift in the way that people interact. The lines between management and employee, between foreman and worker become blurred. Further, information redistributes the power in an organization, increasing dependence on individual workers and their knowledge.

There is an anecdote about a factory worker who retired after having kept the factory's machinery operating for thirty years. Shortly after he left, there was a severe mechanical problem which shut down production. After failing to resolve it, management called the worker back as a consultant. He walked over to a pipe, tapped it with a wrench and the production line started up again. He then presented management with a bill for $1005. When they complained that the bill was a bit steep for five minutes of work, the retired worker replied: "The five dollars was for tapping the pipe. The $1000 was for knowing where to tap".

To understand the forces which are pushing business to shift from an automated to an informated structure, it is helpful to look at the historical context. Table 1, which follows, presents a view of Western industrial history, divided into three phases:

Stage	Workers	Market/Production	Problems	Strategic Focus

[2]Zuboff, Shoshana *In the Age of the Smart Machine: The Future of Work and Power.* New York, Basic Books, 1988.

Pre-Industrial Era (before 1750)	Artisan (Craftsman), Cottage Worker (Weaver), Agricultural Worker.	Market is custom. Production for individual customers or small traders.	There is little technology available to increase productivity and to assure a constant supply of raw materials.	Quality of production. Access to materials.
Industrial Era (1750-1960). Period of automated production	Factory Worker.	Homogeneous market. Production geared to commodities. Bureaucracy is an efficient form of management.	Division of labor isolates worker from final product. Holistic skills devalued. Labor becomes viewed as a commodity. Worker must follow "factory rhythms".	Improve production through automation which replaces human labor with machines.
New Industrial Era (1960 - Period of informated production	Knowledge Worker.	Heterogeneous Niche Markets. Products are customized for market segments. Bureaucracy is inefficient, replaced by "horizontal" management structures.	Worker overloaded by information. Poor communications impair productivity. Individual attributes must be catered to. Production is increasingly abstract.	Strategic use of information processing.

The first row summarizes the pre-industrial period; the age of the artisan. Production in this period was through cottage industry or crafts. An individual, or perhaps a small team, was responsible for creating all aspects of a product. The worker's connection to the product was direct. For a price, the consumer could have the product customized as needed.

Training, in the pre-industrial period, was based on apprenticeship. Each worker had to learn the whole range of production tasks, a process which might take years.

The weakness of this period was that there were no ways to significantly increase productivity. Automation was yet to come.

Beginning in the 1770's, a new industrial structure: factory-oriented, technology-driven and geared toward mass-production, displaced the artisan.

Writing in 1776 in *Wealth of Nations*, Adam Smith proposed that the basis of an efficient production system lay in the division of labor -- dividing the process of production into sub-tasks,

which are assigned to individuals or small teams. This was a significant paradigm shift. The craft shop was replaced by the assembly line, with each factory worker was responsible for only one aspect of the product Mass production sacrificed the individual touch for production efficiency.

Classic management theory, which found its scientific justification 135 years after Adam Smith in Frederick W. Taylor's 1911 treatise *Principles of Scientific Management*, became the predominant economic model of the industrial world.

Since the industrial model did not require its workers to have a broad base of knowledge, workers were transformed from craftsmen to specialists.

From the worker's point of view, the industrial model was unfulfilling because it divorced the worker from the product. If one's job consists of repetitively turning a screw on the assembly line, it is difficult to develop a sense of pride and ownership of the final product. Nor does it matter a great deal if the end product is an automobile or a refrigerator.

The strength of the industrial model is its ability to produce material goods efficiently and cheaply. As Western society evolved from rural to urbanized, the inexpensive products of Western factories made it possible for many to achieve a relatively high standard of living. The bulk of the population considered itself to be middle-class; if not rich then certainly far above want.

The weakness of the industrial model is its inflexibility. Automated production is mass-production. It works best when producing a standardized product. It was said of Henry Ford's Model T automobile, for example, that it was available in any color the customer wanted...so long as it was black.

As consumers became more sophisticated they began to demand less standardized products. Industry, seeking a competitive edge, began to look for ways to distinguish their products. A production facility which cannot vary it's product efficiently may become less competitive than one who can. Chemical plants, for example, which produce plastics for use in such diverse products as automobile bumpers and lawn chairs may waste up to 50,000 pounds of plastic when modifying the formulation for a specific customer.

By the 1960's computer technology was adopted by corporations and dumb machines became smart machines. By the 1980's the microcomputer and other microminiaturization technology such as stepper motors made it possible for small companies to successfully compete against larger companies.

As technology allows the creation of smaller and less costly tools of production, the economies of scale often shift to favor distributed over centralized production. If a product can be tailored to a niche market, at a price comparable to the standardized product, it will be more desirable to the consumer. Why send data processing to a central service center when you can get access to a powerful personal computer? Why send photos to a central lab and wait days for processing when you can bring them to a local one-hour photo processor? Why drink canned beer when "micro-breweries" serve a fresh product.

As local small-scale production becomes increasingly cost-effective, consumers have re-awakened to the fact that when dealing directly with the producer, there is increased choice and increased satisfaction. Products can be tailored for the niche market rather than for the convenience of the producer. This offers serious competition to the large established company and encourages them to consider an alternative model of production which can adapted to serve niche markets.

Alvin Toffler in his book *Powershift*[3] points out that:

> There is mounting evidence that many giant industrial firms, once the backbone of the economy, are too slow and maladaptive for today's high-speed business world.

To remain viable, large corporations are restructuring. They are emulating smaller business, becoming collections of autonomous business units within a larger corporate structure. These hybrid corporations are not totally decentralized but they tend to be less hierarchical than their traditional counterparts.

Information Needs in the Informated Organization

All this suggests that the corporation of the 21st century will be comprised of small semi-autonomous units each serving a specific market segment. The new corporation will have information requirements which are quite different from the traditional industrial organization.

In the new corporation, each worker must understand the product and its underlying technology. Workers will need to understand an increasingly complex regulatory environment. Because the autonomous business units will be servicing niche markets, workers will need to understand their customers' business and assist customers in integrating products into the customer's environment.

Table 2, which follows, shows the type of information that workers must have at their fingertips:

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[3]Toffler, Alvin. *Powershift*. New York: Bantam Books, 1990.

The Organization	Organizational Structure Resources Available Organizational Goals
Policies and Procedures	What Can be Done How Activities are Performed Regulatory Considerations
The Product	Functionality - What the Product Does Features and Benefits Underlying Technology
The Market	Customers - Who Uses the product Applications - How Customers Use the Product Competition - What Alternatives Customers can Select

Information Delivery in the Informated Organization

It seems obvious that in the new corporation, training will be important. Traditionally, training has been devalued in corporations, I suspect because assembly-line workers are not required to have broad skills. But in the new corporation training will be an essential productivity tool.

Workers will also need instant access to information and protection from information overload. This suggests that in the new corporation, information must be delivered on-demand. A requirement which mandates electronic documentation.

The hardware to support on-demand information delivery is more or less in place.

The networked personal computer will be at the heart of the informated organization. Some information will be stored locally, other information will be stored remotely. Where the information comes from is transparent to the user. High-speed communications links will connect computers in local area networks and across long distances in wide-area networks. Such communications technologies as frame relay and cell relay will carry images, sound and full-motion video from computer to computer, fast!

Today many personal computers are being delivered with CD-ROM drives. Within a few years personal computers will routinely be delivered with digital multimedia capabilities. This will enable them to display documents with sound and full-motion video and will enable corporations to send multimedia over digital networks.

Computer screens are becoming larger with higher resolution. This makes displays easier to read and large enough to be shared by several programs at once. Multi-tasking operating systems allow users to suspend a program, look up a piece of information, and resume the task at hand.

As usual the engineers will competently solve the hardware problems and provide the capabilities. Our task will be to design the software which will turn the networked personal computer into an information resource.

Mission Statement

Cognetics Corporation, the company of which I am President, recently revised its mission statement as follows:

"To deliver finely-crafted interactive systems that empower individuals by providing them with:

- the information they need
- at the time they need it
- in the form they need."

I would propose that this mission statement might serve well as a goal for electronic documentation.

The key word, as I see it, is "empowerment." When we talk about delivering information electronically, we do it to empower individuals; to make them capable of executing tasks more efficiently and more effectively than they otherwise could.

When we talk about electronic documentation, there is an implicit assumption that the user is performing some task and is requesting the information to facilitate the completion of the task. The most obvious example is that the user is working with some software and needs access to the documentation in order to find out how to perform some particular function.

But there are other situations that can be imagined. For example, a mortgage banker might be filling out a form and need instructions and information to complete it. Or a customer service

representative might need to access product information while resolving a problem with a customer.

The Electronic Bookshelf

I envision an information management resource, resident on every personal computer in the new corporation. I think of this resource as *The Electronic Bookshelf.* Like a traditional bookshelf, it holds books, in this case of the electronic variety.

Gone from the office are the shelves filled with policy and procedure manuals, software documentation, and other dusty resources. Anytime the user needs information she consults the bookshelf which responds by displaying it on screen, with audio and video if appropriate.

The *Electronic Bookshelf* is also available to programs running on the user's computer. With a keystroke or mouse click, it can bring up context-sensitive help.

Performance Support

The *Electronic Bookshelf* is a collection of *performance support* tools. These are tools which are available to the workers to assist in the completion of job tasks. Integrated into the electronic documentation are training modules which provide the worker with instruction on-demand. Also available are search engines and indexes which permit the worker to quickly locate any relevant piece of information.

Software for Electronic Documentation

Several software engines will be needed for producing and managing electronic documentation.

Image processing is a technique which takes pictures of printed pages and stores them on direct-access storage for later retrieval. It is, in principle, an electronic replacement for microfilm or microfiche, although the technology is quite different.

Image processing is valuable when there are many documents which need to be converted to electronic form. It is best used on masses of single-page or very short documents. It is less-suited for long documents or books because the content is unavailable for computer processing. It stores a picture of the page, not its content. This means, for example, that documents processed as images cannot be searched with a full-text retrieval system. Typically a series of keywords is assigned to each document, like tabs on a file folder.

Full text search is a technique in which the entire text of the document is indexed. For this reason, it can only be performed on documents created electronically or documents which have been converted into electronic form (not images!) through optical character recognition.

Full text search has the advantage of requiring no special authoring technique. Once in electronic form, the entire set of documents can be indexed automatically. This advantage is offset by the fact that the documents are not necessarily retrieved in any useful order. Nor is there a way to separate important mentions of a phrase from incidental mentions. I think of reading a document from a full-text search as similar to trying to read a book from the index. There are times that it is helpful but it is not ideal in general.

Hypertext

Although both image processing and full-text search have a place in electronic documentation, I see *hypertext* as the core technology of electronic documentation.

Hypertext is a technique which stores information as a series of nodes, linked together. Each node has active cross-references to other nodes and allows the reader to "jump" to other parts of the database as desired. This makes the reading (and writing) process nonsequential.
In a hypertext database conceptualized as a network of nodes and links, the documents are the nodes and the cross-references are the links. I often prefer to refer to a hypertext database as a *knowledge base* because hypertext tends to have a less restricted record form than a traditional database.

In a traditional database records all have a uniform format and are divided into fields. Generally, a user moves from record to record by means of an index -- that is, based on the contents of a field. In hypertext, in contrast, pieces of text or graphics are directly linked to other information. Therefore, the movement is from document to document rather than via indexing.

The knowledge network which comprises the hypertext is often designed around a metaphor. For Hyperties®, the metaphor is an electronic book. For Apple's Hypercard it is a stack of index cards. The metaphor can strongly influence the type of knowledge base created. In my view, the index card metaphor is best-suited to small, discrete chunks of text and graphics. The book metaphor is more appropriate to larger textual databases such as manuals.

Each single document in a hypertext database is a node. This may be a "card" in the stack metaphor or an "article" in the book metaphor. Nodes are usually written so that they are self-contained and do not depend upon the reader having viewed other documents. The documents which are nodes are not restricted to text but may include graphics, photographs,

sounds, or video. When the documents are multimedia in nature, the term *hypermedia* is often used.

Documents or nodes are connected by *links*. Each link must be activated in some fashion. In some systems, the links are hidden and need some actions to reveal their presence. I tend not to like this approach because it causes additional work for the user.

An important form of link is the *text link*. It is possible to create text links automatically or, at least, support the link creation process with software tools. The design of knowledge network defines the way in which browsing is performed and therefore a lot about the user interface.

There a number of hypertext systems which have been developed and you may encounter several of these throughout the course of this conference. I will concentrate on one system called Hyperties® because it is the one which I have a part in designing and which embodies many of my ideas as to how best to solve the problems of hypertext design. I do not mean to suggest that Hyperties® is the best solution for all problems and I will try to point out situations in which I would prefer systems designed with a different metaphor in mind.

Hyperties®

In 1982, Professor Ben Shneiderman of the University of Maryland began exploring software designs to create "electronic books". Professor Shneiderman's main interests are the design of user interfaces and the experimental study of human/computer interaction. He has written two influential books on the subject, *Software Psychology* (Little, Brown, 1980) and *Designing the User Interface* (Addison-Wesley, 1987,1992).

Professor Shneiderman's original hypertext system was called TIES (The Interactive Encyclopedia System), now available commercially as Hyperties®. Hyperties® is a software system for creating hypertext knowledge bases conceptualized as "hyperbooks". Readers may browse through the knowledge bases following links of interest. In addition to browsing, a reader may locate a specific article by topic, through a Table of Contents or a specific article by title, through an alphabetical Index. Hyperties also provides a full text search facility which allows the reader to locate articles by keywords.

Articles may consist of text, illustrations, audio and video sequences. This makes Hyperties® a *hypermedia* system.

By design, Hyperties® is extremely easy to use. This was a major design goal and was supported by extensive laboratory research. Research shows that readers use Hyperties within a few minutes. This means that Hyperties can be used without incurring training costs. Hyperties is

also easy to author. Authors become proficient in basic Hyperties in less than one hour. This means that non-programmers can use Hyperties to create powerful and useful databases.

Hyperties consists of two programs: *The Author* and *The Browser.*

The Author allows you to create a database of articles, and illustrations. Authoring is simple; experience has shown that authors become proficient in under an hour for the basic system. Advanced authoring options such as scripting require additional training.

The Browser is used to access the Hyperties database. A **highlighted** word or phrase indicates a link to additional information. The user can access the entire Hyperties database, with a mouse, a touchscreen or by using only three keys. Hyperties therefore requires no typing skills nor does it require the user to learn a command language.

The power of Hyperties comes from its ability to create *links* which tie articles together. A link is a cross reference, an indication that more information on a particular word or phrase is available. Links are specified by enclosing the word or phrase to be linked in ~tildes~. Hyperties performs the linking automatically.

Shneiderman believes that designers and researchers must go beyond the informal arguments about user friendliness and develop a scientific discipline of user interface design. He sees hypertext as an easy-to-use, yet powerful way of organizing and presenting information. He also feels that there is a need for research on the structure of knowledge and design of computer systems to take advantage of hypertext.

The Role of MIS in the Informated Organization

As organizational entities go, the MIS department is a recent innovation. Thirty years ago, when the few computers in industry played a minor role in management, the MIS department was unknown. Over the last three decades, as the computer evolved into a core operational technology, MIS departments were born, matured and now face mid-life crises.

How well are MIS departments equipped to develop the information tools needed in the new corporation? In some respects, they are well-equipped. The high-speed communications networks that will tie the informated corporation together are highly technical and their maintenance will naturally fit under MIS.

Multi-tasking operating systems are complex to install and maintain. This task too will naturally fall under MIS.

There is another, more important reason, for MIS to play a key role in this transformation. As corporations restructure, the information systems will cross divisional lines. This will create turf battles, "not-invented-here" barriers and other organizational issues which impede progress. In terms of corporate structure MIS is generally well-placed to handle these problems.

Unfortunately, the culture of MIS is not particularly user-friendly. People in MIS are not typically experts in communications nor in knowledge management. These skills are more typically found in training and documentation departments.

It will be necessary therefore for trainers, documenters and systems personnel to collaborate in the development and delivery of electronic documentation.

Conclusion

Technological and social forces are creating a shift in the way that industry is organized and operates. This shift has been characterized as the transformation from automated to informated production.

Electronic documentation will be a key component of the informated organization. Hypertext will be the core information management technology.

It will be necessary for training departments, documentation writers and MIS departments to collaborate on the development and delivery of electronic documents in the informated workplace.