Making the Most of Interactivity Online

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Technical communicators need to foster useful online interaction to help users understand the scope, purpose, and limits of the online documents we create. Ideally, a well-designed online document provides a total integrated data environment. It functions as the interface between the user and a system, allowing for the retrieval and integration of supporting data as needed to perform a task. Online information can be presented in a variety of ways, including online help systems, computer-based training (CBT) programs, and interactive electronic technical manuals (IETM). The benefits of an effective online information system include the elimination of paper bulk and storage, improved document usability through interactivity, and the use of the document as a learning, training, and research aid.

MOVING BEYOND THE BOOK

As more of our work as technical communicators moves into the online world, we need to consider how our users will put our online products to use. When writing for the printed page, we make a vast number of assumptions about how users will make use of the final product. We know how they will use the pages, the binding, the covers, the table of contents, the page numbers, the headers, the footers, and the indices we have provided for them. The printed and bound text is an information technology we're all intimately familiar with.

When we move into an online environment, only some of the cues we have learned from printed documents carry into the new realm of information presentation and delivery. Some of what happens online does indeed "feel" like using a book, a listing of hyperlinks at the start of a document does appear to function like a standard printed table of contents, and some search engines do function like a well-written, printed index. However, there are far more print metaphors and their related functions that fail us in an online environment. Without the printed document in our hands, without the actual book, a user often has a great deal of trouble understanding the scope of the information we're presenting in an online environment.

The weight of a book tells us how much text it contains, and the size of the binding tells us even more. The binding tells us where to begin and where to end. The object itself sets the limits for the information contained inside. All the cues from the physicality of printed text evolve and intermix in an online environment, sometimes to the point of total confusion. One online construction may at first seem voluminous, but through use, reveals that it actually contains very little information. Another online construction may seem shallow and "thin" at the start, but later reveal itself to be vast and complex. In an online environment, text isn't permanent. Users can often interact with, change, update, mark, and revise the text on their computer screens. Where the user's text begins and our prepared text ends can sometimes be difficult for users to adequately comprehend.

The book is a finished product—it is a final piece of work and it usually has just one primary use, one primary purpose. The computer screen can be used, in a single session, for creating text, editing text, revising graphics, viewing prepared material, researching distant information resources, game playing, and even office gossip. To accommodate such a wide range of activities, most online environments have no sense of finality, no established limits; therefore, online environments can become infinitely mutable, adaptive, and ever-changing.

As technical communicators, we are interested in setting and defining limits; we are invested in accuracy, clear presentation, and telling the truth. Therefore, to demonstrate the established limits of our presentation format, to be accurate with the information we're delivering, and to gain the trust of our users, we need to first learn how to instruct our users in the use of the online documents we create. We need to help them interact with our creations in ways that allow them to fully understand the limits of our presentations. We need to guide them through our information creations in a consistent manner and show them how much information is actually contained inside. We need to teach our users how to find what they are looking for, and to allow them to put that information immediately to use. Through consistent, clear design, and with a solid understanding of the type of interaction we are encouraging and discouraging, we help gain our users' trust and help maintain their confidence that they are using the technology for their purposes, instead of the technology using them for its own ends.

INTERACTIVITY IN ONLINE HELP SYSTEMS

The purpose of interaction in online documents is to increase user learning and retention. Researchers have found that interaction results in more effective education since its use allows students to learn faster and retain knowledge longer. Additionally, users are often able to transfer and apply knowledge more readily in real world situations. Such explanations of the benefits of interactivity tend to lead people to think in terms of

simulated environments and multimedia. In fact, most people define interactivity in terms of the amount of multimedia the system contains.

More important than multimedia is an older concept – hypermedia. Researchers recognize that the "essence of hypermedia is the instantaneous and dynamic linking of concepts" (1). Today, it is a relatively inexpensive endeavor to create interactive hypermedia systems. An important issue that designers must address when creating interactive systems is ensuring the user is not a passive participant. Traditional genres of information, such as books and TV, provide one-way interaction – the users are simply presented with information. Adding multimedia to an electronic information system does not necessarily make that system more effective as a learning mechanism. When it is not properly designed, "multimedia forces the user back into that passive role of watcher" (2).

Designers should provide users with the option to respond to information within the system and receive immediate feedback. This type of two-way interaction is often accomplished by providing users with the ability to easily navigate and search the system to meet their informational needs. In an online document that allows users to maintain control over the type and amount of information that is presented, "learning can occur at a deeper level of cognitive processing [and] the possibility of transfer to 'real life' will greatly increase" (3). As simulated training environments and the bells and whistles associated with multimedia have become more impressive, some people have lost sight of a more fundamental form of interactivity – the user's interaction with the text.

When designers define interactivity in terms of the user's interaction with the text, they must focus on three major components: creating information access mechanisms, planning navigation routes, and giving users control over hiding and revealing information. The first two components are closely interrelated. Information access mechanisms are only effective when they lead users to pertinent information and aid them in navigating the system. By designing the content and links with navigation in mind, it is possible to create a system wherein users "are able to use efficient procedures to access specific information nodes and to move freely between associated nodes" (4). The users' ability to move through a document and find the information they need – their ability to navigate – contributes greatly to the success of that document.

The third component of textual interactivity, user control over hiding and revealing information, is beneficial because users have proactive control of the system; in other words, they "can make decisions about what will be presented and how it will be presented" (5). Designers must remember that their users should have the ability to reveal only the information they need in addition to the ability to successfully navigate through the system.

These three components represent ways that designers can create documents that focus on the user's interaction with the actual text, thus creating successful interactive online systems. The success of these types of interactivity stems from the fact that "students are actively involved in selecting, exploring, and studying from a knowledge base of learning materials" (6).

Interactivity can be looked at from either the user's or the designer's perspective, and both these approaches are typically concerned with predictability. From the user's perspective, any system that allows them to choose the type and amount of information that appears seems to contain limitless interaction. Until they have chosen every possible option and explored every facet of the system (a level of familiarity most users never attain), users will perceive that system as wholly open.

The designer of that same system, however, is more inclined to see the system as closed. While the user is often focused on a particular portion or segment, the designer is intimately familiar with the entire structure. Designers know the boundaries of the system and "even though users make their own choices, it's up to [the designer] what choices they have – what they see first, where they can go, and what they don't see at all" (7). These characteristics cause designers to view their systems as predictable and limited.

In order to be successful, help authors should always strive to incorporate textual interactivity. The user's interaction with the content must be our primary concern. In this context, Newman and Butler's dictionary analogy is useful, reminding online document authors that "dictionaries were designed to recall elements of a job task and make memorization less necessary" and that online help should mimic this design by providing a "predictable structure designed for a specific audience" (8). We should consider interactivity from the users' perspective, in order to envision what structure would be most useful as well as how varied – or overwhelming – the users' options will seem.

Interaction Through Information Access

A help system must provide users with easy information access in order to meet the first criteria of textual interactivity. There are several different types of information access designers may choose from. Two of the key areas of navigation designers need to focus on are making information accessible and creating useful links. Horton discusses three types of information access: automatic, where the computer decides what the user needs to know and then retrieves it; semiautomatic, where users decide what they need to know and the

computer retrieves it; and manual, where users decide what they need to know and then retrieve the information themselves. Semiautomatic and manual are the types of access most often found in online help systems.

Most online help users are familiar with semiautomatic access mechanisms, but think of them in the more common terms of keyword or full-text searches. These searches provide users with the opportunity to interact with the text because they choose the type of information the computer should retrieve for them. Full-text searches retrieve every instance in which a user-entered word or phrase appears. Designers should remember that these searches are not typically beneficial to the average user. In fact, without knowledge of the "specific terminology used in the online document…users may find no hits or hundreds" (9). Full-text searches can be enhanced using Boolean and parametric logic, which allow users to further customize the information the computer retrieves.

Keyword searches match information entered by the user with tags the author of the help system assigned to topics. Users can execute a keyword search on the index, which is one of the primary manual access mechanisms for user interaction in any online help system. One of the benefits of indices in online documents is the ability to create hypertext links between the index and the topic. Users benefit from this type of interactivity because they can quickly link to the topic and determine whether it contains the information they are seeking. It is important for authors to distinguish between index searches and full-text searches.

Creating a useful index is a difficult task because it requires that authors conceptualize all the ways their varied audience members might choose to access the information. Horton advises authors to list all the user's questions that the topic answers, select the principal words and phrases from these questions, select primary nouns and verbs from the topic title, introduction, and content, add terms that are general and those that are more abstract, and finally, add synonyms. Similarly, Hackos and Stevens advise index designers to be comprehensive, use detailed primary entries, and link to the most meaningful occurrences of a subject. Of the many pieces of advice one might consider about indices, the most important to remember is that most users will try only three or four terms for a concept before giving up.

Interaction Through Navigation

Most people are familiar with the lost in hyperspace feeling. It is, unfortunately, a common occurrence for many users of online documents. Users enter online help documents with the intention of finding answers to specific questions, and often end up asking themselves questions such as "where am I?" and "why am I so lost?" Researchers have identified three situations that lead to this type of disorientation:

- users do not know where to go next
- users know where to go but do not know how to get there and
- users do not know their current position relative to the overall document structure.

In order for designers to be proactive about the disorientation problems that can occur in online help systems, they must design the system with interaction in mind. Thorough designers incorporate navigation into their system to ensure that users will not get lost in the virtual space of their hypertext system. One of the most effective techniques designers can employ is "the development of the metaphors of the real world to the interface design" (10). The most prevalent metaphor linking navigation in hyperspace and reality is that of a book.

Most people are first exposed to books when they are less than a year old. We start out watching and listening as others read them to us, even helping our readers turn the pages. As time passes, we are able to point to pictures on the page and identify them. Eventually, we are able to sound out and then read the words in those books. The majority of our interaction with books is based on holding them, physically manipulating them in order to find what we need, and using their size to gauge the amount of information they contain. It is our users' inability to physically interact with an online document – to hold it in their hands – that makes them susceptible to feeling lost or disoriented. And it is this susceptibility that makes designers responsible for providing them with an "interface…which allows the user to interact coherently with the underlying application by being engaged in its mimetic environment" (11). Interface design gives a shape to online documents that makes them understandable and navigable.

Online help authors should consider the book metaphor as they design navigation routes through their systems. A good navigation design will minimize travel, depth, and redundancy throughout the system. Users should not have to navigate to several topics or though several layers to find the information they need. In systems that do require users to travel deep into the system, the users are more likely to become frustrated, or worse, lost. Designers who keep these cautions in mind as they create the navigation system will be more successful. Because indices and tables of contents are primary mechanisms for navigating through traditional books, they should serve the same function in online help systems. In a webhelp system, users have the advantage of the always visible table of contents to help orient them within the system.

Along with indices, tables of contents are another

primary manual access mechanism in online documents. As one of the first screens users see, it is imperative that the table of contents provide adequate information about the system. This is also the screen that users will see more often than any other, and so it should be visually appealing.

Horton suggests that the table of contents should be designed to “show how topics are organized and the relationships among them (12)." The hierarchy within the table of contents should be logical, allowing users to easily find the information they need. It is particularly important to provide a useful table of contents in a help system to provide cues for gauging the size of the information contained within.

Hackos and Stevens provide a number of tips for designing tables of contents. They describe the most important issues, which include:

- making information readily accessible from anywhere in the document
- showing the hierarchical relationships among topics
- creating expandable/collapsible topics
- highlighting the current topic
- indicating the type of information provided in the topic title
- using informative and unique topic titles
- using terms users know in topic titles
- ensuring consistency between table of contents and topic title and
- allowing users to determine scope (9).

Interaction Through Hiding and Revealing Information

In addition to a thoughtfully designed and organized table of contents in an interactive online help system, users should also be given the option of hiding and revealing information according to their specific needs. One of the ways designers can give users this option is by carefully structuring the hypertext link system. In a well-designed system with an effective link structure, users can move freely throughout the files, calling up those topics that contain the specific information they need.

Although users control when links are activated, they do not control the actions that are triggered by links. The three types of links are replacement or jump links; comment, note, or pop-up links; and swap or reference links. Online help users will typically use the first two types, depending on their information needs. Comment or pop-up links provide additional information layered over the original topic, while replacement links move the user to an entirely new subject. Creating pop-up or comment topics is a good way to prevent users from getting lost. However, these links should normally be no longer than one or two sentences. Longer pieces of information must be placed in secondary windows, or provided as additional topics, with both being accessed via a jump link. It is clear that help authors must carefully consider their choice of the types of links to use as they design the structure of their online help system.

Designing a system with both pop-up and jump links creates a system that is useful for novices, who might require a large number of pop-up links, as well as experts, who will want to quickly move on to new topics. Links should give users the opportunity to expand or limit the information to the level of detail they need at the time. Hypertext links are one of the most powerful tools online help authors have for helping their audiences to customize the information to their specific needs.

As online help authors plan their system of links, they must keep the price of those links in mind. There are a number of access controls designers can implement in help systems, including back, forward, stop, contents, index, and home buttons. The back and forward buttons are especially important because they allow users to retrace their steps and return to their starting point or advance to a particular point in the document.

Although users should be given the opportunity to move freely throughout a help system using links, the designer should ensure that the link system is intuitive. Users should understand when they are moving between topics, within topics, and outside of the system entirely. One way to help users is to structure the links according to their purpose. As they choose to reveal information, users should not be surprised by links that take them someplace new, and they should always have the ability to return to their starting point or topic.

INTERACTIVITY IN COMPUTER-BASED TRAINING PROGRAMS

Computer-based training, or CBT, is the use of a computer to help learners acquire knowledge or learn a particular skill. CBT programs come in a variety of types, including informational or knowledge-based programs, games, and simulations. The learning interaction involves a process wherein the computer provides a stimulus, the learner makes a response, and the computer analyzes the response and provides the learner with feedback (18). Key factors in promoting interaction in computer-based training programs include the method of interactivity employed and the type of feedback used.

Interaction Through Methodology

Interactivity is characterized by the level and type of exchange that takes place between the learner and the computer. The effectiveness of this exchange differs from

person to person, depending on their preferred method of learning. Since people assimilate information in a variety of ways, including seeing, hearing, moving, and touching, CBT often employs multimedia in an attempt to accommodate different learning styles (19). Multimedia is useful in communicating information because it combines such elements as audio and video to reinforce learning by calling upon two of the learner's senses, rather than just one, to process information (17). However, for each person, only one mode–visual, auditory, or kinesthetic–is the one through which he or she learns best (19).

The gamut of interactivity in computer-based training programs runs from electronic books or "page-turners," to sophisticated games developed by companies like Corporate Gameware, to realistic simulations offered by the military. Early CBT programs required learners to do little more than depress the Enter key on a keyboard to page through a lesson. The result was that users often become bored with the programs. Questions to measure a learner's comprehension of the material commonly called for either a true-false response or a multiple-choice selection, where the learner could usually guess the correct response (13). With few opportunities for learners to exercise their cognitive processes, a limited amount of learning and even less retention was achieved.

More modern computer-based training programs are grouped by tasks or topics into modules that can be reviewed independently of other modules. This structure allows learners to navigate freely through a program, to explore certain modules and disregard others, and to exert a certain amount of control over their learning experience. Questions at the end of training modules often require learners to type in an answer or drag-and-drop text or visual images to the appropriate areas rather than simply clicking on a multiple-choice selection or a true-false option, thereby increasing the learner's level of interaction with the computer. Additionally, learners must retrieve information previously learned into their working memory to correctly answer a question, thereby engaging their cognitive processes and promoting retention of the material (19).

According to expert opinion, games are one the most effective methods for teaching new concepts (14). Companies such as Chase Manhattan, American Express, IBM, Reuters, and Bankers Trust understand the value of games and employ them in different types of training programs. The theory behind the attractiveness of games is aptly explained by Bernard W. Jordan, Jr., CEO of Virtual Experience Corporation. "The reason is very simple, it's pull vs. push. A game *pulls* you into the instruction and engages you, whereas more traditional instruction tries to *push* information into your head" (14). Also, most computer games automatically lead you to increasingly difficult challenges as your skill level increases. The result is that your reactions get faster and you make decisions faster (14).

The most sophisticated method of interactivity in computer-based training programs is evidenced in the simulation. Typically used by commercial aviation to train pilots in instrument conditions and by the military to prepare soldiers for battle, simulations are also being used in the medical arena to simulate surgical procedures. Simulations are especially useful for training that requires "hands on" experience and for training those individuals who learn best by "doing." Simulation software is less popular than other types of computer-based training programs due to its high cost and the limited number of applications currently being offered.

While the level of interactivity in CBT can range from minimal user intervention to high user control, the type of knowledge being imparted or the particular skill being taught should dictate the appropriate level of interactivity. Developers should seek to give users a sense of control while providing training in a structured environment that promotes optimal learning and retention. The key to successful CBT involves developing an interesting program, asking relevant and well-conceived questions, calculating the many paths users will take in exploring the program, and anticipating varied user responses — all in the context of an aurally and visually rich environment.

Good principles of design, such as the proper use of color and white space, the absence of scrolling, the limited use of attention-capturing devices, and the variation in type sizes and styles for effect, all impact how learners view a CBT program, and therefore, how they interact with the program (15). Additionally, consistency in the placement of text, graphics, audio-visual elements, and navigational devices are crucial in gaining user confidence and attaching credibility to a CBT program.

Interaction Through Feedback

The second distinguishing feature of a computer-based training program is its ability to provide learners with *immediate* feedback to their responses. Gery defines feedback as "the flow of information about the outcome of an action back to the source of the action so that it can be used to improve subsequent actions" (13). Feedback is an important part of the interaction between the learner and the computer because it lets the learner know how well he or she is doing after every response. This is crucial since Gery notes that "learners get very upset when there is no indication about whether their response was correct or acceptable (13)." Feedback not only informs learners about their progress and competency levels, but also increases their level of confidence and decreases their level of anxiety (13). The reinforcement provided for correct responses motivates students to continue with the CBT program, and their ability to immediately discover the correct answer to an incorrect response is an effective method of not only learning

information, but retaining it.

Although feedback can be either aural or visual, the former is not recommended for adult learners since aural feedback can be irritating to the learner and anyone else within earshot (13). Within the realm of visual feedback, there are suggested guidelines for providing feedback for *correct* responses and *incorrect* responses, as well as guidelines that apply to both types. The feedback offered for both correct and incorrect responses should be brief, like using the word 'Good' or 'Correct' for the right answer (13). Feedback for incorrect responses should begin with the word 'No' or 'Incorrect' followed by a sentence containing the correct response, and possibly, a reason why this particular answer is considered to be correct. A more sophisticated program may also anticipate incorrect user responses and offer feedback that includes why an answer is incorrect or only partially correct (13).

It is important, for the sake of consistency, that feedback be displayed in the same location on every screen. The type size, style, and color of the font used to display feedback should also be consistent. In addition, the amount of time the word 'Good' or 'Correct' is displayed on the screen should be the same for each correctly answered question. Alternatively, feedback for an incorrect response should be displayed just long enough for the average learner to read the text contained in the feedback response.

There are three primary methods for providing learners with feedback for incorrect responses. The first method provides learners with the correct answer as soon as they make an incorrect response. This type of feedback is less likely to promote learning and retention since learners really don't have to spend much time or thought in laboring over a question when they know that the correct answer is forthcoming. A way to counteract the negative effects of this type feedback is to include a scoreboard in the Q&A portion of the CBT to record the number of correct and incorrect responses made by the learner. Games are very effective in arousing the competitive nature of learners and motivating them to come up with correct responses so they can "win." By its very nature, CBT affords learners an easy way to improve their scores—by simply taking the lesson over again.

The second method of providing feedback involves giving learners a certain number of tries to make a correct response (13). For example, a CBT program might give the learner three chances to make a correct response before scoring the response as incorrect. The feedback offered after an incorrect response might be: "Sorry, that's incorrect. You have two more tries." The feedback might even include a hint in an effort to assist the learner in answering the question correctly. A variation on this theme involves imposing a time limit during which the learner can make as many tries as possible within a designated time frame. A program employing a time limit for entering a correct response might allow 15-30 seconds for each question, depending on the complexity of the question. This method of providing feedback is highly interactive since the learner is closely engaged in a competition with the computer. To reinforce the gaming metaphor, a clock ticking away the seconds remaining, or a scorecard showing how many tries the learner still has left should be prominently displayed in a consistent location on each screen.

The third method of providing feedback is known as mandatory practice feedback, which has been shown to have a positive effect on both learning and retention (16). When a learner answers a question incorrectly, he or she is branched back to the part of the program that contains information on the objective or concept being queried. After the learner reviews the information, he or she is required to answer the same question and this "loop" continues until the learner correctly answers the question. The learner *must* enter the correct response before he or she is allowed to advance to the next question. This type of feedback is effective because it employs repetition in both a review of the material and a re-answering of the question, and according to behaviorist theory, repetition is a crucial element in learning (19).

Guidelines for Interactivity in CBT

Components of a good computer-based training program include a functional design, well-developed program content, and interactivity appropriate to the task. The level and type of interactivity will vary, depending on the type of CBT program being developed and its task. A strictly informational CBT calls for minimal learner intervention, with the majority of interactivity taking place in the Q&A portion of the program. Alternatively, CBTs that employ games dictate much higher levels of learner intervention, with simulations requiring the maximum amount of user interaction.

The type of feedback employed will also vary, depending on the nature of the CBT program. Feedback in a knowledge-based program is typically text-based and should anticipate learner responses while providing a supportive environment conducive to learning. Feedback in games is rapid, visual (sometimes aural), and stimulates a learner's competitive nature. Simulation programs typically simulate a procedure or task and feedback can be subtle, such as a gauge showing a gradual decrease in a plane's elevation, or abrupt, as in the case of a patient going into cardiac arrest during a surgical procedure.

Whatever its purpose, all CBT should strive to provide task-appropriate information designed to accommodate differing learning styles in a well-structured environment.

INTERACTIVITY IN ELECTRONIC TECHNICAL MANUALS

For an online reference system to be effective, particularly an Interactive Electronic Technical Manual (IETM), the user must interact with the system while the system interacts with an external source or an internal knowledge module. Using the theoretical and practical applications of interactivity and information design, paper technical manuals can be converted to an intelligent, interactive reference system.

Interactivity and the Physical Environment

The first step in converting a paper technical manual into an Interactive Electronic Technical Manual (IETM) begins with the understanding of how the book will be used, the environment the book will be used in, who will use it, and for what purpose. The second step concerns the redesign of the confined static reference material into an interactive usable tool. What results from this process is a software application that demands user intervention in order to benefit from an electronic reference maintenance system. With this type of system, a user must interact with the IETM while the IETM interacts with an external source such as an embedded sensor in a truck engine, or an expert system like a parts database. Through interactivity, the IETM becomes an intelligent interface agent.

Many in the defense industry have incurred high costs to develop an IETM, yet the end product is not usable in the field and interactivity is nothing more than electronic page turning. The problem is that developers of IETMs simply put the paper manual online, retaining the original design. This implies that the original document was usable, which is often not the case with technical manuals. It does indicate, however, that IETM developers recognize the conversion process as software development, but it also suggests that engineers are best suited for the task. This is a problem since engineers are typically concerned with a system's structure rather than the content of the documentation.

IETM usability is of the utmost importance. When the military decides to no longer carry paper manuals into the field, the soldier must be able to rely on the IETM for all reference data. If the system is not usable, the soldier will not have the paper-based manual to fall back on. An IETM must also account for a diverse user-base. It must "walk" a novice through complex maintenance procedures during a mission critical period. To do this, the IETM must engage the user while offering an intelligent interaction between the user and the system based on the user's input. An effective way to accommodate novice, intermediate, and expert technicians, as well as the varying levels of computer skills, is through interactivity. A knowledge or expert system accessed via dialog prompts can increase user productivity and help unskilled users work through complex tasks.

One reason why many soldiers find the use of an IETM difficult is that the designers do not understand the situation or the environment in which the IETMs are used. The problem here is that “online information is badly designed and inappropriately written” (20). Often technical writers develop the paper documentation, but it is the equipment engineers who convert it to an online form. They do not understand the user or the physical context in which it is being used, but are “more concerned with the underlying structure” (20). This is a case for technical communicators to become involved early on in the design phase of the equipment. Those who do not understand the use of the document “often put their old legacy manuals online. These manuals were designed and written for paper” (20). Designers cannot assume that “information written for paper can be transferred without change into online forms, nor should we assume that the paper documents were themselves effective” (20). This is particularly true of maintenance manuals, which were originally created by one contractor and may have subsequent updates by several other contractors in many different formats. Hackos adds that “well-designed and –written online information focuses on the users and what they are trying to do” (20).

Interactivity Through Information Design

One way to make the transition from paper to online documentation is to include some of the print cues in an attempt to bridge the two media. For example, major topics of the technical manual can be included as topic buttons located on the main screen. Another idea is to include the cover information from the paper manual as the information presented on the first screen. The presentation of the online manual can act as a link between the paper and IETM transition process.

Interface Design. An important element to consider in transitioning users from a paper technical manual to an IETM concerns the metaphorical element of the interface design. Erickson defines metaphor as an “invisible web of terms and associations that underlies the way we speak and think about a concept. This extended structure makes metaphor such a powerful and essential part of our thinking. Metaphors function as natural models, allowing us to take our knowledge of familiar, concrete objects and experiences and use it to give structure to more abstract concepts” (21). Before designing the interface for an IETM, the designer must understand the use of the online technical manual and its subsequent support system. For example, an IETM can belong to many types of systems. It can function as a training tool in an

electronic classroom, reside on a desktop workstation in a technician's work environment, or run as a soldier's diagnostic maintenance tool on a ruggedized computer far removed from other technologies. A designer must consider the end use of the manual in selecting a metaphor for the interface. After identifying the end use of the IETM, the designer considers the potential problems that the user will have in that particular environment.

Horton states that "users inexperienced with online documents benefit from online documents designed to be analogous to familiar paper documents" (22). Users want to see some of the cues they are familiar with transferred to the screen. Horton warns that the book metaphor "fails to suggest the rich interconnections possible in online documents" and that it may "mislead users into believing the document is organized as a familiar paper book" (22). Further, Horton claims that "using the book as a metaphor for online documents is like using the typewriter as a metaphor for electronic publishing systems" (22). However, while Horton would probably object, the Reference book metaphor is used frequently in document conversion projects in order to create a bridge between a paper and online technical manual, using reference topics as one entry point into the IETM. A new user can select the troubleshooting button or the maintenance procedure button without digging through other information first. Predefined bookmarks, user-defined notes, or placemarkers offer other entry points into the IETM.

Presentation. The presentation addresses the orientation or the view of the online manual. Interactive electronic books follow one of three orientations. Most of the time, the information is authored in the traditional front-to-back system, but is approached from one of the three orientation methods described below.

- Book. A fast, simple approach to electronic books with a table of contents on the left and the text on the right. The panes can be divided into a top and bottom pane with a floating navigational bar. It can also include pop-up tables and graphics in separate windows, as well as multimedia and hyperlinks. A user approaches this book in much the same manner as a legacy book.

- Task-Based. This approach does not use a book orientation but offers a selective way to display information, depending on a set of input conditions and statuses. The user can select a task or topic without traversing through a multi-level structure to find it.

- Hypermedia or multiple entry point. This approach replaces the book with "nodes" that are traversed via links that are prearranged. Nodes consist of multimedia, reference material, databases, and other reference systems that are not part of the actual book. The user can reenter the book through any of these nodes. Examples include a computer-based training program or a distance learning program.

Organization. Presentation and organization are similar in that the way a manual is presented online influences the organization of the content. According to Horton, "organization concerns itself with how information is divided into separate topics. It determines the order in which these topics are presented and establishes the interrelationships among them. . . for paper documents, organization determines where information goes; for online documents, it determines when it appears as well" (22). A book-orientation typically requires that the table of contents be presented in one pane while the text is presented in a second pane. Navigational devices may be located at the top, bottom, left, or right side of the display. In this view, the table of contents entries are hyperlinks to the text, which is presented in linear order. When selected, the text is displayed in the opposite pane. The problem with the book orientation is that it works best for reading and not for completing tasks. Technicians in the field do not want to scroll through pages of data to find the needed information. Like all reference data, technicians approach IETMs on a task basis.

Screen Design. Converting a technical manual into a usable screen design depends in part on the original design of the paper manual. Document conversion goals should focus on:

- Retaining useful content
- Replacing illustrations with interactivity and multimedia where useful
- Adding help for the novice user
- Full-text searching
- Organization by task versus linear organization
- SGML tagging

Much of what appears in print no longer applies when converted to an onscreen usable format. Headers, footers, page numbers, table of contents, indexes, and other paper navigation cues are replaced by automated functions, hyperlinks, and dialog prompts. Bernhardt offers nine dimensions of screen-based text that can help a designer "map the differences between paper and onscreen text" (23):

Dimension	IETM
Situationally embedded	Computer-based interactive training lessons, Help, full-text searches, reports and forms, parts ordering, maintenance procedures, troubleshooting procedures
Interactive	Bookmarks, user-defined notes, placeholders, dialog prompts, CBIT lessons, reports and forms, pull-down menus, keyboard, mouse, cursor, warnings, cautions, notes

Dimension	IETM
Functionally mapped	Hyperlinks, icons, cues
Modular	Single task or graphic per frame
Navigable	Bookmarks, place holder, user-defined notes, multiple entry points, history list, next and previous frame buttons, home button, table of contents, escape button, index button, full text search
Hierarchically embedded	Embedded text, cross-references
Spacious	Unrestricted navigation; can access external programs; multiple volumes accessed via a single interface
Dimension	IETM
Graphically rich	Animation, video, line art, icons, color
Customizable and publishable	User-defined notes, bookmarks, report retrieval, printing, redline capability

Interactivity and Digital Architecture

The ability to create simple and complex navigational structures and interactivity is based on the IETM's digital architecture. Digital architecture provides the foundation in which artificial intelligence components, expert systems, if-then rules, inference engines, and knowledge bases can function within an IETM. These are the necessary components of an effective interactive system. Heba defines digital architecture as the "complex system of electronic coding that underlies the creation and distribution of all online documents" (24). The Standard Generalized Markup Language (SGML) provides the digital architecture of the online manual. In an SGML document, structure and style are separate. SGML provides structured document encoding. One benefit to a generalized markup is portability. An SGML tagged file developed in a Windows environment can be read in a UNIX environment, so "by generalizing markup languages, tags can be read across computer platforms and programs, making it possible to transfer information electronically" (24).

SGML can easily be adapted for "nonlinear or alternative pathways through contents" (25). References, footnotes, citations, and technician's warnings, cautions, and notes, just to name a few, can be tagged and used with program scripting. "Program scripting directs the hyperlinking of the spatially separated sections" (25). A simple unique id is added to each reference so that that reference can be used repeatedly. For example, a typical warning, caution, or note contains the following id tag:

```
<alert type="note" id="n9">
<para>Perform Engine
Troubleshooting (a2. Engine
Cranks But Does Not Start)
before starting here.</para>
<para>Fuel tank hoses and
fittings may be loose, allowing
air to be drawn into fuel
system.</para>
</alert>
```

If this note is needed in several areas throughout the technical manual, a reference is made in the tagging only:

```
<task>
<alert type=”note” id=”n9”>
</alert>
<para>Begin troubleshooting
procedure</para>
</task>
```

Through the unique id references, an SGML document can include chunks of data from other documents. In an IETM, this modularity allows one IETM to contain many revisions of the manual. For example, a technician that needs to view Revision 1 of the manual instead of the current configuration can do so by selecting that revision from the menu. The architecture calls up the appropriate id references and displays the revision as requested.

Accommodating Novices and Experts. Every IETM is accessed by first logging on to the system. In a military developed IETM, tags delineate novice and expert data because "users differ in their needs. Experts are looking for help performing more complex tasks, while novices (beginners) want help with the basic. Experts want in-depth explanations of how the technology (software) works, while novices (beginners) only want to complete a task as quickly as possible" (20).

If a user's logon ID is equal to an expert, that user has access to both novice and expert data. However, a novice logon ID prevents the user from accessing expert tagged data. Reference data, notes, or help for the novice can be tagged as <novice>. Advanced diagnostics and critical maintenance procedures can be tagged as <expert>. The basic technical manual is presented to all users. When a novice logs in, any information tagged as <novice> appears. However, the novice does not see any data tagged as <expert>. On the other hand, expert users can view the data for both <expert> and <novice> tags.

Questions to Guide Interactivity

In developing an IETM, whether it is a new project or a document conversion, we must ask the following questions.

- What is the context of use?
- What is the best metaphor for the interface?
- How should the manual be presented? In panes, frames, or a linear page structure?
- Should the content be organized by task, topic, or per the original table of contents?

- Because the traditional paper navigational aids no longer apply, what type of search capabilities will be available? What type of navigational devices should be included?
- What type of architecture can support the goals of the manual? HTML, XML, SGML, or PDF?
- Since the paper technical manual contains no Help system, what type of Help should be included in the online manual?
- How do we accommodate novice and expert technicians?
- Will the use of mixed media help the technician?
- Can we convert the legacy illustrations into animation, color graphics, and mixed media?

We should also remember that once the technical manual becomes an online form, it must be treated as a software application where all the elements of information design apply.

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