ELECTRONIC DOCUMENT PRODUCTION

OVERVIEW

An electronic document, today more commonly called an online document, is one that is created, transmitted, received, and read with a computer or some other electronic encoding and decoding device. From the very beginning, the electronic document has owed its existence to technologies developed by electrical and electronics engineers. Moreover, engineering professionals, as well as business and general users, typically use electronic documents as one of their basic methods of professional communication.

The Origins of Electronic Documents

The earliest electronic documents were made possible by the telegraphs invented simultaneously in 1837 by Samuel F. B. Morse in the United States and by Charles Wheatstone and William F. Cooke in Great Britain. In its original form, the telegraph transmitted messages by electrical pulses over wire. Morse devised a code consisting of the letters of the alphabet, numerals, and basic punctuation marks that was commonly used to encode messages at the sending end and to decode them at the receiving end. Over the next hundred years, telegraphy was significantly improved to use wireless radiowave transmission. Eventually, Morse's code system was replaced by teleprinting (teletype), which is still occasionally used, and by telegraphic facsimile reproduction, which was replaced in the 1980s by telephone facsimile transmission.

Teleprinting, which is limited to text-only messages, uses a keyboard at the sending end to encode each character of the message into electronic impulses. The receiver decodes and prints the message. Teletype systems were most often used by news organizations to gather and disperse information. Beginning in the late 1950s, many general business customers took advantage of teleprinting systems such as the Telex, which employed special lines offered by telephone services. Since the 1970s, however, the news media have almost universally replaced teleprinting; first with satellite transmission and later with electronic mail, and business teleprinting systems have essentially been replaced by telephone facsimile and electronic mail.

Although no longer used, telegraphic facsimile systems are notable because they had the capability of sending and receiving both text and images such as photographs or drawings.

Telephone facsimile transmission, commonly called fax, has been increasingly used during the past 30 years to transmit text, photographs, and drawings. In its original form, fax uses a transmitting device to translate text and graphics on paper into electrical impulses sent via telephone lines to a receiving device that decodes the signals and prints a facsimile copy. Since the 1990s, it has been possible to transmit the contents of word processing, spreadsheet, and graphics files directly from one personal computer to another via telephone modems, which now typically include fax transmission and receiving capabilities, without the need for dedicated facsimile machines.

Although fax was originally used to transmit news photographs, it was later widely used in business and industry for a variety of applications.

- It is a quicker and usually less expensive alternative to postal or express delivery services.
- It is also an easy way to transmit documents written in Japanese, Chinese, and other nonalphabetic languages.
- It is an electronic document exchange technology that doesn't require computer access.
- It is of poorer quality than originals due to data loss inherent to input and output devices when the input is paper rather than electronic files.

Contemporary Electronic Documents

The period since the early 1980s has seen significant advances in the creation and distribution of electronic documents over telegraphy, teleprinting, and facsimile transmission. Most of these are directly related to the computer technology that has now become ubiquitous.

Computer-based electronic documents were not feasible until the keyboard and monitor began to replace the card punch and card reader as the most prevalent computer input and output devices in the late 1970s. These documents have become an increasingly common form of communication since personal computers started to become fixtures in the office and laboratory — and even on the shop floor — in the 1980s.

In its simplest form, today's electronic document consists entirely of text and is communicated to a single reader. For example, an engineer might send an e-mail message to ask a technician to calibrate a new piece of equipment. The document would be created, transmitted, and read using e-mail software. But the assistant could also choose to print the message to have a tangible reminder of the next day's priority task. This simple document has a corresponding paper counterpart and need not be created or viewed on-line.

On the other hand, a very elaborate electronic document intended to teach secondary school physics students the basic principles of electrical currents may combine text, charts, drawings, photos, animation, video, voice narration, music, and sound effects. Such complex examples require more elaborate hardware and software for both authoring and viewing, and are usually intended for multiple readers (most often, readers who are personally unknown to the author). These more elaborate documents have no paper counterpart and must be created and viewed on-line.

In addition to simple office applications such as e-mail and elaborate ones such as the multimedia lesson on electrical currents just described, electronic documents are frequently used in electrical and electronics engineering today to support products. For example, software that monitors electricity usage in the various parts of an office tower might feature online help; a mobile telephone with a built-in personal telephone directory might include prompts to assist users in entering names and telephone numbers; a high-definition television receiver might be effectively marketed with a multimedia brochure on the World Wide Web.

J. Webster (ed.), *Wiley Encyclopedia of Electrical and Electronics Engineering*.

But as the tools for creating complex electronic documents become more powerful and easier to use, increasingly elaborate on-line documents are becoming more common not only in selling products and training users to operate them, but also for noncommercial uses such as reports and laboratory notebooks. The advantages of such capabilities are obvious. A report of test results that combines video clips of the test with the quantitative data collected during the test arranged in tables and plotted in graphs is likely to be easier to understand for many audiences than the same report without the video.

Besides their ability to communicate sound, video, and other types of information that cannot be transmitted on paper, the most significant advantages of on-line documents over paper documents are their relative cost, increased accessibility, and greater ease of updating.

- Not only can an electronic document avoid the cost of printing and paper, but it weighs significantly less and requires little or no physical storage space — significant considerations for the documents required to support equipment aboard a ship, aircraft, or space station, for example. However, the server storage requirements of online documents should not be ignored.
- Information in an electronic document can be located far more quickly than in the paper equivalent by using electronic search tools rather than relying on the more limited search capabilities provided by paper indexes and tables of contents. Electronic document searches, though, can often return very large numbers of "hits."
- Information in an electronic document can be linked to related information in the same document or in other documents by means of hyperlinks. These electronic links between parts of a document or between parts of multiple documents allow users to retrieve related bits of information more quickly and reliably than is possible using cross-references in paper documents.
- Complete electronic documents or subsets of them can be automatically reformatted or adapted to alternate delivery media such as a computer or mobile device screen, fax, voice synthesizer, or printer if content management and single sourcing have been implemented for the product information.
- When software is updated, a revised version of the documentation can be automatically installed on the user's computer or other device along with the new program files, avoiding the need for users to insert revision pages in loose-leaf manuals or to replace entire volumes on their shelves with the latest update. In addition, the Web, intranets, and portable media allow other businesses to make revised versions of documents available quickly and easily and can help ensure that all users always have the most current version of a document available. Note that some international, national, and corporate standards require electronic delivery of all documents to reduce deforestation and waste paper.

But even though on-line documents offer many advantages, it is unlikely that they will ever entirely replace paper.

- The very best computer monitors available today offer lower resolution — and therefore lower legibility — than that of the typical laser or inkjet printers.
- Electronic documents are also usually less portable than paper documents and are sometimes not accessible — an on-line manual is not much help if the computer won't boot.
- Users cannot easily determine the size and amount of reading time required upon opening some electronic documents because they lack the physical bulk associated with the amount of content of a paper document and do not include indicators of length.
- And some users are still intimidated by electronic documents just as they are intimidated by the computers that provide access to the documents. This problem is increasingly less common each year, however.

Approach of This Article

In the remainder of this article, the terms electronic document and on-line document will be used interchangeably primarily to refer to more complex, elaborate documents, although most of the information presented here could be applied to even the simplest such documents. Also, because the computer hardware and software industry changes so rapidly that references to specific tools or technologies would be outdated before this encyclopedia is published, the primary focus of this article will be on principles for developing effective on-line documents rather than on the tools that might be used to build, deliver, or read them.

The principles described in this article are derived from theory and research on effective oral and written communication developed over the past 2500 years and adapted to the media, audiences, and contexts of on-line documents. These principles also reflect the methods and processes for managing successful engineering projects that have proven successful over many years. This combination of effective communication and effective project management techniques is the key to producing electronic documents that are useful to readers in an efficient and cost-effective manner.

CHARACTERISTICS OF ELECTRONIC DOCUMENTS

The term *electronic document* as used in this article refers to a communication artifact with the following characteristics:

- One or more authors
- One or more potential readers
- A message consisting of text, numbers, pictures, video, and/or sound
- Creation, transmission, and delivery via computer

This last component requires some amplification. Most people usually think of electronic documentation in terms

of computers, but the definition of computer should be sufficiently broad as to cover any product that uses microprocessor technology. Because much of the electronic equipment on the market these days incorporates such technology, many products created by electrical and electronics engineers can include electronic documentation, although it is not cost-effective or efficient to produce it for every product.

In addition, the more elaborate types of electronic documents include other significant features.

- They incorporate hypertext or hypermedia, the ability to link one element of text, graphics, video, animation, or sound, to another, whether within a single document or between multiple documents, possibly across multiple computers.
- They are easily searchable, enabling readers to quickly locate relevant portions of the document.
- Unlike many paper documents, they often have a nonlinear structure and provide multiple points of entry and methods of navigation.
- They sometime provide readers with opportunities for a high degree of interaction with the text and other media by responding to dialogs, making annotations, asking questions, requesting information, and so forth.

All these characteristics make it possible to communicate much more effectively and to transmit many more types of information with electronic documents than is possible using paper documents. Electronic documents not only make it possible to provide readers with enhanced information, but they can also facilitate collaboration and learning, and they can support performance in ways that are impossible with paper documents. For example:

- Mechanics can learn how to maintain complex, expensive equipment from animation or video.
- Students can master foreign languages through computer-based training modules that include videos of dialogs between native speakers, vocabulary lessons that combine pronunciation clips with graphics illustrating the words, and unit mastery tests.
- Software help systems can guide users through seldom-performed tasks by prompting them for the needed information and almost completely automating the task.

DEVELOPING ELECTRONIC DOCUMENTS

In most respects, the process for developing on-line documents parallels that for developing print documents — or most engineering products, for that matter. There are four broad phases: analyzing, designing, constructing, and testing. To these four phases should be added a fifth: assembling a team with the expertise necessary to build high-quality multimedia electronic documents. This step is assumed in most engineering tasks, but it should be an explicit part of any on-line documentation project because of the variety of highly specialized skills needed to assemble such a document. A sixth phase this is also assumed for most engineering projects, evaluating the document after its publication, provides feedback that the documentation team can consider when planning a new release of the document.

Assembling the Team

Identify the Skills Needed. As with any other engineering task, the success of an electronic documentation project depends in large measure on assembling team members with the right mix of talents and previous experience to ensure that the project achieves its goals. No sensible engineering manager would consider undertaking the development of new fiber optic technology without the assistance of staff members who have the appropriate expertise to work on the project. Similarly, building a complex on-line document requires a broad range of skills.

- Technical writers and editors with knowledge of the proposed document's subject matter should form the core of the team. They can contribute both the precision of expression needed in any technical document with the ability to write concisely and to structure electronic documents effectively. They can also ensure continuity of language, style, fonts, colors, and other elements of the document.
- A human factors specialist can help ensure that information is clearly presented to the target audience through the selected media by choosing the basic metaphor to be used in the design and presentation of information for the target audience.
- An information designer can determine how to chunk and tag information for content management database storage and reuse.
- A translation expert (either an in-house translator or someone who coordinates with outside translators) can anticipate the problems and requirements for translation of the document into other languages and localization of its content for other cultures.
- Artists, illustrators, and videographers can add a professional touch to the visual components of the document.
- An experienced on-line document indexer can help ensure that search strategies are properly designed to make information easier for users to locate.
- Musicians, audio engineers, and audio mixers may be necessary if the document will contain a significant amount of sound.
- Programmers may be needed to write or modify code for the project, even if the latest automated tools are used.
- Systems managers may be needed to support projects that will reside on networks or multi-user computer systems.
- Technicians with expertise in traditional and multimedia computer hardware can assist with configuring equipment.

- An accessibility specialist can ensure that the document complies with government and industry accessibility requirements and guidelines.
- Usability specialists who are experienced in evaluating the usability of on-line documents may be helpful during the testing of the document to help the project team determine how effectively it meets the audience's needs.
- Users of the planned document can provide essential input, especially during the analysis, design, and testing phases.
- An experienced project manager — preferably one who has worked on previous multimedia projects — will ensure that the project meets the customer's and users' needs and comes in on time and at or under budget.

Even though the need for such specialists will be obvious to experienced multimedia project managers, it may not occur to those embarking on their first significant electronic documentation project. It is easy to be misled by the hype surrounding the tools available to create multimedia documents. Even a tool that is easy to use does not produce professional results unless the person using it has the requisite knowledge, experience, and skill. What tool could be easier to use than a paintbrush, for example? But there are relatively few who can produce a professional-looking portrait using that "simple" tool.

The people in these roles need not be full-time or dedicated to the on-line document project. Occasionally, a single individual may possess skills in more than one of these areas, but the project manager should be wary of equating casual familiarity with expertise. Just because some team members have used a camcorder to make home videos does not mean that the project can do without the services of a professional videographer, for example.

Although hiring specialists to produce electronic documents may seem needlessly expensive on first glance, experts work significantly more quickly and produce higher-quality results than amateurs. This is especially important when the document either is part of a product or otherwise supports a product that is offered for sale, but it can also be a substantial factor when the document is intended solely for internal use within a company. Employees who use an on-line document for training are less likely to take an amateurish effort seriously and to benefit from the information it contains than they will one that results from the professional collaboration of experts.

Deliverable: Documentation Project Team Organization Chart. Identifying the skill set needed for a project and recruiting staff with the necessary background usually spans the entire analysis and design phases and may extend into the construction and testing phases as well. But at the outset, the documentation project team manager should begin building the organization chart for the project.

At the very beginning of the project, the documentation team manager should examine the list of skill areas and identify which will definitely or likely be needed on the current project. After these skills have been identified, the manager can then start identifying or recruiting personnel for those positions.

For example, most on-line documentation projects will require at least one technical writer, one editor, and one illustrator. The project manager should identify someone to fill each of these positions, and recruit them for the project team as soon as possible. For larger projects, these people will probably be the writing, editing, and illustrating leads, and will eventually be guiding the efforts of others who will assist with those functions.

The project manager of an electronic documentation team must ensure that the team works together effectively. The manager should recognize that the team members have an unusual mix of skills and may not be accustomed to working together. Both the manager and other team members must understand the need to compromise their individual desires for the good of the team and project — for example, the video experts may not be able to produce "perfect" movie clips because of file size limitations imposed by the programmers.

As the project proceeds through analysis, design, construction, and testing, the documentation manager monitors the tasks that must be performed and the staff required to do the work within the schedule and budget constraints for the project. Additional functions are added to the organization chart as needed, and personnel are identified to perform those functions. Specialty skills such as videography, audio mixing, and photo editing may require outsourcing, so it is essential to budget with these needs in mind.

Analyzing the Purpose, Audience, and User Environment

The first step in developing any new engineering product should be to answer three questions:

- Why is it needed and what is it intended to accomplish? In other words, what is its purpose?
- Who will use it to accomplish that purpose? In other words, who is its audience or user group?
- What setting will it be used in? In other words, what is the typical user environment?

The answers to these questions determine how it will be designed, constructed, and tested in subsequent phases of product development.

Purpose and audience are inextricably linked, so it is impossible to analyze one in isolation from the other. The readers' needs are the central focus in defining the document's purpose, and the document's purpose must likewise be considered when performing the audience analysis.

Determine the Document's Purpose. All documents serve the same basic purpose, to convey information from the author to the reader. But what kind of information is conveyed and how the reader will use it differ significantly from one document to another.

There are four major types of technical information.

- *Procedural* information walks a user through the steps needed to use a product to accomplish a specific

task (e.g., the sequence of steps required to print a large engineering drawing using computer-aided design software).

- *Conceptual* information provides the background that users need to understand the context of a procedure (e.g., an explanation of why animation is a better choice than video to demonstrate how to insert a microprocessor chip).
- *Reference* information helps users make decisions and is meant to be consulted repeatedly, not to be learned (e.g., the list of part numbers for items that might be included in an inventory report or inquiry).
- *Instructional* information provides users with the data they need to perform tasks as well as the background they need to master those tasks and perform them routinely (e.g., a tutorial describing how to embed graphics files containing circuit diagrams in a technical report).

Two or more of these types of information are often mixed in a single document because one document must frequently meet the needs of a range of users and situations. Such documents might contain procedural information to step some readers through a task for the first time as well as conceptual information to help more experienced readers understand why they should choose one procedure rather than another similar one.

The next step in analyzing the document's purpose is to define at a high level the tasks that the document should support. This is not intended to be a detailed list of all the functionality that the document needs to describe but rather a general list of function areas that the document will cover. For example, the on-line help for a simple text editor might need to address five high-level tasks: entering, editing, formatting, outputting, and saving text.

Knowing the kinds of information that readers will need and the tasks that they will need to be able to perform will help the documentation team determine both the content and the organization of the document, as well as such elements as navigation and searching strategies. Without the information provided by a thorough analysis of the proposed document's purpose, the success of the resulting document cannot be predicted.

Analyze the Prospective Audience. It is essential to examine the audience in as much detail as possible before beginning work on the document. The team should collect at least three kinds of data about their prospective readers.

Compositional Data. Is the target audience homogeneous or heterogeneous? In what significant ways are they alike or different? What are the relative proportions of each component population?

Sociological Data. What are the prospective readers' ages, education levels, reading abilities, comfort with English (or other target language), national origins, and other social characteristics? Do audience members have visual, auditory, motion, cognitive, or learning disabilities that must be accommodated?

Subject-Matter Data. What previous experiences do the readers have with the subject matter of the document? Where do they stand on the experience scale from novice to expert? What are their interest levels in and general attitudes toward the subject? If their prior experiences have been negative, is it possible to determine the reasons for those problems? Are they likely to be open to new experiences with the subject matter?

The answers to all these questions will help the project team better understand the backgrounds of its prospective readers and therefore communicate with them more effectively. A richly detailed description of the target audience resulting from this analysis will enable the project team to select the best words, writing style, depth of coverage of the subject, examples, tone, and supporting media to use in transmitting information to these readers.

Describe the Typical User Environment.. Where the document will be read can sometimes have a dramatic impact on its design. The documentation project team will not always be able to provide a detailed description of the user environment, particularly when the potential user group is very large and diverse. But it is generally helpful to consider the following questions.

- Where will the typical user read the document? In an office or cubicle? On the shop floor? At home? In school? Outdoors? In a public or semipublic space?
- How much time do users have to view the document? Do they need to obtain information quickly to answer questions or solve problems, or do they have more extended time to devote to viewing the document? Is this time structured (programmed into the workday) or ad hoc?
- What are the typical lighting conditions in the user environment? If the user group is very large or diverse, what is the range of lighting conditions in which the document will be used?
- What sounds or noises are typically present in the user environment that might affect user concentration or ability to hear sound used in the document? What limitations does the environment impose on use of sound in the document?
- Does the user environment impose any special restrictions or limitations, such as the need to preserve a sterile field (as in an operating room) or to avoid potential contamination by radioactive, chemical, or biohazardous materials (as in a laboratory)?
- If the document will be read on the user's computer, what are the typical users' hardware and software platforms? What operating systems and releases? What processor chips and speeds? What monitor sizes and resolutions? How much random-access memory (RAM)? What hard disk sizes? Can they read portable media (CD-ROM, DVD, USB flash drive, memory card, etc.)? If so, what kind(s)? Do they have sound cards and speakers? Do they have advanced video cards? If so, how much video RAM do they have? How and at what speed do they connect to the Internet or to a corporate intranet?

- What limitations or restrictions (security or other corporate policy) exist regarding changes to the user's hardware and software? Will the project target the user's existing computer infrastructure or can it require upgrades? How much infrastructure can be supplied with the electronic document in the form of fonts, audio or video software, document readers, and so forth?

The answers to these questions will not only help the project team to understand the environment in which the document will be read but will also help them to make decisions later in the development process about supporting media to be incorporated into the document and about tools to be used for delivering, reading, and updating the document.

Analysis Phase Deliverable: The Information Plan. Using the data about the document's purpose and audience and about the users' environment gathered during the analysis phase, the project team is ready to assemble a document information plan. The plan should include the following:

- Document purpose statement
- Audience description
- Information types the document should contain (list with brief explanations)
- High-level descriptions of user tasks the document should support
- User environment description
- Preliminary documentation project schedule
- Revised documentation project organization chart

The more elaborate the document envisioned, the more elaborate the information plan should be. The information plan for a simple on-line document might require little more than a page; very complicated documents will require much more complex information plans.

The information plan should be reviewed by the entire documentation project team, and it should also be reviewed and approved by the product development team's management to ensure that it conforms to the analysis and schedule for the product-development project.

Designing the Document

After the team has determined the document's purpose and collected information about the intended audience and their environment, the design phase of electronic document development can begin. In design, the team will consider schedule, budget, and staffing constraints; choose the appropriate type of on-line document to build; define the topics it will contain; decide on the navigation sequence and search methods to be offered; identify the hypertext and hypermedia links to be included; identify the supporting media that will be used; and finally select one or more tools for developing the document.

Consider Budget, Scheduling, and Staffing Constraints. Although the project manager will be concerned with budget, schedule, and composition of the project team from the very beginning of the electronic document project, these elements become crucial considerations in the design phase. The time, budget, and human resources available to the project are matters that must be weighed carefully before the document is built. Because the technology and capabilities of electronic documents can be quite seductive, it is important to balance what the project could deliver if resources were unlimited against the realities of time, money, and staff available to do the job.

Many on-line engineering documents are either embedded in the products they support or must be delivered simultaneously with those products. The schedule for such documents must thus be incorporated into the overall product schedule. Specific operating instructions, for example, cannot be written before the product specifications that describe its functionality are approved. Final video clips depicting product assembly cannot be shot before a prototype of the product is built, but a mock-up clip can be supplied in a prototype or test document and replaced with the final clip in the last stages of document production. In short, the design and construction of the document must parallel — and usually lag a step or two behind — the design and construction of the product it supports. Careful coordination with the overall project schedule is vital at all stages. The documentation team and the rest of the product development team must work together closely to ensure that all aspects of the product's development — including the documentation — are completed in a timely manner, and that minimal rework is required.

Similarly, the budget for the document must fall within the allowable limits. An elaborate electronic document that includes several types of information and multiple supporting media will ordinarily require more staff with greater expertise, more elaborate equipment, and thus a larger budget than a less ambitious project. Although documentation teams strive to prove that they add value to the product rather than simply being part of the cost of bringing it to market, and although more elaborate documentation may make the product significantly easier to use, the documentation project manager must weigh the benefits of increased ease of use against the realities of the overall project cost. The project manager must also identify proposed use of expensive technology, such as video or custom photography, and approve its use only when it adds significant value to the document.

Finally, the staff available to work on the electronic document must be realistically considered. A documentation manager must frequently allocate limited staff to multiple projects. If the human resources needed for an electronic documentation project are not available within the company, then the budget and schedule must allow time and money to recruit that talent, either on a contract or permanent basis, or outsource those tasks. The manager may also consider using clip-media or reusing earlier work (previous versions of the same or similar documents) to reduce the need for specialized skills or larger staffs. At the design stage, the project manager must make a final determination of the skills needed, the personnel currently available, and the likelihood of acquiring additional resources with the

necessary experience and skill if budget and schedule permit.

Select the Appropriate Document Type. Using the information gathered about the electronic document's audience and purpose, the first step in the design phase is to choose the type of document that will best serve the audience's needs and accomplish the project's purpose. The following document types include those most commonly produced when this article was written.

On-Line Books. On-line books (including such diverse types as encyclopedias, manuals, and reference guides) typically provide reference information about a product or other subject. Users consult this type of document to obtain further information about a topic and to understand the context in which certain product features would be used. On-line books are the closest equivalent to paper documents, and paper reference manuals can often be successfully and easily translated to electronic form.

Brochures, Kiosks, Demos, and Guided Tours. These document types are primarily marketing tools that typically describe one or more of a company's products or services. They may be self-running, in the fashion of a slide show, or they may require reader interaction. These types of electronic documents are often found in stores and trade shows, but they are also sometimes distributed through the mail on portable media or published on the Web. Some documents of this type are informational, rather than promotional. Informational brochures, kiosks, demos, and guided tours are also found in museums, historic sites, and other public places to explain or interpret displays or simply to assist the user in locating a desired destination. Occasionally, these document types are also used as stand-alone instructional tools.

Readme Files. Readme files typically supplement paper documentation by providing information about a product that was not available when the paper documents were prepared or that has changed since the paper documents were printed. Although many readme files are plain text with minimal formatting, Web browsers, operating system-specific help engines, and "digital paper" products that reproduce the look and feel of paper documents make possible more complexly formatted readme files incorporating hypertext and multimedia.

Messages. Messages are embedded within a product and inform the user about the status of a task or about problems encountered in completing a task. They are usually very brief, but the best messages are as complete and self-contained as possible. For complex conditions when complete information about resolving the problem cannot be provided because of space limitations, the message should offer advice on where to find additional information in paper documentation or allow the user to summon the help facility for further detail on resolving the problem.

Help. On-line help is intended to assist users in operating a product (usually a software package) and is almost always embedded within that product. Help is typically consulted when a user experiences an operational problem and is uncertain about what to do next. The help facility's ability to anticipate the task the user is seeking assistance with is called context sensitivity. The degree of context sensitivity may vary depending on the capabilities of the tool used to author or deliver the help, on the capabilities of the product being documented, or on implementation choices made by the documentation team. For example, some help facilities are designed so that they take the reader to the topic corresponding to the field or other area on the screen where the cursor is located when help is requested, whereas others will take the reader to a menu where a topic can be chosen.

Computer-Based Training. Computer-based training (CBT) typically includes one or more lessons or modules combining instruction, drills, reviews, and exit testing to certify the user's competence on a subject. Because most implementations allow users to progress at their own pace and learn on their own schedules, CBT is an excellent substitute for "stand up" instruction on many topics when a large number of people must be trained. The results of module pretests may allow users to bypass instruction on topics they have already mastered. Because it is now possible to deliver computer-based training directly to the desktops of users with multimedia-ready workstations, CBT is a much less expensive option than it once was.

Computer-Based Reference. A computer-based reference tool allows readers to look up seldom-used or widely varying information. For example, such a document might display the correct postal code for a user-specified address or list the manufacturer's contact information for a user-specified part number. Computer-based references are often interfaces to databases that might not be considered "documents" in the usual sense of the word.

When the audience for the electronic documentation project is diverse and the project has multiple goals, it is usually advisable to create two or more types of document. For example, many software documentation projects include readme files, on-line help, and a computer-based reference. The time, staff, and budget available for the project will determine the feasibility of including various document types that might be called for based on the analysis of purpose and audience performed in the project's analysis phase.

Define the Topics. Topics are the building blocks of on-line documents, just as chapters and sections are the building blocks of paper documents. In designing an electronic document, the project team must identify all the topic components of the document, ensure that the topics are sized for optimal effectiveness, and take care that the topics approach the subject from the reader's perspective.

The first step in defining topics for the on-line document is to review the list of high-level tasks in the information plan. The documentation team analyzes these tasks and develops a detailed list of user tasks that the document will support and then classifies each of them according to the type of information the user will need to perform the task.

The team then develops a list of topics that the document will provide to support users in performing each item in this detailed, classified list of tasks.

The documentation team should resist the urge to pack too much information into a single topic. Each topic should be an easily understood chunk of usable information, not a mass of data. Each topic should answer a single question, such as What are the steps in this process? or When is this process performed? In sizing topics, the team should remember that the attention span for readers of on-line documents is 10 to 15 min at a sitting compared to 30 to 60 min for readers of paper documents.

In terms of physical appearance, depending on the tool used to read the document, a topic can be defined as a single screen, panel, or page of an on-line document. Ideally, especially when the document is being designed primarily for online reading, the reader will be able to see the entire topic on screen at one time without having to scroll the display. Sometimes, however, the amount of information comprising the topic makes minimal scrolling unavoidable. Designing topics requires the juggling of two apparently contradictory goals. To present topics without requiring readers to scroll, the documentation team must carefully define each topic in such a way that the completed topic will contain only essential information or in a way that a larger topic can be broken down into two or more smaller topics. At the same time, the team must ensure that the topic's design contains all the information the reader will need to understand it.

In terms of content, a topic will correspond to one of the four information types discussed earlier: procedural, conceptual, reference, and instructional. It is important not to mix information types in a single topic. If one topic provides readers with the procedure for performing a task, it should not also contain a conceptual explanation of why that procedure is used in preference to another similar one. The reason for limiting a topic to a single information type is that different readers have different needs for different types of information. Because users of on-line documents (even more than users of print documents) tend to skim or browse rather than truly read, isolating information types that address similar subjects in unique topics helps ensure that users will find the information that they need quickly and efficiently.

Although the term page is sometimes used to refer to a topic, especially for documents presented over the Web, an electronic page does not usually correspond to a page in a paper document. There are exceptions to this rule — as in electronic equivalents of paper catalogs, for example, that present each of a company's products on a printed page. Most often, however, an electronic document topic should contain no more than one-third of the information on a typical printed page.

When designing topics for an electronic document supporting a product, the project team must ensure that the topics are user-centered, not product-centered. Consider the on-line help for word-processing software, for example. From the documentation team's perspective, it might appear that the most useful way to define topics would be to address the various menu selections a user can choose. This is a product-centered approach to topic design. The user-centered approach addresses the tasks that a user can perform with the product. Instead of a topic on the Tools Envelopes and Labels menu selection, the documentation team should define a topic on how to address envelopes.

Although this approach might seem to apply only to the title of the topic, it goes much deeper. A product-centered document focuses on the product's functionality. A user-centered document, on the other hand, focuses on how the product helps users perform common tasks or solve common problems. Although it may be effective to market products by listing and briefly describing their capabilities, users don't typically learn functions. Instead, they learn how to solve problems or perform tasks they need to do using the product.

Decide on Navigation Sequence. Unlike many paper documents, electronic documents are not usually organized in a linear fashion. Readers of nonlinear on-line documents do not start at the beginning and read through the document until they reach the end. Instead, they access the document at the point that introduces the information they need, and they read only the relevant portions of the document.

There are four basic types of navigation or browsing sequences for on-line documents: linear, grid, hierarchy, and web, as shown in Fig. 1.

In a linear sequence, the user is intended to navigate through the topics from the beginning to the end, much as in the typical printed document. The information is organized from beginning to end (chronologically, as in a narrative), from general to specific (logically), or in some artificially ordered way (alphabetically by topic title or numerically by some uniquely assigned identifier). The linear sequence is best used to meet a defined outcome, such as stepping through a multipart procedure with a fixed order.

A grid sequence resembles the linear but adds complication. In addition to navigating from left to right in the grid, readers can also choose to move up and down. This greater flexibility allows grid navigation schemes to serve more diverse user groups. For example, a grid browsing sequence can allow users who are reading a procedural topic to move to a related conceptual or instructional topic quite easily if they wish to obtain a different slant on the material. Grids are also ideal for presenting similar categories of data about multiple subjects. Thus, the grid sequence allows users to explore a topic in more or less detail, depending on their prior knowledge or experience.

A hierarchy sequence resembles an organization chart. It usually consists of a single topic at the top of the hierarchy, which branches to multiple topics at the next level, each of which may branch further at subsequent levels. The result resembles the menu structure of many software applications, and this scheme can be an easy way to provide reference information about a product. This structure is most effective when the information is highly organized. The hierarchy sequence allows users to drill down to locate the precise information they need to answer questions or perform tasks, but it sometimes requires a greater degree of knowledge of or experience with the subject area than does the grid sequence.

Finally, the web sequence is the most complex, resembling a spider's web. Here, the user may move from one

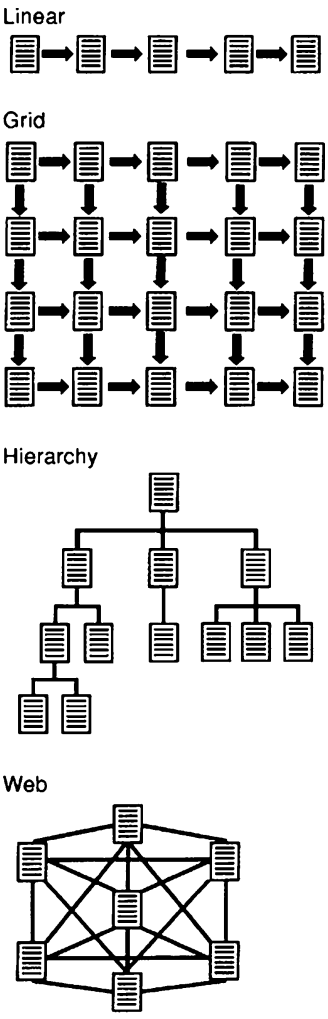

Figure 1. The topics in an electronic document can be structured in four ways: linear, grid, hierarchy, and web. Each major part of a large, complex electronic document can have its own organization.

topic in the web toward related information at any connected node. The web organization is the least structured and is effective for presenting large amounts of information that is only tangentially related. The web sequence allows the most opportunities for user exploration, but it also provides more chances for users to get lost.

The simpler the organizational structure, the easier it is for users to predict what information they will find when they navigate to the next topic; the more complex the organizational structure, the easier it will be for users to get "lost in hyperspace" and become distracted from the job at hand.

But the predictability and ease of use of the simpler structures also incur a handicap. The simpler the navigational structure, the less easy it is for readers to understand the connections between related topics.

For large, complex on-line documents that are intended for a diverse audience of users, it is possible to combine several of these structures. One major part of the document might consist of a linear or hierarchy structure designed to meet the needs of beginners who need procedural and conceptual information, whereas another takes the form of a grid to accommodate the requirements of more advanced users who need reference information.

Determine Information Access Methods. After the documentation team has defined the document's organizational structure, it must then address how readers will find the information — how readers will navigate to the first topic in a browsing sequence. Context-sensitive on-line help provides one access method for that type of document. Document tables of contents, indexes, and searching capabilities provide other ways for readers to find the information they need.

Context-Sensitive Help. Most software applications on the market today allow users to summon help in performing tasks by pressing a key or clicking an icon. In response, the software displays a help topic that addresses the screen the user was working on and sometimes the field where the cursor was located when help was requested. This capability is possible by linking the software code to the help file by means of "context strings." The documentation team must work closely with the product developers to ensure that context strings are used consistently in the programs and in the help.

Document Tables of Contents and Indexes. Good electronic documents have tables of contents and indexes that allow users to locate topics. Just as in a printed book, an electronic table of contents appears at the beginning of the document and reflects the overall organization of the document. The electronic index, much like a paper index, is an alphabetical list of concepts presented in the document. Hyperlinks in both the table of contents and index allow readers to move directly to the topics they want. As with paper document indexes, it is important that an electronic index allow readers to access information not only using the terms found in the document itself but also using synonym terms.

Search Capabilities. The electronic index gives the user the ability to search the document for the keywords chosen by the indexers, but keyword searches often do not allow readers to find information they are looking for. Depending on the tools chosen to author and deliver the document, other types of search capabilities may be available, including full-text and Boolean searching. In some cases, such as Web documents, search capabilities native to the reading tools can be extended with scripts or external programs that allow additional searching capabilities.

When electronic documents consist of more than a single file, the documentation team needs to consider the problems that can result if the reading software's built-in search mechanisms allow users to search only one file at a time. In such cases, the information readers are seeking may be available in other parts of the document, but readers may not be aware of that fact. In such cases, it is advisable to determine a way to extend the search function to span the entire document or provide readers with information about how to look elsewhere if they do not find what they are attempting to locate.

Identify Links. The links in a document not only implement its navigation or browsing sequence (navigation or browsing links) but also connect points within one topic to points in the same or other topics (hyperlinks). Because navigation links have already been addressed, this section will consider hyperlinks.

Not only text and graphics, but also sound, video, and animation can be hyperlinked. The term hypertext refers to the linking of text only, whereas hypermedia refers to the linking of any electronic document medium to any other.

Hyperlinks in an electronic document should add value to the electronic document by helping users find significant additional information such as

- Definitions of unfamiliar terms
- Photos or drawings of equipment
- Video or animation of a process
- Confirmation or cautioning sound effects
- Music to illustrate or reinforce a point
- Voice narration
- References to related information

Because of the time required to create, test, and verify hyperlinks, as well as the need to minimize user distraction, the documentation team should avoid providing more than two or three links within a topic. They should enhance the information contained in the topic, not be necessary side trips to obtain all information on the topic.

Additionally, the documentation team should develop standards for implementing hyperlinks within a document. Although most computer users today recognize that a blue-or green-shaded word or phrase with a dotted underline, or a button indicates a hyperlink, they may not recognize graphics or icons that serve as links, or links indicated with nonstandard colors or other cues. The cues should be carefully established and consistently implemented throughout an electronic document, and they should be made obvious to users.

Links from one document that take readers to another document require special care in implementation and maintenance. The documentation team should take care that all the documents needed for links to work get correctly installed to avoid inoperative links when users choose them. Furthermore, if the electronic document is implemented on the Web or a corporate intranet and contains links to external documents such as other sites on the Web that are outside the documentation team's control, the links should be monitored to ensure that they do not become stale. The decision to use relative or absolute paths to specify the locations of linked files is complex and requires careful execution. Relative paths are generally the safer alternative, especially since the absolute locations can vary significantly from prototype to test to production versions of the document.

Determine Supporting Media. In most cases, sound, video, and animation support the message communicated by text and graphics but do not bear the brunt of the communication burden. That is, the sound effects, music, narration, dialog, animated sequences, and video that are incorporated into electronic documents are generally not essential and can be eliminated without significant effect on the amount or significance of the information being conveyed to the user.

There are obviously exceptions to this rule. The sound clips accompanying a training module on the significance of various safety alarms communicate much more effectively and clearly than the verbal descriptions of those alarms. Sometimes a sound effect, a picture, or a video is worth far more than 10,000 words. When these media play a defining rather than supporting role, however, it is essential to provide alternate media for those with visual or hearing disabilities, or those whose environments may not permit them to play the media.

Media other than text are also relatively expensive to produce, require more elaborate user hardware, and can require significant storage space. For example, not only does high-quality video require installation of plug-ins to allow execution as well as the services of a professional camera and sound crew, lighting, and editing, but it also typically requires "talent" — people who act out scripts that have been prepared in advance. Add to these costs the overhead incurred by storage space requirements on the user's hard disk, the competition for space on a CD or Web site, the network bandwidth required to download the file from a network server, or the contention for processor time on the user's workstation, and the costs become even more significant.

Animation, sound, photography, and illustrations are usually significantly less expensive than video, but a document that will incorporate large quantities of these media can still prove costly.

Some of these overhead costs can be reduced. For example, the storage and bandwidth required for full-motion video (30 frames per second) can be significantly lowered by sampling the video at a rate of 15, 10, or even fewer frames per second. Even though the difference is perceptible, it is less noticeable and is generally acceptable to most users in some situations (e.g., where video portrays "talking heads" — individuals speaking while seated or standing at a podium, and making relatively few movements).

When the documentation team decides to incorporate essential or highly important multimedia data in a document, it is vital to alert readers in a conspicuous way in every topic where those essential media appear. This practice will ensure that readers whose workstations do not support those media, who have disabilities that prevent them from seeing or hearing those media, or whose environments do not permit playing those media will not miss important information. In these cases, it is advisable to provide a text and graphical summary of that information, either directly in the topic or by means of a link to a supplementary topic.

Finally, if a document will incorporate multimedia, the documentation project team must be aware of the copyright requirements that protect the creators of these media just as they protect creators of books and articles. The documentation team should avoid reproducing anything in an on-line document — text, graphics, photography, animation, video, music, or sound effects — that are not clearly in the public domain or for which they have not paid a royalty.

Select the Tools to Be Used. Except in rare situations, the project team should not make any assumptions about the tools that will be used to create, distribute, and view an online document until the very end of the design phase. The reason is a basic one: a tool cannot be selected wisely without first performing the required analysis and design steps, and identifying

- The document's purpose and audience
- The kinds of information needed
- The users' environment
- The user tasks that the document needs to support
- The type of document to be created
- The topics to be included
- The navigation sequence and search methodologies to be employed
- The number and types of hyperlinks to be used
- The supporting media to be used
- The project's budget and schedule constraints

If tools are selected prematurely, the choice may not deliver the needed information effectively, have the needed functionality, or be usable by the intended audience. For example, to assume that a document will be created with sophisticated multimedia authoring software is not realistic if the project manager is unable to recruit staff members who are sufficiently familiar with the tool to meet the schedule. Similarly, to take for granted that a document will be delivered as a help file supported by one operating system is foolish if the audience has a significant number of users whose workstations run a different operating system.

The best way to proceed, then, is to wait until the very end of the design phase to select the tools and follow these guidelines:

- Select authoring tools that best conform to the document that has been defined and can be competently handled by the staff available to perform the work. Avoid the temptation to select a tool that offers capabilities that users don't need or that require staff talents that aren't available.
- Choose a viewing tool that is appropriate to the user base. Avoid the temptation to select a tool that users are unfamiliar with or that will require extensive training for them to use effectively. Similarly, be certain that the tool selected is compatible with the users' existing hardware and system software (or planned upgrades).
- Pick a delivery technique that is appropriate to the type of document, the product it supports, and the needs and capabilities of the intended users. Avoid placing a burden on the user by making delivery as transparent to the user as possible; embed the document in the product it supports or otherwise install it automatically.
- Prototype a small segment of the document in the selected tool. The prototype will help you identify the tool's limits (e.g., supported levels of hierarchical links and multithreading of topics and files, font portability between operating systems, and so forth).
- Be aware of the cost of licensing run-time versions of nonstandard viewing tools for each user of the document.
- Above all else, be conservative in choosing authoring and viewing tools as well as delivery method. This approach will not only save the project money and time but will also usually result in a more effective document from the user's perspective.

Many on-line documents need to be accessible to readers who use multiple hardware and software platforms. The easiest way to ensure cross-platform compatibility for the commonly used operating systems is to rely on Web browsers as the user's reading tool. Because browsers for each of these platforms can interpret the same files on Internet servers, intranet servers, local area networks, and the individual user's machine, they provide a great deal of flexibility. Since virtually all users today already have Web browsers installed on their desktops and because browsers are easily available for download for those who don't already have them, they are often the tool of choice. Nevertheless, the electronic documentation team needs to consider cross-browser compatibility issues as well as various browsers' support for media, and they must monitor market penetration for screen resolution and dial-up versus broadband connectivity for the target audience.

Other tools in common use as this article went to press include the following:

- Operating system online help engines — The continuing evolution of the Windows and Macintosh operating systems, however, mean that a single help file may not be compatible with all users' workstations, depending on the versions of the operating system they run.
- "Digital paper" tools — Software such as Adobe Acrobat reproduces the look and feel of existing paper documents and adds hypermedia and on-line indexing and searching capabilities.

Design Phase Deliverable: Document Design Specifications. The document design specifications describe in detail the content and organization of the entire electronic document. As with the information plan prepared at the end of the analysis phase, the more elaborate the document envisioned, the more elaborate the design specifications need to be. Two major components are suggested.

Story Board. It is helpful to construct a story board consisting of one panel for each topic the document will contain. Each story board panel should include

- A unique alphanumeric topic identifier for this topic
- The topic title that is grammatically parallel with the titles of other similar topics (For large projects, it is helpful to develop naming conventions for the titles of various types of topics.)

- A descriptive outline of this topic's contents, including cross-references to pages in the product's design specifications that describe the functionality to be addressed in this topic
- The file name (including full pathname) for each text, graphic, sound, animation, and video source file that will be built for this topic (For large projects, it is helpful to develop naming conventions for the filenames of various types of files.) Warning: Links cannot be maintained if files are moved or their names are changed
- The search terms to be used in building any index that will help users locate information contained in this topic
- For help topics, the product code routines and parameters that call this topic when help is invoked
- The unique identifiers of all topics from which this topic can be accessed, both through the planned browsing sequence and through embedded links
- The unique identifiers of all other topics that can be accessed from this topic, both through the planned browsing sequence and through embedded links
- The name(s) of the person(s) assigned to build each text, graphics, sound, animation, and video source file for this topic
- The name(s) of the person(s) responsible for fact-checking, editing, and testing each source file for this topic
- The deadline dates by which each source file must be built, fact-checked, edited, and tested for this topic

Figure 2 shows a sample story board panel for an electronic document topic.

Document Diagram. In addition to the story board, which provides a detailed view of each topic of the proposed document, it is helpful to construct an overall document diagram that shows each topic and its position in the intended browsing sequence. If space allows, additional lines can be drawn between topics to depict embedded links. This diagram gives the documentation project team a bird's-eye view of the entire document.

Topic Templates. To ensure consistency and minimize rework, it is helpful to prepare a template that indicates the arrangement and formatting of information for each type of topic. Depending on the types of information the document will contain, the design specifications may include a procedural topic template, a conceptual topic template, a reference topic template, an instructional topic template, and a home or menu topic template.

Revised Documentation Project Schedule and Organization Chart. The project team needs to revisit the schedule and organization chart for the documentation project at the end of the design phase and make any revisions needed. The information on the project schedule should be as detailed as that on the story board to allow the teams to update the status of each task as the various document components are constructed.

As the project continues through the construction phase, the story board, diagram, templates, project schedule, and organization chart need to be maintained to keep them up to date and useful to members of the project team — and especially to assist the documentation project manager in tracking the project to ensure that the team has the necessary resources to deliver the project on time and at or under budget.

As with the deliverables at the end of the analysis phase, the design specifications should be reviewed by all members of the documentation project team; they should also be reviewed and approved by the product development team manager to ensure that the documentation effort is in line with the overall product development effort.

Building the Document

If the electronic document has been designed according to the method advocated in this article, the project team will find that building the document is an easy task because the specifications contain all the information necessary for the writers, illustrators, animators, sound engineers, and videographers to produce the necessary parts and for the document production staff to assemble those parts.

Creating and Assembling the Parts. Using the document design specifications, the documentation project team members create the components for each topic; assemble and format the components of each topic; create the index entries for each topic; create the links between topics; and then assemble and compile the entire document.

- Each story board panel provides the documentation project team with the data needed to write the text, draw the illustrations and animations, record the sounds, and produce the video required for that topic. When each of these files is created, it is named and stored in accordance with the file names and locations specified on the story board. As each file for the topic is created, its status is updated on the documentation project schedule.
- The story board panels also contain the information required to create both browsing sequence links and embedded links from one topic to another. As the links for each topic are completed, their status is updated on the documentation project schedule. Note that linking is a bottom-up process. The file or topic to be linked to must exist before the link will work. Good design can provide the filename, but the file must be created before the link can be tested.
- The story board also contains the information needed to index and create search terms for each topic in the online document. As the search terms and index terms for each topic are created, their status is updated on the documentation project schedule.
- The document topic templates provide the document production staff with the information needed to format and assemble each topic as specified by the story board panel. As the assembly and formatting of each topic are completed, their status is updated on the documentation project schedule.

Topic identifier: PROC22

Topic title: Opening a document

Topic outline:

1. Click Open icon.
2. Choose document path from Look In box.
3. Double click desired file.

Note: Choose program that created file from Files of Type box if not created with WOWTEXT.
Tip: To open recently used file, choose from list at bottom of File menu.

Source files:

M:\ONLINDOC\PROC22\PROC22.TXT
M:\ONLINDOC\PROC22\PROC22_1.TIF

Index terms:

open existing file; access document; work on file

Accessed from:

PROC21

Access to:

PROC23
PROC37

File creators/deadlines:

M:\ONLINDOC\PROC22\PROC22.TXT—Mary Williams (02/01/08)
M:\ONLINDOC\PROC22\PROC22_1.TIF—Tim Dole (02/01/08)

Fact checkers/deadlines:

M:\ONLINDOC\PROC22\PROC22.TXT—Ken Smith (02/02/08)
M:\ONLINDOC\PROC22\PROC22_1.TIF—Julie Strong (02/02/08)

Editor/deadline: Kelly Adams(2/3/98)

Testers/deadlines:

M:\ONLINDOC\PROC22\PROC22.TXT—Ken Smith (02/04/08)
M:\ONLINDOC\PROC22\PROC22_1.TIF—Ken Smith (02/04/08)

Figure 2. This sample topic story board, a part of the document design specifications, provides all the information the documentation team needs to create the topic.

- The document diagram provides the documentation team with guidance on the shape of the entire document and the links between its major parts.
- All the design phase deliverables provide the project manager with the information needed to track the progress of the project. By monitoring the status of each task on the documentation project schedule, the project manager can determine which parts of the document are proceeding according to or ahead of schedule and which are behind. The project manager can thus determine the cause of any problems and assign additional staff as needed to ensure that the construction of the entire document is completed on time.

When all the components of the document are essentially complete, the document may require compiling before it can be viewed with the reading tool chosen for the electronic document. Complex electronic documents that must be compiled often require multiple iterations to compile successfully. The documentation project team should allow sufficient time in the schedule to produce a clean compile before turning the draft document over to testing.

Construction Phase Deliverable: The Draft Document. After the document has been substantially completed and compiled if necessary, it is ready for testing. Depending on the size and complexity of the project, there may be more than one version of the draft document, but this description will assume a single draft. It will be reviewed by the entire document project team as well as by the testing team in the next phase. The product development team management may review and approve the draft for testing separately at this point, or that review may be delayed until the end of the testing phase.

As at the end of the analysis and design phases, the documentation project manager should review and update the project schedule and organization chart at the completion of the construction phase.

Testing the Document

During the testing phase, members of the documentation project team as well as product developers check the entire draft document carefully and thoroughly to ensure that it is complete, correct, fully operational, and otherwise meets the organization's quality standards. Members of the documentation project team may — and indeed should — test individual topics and topic clusters before the draft is complete, but that unit testing is not a substitute for comprehensive system testing of the entire document.

A test plan that briefly describes exactly what tests and checks are to be performed on each topic should be prepared. The test plan should also provide a test results form on which the tester records the completion of each test for a topic (along with tester's initials and date), as well as any problems noted.

What Testing Is Performed and Who Performs It. Depending on the document's complexity, the project schedule and budget, and the personnel available to conduct the testing, some draft document tests may be more or less elaborate than others. At a minimum, the test plan for each topic of an electronic document should ensure that:

- The text uses correct spelling, punctuation, grammar, syntax, and word usage (tested by the technical editor)
- The text is legible and readable by the target audience (tested by the technical editor and usability specialist)
- The vocabulary is understandable to the target audience (tested by the technical editor and usability specialist)
- The facts contained in the topic are correct (tested by a product development team member or other subject matter expert)
- Illustrations, animations, video, and sounds are correct and accurately rendered (tested by a product development team member or other subject matter expert), and that the system returns to normal operation (screen colors and cursor focus) after the multimedia event is completed
- Navigational and cross-reference links work correctly (tested by the technical editor)
- For help, the context strings in the program code call the correct topic (tested by the technical editor and programmer)
- The text, colors, illustrations, photos, animations, videos, and sounds are correctly rendered on the various user hardware and software platforms (tested by the media specialists and hardware/software specialists)

In addition, procedural topics can be tested by the quality assurance personnel who test product functionality, thus ensuring that the steps outlined in the document produce the specified results.

Testing should be conducted on machines that closely resemble those used by the target audience because developers' machines will be biased against independent testing. The developers' machines usually have all software and the contexts for any relative links preinstalled, conditions that will not exist on users' machines.

How Test Results Are Reported and Resolved. Draft document testers record their completion of each test of a topic on the test results form for that topic by initialing and dating the form adjacent to the test description. They also record any problems noted on the form.

When a problem is reported, the person responsible for the topic resolves it, and the revised topic is retested. This cycle continues until all problems have been addressed.

Warning: Fixing one problem may cause another problem. The testing cycle must include systematic testing of areas adjacent to modifications, and sufficient iterations to guarantee that all problems are identified and repaired.

During the testing phase, the documentation project manager carefully monitors the progress of the tests, notes the problems that are reported, and ensures that resources are available to assist in resolving them. Because thorough testing is crucial to ensuring a quality electronic document that will be both usable to and accepted by readers, the manager must resist the temptation to hurry testing or approve the document for publication before all problems have been resolved. This is particularly important because other product development deadlines will frequently have already been met before document testing is completed.

Testing Phase Deliverable: Final Draft of the Document. When all testing and revisions to the document are complete, the documentation project team reviews the final draft of the document. It is also reviewed and approved by the management of the product development team.

After the final draft is approved, the document is published.

Publishing the Document

After the electronic document has been built and tested, it is published, but publication does not mean the same thing for all electronic documents, and electronic publishing is quite different from paper publishing.

To publish a paper document, the originator prints it and then makes it available by distributing it to the potential audience. In the case of an on-line document, however,

the document is not printed — at least not by the originator — and distribution can take many different forms.

The method of distribution must be addressed at the design phase, but the actual distribution must be monitored to ensure that the document reaches the prospective readers.

Much of the best software currently on the market demonstrates the best way to distribute electronic documents: by embedding them within the products in such a way that users cannot distinguish product documentation from the product itself. Readme files displayed automatically during product installation, help files, messages, and even features of the product's interface such as prompts for user input are all delivered transparently to the user. That is, the user does not have to think about or choose to install these documents; they are automatically installed during product installation.

Electronic documents that reside on the product's installation media (Such as a DVD or CD-ROM disc) after the product has been installed or that must be retrieved from the Internet may not always be available when users need them.

When the electronic document is published, the development team must ensure that all source files and compiled libraries are archived so they are available the next time the product or its documentation is revised.

USING ELECTRONIC DOCUMENTS

No matter how convenient or well designed, no matter how great their potential for supporting user learning or performance, electronic documents are useless unless people actually read them and find them helpful.

In the past, paper documentation has been neglected by users who are far more interested in using a product than in learning about how wonderful it is. Most users tend to learn how to use products through trial and error rather than by reading the documentation, so paper documents have often been relegated to the status of shelf decoration. Even in the nuclear industry and other situations where users are required to follow a written procedure step by step, and initial and date/time-stamp each step as it is completed, there are numerous instances of employees who have not actually used the procedure in performing the work.

Is the record any better for electronic documents? Unfortunately, the answer is probably not.

Despite the fact that virtually all software applications now offer electronic documentation, the user who experiences a problem or who needs to perform a task for the first time is more likely to ask a co-worker or call the manufacturer's technical support line than to summon the on-line help. As a result, experienced creators of on-line documentation are looking at alternative ways of approaching electronic documents.

- They are applying the principles of minimalist documentation to on-line as well as printed documentation. Minimalism basically endorses supplying users with the minimal amount of documentation they need to get up and running with a product and encouraging users to explore and learn on their own.
- They are usability testing on-line documents and applying the results to the next major release of the document.
- They are replacing at least some of their existing on-line procedural documentation with wizards that walk users through seldom-used processes by prompting them for the necessary parameters and essentially automating the processes. Even though wizards offer less control over the fine details of performing the process, many users prefer them because the wizards allow them to get real work done quickly rather than having to learn product features.
- They are looking at more creative, just-in-time delivery methods to get information to users. Nontraditional resources such as wikis, blogs, and message forums may be more appealing to or appropriate for some users than traditional electronic documents.

REVISING ELECTRONIC DOCUMENTS

One of the major advantages of electronic documents is that they can be more easily revised, and the revisions, more easily distributed to readers than is the case with printed documents.

Because the on-line document is not printed except by some users, the document's originator has no investment in an inventory of printed copies. This fact alone frees electronic document originators in some cases to update their documents continually and make the revised versions available to their readers as they are approved for distribution.

Similarly, the cost of distributing revised documents is essentially nonexistent.

Revised versions can be posted on Web or file transfer protocol (FTP) sites for easy, free downloading via readers' Internet connections. Corporate intranets provide the same capability.

New releases of on-line documentation for new releases of the hardware and software products they support can be distributed with the revised product, either through the post, over the Internet, or through commercial outlets. The cost of shipping the new documentation on portable media is slight, and in most cases, the electronic documents can be included on the same media as the application or system software for the product at no additional cost.

As a result of the low associated cost, document creators can issue more frequent releases of the electronic documents than would be practical with paper documentation, and users can be assured of having the most recent version of the document. In cases where up-to-date documentation is critical to safety or security, the electronic document can be made available only via the Internet or corporate intranet.

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