DOCUMENT AND INFORMATION DESIGN

In all fields of engineering, communicating well is an essential part of every job. Information is an extremely valuable commodity, both to those who produce it and those who receive it. Information may be delivered in many ways: in writing, orally, through video, or through live action demonstrations. Other articles in this volume focus on oral presentations and video production. This article focuses primarily on written information, on designing documents that others will look at rather than primarily listen to and that others will read (or at least read parts of) rather than just watch. Of course, even before computers, written documents could include more than words. Medieval manuscripts were richly illustrated. Equations and technical illustrations have long been part of engineering documents. With today's computer technology, written documents may also include both audio and video clips, so the boundaries among media are blurring even more.

As an electrical or electronics engineer, you may deal with many different types of documents. Table 1 lists some of the document types that you may have to create or use.

Written (and graphic) information may also be disseminated in many ways: in print, on line as a stand-alone document, on line embedded in another product (for example, an on-line help system or an electronic performance support system), through a CD-ROM, or through an intranet or the World Wide Web. No matter what type of document you develop, you should find this article relevant. The process that I describe in this article applies to designing documents for any dissemination channel.

Table 1. Types of Documents Electrical and Electronics Engineers Prepare

Requests for proposals	Reports	Standards
Proposals	Procedural manuals	Guidelines
Feasibility studies	Forms, letters, memos	Specifications

In the literature, the term *document design* is used in two meanings: both for the overall process of developing a successful document and for the piece of that process that refers to formatting (what the page or screen looks like; what typography to use). This article uses the broader definition. Document design is the entire process of planning, selecting content, organizing, writing, formatting, reviewing, and testing documents to be certain that they meet the authors' and company's purposes for developing them and the users' purposes for turning to them.

The rest of this article covers these topics:

- Exploring what makes documents successful
- Using a process model as a job aid for successful documents
- Planning successful documents
- Working out the logistics of a document project
- Focusing on the content that users need
- Organizing to help users
- Writing so users can understand what they find
- Formatting (the other meaning of *document design*)
- Reviewing, evaluating, and revising drafts

EXPLORING WHAT MAKES DOCUMENTS SUCCESSFUL

To be successful, a document must be sufficient, accurate, and usable.

Sufficient means that the information that the users need is there. Note that I did not say "complete," because that might be taken to mean that the document includes everything that could possibly be said on a topic. That level of completeness may be more than users need, want, or are willing to work with. If you develop hardware or software, you can compare sufficiency in a document to functionality in the hardware or software.

Accurate means that the information that is there is correct. Users can rely on it. If you develop hardware or software, you can compare accuracy in a document to reliability in the hardware or software.

Usable means that the people who come to the document can find what they need, understand what they find, use the information to accomplish their goals, and do all that in the time and effort that they are willing to spend on the task.

Usability is an attribute of every document as well as of every piece of hardware and software. Good usability is as critical an aspect of documents, hardware, and software as are sufficiency and accuracy. Even if the information that a user needs is in the report or manual somewhere, and even if it is correct, if the users cannot find it and cannot understand it, then you have wasted the time you spent to put it there.

USING A PROCESS MODEL AS A JOB AID FOR SUCCESSFUL DOCUMENTS

Developing any type of document requires an iterative process of planning, creating, reviewing, revising, and testing. Figure 1 is a model of that process that has evolved over several years of working with many types of documents. (Much of the evolution of this model took place while I was at the

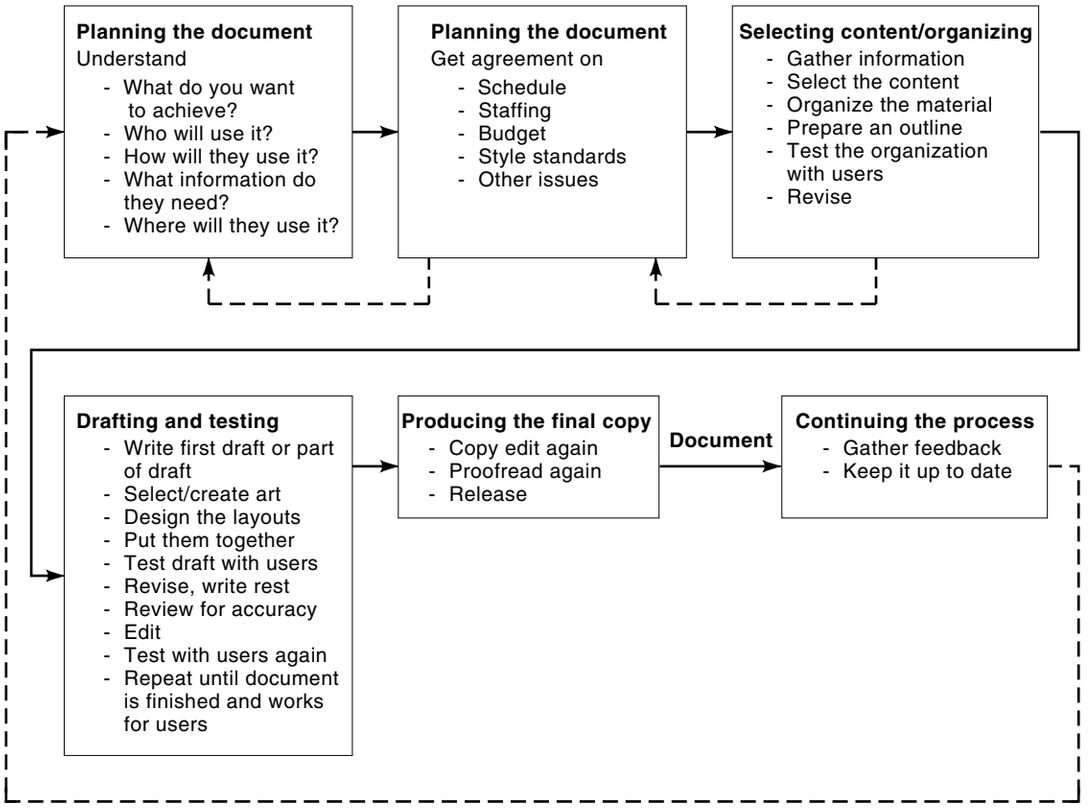

Figure 1. A model of a successful process for document design.

Document Design Center of the American Institutes for Research. For an earlier version of the model and its uses, see Refs. 1 and 2.)

Thinking of document design as a process serves at least three purposes. First, when you look at the model in Fig. 1, you realize that developing a document does not start with writing. Just as developing hardware or software starts with knowing the users, gathering requirements, and planning a design, developing a document starts with similar planning issues.

Second, when you see all the steps in the model in Fig. 1, you realize that developing a document takes time. The amount of time varies with the complexity of the situation and the document, but the steps are always necessary. You should go through all the steps in the process even when composing a letter or memo for which the planning might be 5 or 10 minutes of thinking. When you are working on a longer document, all of the phases take a proportionately longer time. For documentation in a hardware or software project, the document development process parallels exactly the hardware or software development process and may take an equivalent amount of time.

Third, the process model provides a structure or framework for capturing all the issues you must deal with throughout the process and keeping them in front of you. Note that the model in Fig. 1 is meant as a job aid. It is not a cognitive model of what goes on in people's minds as they write or as they read. (For a cognitive model of the writing process, see the work of J. R. Hayes in Ref. 3.) Furthermore, although the picture of the model puts the phases in a linear order, in fact, the process is cyclical and iterative, just as the hardware and software development processes are. The dotted arrows leading back from each phase to the previous one are meant to indicate the iterative nature of the process. Planning starts before anything else, but as you select content, organize, and begin to write and format the document, you may well find yourself revisiting some of the planning questions. After you have had users try to work with the document, you will almost certainly revisit decisions you made earlier on content, organization, writing, or formatting.

The process model in Fig. 1 also serves as a graphic representation of the organization of this article. In the following sections, I elaborate on each of the phases and steps in the model.

PLANNING SUCCESSFUL DOCUMENTS

Planning is critical to successful documents. As you plan, you must get the information to answer these four questions:

- *Audiences:* Who will use the document?
- *Purposes:* These are *your* purposes, or your company's or agency's or client's purposes. What do you want to achieve by creating the document?
- *Users' Ways of Working:* How will people use the document?
- *Users' Needs:* Why will people come to the document?

When you have answers to these four questions, you will have to select the appropriate document type(s) and media.

Audiences: *Who* Will Use the Document?

Documents do not exist only to record information. You want people to get information from your documents. That means you have to know who the audiences are and enough about their relevant characteristics that you can address their needs and use their words. You cannot assume that just because you wrote a document, people will read and understand it. Writers do not determine how much of what they write will be read and used. Audiences decide that for themselves (4). As you think about audiences, consider that reviewers may not be your real audience and that you may have to observe and interview users to understand them.

Reviewers May Not Be Your "Real" Audience. The first people who see and comment on your documents may be reviewers within your company or agency. They are often not the audiences for whom you are preparing the information, and they may not be good candidates to represent your real audiences. These reviewers may differ significantly from your real audiences in their subject matter knowledge, motivation, vocabulary, and so on. They are *gatekeepers.* Their review is important, especially if they are making sure that the information is technically or legally accurate and that it is in keeping with company policies. However, both you and they must realize that their needs, knowledge, and ways of working with the documents may not match those of the people for whom the information is intended.

You May Have to Observe and Interview Users to Understand Them. Naming your audiences is only the first step in knowing enough about them to write for them. You may think of your audiences with titles and major roles (for example, as reviewers of proposals for funding of electrical engineering projects, as managers within other companies who make purchasing decisions on equipment for their companies, or as users of your software). To plan successful documents, however, you need to know more about these audiences. You probably need to know more about their domain knowledge (what they know about the subject matter), their tool knowledge (what they know about the type of device or operating system they will be working with), their interest in the topic and motivation to go to your documents, and the vocabulary they use to talk about the objects, actions, and topics you are documenting. In some cases, knowing their general literacy level and native language may be important.

If your audiences are close to you so that you see them, talk with them, and work with them every day, you may know all this information about them. Most engineers, however, are writing for people whom they do not know that well. In particular, for most hardware and software documentation, the assumption that the audience is just like the hardware or software engineers is almost always *not* correct. To gain a better understanding of audiences, you might look at documents that have been successful with these audiences. You might talk with technical support staff: people who take phone calls from your audiences when they need help or who go out and help them in their own workplaces. The best way, however, to understand the audience's levels of knowledge, motivation, vocabulary, and so on is to do field studies—that is, to observe and talk with representative users in their work sites as they are working (5,6). The same type of field studies that bring back information about users to develop successful interfaces can be used to develop successful documents.

Table 2. Types of Documents and Purposes Writers Have for Writing Them

This Type of Document	Might Be Written for These Purposes
Term paper	Get a good grade; impress the professor; learn something new
Functional specification	Get the product coded correctly without rework
Proposal	Get agreement to do the project; get funding
On-line help	Increase users' productivity; reduce support calls to the company

Purposes: *What* Do You Want to Achieve by Creating the Document?

Documents in the working world serve functional purposes. People write them to make things happen. Table 2 shows some document types and purposes the writers might have.

Understanding your purposes or your team's purposes can help focus what you are doing in a documentation project. One reason for considering purposes early is to find out if everyone on the team or in the company agrees on the reasons for creating the documents. If there is disagreement, discussing purposes at the planning stage allows you to negotiate which purposes are going to be handled in which document. For example, a user's manual is not the place for persuasive marketing information; people go to user's manuals to get information to solve their immediate problems. Marketing's purposes might best be served by a colorful brochure that is also packaged with the product.

Articulating purposes early also gives you reasons for decisions later in the process and goals to use in measuring success later. If the team agrees that the purpose of a functional specification is to reduce the amount of rework needed during coding, they can measure success by measuring rework. For the functional specification to serve its purpose successfully, the team must realize that they have to keep the specification up to date, distribute it to all who need to work with it, and organize and write it so clearly that people really use it. Many functional specifications just sit on shelves or remain unused on the network because no one articulated the purposes and worked to be sure the purposes were met.

Users' Ways of Working: *How* Will People Use the Document?

Documents in the working world are functional both for you and for your audiences. In addition to articulating what you want to achieve by creating the document, you should think about how your audiences will work with what you create. Some documents are meant to be read from beginning to end. I hope you are reading this encyclopedia article that way. But people do not *read* most engineering documents. They *use* them. Even with articles like this one, or journal articles, or reports, most people skim, skip, and use the headings to orient themselves and decide what to spend more time on. With procedures like user's manuals or on-line help for hardware or software, users generally want to go directly to the place that has the information they need, understand the informa-

tion as quickly as possible, and get out and back to whatever task they were doing with the hardware or software. They do not read the document from beginning to end.

Sticht and colleagues (7) categorize documents as either "reading to learn" or "reading to do." Students with textbooks are reading to learn. They are expected to read carefully, spend time analyzing the information, and be able to remember the information later. In the workplace, most people use most documents for immediate purposes like making a decision or getting information to act on while working. Busy people do not have time to study documents. Even if they do read the document through once, they do not memorize it. They expect that if they need the information later, they will be able to go back to the document and quickly find the right place again. They are reading to do. Redish (8) suggests that many users' manuals and on-line help systems for hardware and software fall into an intermediate category of "reading to learn to do." We want users to learn from them, but users want to use them "to do."

Audiences for many engineering documents, including data sheets, procedures, specifications, user's manuals, on-line help, and Web sites, are busy people with little time to read to learn. They are reading to do or reading to learn to do. Even for proposals and reports, it is useful to think of audiences as *users* of documents and not as *readers.* This article focuses on how to design documents that people can *use* successfully.

Users' Needs: *Why* Will People Come to the Document?

The earlier topic on purposes was about understanding why *you* want to write the document. You have purposes (goals) as a writer. The people who use documents also have purposes (goals). This topic is about the users' (readers') goals. Understanding users' goals can be a major help in selecting content, organizing, and formatting a document.

With some documents, particularly those in an academic setting, the user's goal may be to get general information on a topic. In the workplace, however, people usually come to an engineering document with a specific question or because they need instructions to accomplish a specific task (9). To create a successful document for those audiences, you have to know what those questions or tasks are. That is, you have to gather the users' requirements for the documents, just as you must gather users' requirements for any other aspect of an engineering project.

Gathering requirements for documents requires two critical steps. (1) You must work with the people who will actually be using the documents. (2) You must frame the questions or tasks in the document in the users' words. In many requirements-gathering exercises, engineers talk only to people who say that they speak for users but who are not users. These spokespeople may be either decision makers who will fund the project or supervisors who believe they know what users need. But they are most often not the people who, in the end, will be trying to get information from your documents.

Just as the best way to understand the audience is to observe and talk with representative users in their work sites as they are working, that is also the best way to find out what users need to know about your topic. If the document is about procedures, such as a user's manual or an on-line help system, then people are using it to accomplish tasks. That requires gathering a list of the tasks that users do with the product, in the users' words. When users later go to the document, they will be searching for specific information related to what they want to do. They are the ones who will be doing the search and, therefore, they will be using their own search terms. To make the information in the document accessible to users, you must organize it by their tasks and write it in their words, not those of the technology or the particular product.

Another aspect of users' requirements may be very important in your project: the environment in which the document will be used. Documents are not used only in offices. For print documents, decisions you will need to make about the physical size of the document, weight of paper, binding, and so on may be affected by where and how people will use the document. If a device is going to be installed on roofs, and the installer needs both hands on the device, how are you going to deliver installation instructions? Thomas F. Callaghan explains that to get information from astronauts in a questionnaire, his group had to make the document fit onto the astronauts' kneeboard, which is velcroed to their pants. As Callaghan says, "If you want to provide or capture information 'on the job,' sometimes you have to make it fit the user[s], not just [their] environment" (10). For on-line documents, you may need to be concerned with issues of what size monitor people have, what operating system, what Web browser, and so on.

Selecting the Appropriate Document Types and Media

As the last example shows, once you have information on audiences, your group's purposes, how people will use your documents, and the users' requirements for the documents, you must make decisions about how you will deliver the information. Sometimes the right decision at this point is not to create a document, but to deliver the information in some other way, such as through a telephone call, a video presentation, or an in-person demonstration. Sometimes the type of document you need is obvious. The response to a request for proposal must be a proposal, although even there you may have some choice about the medium to use and what to include in the body of the proposal and what to put in appendices.

Sometimes the choice of document type and medium requires analysis. For example, if you are planning the documentation set for a software or hardware product, you might want to design different types of documents for different audiences and different tasks. A good way to analyze the information you have gathered in that situation is to create a table or matrix of users and tasks. An example of part of a table that lists user types, tasks, comments, and proposed solutions to user's information needs is shown in Fig. 2.

WORKING OUT THE LOGISTICS OF A DOCUMENT PROJECT

Logistics is about resources: people, schedules, and budgets. Developing documents requires resources, and part of successful management of documentation projects is knowing how to estimate the need for resources, track the use of resources, and deal with the inevitable changes in schedules and scope of work (11). Because there is another article in this Encyclopedia about management of documentation projects (MANAGEMENT OF DOCUMENTATION PROJECTS), I will not cover that aspect of logistics here. Instead, this section fo-

User types	Tasks	Comments	Proposed information solutions
Manager and system administrator	Make decisions about buying	Manager wants to know what software does, sys. adm. wants technical information	Marketing brochure with pull-out page of technical specifications
System administrator	Install software on server; configure; change parameters later if necessary	Wants to do it quickly; but also wants to understand system	Step-by-step installation guide with some information about how choices affect system and why should do some steps; headings that relate to tasks so that can get back to specific steps when need to later
User on a personal computer	Install software on personal computer	Does not want to deal with it	Installation wizard; no documentation; words and questions in wizard in clear language
Experienced user transferring from other program	Same tasks as did before but new steps	Wants to be up and running quickly; no interest in tutorial	Quick reference card explaining differences; include old words in new on-line help system

Figure 2. Part of a table that writers constructed to analyze different people's information needs and to find the best ways of delivering that information to them.

cuses on the interpersonal aspect of logistics: collaboration and teamwork.

You may be the lone author on a project. In that case, planning the logistics may be largely a matter of planning your own time and knowing your deadlines. However, even lone authors are likely to have to coordinate with subject matter specialists, with editors, with reviewers, and with publication departments. Understanding their roles and their schedules may be important for planning your own time. In work situations, being the only person working on a project is the exception rather than the rule. In almost all cases in work situations, developing a document requires collaboration and teamwork.

Collaborating on Reports, Journal Articles, and Proposals

One type of collaboration is between subject matter specialist and professional technical communicator. Professional technical communicators are people who live by the process described in this article. Many technical communicators are experienced in more than just writing. They are familiar with the entire process: They do requirements gathering, user (audience) analysis and task analysis, planning, setting up formats that work, and testing documents with users, as well as, of course, writing and editing the documents. They are often skilled at interviewing professionals in other disciplines and translating that information into an organization and language that works for the audiences. Two common modes of working are (1) for the engineer to take the lead as writer, with the technical communicator as consultant, mentor, and reviewer; and (2) for the technical communicator to take the lead as writer, with the engineer as information source and reviewer.

Some technical communicators prefer to specialize in specific aspects of the process. Some are primarily editors who work with scientists and engineers to help them communicate effectively. They usually work in the first mode: The scientist or engineer prepares the first draft, which the editor then reviews. Some are primarily graphic designers and technical illustrators who help create effective page layouts and add relevant artwork. Some specialize in indexing. An increasing number of technical communicators, however, see their role as encompassing all aspects of the document design process. They usually work in the second mode: They are responsible for the document, and the engineer provides information and reviews the document for technical accuracy.

Collaborating on Creating Successful Hardware and Software

Another type of collaboration, especially in creating hardware or software products, is teamwork among many specialists, including business analysts, designers, developers, documentation specialists, human factors engineers, marketing and sales specialists, programmers, subject matter specialists, training specialists, usability specialists, and users. In this context, documentation specialists may be called technical communicators, information developers, information products engineers, and other similar titles. Training specialists may be called instructional designers, learning products engineers, multimedia specialists, and other similar titles.

Human factors engineers on development projects may specialize in ergonomics or in cognitive psychology or both. Ergonomics refers to matching products to the physical needs of users and is relevant to issues such as building keyboards that reduce the risk of repetitive injury syndrome or making sure that the keys on a hand-held device are spaced far enough apart that a typical user will succeed in pressing only one key at a time if that is the way the device is meant to work. Cognitive psychology refers to understanding how people think and work and is relevant to issues such as the de-

sign of a software interface so that it does not overwhelm the users, so that the users can relate to the overall metaphor and icons, and so that the pathway to accomplishing a task is logical to the users. For an excellent book on cognitive psychology and design, see Norman's *The Design of Everyday Things* (12).

The cognitive psychology side of human factors can be relevant to hardware as well as software. Here is an example: Macintosh disk drives do not have buttons, but disk drives on other personal computers do, and the user must press the button to eject a disk. When Apple released a new Macintosh with the ability to read both Macintosh and other personal computer disks, one of the marketing goals for the new Macintosh probably was to attract users whose previous experience had been on other personal computers. When some users who were transferring from other computers wanted to get their disks out of the Macintosh disk drive, they reached for a button—and their hands found one just below the disk drive, so they pushed it. Too late they discovered that the button did not eject the disk as they expected. It turned off the computer. Human factors specialists would have known not to put the On/Off button there. They know that all people use their prior experience when working in new situations, and they would have known how important it is to find out about what users would expect, especially when a company is expanding its market to new users.

Usability specialists are people who focus on keeping the user at the forefront of everyone's thinking during the entire design and development process. Many technical communicators as well as many human factors specialists have moved into positions as usability specialists, because the skills and knowledge required are what I have just outlined: an empathy for users; understanding how users think and work; good skills at observing, listening to, and talking with users as they work; doing task analysis; analyzing the implications of what is learned about users for the design of hardware, software, and documentation; and making sure products communicate effectively with users. Many business analysts, marketers, and engineers are also becoming usability specialists. In an ideal world, everyone would understand that the only successful products are those that work for users, and thus all members of a product development team would be interested in gaining the skills that cognitive human factors specialists, technical communicators, and usability specialists now bring to teams.

FOCUSING ON THE CONTENT THAT USERS NEED

An important aspect of information or document design is deciding what information to include. The major goal in selecting content should be to give users just what they need, not more and not less. That goal is not easy to achieve because most documents have many users whose information needs differ. If you can identify different user groups with different information needs, you may be able to use organization and page layout to help all users fulfill their information needs quickly.

For example, if you are reporting on a series of tests and your audiences include managers who are only interested in the critical results, engineers who want to know what you found and what they should do about it, and other researchers who might want to duplicate your tests, here is what you might do: You might prepare a single document with three parts. Start with a one- or two-page executive summary for the managers and include a brief description of what you did and a bulleted list of the major findings and recommendations, but without the details of how to carry out the recommendations. Address the body of the report to the engineers, focusing on presenting the findings with data and the recommendations with details. Prepare an appendix for other researchers in which you describe how the tests were carried out. You might also distribute three different documents, making the executive summary into a separate memo for managers, making the body of the document (with a short introduction) into the report for engineers, and having the appendix available as a separate report for other researchers who request it.

Three keys to selecting the appropriate content are (1) being alert to constraints, (2) knowing what users are looking for, and (3) knowing where to get the information.

Being Alert to Constraints

In selecting content, it is useful to be alert to constraints that may affect what you must or can include. If there are industry or company standards for the type of document you are writing, the outline in those standards will dictate the types of information that must be included. If you are responding to a request for proposal, the topics in the request dictate the types of information that you must include. You may also be given a page limit or word limit for your document, which should make you consider both how many topics you can include and how much you can say about them.

Knowing What Users Are Looking For

As you gather information for a document, you must pay attention to what users will look for as much as to what you want to tell them. For example, in a feasibility report, busy managers look for conclusions or recommendations and justification or supporting evidence, with perhaps a brief description of methodology. They are usually not interested in a long narrative that describes the process of discovery or research that led to the conclusions. They do not have time for that. They are focused on achieving a goal quickly. The goal in this case is to make a good (that is, cost-effective) decision, so the managers need just the information to do that, organized in a way that they can use quickly and easily.

For a user's manual or any other set of procedures, users most often look for information on when to do a task and how to do it. Long passages of conceptual or background information are seldom read (13). For on-line help, users are most often looking for answers to one of these questions:

- "How do I do *X*?" (where *X* is a task)
- "What happens if I choose *X*?" (where *X* is an icon or menu choice or something else that can be pointed to or named)
- "How do I get out of this problem I'm in?"

As Patricia Wright says, users seldom ask, "How does this system work?" (14). Users of software and hardware seldom want you to describe the system. They want you to tell them how to do their work with the system. They do not want to

know the functions on the Edit menu. They want to know how to move text from one place to another.

Knowing Where to Get the Information

Sources of information for documents may be people, paper (in the broad sense of any document, whether available in print or on line, in a physical library or found on the Web), programs, or products. Because other people are often the best source of information, interviewing and listening skills are crucial to competency in designing successful documents. (Chapter 10 of Ref. 5 discusses interviewing skills.) For a user's manual or an on-line help system, observing, listening, and talking to users is the best way to find out what tasks to include, what to call them, and how to group them. That information should be gathered before the product is designed. Then, as the product is being developed, using the product itself or watching a competent user work with it is the best way to get details for explaining how to do the tasks.

When technical communicators are responsible for documentation of products being developed by engineers, continuous, ongoing communication between the two groups is absolutely necessary. Both technical communicators and developers must have access to the users so that they can know how to develop the product to match users' tasks and mental models and so they can know how to organize the information to match users' search strategies and search words. Throughout design and development, technical communicators must have access to the product to see how to do the tasks. They must have access to the developers to get issues clarified and questions answered. They must be on the distribution list for updates to technical specifications and be informed of changes that are being made even when the changes are not being formally recorded. Managers must make it clear to developers that working closely with technical communicators is part of the developer's job, not an imposition of extra work.

Successful collaboration with technical communicators can make the engineers' jobs much easier, as Pieratti shows (15). Technical communicators are often able to suggest improvements to interfaces and to procedures. If a procedure is difficult to explain, it will probably be difficult for users to do. Rather than using documentation to translate technical terms into users' terms, technical communicators can help engineers put the users' terms directly into the product.

Cover, Cooke, and Hunt (16) show how lack of collaboration or poor communication between technical communicators and engineers can be costly to companies. If technical communicators are not part of the ongoing teamwork, they may inadvertently produce information that is neither accurate nor sufficient. Changes during development are more costly than collaboration that avoids misunderstandings. Changes required after release are even more costly, both in real dollars and in lost customer satisfaction.

ORGANIZING TO HELP USERS

Organization provides the structure or framework for a document. Organization means the way that the information is arranged: how information is ordered (what comes first), how it is grouped (into sections, chapters, Web pages, help topics, etc.), and how topics are linked (by cross references on paper or hyperlinks on screen). Users see the organization of documents through the headings that you put on each topic, section, and chapter. Those headings get accumulated into a table of contents, which shows your organization to the users. An excellent strategy for information design is to start by creating at least the first few levels of the table of contents. That is, put down the major headings first rather than letting them emerge through the writing. The table of contents that you create before you write is an outline.

Outlining to Help Yourself Create a Coherent Document

An outline is the skeleton of the structure of the document. For a paper document, an outline is a list of all the headings that will be in the document, in order, with some indication of how they are grouped into sections or chapters. For an online document like a help system or a Web site, an outline might be a map that shows not only the headings and their groupings but also their hyperlinked connections.

In the process model in Fig. 1, selecting the content and organizing it are in the same box because the two aspects of designing documents are closely intertwined. If you outline before gathering all the information, the outline can help you decide what content is needed. If you start by writing without outlining and without considering organization and content, you may waste time writing sections that you later find have no place in the document.

Outlines of documents can even help teams decide on the content for other aspects of products. If you develop the outline of a task-based user's manual for a software or hardware product by analyzing the users and their tasks, what you have is a list of what the users need to accomplish through the product and the way the users group those tasks. If you develop that outline for the manual *before* designing the product, you can use it to determine both the functionality the product must have and how to group that functionality into menus or toolbars.

Starting with an outline saves time and usually makes the process easier, especially for engineers with writer's block who have difficulty starting to write. Remember, however, that the process of designing documents is iterative. As you move from outline to text, you may reorganize the information, rewrite headings, add new pieces, take out parts, and so on. The outline should not be cast in stone. To make sure that you continue to develop a coherent document, periodically use the computer to produce a table of contents of the headings in the emerging document. Review the table of contents to see that it continues to meet users' needs. Do usability testing on the table of contents, as described in the last section of this article.

How can you tell that your outline reflects an organization that meets users' needs? Good organization serves two major purposes: It helps users (1) grasp what the document is about and (2) get where they want to go. It helps them do both quickly, within the time and effort that they are willing to expend on trying. (Again, it is the user, not the writer, who decides how much time and effort to spend trying to find and understand information.)

Helping Users Quickly Grasp What the Document Is About

Users should be able to glance down the table of contents of any document and understand both the major points it is

Using Your Model 345 Fax Machine

Table of Contents

Unpacking the Machine 1
Checking that you have all the parts 1
Saving the packing materials in case you need them 2

Setting up the Machine 3
Choosing a good place for your fax machine 3
Connecting the telephone handset 4
Putting the document tray on the machine 4
Connecting to a power outlet 5
Connecting the telephone line 5

Starting to Use the Machine 7
Loading paper 7
Setting the date and time 9

Figure 3. Part of a table of contents that both helps users see the overall picture and find a specific part quickly.

making and how those points are put together. Figure 3 shows a small section from a successful table of contents for a procedure manual. Note that listing the same functions alphabetically would not serve as well to give users the "big picture" of the product.

In a long document, with many levels of headings, you may want to restrict the headings in the table of contents at the front to two levels so that the big picture is easier to see. You can then show a more detailed table of contents at the beginning of each chapter. In an on-line help system, in which the amount that users can see on the screen at one time is limited, using a technique called progressive disclosure serves the same purpose, as shown in Fig. 4.

Within any chapter of a print document, try to use no more than three levels of headings. If you need more, you probably need another chapter. For on-line help systems, the screen size usually restricts you to two levels: a title and one lower level of heading.

Furthermore, try to keep all the headings at a given level in similar sections of a document in the same sentence structure. For example, if you are using verbs that end in -ing as the headings in a procedures manual, be consistent in doing so. Busy users can skim the parallel headings faster; understanding them takes less mental energy. Compare the headings in the two parts of Fig. 5.

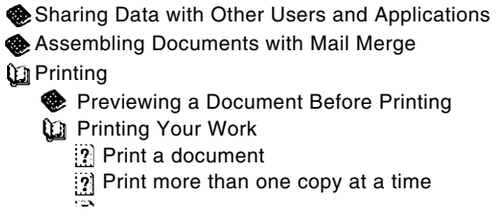

Figure 4. Clicking on the book icon opens the next level of headings in this content list, progressively disclosing more and more detail. (The example is from the help for Microsoft Word for Windows 95, version 7.)

Envelopes
Envelope specifications
Orienting the envelope
How to load the envelope feeder

Printing envelopes
Choosing envelopes for this printer
Printing one envelope
Printing more than one envelope

Figure 5. Nonparallel headings (top list) are harder to understand quickly than parallel headings (bottom list).

If you have similar information in different sections, you might repeat the same series of headings in the same order for each section. When the pattern you establish in one section carries over to another section, users quickly learn to know what types of information to expect and where in each section to look for that information.

Helping Users Get Where They Want To Go Quickly

Successful navigation is as critical in a document as it is in any software or hardware product. If users cannot find what they need, they cannot use it. The key to successful organization is to match the users' expectations and the users' strategies for searching for information. With paper documents, users search in three ways: through the table of contents, through the index, or by flipping and scanning pages. With on-line or CD-ROM documents, users search through menus, through keyword search lists, by browsing, and sometimes by full-string search. Menus are the equivalent of tables of contents; titles of help screens are the equivalent of headings; keyword search lists are indexes; browsing is like flipping pages, although scanning is more difficult on line and users may feel more lost in the hidden space of hypertext than in the familiar physical space of a book.

Matching users' expectations and users' search strategies means writing headings that match what users have in their minds when they come to the document. For procedure manuals, users come wanting to know how to do tasks. Therefore, verb phrases that match the tasks users want to do are the best headings for a procedure manual, as you saw in Fig. 3 and in the second list in Fig. 5.

Because you are deeply involved in the system you are working on, you may not always recognize when you are thinking from the system's point of view and not the user's. One way to make sure that you are matching users' needs is to ask whether your heading describes the task users want to do or the *system's solution* for that task. To develop documents that serve users' needs, use the user's task as the heading and present the system's solution and how to use it in the text. (Reference 17 explains this point further.) Here are two examples that show the difference between headings that reflect users' tasks and headings for the same information that reflect the system's solutions:

User's task:	Timing how long a call lasts
System's solution:	Using the CLOCK function
User's task:	Keeping envelopes from wrinkling during printing
System's solution:	Changing the envelope enhance setting

Numbering Paragraphs: Should You Do It? When Should You Not Do It?

The issue of whether to use numbering as part of every level of heading or even every paragraph may be relevant for many writers of electrical and electronic engineering documents. If the audience expects documents with numbered paragraphs or if the document has many cross references, numbering may be useful. Documents for nontechnical audiences, however, should have numbers only at the chapter level and not for any headings below the chapter title. Nontechnical audiences see documents with numbered paragraphs as overly formal, overly technical, and not applicable to them.

Even for technical audiences, if you do not have to use numbering, do not. Numbering is a holdover from a time when writers had few options for showing levels in a document. Today, writers have many options for showing those levels. Changing type size, type font, and placement on the page are better ways of showing levels of headings than numbering. Numbering every section or paragraph may cause problems in a document that is updated frequently.

If you must use numbering, prefer a simple system with Arabic numbers (1.0, 1.1, 1.1.1) to any system that mixes numbers and letters or types of numbers. Do not expand the system beyond three levels. People have a hard time finding the right section when the numbering system gets more elaborate than three levels.

WRITING SO USERS CAN UNDERSTAND WHAT THEY FIND

When you have planned the document, gathered the information, organized it, and perhaps thought about the page design (which is covered in the section after this one), you have to write down the information on paper or on the screen. Writing—conveying the information in text and graphics—is obviously a critical part of information design. To help busy users quickly grasp your information, consider these seven guidelines for writing useful and usable documents:

- Start sections with context and signposts.
- Even on the sentence level, put new information into context for users.
- Keep sentences straightforward and simple.
- Prefer the active voice with action verbs.
- Use words your audiences know.
- Use lists for instructions, conditions, and multiple items.
- Combine text with graphics when appropriate.

Start Sections with Context and Signposts

When users get to a particular section of a document, the first thing they want to know is, "What is this all about?" They are asking themselves, "Do I want to be here?" and "Do I want to read further?". If you plunge right into technical details without explaining what the section is about (providing context), you may lose your readers. Remember also that users may not have already read everything up to this section; they may have come to it by jumping directly from the table of contents or the index, or even by flipping the pages. Busy users decide quickly if they have jumped to the place that has the information they are seeking. If they are not sure, they are likely not to read further. You set context in part by writing a heading that is meaningful to users. You also set context by telling users what they will find in the section.

If the section is long, the next questions in most users' minds are, "What's in this section?" and "If I want a particular piece of information, can I jump again within this section to get to it?". A bulleted list often helps to give users signposts to what is coming throughout the section. As examples of context and signposts, consider the heading, introductory sentences, and list that start this section on "Writing So Users Can Understand What They Find." Note how, as you scan the rest of the section on writing, each item in the list becomes a heading at the next lower level. The rest of the section is an elaboration, topic by topic, of the items in the list in the order of the list. If you were particularly interested in just one of those topics, you could go to it directly.

Even on the Sentence Level, Put New Information into Context for Users

When you are writing, you are usually presenting information that is new to the readers—otherwise, why would you be creating the document and why would they be reading it? However, people understand new information best when they have some context for understanding it. A major problem with many scientific and engineering documents is that writers present new information without giving readers the links they need to what the readers already know. That happens on the sentence level as well as on the level of paragraphs, sections, and documents. Consider these two versions of the same sentence:

New before old:	Four stages which are described in the following paragraphs were used in the testing process for a test of the ABC system.
Old before new:	In testing the ABC system, we went through four stages, which we describe in the following paragraphs.

Readers of the first sentence have to wait until the end to know the context—that is, what the writer is talking about (the test of the ABC system). By the time they get the context, many readers will have forgotten the new information the writer is providing: namely, that the test took four stages.

Keep Sentences Straightforward and Simple

People can only process so much information at one time. If you overload a sentence with more than two or at most three thoughts, you ask more of people than they can remember. English is a very flexible language. We can take simple sentences and embed them in other sentences, piling up lots of information between the subject and verb of the original sentence. A little of this makes sophisticated sentences; a lot makes sentences too complex for busy readers to grasp quickly. Linguistics research also shows that readers remember information better when it is at the beginning or the end of a sentence than when it is buried in the middle. Do not overload sentences. Write more sentences instead.

Prefer the Active Voice with Action Verbs

Engineering documents, like scientific documents, have traditionally been written in the passive voice, with the emphasis

on the object of study and not on the people who did the study. An occasional passive sentence, like the one that begins this paragraph, will not bother most technically sophisticated readers. However, when an entire document is in the passive voice, readers may find the document difficult to use. Readers make better connections to documents when people are present in the writing. Look back at the example about testing the ABC system. Which sentence does a better job of enticing you to read further?

In a well-known study some years ago, Flower, Hayes, and Swarts (18) asked people who were supposed to use a particular document to read it and think aloud as they were reading it. The document was entirely in the passive voice, with no mention of actors and with few verbs that indicated real actions. As the readers were working through the document, they actually translated the passive sentences into little stories (scenarios) of who did or might do what to whom. Their translations were often wrong. You can save your readers the burden of doing their own translations and you can make correct understanding more likely if you present information that includes who did or should do something (that is, by writing in the active voice). If you are writing for nontechnical audiences or if you are giving instructions, address the audience directly, using *you* or the imperative. Which of the two sentences in the following example takes less time to understand?

No actors: The recent decision to reschedule the implementation of the OPS product has resulted in the need for allocation of developer resources to other projects.

Has actors: Because we are delaying implementation of OPS, we need to assign the OPS developers to other projects.

Use Words Your Audiences Know

If your goal is to communicate clearly, you want to speak in the language that is quickest and easiest for your users. Technical jargon is appropriate if all the people who will read your document know that jargon and use it comfortably. However, writers more often overestimate than underestimate how much of their own technical jargon their audiences know. The words are so familiar to them that they forget that those words are not common English. Even other engineers who work on other aspects of similar projects or in other engineering fields may not share the same technical vocabulary. Certainly, nontechnical readers are unlikely to know the technical jargon. Moreover, in many industrial settings, managers come from managing other groups and do not share the technical training or technical vocabulary of their staff members. Trying to impress people by using big words often backfires. Even when readers know the big words, they are very busy and will read more if the reading goes quickly—with short sentences and common words.

Use Lists for Instructions, Conditions, and Multiple Items

Readers often bypass long paragraphs of text. To make pages look inviting and to help readers find information quickly, keep paragraphs in print to just a few sentences. (In on-line documents, particularly help text, making each sentence into a separate paragraph is often appropriate.)

A useful way to break up many long paragraphs of text is to make them into lists. If you are giving instructions, make them steps in a numbered list. Readers will be able to follow the instructions from a list much more easily than they would from a prose paragraph. The numbered list tells them at a glance how many steps there are. If they use the list while working, they can more easily look at the document, do a step, and return to the correct place in the document. They are much less likely to skip a step from a numbered list than from a prose paragraph. In addition, you can put illustrations next to the step to which they apply when you use a numbered list for instructions.

Use lists when you are telling readers what all the components are for a piece of hardware, a test setup, or any type of configuration. Checking off items is easier from a list than from a prose paragraph. A page with lists also looks more inviting because it seems to be less dense and has more open space.

Combine Text with Graphics when Appropriate

Graphics (tables, charts, graphs, technical illustrations, screen shots, equations) have a major role in most electrical and electronics engineering documents. When they are well constructed and used appropriately, graphics are an extremely useful way of conveying information quickly and succinctly. Research shows that users understand information better when it is presented in both text and graphics than in either alone. Try to keep the graphic on the same page as the relevant text and always refer to the graphic in the text so that users can link the two presentations easily.

Make sure that your audiences are familiar with the type of graphic that you are using. Do not try to make a single graphic convey too much information at one time. Use more graphics (blow-ups for technical illustrations; secondary tables or charts for details) if necessary. The right amount of information in any one graphic is what your audiences can use to meet their needs in the time and effort that they want to spend. To be sure that you have chosen the right type of graphic and that you have the right amount of information presented clearly in the graphic, do usability testing. (That is, have a few representative users come and try to use the document with the graphics. See the last section of this article.)

FORMATTING (THE OTHER MEANING OF "DOCUMENT DESIGN")

Formatting, the way that you physically show the information to users on paper or on screen, is another critical dimension of information/document design. Decisions relating to formatting for a paper document include the physical dimensions of the document, the way it is bound, the weight and color of the paper that you use, the way the information is set out on the page, the ratio and relationship between text and graphics, and the typography used for each element on the page. All of these except binding and weight of the paper are also relevant for information on the screen. (Color of paper can be translated into the color you choose for the background on a screen.)

Formatting governs the physical appearance of the information, and physical appearance affects both attitudes and experiences with documents. Users' first impressions of a doc-

ument come before they even attempt to read it. Users are more likely to attempt to work with a document that looks inviting and seems to be easy to work with. Once users start to work with a document, formatting can actually help or hinder them in their attempts to find what they need and to grab information quickly from the page. You can use page layout effectively to make the way you have organized your document obvious to your users. Depending on the importance of the document, the audiences for the document, and the number of copies you will be distributing, you may want to involve professional designers in planning and implementing decisions on formatting.

Considering the Overall Size, Binding, and Paper

The first decisions you need to make are about the overall layout of the document: what size pages to use, how the document will be bound, and the paper to use. United States standard page size is $8\frac{1}{2}$ by 11 inches. (European standard page sizes, A4 and A5, are longer and narrower.) If your document will be printed through a desktop printer or will be photocopied, you will probably want to use the standard size. For user's manuals or other documents that will have large press runs, consider a smaller page size. Typical user's manuals are now $6\frac{1}{2}$ to $7\frac{1}{2}$ inches wide by 8 to 9 inches long. The smaller page size takes up less room when open on the user's desk. Smaller size documents are easier to handle and seem friendlier and less formal.

Documents may be bound in several ways. Professionally printed books typically have the pages printed in sections (called signatures), and the sections are glued into a spine that is part of a wrap-around cover. That is called perfect binding. Perfect-bound books look good on a shelf. They usually have printing on the spine so that the title can be read from the shelf. Professionally printed booklets and other thin documents can be bound by stapling them through the spine. That is called saddle stitching.

For reports and other documents that are printed on a desktop printer, you have four choices: You can use a wire or comb binding, which requires a special machine to punch holes and insert the binding. You can use a heat-pressed binding that can be put on automatically by a photocopying machine. You can put the material in a three-ring binder, or you can staple it. If the material will be used often and must lie flat while the user is working, consider the wire or comb binding or the three-ring binder. The other treatments may not hold up as well under constant use if people try to make them lie flat.

Planning Page and Screen Layouts: An Engineering Approach

Page (or screen) layout is one of the most critical aspects of document design. Following the steps in a carefully planned process can help you develop page layouts that are aesthetically pleasing and that also help users find what they need and see the relationships among different types of information. In her book, *Dynamics in Document Design* (19), Karen Schriver presents a ten-stage iterative heuristic (a process with guidelines) for planning page layouts. The first two stages are

- Listing all the elements that the document requires, such as headings, text, lists, examples, indented quotes, charts, tables, illustrations, footnotes, and references
- Organizing the elements into clusters that go together, such as illustrations go with leader lines and callouts, and with figure numbers, captions, and credits

The heuristic continues with carefully measuring the space available and experimenting with different ways to put the clusters together into grid patterns. (See Chapter 5 of Ref. 19 for the entire explanation. See other parts of Ref. 19 for excellent advice and research on many aspects of layout and typography.)

Schriver's view of the process of planning page layouts can lead to many different solutions, as the examples in her book show. To Schriver, and to me, you know that you have achieved a good solution when usability testing shows that the users of that document can find what they need and understand what they find. As Schriver points out, there is an interplay between content and layout. As she says (19, p. 342), "Although it is most common to flesh out the words and pictures first, the grid [that is, layout] itself often serves as a catalyst for new ways of integrating the words and pictures, which in turn may change the structure of the content."

In the process model in Fig. 1, design is part of the fourth box with writing. On occasion, especially when the focus is on on-line documents or Web sites, I have put design in the same box as content and organization (and thus before writing). The entire process of developing documents is iterative, and designing pages early can help you decide how to organize the material, what to put in prose and what to put in a graphic, and even how much to write on a particular topic.

Other authors, however, have a much more restrictive view of page layout solutions for workplace documents than Schriver or I do. Some of these approaches are referred to as structured documentation.

In one approach to structured documentation, Robert Horn's Information Mapping (20), information is analyzed into different types, such as concept, procedure, and fact. Based on this analysis, the information is chunked into blocks. The blocks of information are mapped into an organization that presents them in a logical order to the user, and each block is given a relevant label. The page layout shows the labels and the blocks by using horizontal lines to divide the blocks and by using a two-column format with the labels on the left and the text, figures, or other elements on the right. Figure 6 shows a typical structure for a page constructed through Information Mapping.

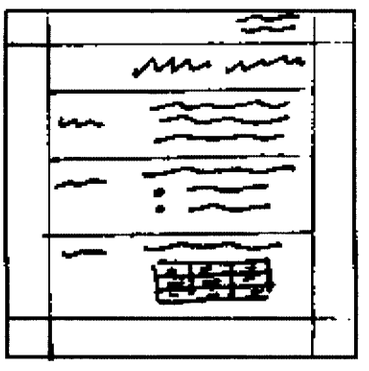

Figure 6. Sketch of the layout of a typical page developed through the structured documentation approach of Information Mapping.

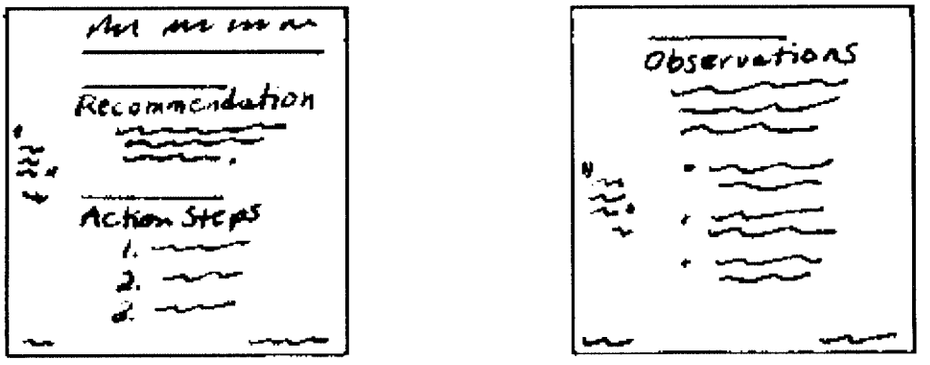

Figure 7. Layout of a two-page spread that worked for all pages of a particular document.

In another approach to structured documentation, Edmond Weiss (21) advocates thinking of documentation as modules of information. Each module may contain headings, summary, text, and graphics on a single topic. Weiss suggests page layouts that bring all the information in one module to the user at once, in either a single page or two facing pages.

Others have found two-page spreads useful in some types of documents, even when they would construct very different page layouts in other situations. Mirel, Feinberg, and Allmendinger (22) describe a case in which a consistent two-page layout worked well for a user's manual. Redish (23) shows how a two-page layout worked well in a report in which the types of information were (1) heading, (2) recommendation, (3) action steps for implementing the recommendation, and (4) observations that support the recommendation. Figure 7 shows a sketch of the page layout for that report.

Note that advocates of structured documentation, including Horn and Weiss, insist that the name refers not just to page layout, but to the entire process, to the fact that a document must be carefully planned and organized with attention to audiences and purposes. In that sense, the process model that underlies the entire approach and presentation of information in this article is one model of structured documentation. However, in particular in Horn's Information Mapping, while the structured process may lead to different specific pieces in different orders, the information is typically presented in page layouts that look alike. In contrast, like Schriver, I believe that the structured process may lead to page layouts that look dramatically different in different situations. Therefore, I prefer to refer to the model in this article as "process-based" rather than as "structured" to avoid confusion with "structured" as yielding a restricted set of possible page layouts.

Planning Page and Screen Layouts: Useful Guidelines

You will find useful guidelines for designing pages and screens in Schriver's book (19); in many technical writing textbooks, including the chapter on "Document Design" in *Reporting Technical Information* (23); and in several other useful books and articles (24–27). Here are five critical points to keep in mind when designing pages for electrical and electronic engineering documents:

- Set up a grid and use it.
- Select a readable typeface.
- Make the headings stand out.
- Do not crowd the page.
- Do not use long lines of text.

Set Up a Grid and Use It. You help both yourself and your users when you set up a grid (template) for the layout of your document on paper or on screen. Figure 8 shows some examples of grids for engineering documents. Grids are useful for screens for the software itself, too, not just for paper and online documents. With a grid, you will stay consistent in where you put the elements on the pages or screens. Consistency helps users find information quickly. Work to create a grid in which the relationship among the elements is clear and in which users can quickly grasp the different types of information that they might need in different situations. Although the same types of pages in the same part of a document should all have the same grid, you may find that different grids are appropriate in different parts of documents or for different types of information.

Select a Readable Typeface. Experiment with the choices for typefaces on your word processor, but select one that is easy

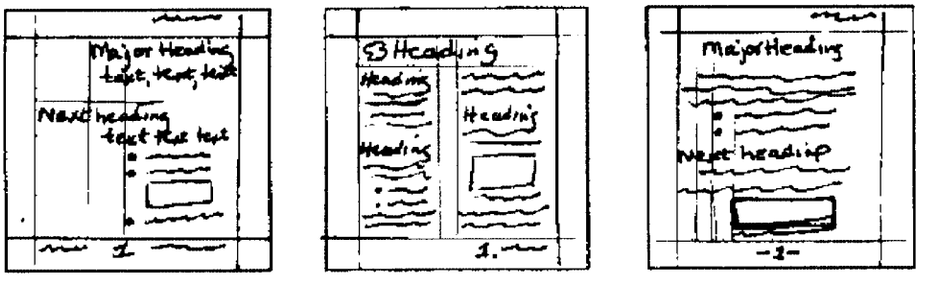

Figure 8. Three possible grids for designing documents.

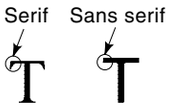

Figure 9. Serif typefaces have extenders on the tops and feet of the letters; sans serif typefaces have no extenders.

to read and put it in a size that your audiences will find legible and easy on the eyes. For most print documents, a serif type, such as Times New Roman or Palatino, works well for the body text. For headings, tables, and callouts and for brochures, flyers, and sometimes for manuals, a sans serif text, such as Arial or Helvetica, works well. Figure 9 shows you the difference between serif and sans serif typefaces. Although older research indicated that serif type was easier to read because the serifs draw the reader's eyes across the page, people have much more experience with sans serif type now and sans serif can be made very readable with a little more space between the lines. For on-line documents, readers generally prefer a sans serif type.

As for type size, the older research was based on typeset text and is not valid for reports or other documents that are printed at 300 or even 600 dots per inch on desktop printers. Most documents that are printed on desktop printers today use 12 point for body text and larger sizes for headings. Slightly smaller sizes, such as 10- or 11-point Arial, work well for tables and for running headers and footers. Type varies not only in point size, which is measured from the top of ascenders (the straight lines of letters like h and d) to the bottom of descenders (the parts of letters like y and p that go below the baseline). Type also varies in other factors, such as the openness and height of the letters without their ascenders and descenders, which is called the x-height, and the spacing between letters, which can be controlled by a process called kerning. Figure 10 shows point size and x-height for two different type faces. Experiment with the options available to you through your software and your printer.

Make the Headings Stand Out. As you saw in the section on organizing documents, the headings are users' cues to what the document is all about and to what is in each section of the document. Many people use the headings to jump to a specific place in the document. Making the headings visually apparent on the page or screen makes navigation and quick reading possible. You can differentiate headings from text by making them larger than the text (increasing size means greater importance in headings), by changing the weight of

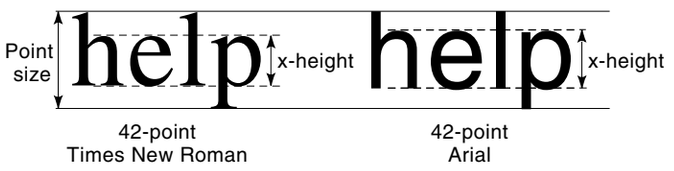

Figure 10. Type fonts with different x-heights look different and may take up different amounts of horizontal space even when they are in the same point size.

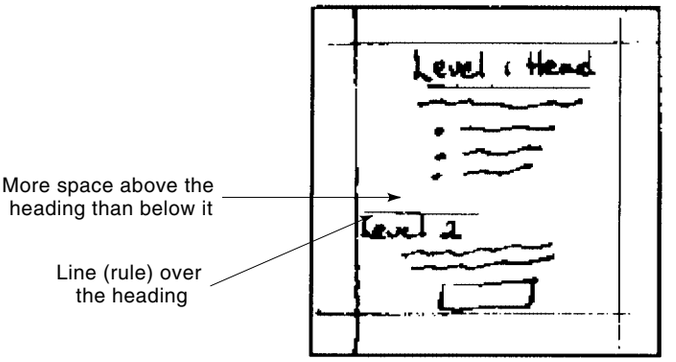

Figure 11. Rules (lines) over the second-level headings draw the reader's eyes down into that section of the text.

the type (bold or color makes headings stand out), by putting them in a different font (a sans serif font like Arial works well for headings even when the type is serif like Times New Roman), and by placing them above or to the left of the text and using space to set them off. You can see different ways of handling headings in the examples in Fig. 8.

A few tips for making headings work well in documents: Put more blank space before the heading than between the heading and the text it goes with. That will help readers see that the heading and a particular section of text are a cluster. Also, if you use a line (the technical term is a "rule") with second- or third-level headings, put the line above the heading, not below it. Again, that will help draw the reader's eye from the heading down into the relevant text. Figure 11 shows a page that uses these tips.

Do Not Crowd the Page. Space is a design element. You can use space to set off different elements of the document. You can use space to show which elements of the document form clusters (go together). You can use space to help users find what they need quickly. Pages include both passive white space (the margins on the top, bottom, and sides) and active white space (the space between elements of the document on the page). Some passive white space (margins) is important both for binding the document and for reducing the overall sense of density on the page. But it is the active white space that really helps users work with the document. It is the space that sets off graphics, lists, and indented quotes that makes them jump out at readers from the page. Figure 12 shows you passive and active white space on a well-designed page.

On-line documents cannot use as much clear space as paper documents. The total amount of space on a screen is much less than on a piece of paper. Computer users do not like to page down or scroll down. Therefore, in on-line help and on Web pages, you have to minimize the use of blank space. However, you can still help users on screen by using graphic design elements such as chunking (keeping the pieces of text short by writing one short sentence as a paragraph and by using lists), typography (for example, putting headings in bold and starting them a little further to the left than the text), and graphics (using tables, including small pictures of icons, etc.).

Do Not Use Long Lines of Text. Long lines of text are tiring to read. Look back at the examples in Fig. 8 to see useful page layouts with either two columns of text or with one column of text that covers about two-thirds of the page and headings that start out to the left of the text. Of course, type size and line length go together. The smaller the type size, the more characters there are in a line of text and the more difficult longer lines become for readers.

For text, line up all lines (except possibly the first in each paragraph) along a straight left margin. Do not center lines of text except as a special style for some headings. Readers do not expect to see text centered and have a hard time reading it. Leave the right margin ragged (unjustified). Ragged-right margins are easier to read, especially in longer lines of type. They convey a friendlier and less formal tone than justified (straight) right margins. To create a justified right margin, the word processor has to put extra spaces in the line or has to tighten up the words that are there. If the extra spaces are only put in between words and not evenly throughout the words, the paragraph will have vertical "rivers of white" that draw the readers' eyes to the space and keep readers from focusing on the words.

REVIEWING, EVALUATING, AND REVISING DRAFTS

Developing a successful document is not a trivial exercise. Expert writers often spend as much, if not more, time revising as writing. The first level of review and revision should be to read over your own work. Review against the information you came up with in planning. Will the document meet your purposes? Will the audiences you identified want to read the document, and will they be able to work with it effectively? Print the table of contents from the headings that you actually wrote. Will the headings help users quickly grasp the big picture of the document as well as immediately find the right section? Read the sections to see if the discussion flows in a logical order and the sentences make sense. Have you followed the guidelines for clear writing? Do you have a format that will attract users to work with the document and that will let them quickly get what they need?

Your own review is important, but not sufficient. You know what you meant to say. To make sure that others will be able to find what they need and understand what they find, you need to have others try to use the document. The only way to really know if the intended audiences will be able to use the document is to have representative people from those audiences try to use the document. The technique for doing that is called *usability testing*.

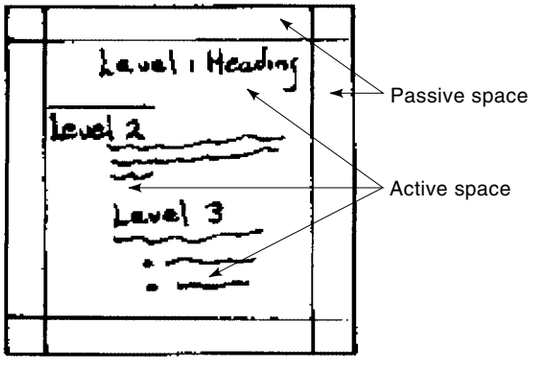

Figure 12. Active white space (space within the text) helps to keep pages from seeming too dense to use.

Usability testing is a valuable technique for any type of document. It is an absolutely essential technique for documents that people will use to accomplish tasks, such as procedural manuals, installation guides, software or hardware user's manuals, on-line help systems, and Web sites. You can, and should, do usability testing with documents at several points during development. You can have users try to work just with the table of contents or the navigational hierarchy of a Web site. You can have users try to work with one module of a manual to see if you have a level of content and an organization that works for users. You can have users try out a draft. Do usability testing when it is early enough to change what you are doing. For information on how to do usability testing, see Refs. 28 and 29.

In most work situations, writers must also have their documents reviewed by others. Reviewers might include editors, supervisors, legal specialists, and other technical specialists. Writers should welcome the expertise of editors, especially technical communication editors, who are skilled in all aspects of the document design process. Writers should also welcome the reviews of others, who can be supportive and assure that various requirements are being met.

The most helpful reviews are ones that have been set up as teamwork from the beginning of the project. When reviewers and writers know each other, they may be able to discuss and negotiate more easily. Writers and reviewers must have a shared understanding of the purposes, audiences, and ways that users will work with the document. If they do not, reviewers may end up suggesting changes that are at cross purposes with what the writer is trying to accomplish, or the writer may prepare a draft that will not meet the company's needs. Therefore, know who the reviewers are going to be *before* you write. Meet with the reviewers. Use the process model to come to agreement on the planning issues. Share your outline with reviewers. Share a draft of one section. Practice the "doctrine of no surprise" by letting reviewers know when you are going to use a style or format that may be different from what they are used to seeing.

Working with reviewers requires negotiation and interpersonal skills on both sides. Successful documents come from collaboration, not contention. Coordinate schedules with reviewers. When you have a draft ready for review, let reviewers know that it is coming, what stage of draft it is, what type of feedback you need, and when you need it. When you receive a review, consider reviewers' comments with an open mind. Do not blindly accept all suggested changes. Discuss those that you are concerned about. Do not ignore suggestions either. If you do not plan to incorporate a suggestion, let the reviewer know why. When a reviewer does not understand what you wrote, do not blame the reviewer. Even if the reviewer's suggestion is not accurate, consider reworking what you did and trying again. However, both you and the reviewer may need to remember that others are the real audience. To know if the real audience understands what you wrote, you must do usability testing.

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DOCUMENTATION MANAGEMENT. See MANAGEMENT OF DOCUMENTATION PROJECTS.

DOCUMENT HANDLING. See INFORMATION RETRIEVAL AND ACCESS.