A GUIDE TO WRITING AS AN ENGINEER

FOURTH EDITION

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GUIDELINES FOR WRITING NOISE-FREE ENGINEERING DOCUMENTS

As every engineer knows, form and content must work together. What is sometimes forgotten is that the relationship of form and content applies to documents as well as to physical phenomena. Without some type of form, be it well or poorly structured, no content can be communicated. . . . Even the word "in-form-ation" implies that ideas must be structured in some fashion or other.

Susan Stevenson and Steve Whitmore, *Strategies for Engineering Communication* (New York: John Wiley & Sons, 2002), p. 247.

Information isn't a scarce commodity, as a leading economist wrote in the 1970s. Attention is. So, what can you do to sustain your reader's attention?

Bruce Ross-Larson, *Writing for the Information Age* (New York, W. W. Norton & Company, 2002), p. 3.0.

This chapter presents guidelines for producing large sections of noise-free writing, from efficient paragraphs to effective and useful documents. These guidelines follow the overall process used by successful engineering writers and include important considerations for your entire writing process. The topics covered here represent common problems you as an engineer are likely to face in the course of writing and formatting your documents.

FOCUS ON WHY YOU ARE WRITING

Consider this statement by Ruth Savakinas:

> *Complex technical writing is likely to be very difficult to read. Readability further decreases when the writer does not define major ideas for the reader and when the written document is not relevant to the reader's experience and interests. These two impediments can be eliminated if you clearly define your purpose and your audience. . . .*
>
> From "Ready, Aim—Write!" *IEEE Transactions in Professional Communication*, *31*(1), March 1988, p. 5.

What she wrote over twenty years ago still holds: Before starting to write, have a good idea of precisely who your audience is and what you want to communicate to them. If these goals aren't first defined, your readers may not get a clear message. Thus, whether you have to write a short memo or a lengthy technical report, you should start with a firm sense of purpose so you can (1) present appropriate supporting data, (2) test its adequacy, and (3) discard anything that is not needed.

Kite power

Kites may soon gather energy in high altitudes (where winds are stronger and more consistent) in order to rotate a ground-based turbine. 500 GWh a year?

For details, see the Preface for the URL.

Broadly speaking, the purpose of most technical writing is either to present information or to persuade people to act or think in a certain way. Frequently, however, your documents will have to be both informative and persuasive. To fine-tune your sense of purpose before writing, ask yourself the following:

Do I want to

1. **Inform**—provide information without necessarily expecting any action?
2. **Request**—obtain permission, information, approval, help, or funding?
3. **Instruct**—give information in the form of directions, instructions, or procedures so that my readers will be able to do something?
4. **Propose**—suggest a plan of action or respond to a request for a proposal?
5. **Recommend**—suggest an action or series of actions based on alternative possibilities that I've evaluated?
6. **Persuade**—convince or "sell" my readers, or change their behavior or attitudes based on what I believe to be valid opinion or evidence?
7. **Record**—document for the record how something was researched, carried out, tested, altered, or repaired?

How you write any document should be guided by what you want your audience to do with your information and what they need from the document in order to be able to do it. Thus, your audience plays a defining role in determining how you approach your task. Only a careful analysis of your purpose (or purposes) for writing and the nature of your audience can give you the answers and thus enable you to write to the point.

FOCUS ON YOUR READERS

If you found yourself in a remote region and met people who had never seen anything electronic, you wouldn't hand them your scientific calculator or iPhone and expect them to use it. First, a great deal of technology transfer would have to take place. This may seem obvious, but a lot of technical writing fails because writers make inaccurate assumptions regarding their audience. Engineers often write without taking adequate time initially to analyze those who must read their work. Since you write for many different audiences during your career, as Figure 3-1 shows, take the time to analyze your audience before writing to them.

No matter who you write to, you write because you expect some kind of resulting action—even if it is only nonphysical "action" such as permission, understanding, or a change of opinion. To get results, your communication must bridge a gap between you and your target audience, likely to involve *knowledge*, *ability*, or *interest*. To determine where you stand before writing, first identify who your audience is and then ask yourself these questions:

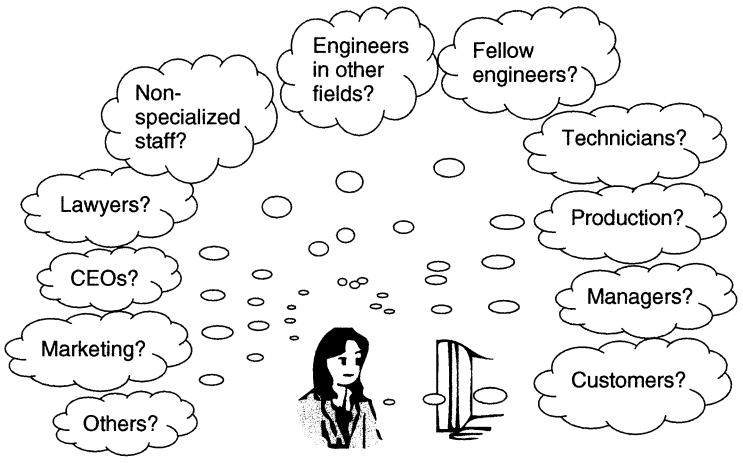

Figure 3-1 You will deal with many different people as your career progresses, so it is best to have a clear picture of who your audience is before beginning to communicate with them.

Knowledge

- Are my readers engineers in my field who are seeking technical information? Will they be offended or bored by elementary details?
- Are they engineers from a different field who will need some general technical background first?
- Are they managers or supervisors who may be less knowledgeable in my field but who need to make executive decisions based on what I write?
- Are they technicians or others without my expertise and training but with a strong practical knowledge of the field?
- Are they nonexperts from marketing, sales, finance, or other fields who lack engineering or technical backgrounds but who are interested in the subject for nonengineering reasons?
- Are they a mixed audience, such as a panel or committee, made up of experts and lay people?

Ability

- Am I communicating technical information on a level my audience can use?
- Am I using appropriate vocabulary, examples, definitions, and depth of detail?
- Am I expecting more expertise, skill, or action from my audience than I reasonably should?

Interest

- Why will my audience want to spend time reading this document?
- Does my document provide the right level of detail and technology to keep my audience's interest without losing them or boring them?
- What is their current attitude likely to be—positive, neutral, or negative?
- Will my document give them the information they want?

SATISFY DOCUMENT SPECIFICATIONS

Before writing, you should be aware of any specifications your document must meet. If management asks for a brief memo, they may be irritated when you overload their circuits with a lengthy, detailed treatise. When a technician requests the specs on a frequency tester, it won't be appreciated if you write about the strengths and weaknesses of the equipment. If you respond to an RFP (request for proposal) that calls for a proposal of no more than ten pages but submit something twice that long, your proposal will likely be eliminated from the competition.

Many documents have *specifications*. Such specifications may require you to provide sections such as experimental problems, environmental impact, decisions reached, budget estimates, and so on. Specification for an engineering journal may

limit the number of words and the number of graphics your technical paper can include. Specification may limit the length of an abstract or summary. Here are the specifications for a research grant proposal:

> Also required is a nontechnical summary (250 words or less) of the research proposed, expressing significance attached to the project and reasons for undertaking it. This summary will be used for public information and should be written in terms that nonscientists can easily understand.

Many reports have specifications not only for their length but also for such matters as headings, spacing, and margin width. Some government agencies, for example, require that the proposals they receive be written in specific formats, in certain fonts, and even with restrictions on how many letters are permitted in each line of text. Here is an example from an RFP for a government research program:

> Each proposal shall consist of not more than five single-spaced pages plus a cover page, a budget page, a summary page of no more than 300 words, and a page detailing current research funding. All text shall be printed in single-column format on 8-1/2 × 11-inch paper with margins of at least 1 inch on all sides....

GET TO THE POINT

Anyone reading your memos, letters, and reports is likely to be in a hurry. Few engineers have the leisure for "biblical" reading—where one reads from Genesis to Revelation to discover how things turn out. Your documents need to have the most important information at the beginning. Start with your key points, conclusions, or recommendations before presenting the supporting details. For instance, if you test to determine whether some equipment should be replaced, your supervisor will want to know what you have found out and what you recommend. A complete, detailed description of your test procedures may be necessary to support your main points and will likely be verified by others—but it could go unread by those people in management who need only the bottom line.

Where you tell your readers what they most need to know depends on the kind of document you're writing. In a letter, it will be in the opening sentences just after an indication of the purpose of the letter. In a memo, you provide a subject line with a specific reference to the topic. Consider these examples:

Vague:	SUBJECT:	Employee safety
Better:	SUBJECT:	Need for employees to wear hard hats and safety glasses
Vague:	SUBJECT:	Emergency requisitions
Better:	SUBJECT:	Recommendations to change the procedures for making emergency requisitions

In a longer report, your main points should become quickly evident to your reader through an informative title followed by a summary or abstract of your findings, conclusions, recommendations, or whatever the important information is. (See the chapters on individual reports and the sections on abstracts and executive summaries.) No matter what kind of document you are producing, however, place key information where readers can most efficiently access it.

PROVIDE ACCURATE INFORMATION

Even the clearest writing is useless when the information it conveys is wrong. If you state that an ampere is defined as a coulomb of charges passing a given point in 10 seconds rather than 1 second, you have presented wrong information. If you refer to data in Appendix B of your report when you mean Appendix D, the error could stump your readers and cause them to lose confidence in your report.

Inaccurate references to the work of others also will cause your readers to be highly suspicious of the reliability of your entire report—and even of your honesty as a writer (see Chapter 11). Inaccurate directions in a set of instructions or procedures might be frustrating at best, disastrous at worst. Considerable problems have resulted when engineers gave measurements in standard units that were assumed to be metric by others. Another kind of inaccuracy might be a claim that is true sometimes but not under all conditions, for example, that water always boils at 100°C. What about purity and variations in atmospheric pressure?

There is also a great difference between fact and opinion. A *fact* is a dependable statement about external reality that can be verified by others. An *opinion* expresses a feeling or impression that may not be readily verifiable by others. The danger comes when opinions are stated as facts:

Fact:	The NR-48 tool features multiple programmable transmitters and a five-station receiver array.
Opinion:	The NR-48 is by far the best piece of equipment for our purposes.

The second statement might be correct but is still only an opinion until supported by verifiable facts. To be strictly honest, the writer should identify it as an opinion unless evidence is presented to support it as fact. In short, make sure that (1) your facts are correct when you write them down and (2) your opinions are presented as such until adequate evidence is provided to verify them.

PRESENT YOUR MATERIAL LOGICALLY

Not only should it be easy to access your document's essential message, but the parts of your information should be sequenced appropriately. Organize your material so that each point or section uses an appropriate overall pattern. If you must follow document specifications, follow those specs, but even then, you may have to present material the way you feel is most effective.

Patterns of Organization

Chronological organization: If readers want to know what progress you have made on a project, what you did on a trip, or how to carry out a procedure, present your material in *chronological* order.

Descriptive organization: If they expect description of equipment or facilities, provide them with a description that moves from *one physical point to another.*

Organization by order of importance: On the other hand, if you have a number of points to make, such as five ways to reduce costs or six reasons to cancel a project, present those points from the *most to the least important*, or vice versa.

Organization by level of difficulty: Perhaps your material needs to be presented in order of *familiarity* or *difficulty*, as when you are writing a tutorial or textbook.

General-to-specific organization: Moving from the *general to the specific* is useful, as in a memo that starts with stringent safety regulations and then provides examples of current unsafe practices.

EXPLAIN THE TECHNICAL TO NONSPECIALISTS

Explaining technical matters to nonspecialists is important to you in at least two ways: (1) your instructors must be satisfied that you thoroughly understand a topic, even though they themselves understand it better than you do; (2) as a professional engineer, you need to be able to explain technical matters clearly so that you can gain people's confidence (and business), their approval for your work projects.

Explaining the technical is a lot about knowing some tools and using them intelligently:

Definitions: One of your most important tools is defining potentially unfamiliar terms. Here is an example of a formal sentence definition: *Noise is a term in both analog and digital electronics that refers to random unwanted perturbation to a wanted signal.*

Examples: For nonspecialists, examples are a big help in understanding the technical: *For example, the "snow" you see on a television or video image is a form of noise.*

Importance: For some readers, discussing the importance of a topic helps them to wake them up and pay attention. For example: *It is important to understand the health effects of noise: Noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects.*

Uses and applications: People also wake up and pay attention when you explain how something can be used to good advantage. For example: *Dithering is the process of intentionally applying noise to create the illusion of color depth and natural-looking variation in computer-generated images.*

Causes and effects (or reasons); problems and solutions; questions and answers: It helps to discuss these pairs of information types. Here are some examples:

High levels of noise can block and distort the meaning of a message in communications.

Thermal noise can be reduced by reducing the temperature of the circuit.

This is why radio telescopes, which search for very low levels of signal from space, use front-end low-noise amplifier circuits cooled with liquid nitrogen.

Categories: Discussing the categories of a topic can help readers gain a broader understanding of the topic. For example: *The French movie director René Clair points to two types of noise, film dialogue and film noise, and suggests that the latter as well as the former can have meaning and be interpreted.*

In-other-words explanations: When you've written something technical and you are not sure readers will understand, try restating it in simpler words. For example: *European robins living in urban environments are more likely to sing at night in places with high levels of noise pollution during the day. After all, that's when they can hear each other.*

Description: Readers can also gain better understanding simply by being able to visualize some aspect of a topic. For example: *At the north of the sound tube, a massive sculptural work was placed consisting of a giant yellow beam hanging diagonally across the road and a row of smaller red beams alongside the road.*

Process explanation: Going carefully, methodically, step by step through an essential process can also help readers understand. For example:

Whenever a message is sent, someone is sending it and someone else is trying to receive it. In communication theory, the sender is the encoder, and the receiver is the decoder. The message, or signal, is sent through a channel, usually speech, writing, or some other conventional set of signs. Anything that prevents the signal from flowing clearly through the channel from the encoder to the decoder is noise.

Jellyfish power

Researchers at Virginia Tech have designed a silicone underwater robot that moves like a jellyfish and that is powered by the water around it enabling it to operate apparently forever.

For details, see the Preface for the URL.

History: For some readers, it helps to know the historical background associated with a topic. For example: *After the passage of the U.S. Noise Control Act of 1972, the program was abandoned at the federal level, under President Ronald Reagan, in 1981.*

Note Source for some the examples is Wikipedia's articles on noise and noise pollution (accessed 2012).

MAKE YOUR IDEAS ACCESSIBLE

The organization and structure of a document—specifically, how well the material is laid out in visually accessible "chunks" for the reader—can be readily apparent with the use of (1) hierarchical headings, (2) bulleted and numbered lists, and (3) paragraph length.

HIERARCHICAL HEADINGS

Hierarchical headings enable us to look at the pages of a document and get a sense of its organization and contents. "Hierarchical" indicates that these headings have levels; some are subordinate to others as in a traditional outline. Headings and subheadings act as signposts that help readers get through a document without getting lost. Informative headings also give your document good "browsability"; that is, they help readers quickly find sections that interest them most.

Although practice varies, a common format for the first three levels of headings is as follows:

FIRST-LEVEL HEADING

Write first-level headings in capital letters and put them flush with the left margin. Use boldface to make the heading stand out and separate it from the written material above and below it by at least one line space. (Some formats center the first-level heading.)

Second-Level Heading

Place second-level headings flush with the left margin with at least one line space separating them from text. Capitalize only the first letter of each main word, and make these headings boldface.

Third-level headings. Place third-level headings on the same line as the text they precede. Capitalize them as a sentence would be; use boldface or italics.

Notice that all three levels of headings use a sans serif font (Arial in this case) while body text uses a serif font (Times New Roman in this case).

Numbered Headings. Some companies and suppliers require numbered or decimal headings. A number system makes it easier to cross-reference other parts of a long report.

FIRST-LEVEL	**1. 0 QUALITY ASSURANCE PROVISIONS**
Second-level	**1.1 Contractor's Responsibility**
Third-level	**1.1.1 Component and material inspection**
Fourth-level	**1.1.1.1 Laminated material certification**

Guidelines for Headings. When you use headings, watch out for these issues:

1. Phrase headings so that they indicate the topic of the section they introduce. "Background" says nothing; "Background on Noise Legislation" does.
2. As for frequency of headings, try for two to three headings per page, as this book demonstrates.
3. Subordinate headings. If you have these headings, "Types of Noise," "Acoustic Noise," and "Visual Noise," the second and third would be *subordinate* to the first—at a lower level—just as in an outline.
4. Make sure that headings *within the same section* and *at the same level* are parallel in phrasing.
5. Avoid "lone headings," headings that are all by themselves within a section, similar to an outline in which there is an A but no B or a 1 but no 2.
6. Avoid "stacked headings," two or more consecutive headings with no intervening text. Use definitions, transitions, or subtopic overviews to get useful information at these points.
7. When you use third-level headings (the ones that "run in" to the paragraph), start the regular paragraph text as a completely new sentence. Don't "run in" the heading grammatically with the regular paragraph text.
8. Avoid referring to the text of a heading with "this" or other pronouns. That causes readers to pause and wonder "this what?" Apparently, we read headings differently from the way we read regular paragraphs.

To see headings in action, browse the examples in Chapters 5 and 6.

Note See the chapter in the website companion corresponding to this one for steps on creating heading "styles" for your reports. Styles make formatting your report much easier. For the web address, see the Preface.

USE BULLETED AND NUMBERED LISTS

A well-organized vertical list is sometimes the most efficient way to communicate information: steps in a procedure, materials to be purchased, items to be emphasized, reasons for a decision. In some cases, readers retrieve information from lists more easily than from regular paragraphs. Consider the following:

Problem:

First of all, set the dual power supply to +12 V and −12 V. Next, set up the op-amp as shown in Figure 1. Use a 1 Vpp sine wave at 1 kHz and then plot the output waveform on the HP digital scope. Then obtain a Bode plot for the gain from 200 Hz to 20 KHz.

Revision:

1. Set the dual power supply to +12 V and −12 V.
2. Set up the op-amp as shown in Figure 1.
3. Use a 1Vpp sine wave at 1 kHz.
4. Plot the output waveform on the HP digital scope.
5. Obtain a Bode plot for the gain from 200 Hz to 20 kHz.

1. Use a numbered list for items in a required order. Numbered lists can also be used to indicate an order of importance in your data, such as a list of priorities or needed equipment.

To set up the computer:

1. Connect the monitor to the computer through the monitor port.
2. Connect the keyboard and mouse to the computer through the ASF port.
3. Connect the power supply to the computer.
4. Connect the printer to the printer port.
5. Connect the modem to the modem port.

2. Use checklists to indicate that all the items in your list must be tended to, usually in the order presented:

To set up the computer:

- ☐ Connect the monitor to the computer through the monitor port.
- ☐ Connect the keyboard and mouse to the computer through the ASF port.
- ☐ Connect the power supply to the computer.
- ☐ Connect the printer to the printer port.
- ☐ Connect the modem to the modem port.

3. When any list gets longer than ten items, try to break them down into smaller, more manageable sections and give each section its own subheading or lead-in.
4. Use a *bulleted* list when the items are in no required order:

Some of the main concerns of environmental engineering are:

- Air pollution control
- Public water supply
- Wastewater
- Solid waste disposal
- Industrial hygiene
- Hazardous wastes

5. Avoid lengthy bulleted lists—over seven items. When list items themselves are lengthy, get some vertical space between them.
6. If you have sublist items in a required order, use lowercase letters. If the sublist items are in no required order, use a less prominent symbol (for example, a clear disc or an en dash).
7. Make sure all lists begin with a lead-in, as the examples here illustrate. Otherwise, readers won't know what to make of your lists.
8. Don't punctuate a lead-in with a colon if the lead-in ends with a verb: for example, *The five priorities we established are.* Punctuate a lead-in with a colon if it is grammatically complete: for example, *We have established the following five priorities:*.
9. Punctuate list items with a period if they are complete sentences or contain embedded dependent clauses.
10. Be consistent with how you capitalize list items that are not complete sentences.
11. Make list items *parallel in phrasing*. For example, if some entries begin with a verb, all entries should do so; if all begin with a noun, all should. This makes for smoother reading and logical neatness. Note how the following list is bumpy due to problems with parallelism:

Lack of parallel phrasing:

Last week we accomplished the following for WW3-a:

- Completed BIU, ICACHE, and ABUS logic design.
- All instruction buffer blocks have had final simulations.
- Written and debugged 75 percent of test patterns.
- Scheduling of first silicon reticules for WW4-a with Vern Whittington in Fab 16.

Revision:

Last week we accomplished the following for WW3-a:

- Completed BIU, ICACHE, and ABUS logic design.
- Ran final simulations on all instruction buffer blocks.
- Wrote and debugged 75 percent of test patterns.
- Scheduled first silicon reticules for WW4-a with Vern Whittington in Fab 16.

Note See the chapter in the website companion corresponding to this one for steps on creating and formatting the different kinds of lists for your reports. For the web address, see the Preface.

CONTROL PARAGRAPH LENGTH

No one, especially in technical fields, wants to read a solid page of wall-to-wall text of difficult material. A busy manager, for example, will want to scan your information as quickly as possible.

When your readers are trying to follow demanding technical information, they are already challenged, and presenting it to them in solid page-long chunks is discouraging. Furthermore, if they need to refer to a point you made or data you presented, they will have trouble finding it.

When editing your work, look for any overly long paragraphs and try splitting them—for example, at a change of topic or type of writing (from concepts to examples). When you split paragraphs, remember that you may have to add a transitional word or phrase.

USE EFFICIENT WORDING

Opinions vary on how much it costs a company for an employee to produce one written page of technical information, but as Chapter 1 states, it can be anywhere up to and beyond $200. With so much writing in industry, costs mount up. A little training in being concise and in sharpening your writing and editing skills can save time and money—plus much time-consuming work for your readers.

INFLATED WORDS AND WORDINESS

Choose the simplest and plainest word whenever you can. Write to communicate rather than to impress, or as the saying goes, "Never utilize *utilize* when you can use *use*."

A few of the more ostentatious—oops, make that showy—words found in engineering writing are listed here, with some plain and efficient counterparts:

Showy	*Straightforward*	*Showy*	*Straightforward*
commence	start	fabricate	make
compel	force	finalize	end
comprises	is	initiate	begin
employ	use	optimal	best
endeavor	try	prioritize	rank
proceed	go	rendezvous	meet
procure	get	terminate	end

Wordiness can also result from using far more words than you need to express an idea. Unkind editors sometimes refer to this as verbiage (by analogy to garbage?). Few of us appreciate hearing a lengthy excuse when a simple "I don't know" is enough. Similarly, your reader is unlikely to thank you for having to plow through when you could have simply said you recommend buying a new computer.

Wordy: I regret to say that at this point in time I basically do not have access to that specific information....

Concise: I do not know....

Wordy: It is our considered recommendation that a new computer should be purchased....

Concise: We recommend the purchase of a new computer....

You can eliminate a lot of wordiness in your writing by training yourself to edit carefully and to make every word count. Look at the following three pairs; you will see which sentences are more efficient and noise-free.

Wordy: It is essential that the lens be cleaned at frequent intervals on a regular basis as is delineated in Ops Procedure 132-c.

Concise: Clean the lens frequently and regularly (see Ops Procedure 132-c).

Wordy: The location of the experimental robotics laboratory is in room 212A.

Noise-free: The experimental robotics lab is in 212A.

Wordy: There are several EC countries that are now trying to upgrade the communication skills of their engineers.

Concise: Several EC countries are trying to upgrade the communication skills of their engineers.

You can also reduce wordiness by avoiding certain pretentious phrases that have unfortunately become common. A good stylebook will give numerous examples, but here are a few that crop up frequently in engineering writing:

Wordy	Efficient
a large number of	many
at this point in time	now
come in contact with	contact
in the event of	if
in some cases	sometimes
in the field of	in
in the majority of instances	usually
in the neighborhood of	about
in view of the fact that	because
in view of the foregoing	therefore
subsequent to	after
the reason why is that	because
within the realm of possibility	possible
in close proximity to	near
in the event that	if
in my own personal opinion	I believe
due to the fact that	because
in close proximity to	near
at that point in time	then
with reference to the fact that	concerning

Check your writing for such unnecessary phrases—as we do in the next sentence. You may ~~often~~ find ~~that there are a number of~~ words ~~contained in your writing~~ that can be ~~safely~~ eliminated without any ~~kind of~~ danger to your meaning ~~whatsoever~~.

REDUNDANCY

Redundancy refers to the use of words that say the same thing, like *basic fundamentals*, or phrases that duplicate what has already been said, as in *They decided to reconstruct a hypothetical test situation that does not exist.* In fact, if you master the art of redundancy, you can make everything you write almost twice as long as need be. Edit your writing once simply looking for redundancy and wasted words—you may be able to reduce word count by as much as 20%.

Wordiness: With reference to the fact that the company is deficient in manufacturing and production space, the contract may in all probability be awarded to some other enterprise.

Revision: The company may not be awarded the contract because it lacks production facilities.

What does the preceding revision leave out (other than unnecessary words)? Nothing. Here is a matrix of such possibilities:

Categories of Redundancy

Category	*Wordy version*	*Simpler version*
Redundant adverbs, verbs, and other words	completely finish, completely eliminate, tentatively suggest, connected together, prove conclusively, collaborate together, diametrically opposite, permeate throughout, serves the function of being, has the ability to, come into contact with, exhibits the ability to	finish, eliminate, suggest, connected, prove, collaborate, opposite, permeate, is, can, contact, can
Redundant adverbs and adjectives	totally unique, completely finished, thoroughly complete, bothersomely annoying, productively useful, exactly identical	complete, annoying, useful, identical
Redundant adjectives	complete and total failure, a slender, narrow margin, rectangular in shape	complete failure, narrow margin, rectangular
Redundant adverbs	completely and totally fail, carefully and methodically working, just exactly	fail, carefully working, exactly
Redundant adjectives and nouns	transportation vehicle, tactful diplomacy, successful victory, twenty-four-hour day, time schedule, alternative choices, component part vehicle, alternative choices	vehicle, diplomacy, victory, day, schedule, choices, part, choices

UNNECESSARY PASSIVE VOICE

In the technical world, you must use the passive voice; but when it is misused, it leads to unclear, wordy, and even dangerous writing.

Passive-voice problem: In order to estimate company sales, industry estimates should first be looked at, because the sales of an individual company are often reflected by them.

Revision: To estimate company sales, look at industry estimates because individual company sales often reflect them.

English has two distinct "voices." The active voice directly states that someone does something: *The engineer wrote the report.* The passive voice turns it around: *The report was written by the engineer.* Thus the active voice emphasizes the performer of the action—the engineer, in our example—while the passive emphasizes the recipient of the action, the report.

Many engineering and scientific writers are told to use the passive voice, that is, to leave themselves out of their writing. They might write *It was ascertained that...* rather than *We found that...*, or *The deadline was met* rather than *We met the deadline.* Management would rather tell you *It has been decided to terminate your employment* than *We have decided to fire you.* (Perhaps such hedging is necessary at times since it helps conceal responsibility and gives us no one to blame!)

The passive voice is certainly appropriate when writing up your research or describing a process, for example. In plenty of instances, you don't want the "doer" to get in the way of your discussion. Also, it's logical to use the passive if the doer of an action is unknown or unimportant:

Good uses of the passive voice:

Electricity was discovered thousands of years ago.

The bridge was torn down in 1992.

The contaminated material is then taken to a safe environment.

Sometimes the passive will give variety to your writing, even if your inclination is to write predominantly in the active voice. In this next example, the passive constructions not only create variety, but they also create better flow by focusing on the *claim*, its *study*, and the subsequent findings and predictions:

Effective use of the passive voice for variety and continuity:

Computer experts claim that general-purpose processors have unpredictable execution times due to their use of complex architectural features. This claim has now been tested by our group and we have found that the architecture really induces little or no unpredictability. Moreover, data gained from our study show how the execution times can be predicted. It was also found that...

In spite of the passive's usefulness, however, the active voice tends to be more efficient. Look at the following pairs, comparing the first sentence to the second:

Passive-voice problem: Control of the flow is provided by a DJ-12 valve.

Revision: A DJ-12 valve controls the flow.

Passive-voice problem: A system for delineating these factors is shown in Figure 5.

Revision: Figure 5 shows a system for delineating these factors.

Passive-voice problem: By switching off the motor when it started to vibrate and looking at the tachometer, the resonant frequency was determined.

Revision: We determined the resonant frequency by switching off the motor when it started to vibrate and looking at the tachometer.

The passive can become especially problematic in procedures or instructions:

Passive-voice problem: The button is pressed twice.

Revision: Press the button twice.

Passive-voice problem: Previously entered data in the database is eliminated by the Edit menu being opened and Select All being chosen.

Revision: Eliminate previously entered data in the database by opening the Edit menu and choosing Select All.

Nowadays engineering writers are getting away from the rigid use of the passive. Sentences become more vigorous, direct, and efficient in the active form. By showing that a *person* is involved in the work, you are doing no more than admitting reality. Also, the active voice gives credit where credit is due. If we read in a progress report that *several references were checked out from the library and 25 pages of notes were taken*, are we as impressed by the energy expended as when we read *I checked out several books from the library and took 25 pages of notes*?

Pedestrian power

A UK company called Pavegen has developed tiles that harvest kinetic energy from pedestrians walking on them.

For details, see the Preface for the URL.

The best policy is to use the active voice when it is the most natural and efficient way to express yourself and when there is no company policy against it. However, don't hesitate to use the passive if the circumstances seem to call for it.

CAMOUFLAGED SUBJECTS AND VERBS

Wordy, awkward, unclear writing occurs when the true subject—or actor—of the sentence is not expressed in the grammatical subject:

Camouflaged subject: Complaints by *employees* about the food served in the company cafeteria have been frequent.

Revision: Employees have frequently complained about the food served in the company cafeteria.

Camouflaged subject: The invention of writing toward the end of the fourth millennium BCE is credited to the *Sumerians*.

Revision: Sumerians are credited with the invention of writing toward the end of the fourth millennium BCE.

Camouflaged subject: An *analysis* of the data will be made when all the results are in.

Revision: We will analyze the data when all the results are in.

The same problem can occur when the main action of the sentence is not expressed in the grammatical verb:

Camouflaged verb: Employees have frequently made *complaints* about the food served in the company cafeteria.

Revision: Employees have frequently complained about the food served in the company cafeteria.

Camouflaged verb: The Sumerians, who lived in southern Mesopotamia (now roughly the lower half of Iraq), achieved the first *creation* of word writing about 3100 BCE.

Revision: The Sumerians, who lived in southern Mesopotamia (now roughly the lower half of Iraq), created word writing about 3100 BCE.

Camouflaged verb: An *investigation* of all possible sources of noise was undertaken.

Revision: All possible noise sources were investigated.

Camouflaged verb: *Acknowledgment* of all incoming messages is performed by the protocol handler.

Revision: The protocol handler acknowledges all incoming messages.

UNNECESSARY EXPLETIVES

Expletives use some form of "it is" or "there is." While they are useful sometimes for emphasis, they too can inflate writing, making it less direct and understandable. Notice the problem version has three expletives!

Weak expletive: It is the results of studies of the central region of the M87 galaxy that have shown that there are stars near the center that move around as though there were some huge mass at the center attracting them.

Revision: Results of studies of the central region of the M87 galaxy show that stars near the center move around as though some huge mass at the center were attracting them.

MIND-NUMBING NOUN STACKS

Another problem, particularly in the technical world, involves jamming three or more nouns together into a phrase, which is called a *noun stack*.

Noun stack: Cocombustion-chamber exit gas temperatures are approximately 2400°F.

Revision: The temperature of gas exiting the cocombustion chamber is about 2400°F.

Noun stack: Install a hazardous materials dispersion monitor system.

Revision: Install a system for monitoring the dispersal of hazardous materials.

Notice how these stacks of five nouns are taken apart and redistributed into phrases. True, the revisions have more words but are more understandable.

WEIRD COMBINATIONS OF SUBJECTS AND VERBS

When you are struggling to express complex technical ideas, it's easy to combine subjects and verbs in strange ways, especially when lots of words come between them. This problem is known as a faulty predication. In this example, its *causes* can't be *devastating—disappearance* can.

> *Faulty predication*: The *causes* of the disappearance of the early electric automobiles *were devastating* to the future of energy conservation in the United States.
>
> *Revision*: The disappearance of the early electric automobiles was devastating to the future of energy conservation in the United States.

FORMAT YOUR PAGES CAREFULLY

In addition to how you divide information up and how long you make your paragraphs, other factors can also have an impact on your readers. People prefer print that is visually accessible and pleasing. You can easily prevent formatting noise by keeping the following pointers in mind.

MARGINS

Here are some specs for the margins of you document:

- **Margins:** Standard margins are 1 inch all around your page. To get text to fit properly, you can go a little above or below this measurement.
- **Justification:** Avoid full justification, in which the right edge of text is also justified. Instead, use a "ragged" right-hand margin, which makes for easier reading.
- **Binding:** If your report is important enough to be bound like a book, use a wider-than-usual left margin to accommodate the binding and to ensure that the right edge of your text is readable.

TYPOGRAPHY

Typeface is the style of individual letters and characters. *Serif* fonts have small strokes or stems on the edges of each letter, which help guide the eye from letter to letter. Sans serif fonts do not.

Here are some specs for the style of type to use in your documents:

- **Serif fonts:** Use a serif font (for example, Times New Roman) for body text, which is traditionally used by books, magazines, and newspapers.
- **Sans serif fonts:** Sans serif fonts (for example, Arial) are traditionally used for titles and headings. They are also preferred for online text.
- **Font variation:** Documents traditionally use one font for titles, headings, labels, and captions and another font for body text. You will rarely see a third font in all but the most complex documents.

Sans serif: The electric car prototype has regenerative braking, which recharges the supply while decelerating the vehicle.

Serif: The electric car prototype has regenerative braking, which recharges the supply while decelerating the vehicle.

- **Type size:** Standard type size for body text is 10 to 12 point. Use larger type sizes for titles and headings. However, you will rarely see much variation in font size for body text. Regular paragraphs, bulleted and numbered lists, and notices all use the same type size.
- **Capitalization:** Avoid extended text with all capital letters—known as "shouting"—because it is more difficult to read, as the first example illustrates. Use all-caps words for important labels, however:

Problem:

THE GOVERNMENT PLANS TO ESTABLISH A HIGH-LEVEL ADMINISTRATIVE COUNCIL TO COORDINATE SCIENCE AND TECHNOLOGY.

Revision:

The government plans to establish a high-level administrative council to coordinate science and technology.

Good use of capital letters:

DANGER: A 7000V potential exists across the transformer output terminals.

EXPRESS YOURSELF CLEARLY

Engineering is considered a precise discipline (although in reality, as most engineers will admit, it's not always that way). Therefore, engineering writing should be as precise as possible as well. Don't force your readers to work harder than necessary to grasp what you have written. Your sentences must convey a single meaning with no room for

interpretation or misunderstanding. If your readers yearn for suspense, they can read a detective story, and if they enjoy different connotations and levels of meaning, they can read poetry.

AMBIGUITY, VAGUENESS, AND DIRECTNESS

The following sections discuss how the meaning of a sentence can be distorted, blurred, or buried in words.

Ambiguity. The word *ambiguous* comes from a Latin word meaning to be undecided. Ambiguity primarily results from permitting words like *they* and *it* to point to more than one possible referent in a sentence, or from using short descriptive phrases that could refer to two or more parts of a sentence. Consider these following examples.

Ambiguous:	Before accepting materials from the new subcontractors, we should make sure they meet our requirements. *(What or who—the materials or subcontractors?)*
Clear:	Before we accept them, we should make sure the materials from the new subcontractors meet our requirements.
Ambiguous:	The microprocessor interfaced directly with the 7055 RAM chip. It runs at 5 MHz. *(What does "it" refer to?)*
Clear:	The microprocessor interfaced directly with the 7055 RAM chip. The 7055 runs at 5 MHz.
Ambiguous:	Our records now include all development reports for B-44 engines received from JPL. *(What was received from JPL—the reports or the engines?)*
Clear:	Our records now include all B-44 engine development reports received from JPL.
Ambiguous:	After testing out at the specified high temperatures, the company accepted the new chip. *(Did the company or the chip test out at the high temperatures?)*
Clear:	The company accepted the new chip after it tested out at the specified high temperatures.

Vagueness. If ambiguity involves more than one meaning, vagueness involves no useful meaning at all. What would you think if your doctor told you to "take a few of these pills every so often"? Vagueness is also caused by abstract words—they are not precise. Try to avoid abstractions like *substantial amount*, *corrective action*, and the annoyingly lazy and unspecific *etc.* Replace them with terms that have exact meaning such as *in three days, $8,436.00, replace the altimeter.* Here are two more examples of vague writing:

Vague:	The Robotics group is several weeks behind schedule.
Useful:	The Robotics group is six weeks behind schedule.
Vague:	The CF553 runs faster than the RG562 but is much more expensive.
Useful:	The CF553 runs 84% faster than the RG562 but costs $2,840 more.

As you can see, vague writing may require fewer words, but at the expense of precision. On the other hand, vagueness can be an asset to people who don't want to reveal too much—or who have nothing to reveal. The following satirical "Progress Report for All Occasions" has been going around industry for some years now; it is a monument to vague writing:

Vague:

During the report period that encompasses the organized phase, considerable progress has been made in certain necessary preliminary work directed toward the establishment of initial activities. Important background information has been carefully explored and the functional structure of components of the cognizant organization has been clarified.

The usual difficulty was encountered in the selection and procurement of optimum materials, available data, experimental data, and statistical analysis, but these problems are being attacked vigorously, and we expect that the development phase will continue to proceed at a satisfactory rate.

Directness. Being as direct as possible in your writing lets your reader grasp your point quickly. A busy technical reader wants access to your information quickly and easily. The most important part of your message should come at the beginning of your sentences and paragraphs—unless for the sake of coherence you need to use the old-to-new pattern (discussed in the next section):

Indirect:	After a long and difficult development cycle due to factory renovation, the infrared controller will be ready for production in the very near future.
Direct:	The infrared controller will be ready for production March 4. Its development cycle was slowed by the factory renovation.
Indirect:	Fred has been busily working on this project. This past week he also reworked the logic diagrams, rewired the controller arm, and redesigned all of the RIST circuitry.
Direct:	Fred redesigned the RIST circuitry on Thursday. He also reworked the logic diagrams and rewired the controller arm last week.

COHERENCE AND PARAGRAPH STRUCTURE

When you review your rough draft, look for ways to strengthen the organization and flow of your ideas. Do this kind of review at the level of a whole paragraph and a whole group of paragraphs:

- Strengthen transitions between major blocks of thought, such as between paragraphs or groups of paragraphs. (See Chapter 2 for more on transitions.)
- Experiment with the old-to-new pattern: Begin a sentence with the "old" topic of the preceding sentence and put new information afterwards in that same sentence. Repeat—don't vary—word choice for key terms in the discussion.
- Add topic sentences (particularly the overview kind) to paragraphs where appropriate.
- Check the logic and sequence of paragraphs or groups of paragraphs. To do so, mentally label each paragraph or paragraph group with one or two identifying words. This method enables you to get the "global picture" more easily.
- Break paragraphs that go on too long and challenge the reader's attention span.
- Consolidate short paragraphs that focus on essentially the same topic. Too many paragraph breaks can have a fragmented and distracting effect.
- Interject short overview paragraphs at the beginning of sections and subsections.

Using these strategies guides readers through your report, showing them what lies ahead, what they have read previously, and how everything fits together.

The root of the word *coherence* is *cohere*, meaning to stick together, and a cohesive group of sentences does just that.

In a coherent paragraph, all the sentences clearly belong where they are because they address only the topic of the paragraph and are logically connected to one another. In a complete report, coherence means how well the report takes the reader through its pages by means of transitional devices and how everything focuses on the subject of the report.

Transitional techniques help connect ideas, distinguish conditions or exceptions, or point out new directions of thought. Simple words like *therefore, thus, similarly*, and *unfortunately* eliminate ambiguity by helping a reader interpret your information. Neglecting these techniques means creating noise. Consider the problem sentence below. Both sentences in the problem version are grammatically correct and contain important facts, but how are these facts related? Now notice how the three attempted revisions guess at that relationship which the problem version does not indicate:

Problem: The group's long-range plans for the S-34B project have been extended. The completion date for the project is as originally planned.

Revision possibilities:

The group's long-range plans for the S-34B project have been extended. Nevertheless, the completion date for the project is as originally planned.

The group's long-range plans for the S-34B project have been extended. Unfortunately, the completion date for the project is as originally planned.

Even though the group's long-range plans for the S-34B project have been extended, the completion date for the project is as originally planned.

You can prevent readers from having to guess at connections and achieve coherence by using several techniques:

- Make sure each sentence clearly relates to the one before it and after it. If none of the words in a sentence indicates any connection to the sentences before and after it, you've got a problem!
- If each sentence makes some statement about the same topic, find a way to start most of the sentences with that topic toward the beginning of those sentences. (Don't vary word choice for key words.)
- Use the old-to-new technique when possible: the new subtopic often occurs in the second half of a sentence; echo that subtopic at the beginning of the next sentence. (Again, don't vary word choice for key words.)

  These last two points may seem contradictory. That's because the flow of topics (topic strings) can be *continuous* as in the first example or *shifting* as in the second example.
- Use transition words and phrases to further strengthen the connection between sentences.

In the revised version of this example, a continuous topic string is used; each sentence makes a statement about the 125-H CRT:

Poor Coherence

A significant disadvantage of the 125-H CRT is its high power consumption. To produce the high voltages and currents that are necessary to drive and deflect the electron beam, the tube requires substantial power. The 125-H CRT is inefficient because only about 10% to 20% of the power is converted into visible light at the surface of the screen. Portable display devices that run on batteries, where lower power consumption is necessary, are not suitable for the 125-H. We should consider other options before committing to purchase the 125-H.

Effective Coherence with a Continuous Topic String

A significant disadvantage of the 125-H CRT is its high power consumption. *This* tube requires substantial power to produce the high voltages and

currents that are necessary to drive and deflect the electron beam. *In addition*, the 125-H is inefficient—only about 10% to 20% of the power used by the tube is converted into visible light at the surface of the screen. *Thus*, the 125-H is poorly suited for portable display devices that run on batteries, where lower power consumption is necessary. *Because of this drawback*, we should consider other options before committing to purchase the 125-H.

In the original version, notice how the second and following sentences begin with new words, causing us to have to wait to see the connection to the previous sentence. In the revision, notice that in sentence 2 the word "This" makes a strong connection to the preceding sentence. In sentences 3 and 4, "In addition" and "Thus" are transitional phrases that help the flow. In the last sentence, "Because of this drawback" is a powerful transition that summarizes the idea of most of the preceding sentences and connects it as the reason for considering other options.

Here is an example in which the flow is predominantly shifting:

Effective Coherence with a Shifting Topic String

The most important part of a solar heating system is the solar collector whose main function is to heat water to be used in space heating. There are various types of collectors. However, the flat-plate collector is the most common and the focus of the following discussion. A flat-plate collector consists of a box-shaped black plate absorber covered by one or more transparent layers of glass or plastic with the sides and the bottom of the box insulated. These layers of glass or plastic have an intervening air space that produces the heat-trapping effect. Water is heated as it circulates through or below the absorber component, which is heated by solar radiation.

Notice how this paragraph moves from general to specific with each sentence. We start at solar collectors, move to a specific type, then to its construction, and finally the layers of glass or plastic and their heat-trapping effect.

MANAGE YOUR TIME EFFICIENTLY

Few engineers feel they have enough time to do the writing required of them. Often a memo is hastily churned out, or a report is rapidly thrown together and tacked on the tail end of a project. As with anything done in a hurry, the results are usually not the best. As the pressure to get a piece of writing out increases, sloppiness—that is, noise—also increases. Rather than leaving your writing to the last minute, consider it just as much a part of your professional activities as designing, building, and testing.

FINDING AND USING TIME

You can find time to spend on careful writing and editing in a number of ways, but most are not too attractive. Get to work earlier, or take work home (plenty of successful engineers do). Use breaks to concentrate on your writing tasks. Designate a specific time each day for your writing. Write on your laptop computer at airports, in flight, on trains, in hotels, or in waiting rooms.

However, it's much more practical to make your written work an organic part of your day. Assign brief chunks of time for short memos and letters or for small sections of a report. Designate larger chunks of time to concentrate on longer writing tasks.

OUTLINES, DEADLINES, AND TIMELINES

When you have to write anything over two pages long, it's useful to first spend some time making a rough outline. This outline does not have to be final, but it will help you divide your task into smaller sections that can then be written separately at different times, and not necessarily in any order.

Even if you do not have a deadline for completing a document, establish one. Estimate how long you expect the job to take and schedule back from there. You might even draft a timeline for yourself, showing each date by which you should have completed specific parts of the paper. (See Figure 3-2.) Always allow yourself enough time at the end to review and edit the entire document.

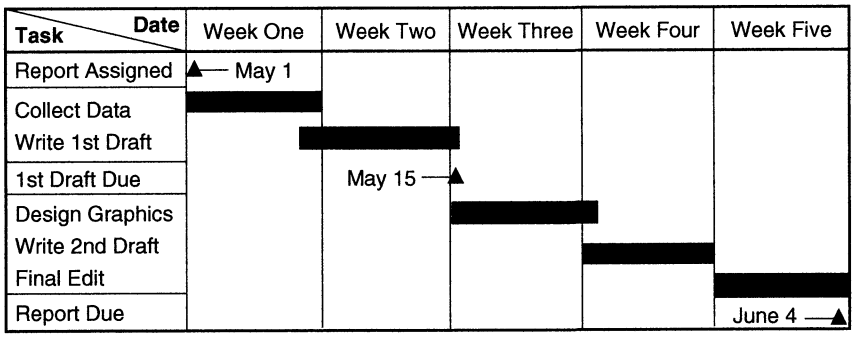

Figure 3-2 The timeline you make for your writing project can be as simple or as detailed as you wish. Make sure you have all your important tasks and due dates down, however, and then do everything you can to keep to them.

EDIT AT DIFFERENT LEVELS

Rather than expecting to randomly find anything in need of improvement, many writers prefer a more methodical approach to editing. First, check your document for *technical accuracy*. Then decide what "writing levels" to approach your editing on, and go through your document at least once on each level.

LEVEL 1

In your first pass through your rough draft, check the overall content, organization, coherence, readability, and accuracy of content. Are headings, subheadings, lists, and graphics used effectively and consistently? Are the parts of the document arranged correctly? Fix these high-level things before working on things like punctuation errors—why fix errors in sentences that will be cut?

LEVEL 2

In your second pass, check for paragraph and sentence length and structure, wordiness, and word choice. Is the tone of your document appropriate? Have you used the active voice where possible? How about transitions, parallelism, and emphasis where called for? These are mid-level considerations, which also should come before fixing things like punctuation errors. No sense fixing what may be cut or overhauled.

LEVEL 3

In your third pass, you check for the nitty-gritty problems like mechanics, spelling, punctuation, typos. Again, a good word processing program will provide you with suggestions on spelling and grammar; however, *you* must make the final choices on many of these options. You might also call upon the services of a friend or colleague who is well grounded in these basics.

LEVEL 4

When you have worked through the previous three levels of review, made the necessary changes, and now have a near-final document, consider its appearance. Are specifications (if any) followed? Is it the right length? Have you used the best font size, margins, and spacing? Are headings, subheadings, lists, and graphics used effectively and consistently? Is the title page attractive? How about the "packaging" of the document, such as paper, binding, and covers?

Breathing power

Engineers at University of Wisconsin-Madison are developing a device that uses low speed airflow like that caused by normal human respiration to generate electricity.

For details, see the Preface for the URL.

SHARE THE LOAD: WRITE AS A TEAM

Not many engineers write lengthy reports by themselves. Technical people work together as teams for research, design, development, and testing. They often find they must team up to write proposals, manuals, and completion reports. Team writing is

not always easy, especially when people with different degrees of writing ability or ego investment are involved, or when team members are torn between team responsibilities and other duties. If your group plans the team project carefully, however, it can be a great experience since as a team you will be tapping into far more knowledge, skill, and creativity than you can bring to a project alone.

FIVE POSITIVE APPROACHES

When you work on a team project or help put together a long written document with others, be prepared to do the following:

- Communicate
- Coordinate
- Collaborate
- Cooperate
- Compromise

This list might seem obvious, but many teams fail to reach their potential because some members have difficulty in following it. Some people even view *collaboration* and *compromise* negatively rather than positively in the context of team activities.

Communicate. Obviously, very little teamwork is possible without frank and open communication. Members of the team must create an atmosphere that enables free discussion at all times. Channels of communication (email, telephone numbers, mail addresses, and meeting times and places) must all be open.

Coordinate. Since team members are not often physically working together, everyone must know what the others are doing, who is responsible for what, when the next deadline or meeting is, as well as other tactical details. Often one member of a team is appointed as the coordinator, and if that person does the job well, a minimum of frustration, repetition, or uncertainty will occur.

Collaborate. The Latin root of this word means "to willingly labor." In a team setting, it means just that—to willingly assist one another. In the spirit of collaboration, for instance, assist a partner who is overloaded and needs help. Freely share your own work with the other team members and work together at creating a final document that is unified and seamless.

Cooperate. Cooperation is essential to the smooth working of any team project. If the project has a designated leader, do all you can to cooperate with that person and to accept his or her decisions, deadlines, changes, or reassignments. If such executive actions by the team leader cannot be the result of open discussion, cheerfully accept a decision you have no control over.

Compromise. This word has two meanings, and only one of them is somewhat derogatory. The other meaning refers to making mutual concessions in order to reach a goal. In practical teamwork, this means you may sometimes have to give a bit on something because doing so will help the team reach its objective. As much as possible, compromise should be the outcome of open and friendly communication.

PRACTICAL TEAM WRITING

Here are two practical ways your team can produce a successful written document:

- **Everybody writes:** Divide the length of the assignment by the number of people involved and get each to write his or her share. Individuals will do any research needed for their own section and should write and edit it. Then the document can be "glued together."

  This method may not result in an efficient or effective product. Individuals bring their personal writing style, vocabulary, quirks, and weaknesses to their part; their material may overlap with other parts of the report; transitions between sections will likely be absent. Your team will need a project manager to push things along and settle disputes. You will also need a final editor who can take the completed draft and mold it into a coherent and useful document.

  However, the good thing about this strategy is that everybody gets to write.
- **Everybody specializes:** In some ways, the best strategy to produce a team document is to assign tasks according to individual members' strengths and interests:
  - One person acts as project manager, organizing and assigning tasks, checking to ensure the project is on schedule, and even refereeing disputes.
  - Another team member gathers the needed information for the document, writes notes, and puts together a very rudimentary draft.
  - Another member, the "strong" writer, generates a working draft. Ideally, this person is good at writing, enjoys writing—and has read this book.
  - Still another team member with editing skills can act as quality control officer, reading, checking, editing, and in general perfecting the document while working closely with writers.

The unfortunate thing about this strategy is that not everyone gets to write—which might be okay in industry but not in an engineering writing course.

For both strategies, other specializations are likely to be needed: someone who is good at graphics; someone who is well versed in the topic to research difficult technical areas; someone who has a flair for graphic design to assemble the final copy.

EXERCISES

1. Think of some significant communication events you have experienced in the past several months at work or in class. What kinds of audiences were involved? Did a lack of clearly defined audience and purpose cause noise in the communication process?
2. Look inside the back cover of an IEEE or other technical journal for advice for authors who wish to publish in that journal. Are specifications given for such details as abstracts, length, headings, margins, columns, graphics, size of print, references, and so on?
3. Find a government or industry report on a subject that interests you. Who is the assumed audience? How does the report get to the point right away—if it does? How useful are the headings and subheadings? How do divisions and paragraph length add to the accessibility of the information? Could any of the information be better presented in list form? Do you notice any ambiguity, wordiness, unnecessary technical jargon, and nouns that could be turned into verbs?
4. Look back on any solo writing project you have done. How long did it take you? Were you working under a deadline? How much time each day did you spend planning, writing, and editing? How could you have done the project better?
5. Look back on any team writing projects you have been involved in. How were tasks or sections delegated? Were you satisfied with the completed document? Was whoever assigned you the task satisfied with your work? What factors would have enabled you to do an even better job?

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