The IEEE Guide to Writing in the Engineering and Technical Fields

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The IEEE Guide to Writing in the Engineering and Technical Fields

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A Note from the Series Editor

With this book, *The IEEE Guide to Writing in the Engineering and Technical Fields*, the IEEE Professional Communication Society (PCS) continues its work to help engineers, technical professionals, scientists, researchers, teachers, and students alike make their work easier, more clear, and better targeted for dispersing information. Wiley-IEEE Press and the PCS are proud to add this guide to our book series titled *Professional Engineering Communication.* This guide, authored by David Kmiec and Bernadette Longo, is a wonderful entry point into reconsidering the technical message, the shape it will take, the readership it will inform, and the mechanical prowess to make it professional. Readers will not only find here some basics about mechanics and purpose, but also come to understand the deeper considerations for writing certain types of technical documents and how to achieve their purpose.

The authors bring their considerable experience in guiding technical professionals, engineering practitioners, and even students to this volume. Even a quick perusal of this volume will realign your purpose, tone, and outcomes when diligently applied.

The series has a mandate to explore areas of communication practices and application as applied to the engineering, technical, and scientific professions. Including the realms of business, governmental agencies, academia, and other areas, this series has and will continue to develop perspectives about the state of communication issues and potential solutions when at all possible.

While theory has its place (in this book and this series), we always look to be a source where recommendations for action and activity can be found. All of the books in the fast-growing PEC series keep a steady eye on the applicable while acknowledging the contributions that analysis, research, and theory can provide to these efforts. There is a strong commitment from the Professional Communication Society of IEEE and Wiley to produce a set of information and resources that can be carried directly into engineering firms, technology organizations, and academia alike.

For the series, we build on this philosophy: at the core of engineering, science, and technical work is problem solving and discovery. These tasks require, at all levels,

talented and agile communication practices. We need to effectively gather, vet, analyze, synthesize, control, and produce communication pieces in order for any meaningful work to get done. This book, like others in the series before it, contributes to that vision.

Traci Nathans-Kelly, Ph.D.

About the Authors

Dave Kmiec coordinates undergraduate technical writing for the Department of Humanities at New Jersey Institute of Technology. He also consults for government agencies and engineering services and manufacturing firms, which he helps them establish knowledge management practices and effective workflows for digital and print publications. Dr. Kmiec earned his Ph.D. in Rhetoric and Technical Communication from University of Minnesota, where his research focused on engineering communication and the cultural history of engineering as a profession. He also holds an M.S. in Technical Writing from North Carolina State University and B.A. degrees in Chemistry and English.

Bernadette Longo is an Associate Professor in the Department of Humanities at New Jersey Institute of Technology. She is the author of *Edmund Berkeley and the Social Responsibility of Computer Professionals* (ACM Books/Morgan & Claypool, 2015) and *Spurious Coin: A History of Science, Management, and Technical Writing* (State University of New York Press, 2000), as well as numerous articles and conference papers in the field of technical and professional communication. Dr. Longo earned her Ph.D. in Rhetoric and Technical Communication from Rensselaer Polytechnic Institute in 1996.

A Technique for Writing Like a Professional

Introduction

What does it mean to write like an engineer? How does writing like a technical professional in a workplace differ from other kinds of writing you may do? Looking at a few examples of the writing tasks that engineers and technical professionals face can help illustrate what the authors of this handbook mean by *writing on the job*:

- A mechanical engineer is asked to research possible material options for a new fastener. She prepares a memo for her manager that presents the options, as well as provides information about the suppliers of each material. As part of the memo, she recommends the best material option based on specific design parameters.
- A software engineer documents his work on a feature change in a software application. The documentation is recorded in an online system that allows other members of the development team to review the feature change and add their own comments.
- A biomedical engineer working on an implantable shoulder joint prepares a series of documents that will allow his company to apply for federal approval from the U.S. Food and Drug Administration (FDA) so his company can test the device in humans.
- A computational biologist reviews a research article submitted for publication in a well-respected science journal. As part of her review, she must ensure that the work submitted is original, appropriately documented, and written using terms customary for professionals in the field.

In its simplest terms, writing like an engineer or a technical professional means conveying specialized information that helps people adopt and implement technologies for practical purposes. However, writing in this way does more than help people use technologies. You are also persuading others to adopt your viewpoint on technology. For example, the mechanical engineer recommends one material choice above

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other options. Her recommendation is based on her research and her evaluation of the options based on design parameters such as cost, sustainability, availability, and time to delivery. Likewise, the biomedical engineer must follow the strict protocols associated with device review and approval, since an implantable device like a shoulder joint must not injure the patient. These communications are, therefore, as much about human relations as they are about technology.

Because all communication reflects human relations, many technical professionals acknowledge that writing is more than simply a neutral conduit to convey information from one person to another. Instead, engineers and technical professionals shape knowledge as it moves between the professional and a client or the end users of technology. In this sense, writing like an engineer or a technical professional means influencing the way that people understand the world around them.

Working engineers and technical professionals understand the importance of writing in their professional lives. Many of them learn how to be effective writers on the job, usually under the mentorship of a more senior colleague, such as an engineering manager or team leader. The purpose of this book and its accompanying website is to provide insight into writing in engineering and technical professions for both students and working professionals. The sections of this book will give you strategies for writing that are based on understanding the work contexts in which writing functions.

Written documents like the examples listed above are not isolated works; they exist in a network of interpersonal and organizational contexts. On an interpersonal level, a writer works within existing relationships with other people in the organization, such as supervisors, co-workers, and people in other departments. On an organizational level, this writer is part of a department or unit that functions in conjunction with other departments. For example, the software developer in the earlier example might be part of a team that is working on a larger project within an organization. They might be working on a control system for a piece of equipment and need to communicate with people in other departments, like the legal or marketing departments, working together as an interdisciplinary team.

In addition to internal contexts, a writer works within a social context that extends beyond the walls of the organization. The work an individual engineer or technical professional does on the job is often shared among other people in a discipline, profession, or industry. The work you do may need to be reported to a government regulatory agency. You might even find that your work is scrutinized by a citizen watchdog group. You will probably find that you are preparing documents for a wide circle of potential readers.

To be immediately effective, the documentation that the software engineer prepares in the example above has to be composed in such a way that his peers can understand it and comment on it. But to be effective in the lifecycle of the project, the document may also need to be written so it can be included in a record of changes made to that version of the product or incorporated into a report on work done for a client over a certain time period. For it to be effective beyond the life of the project, the

software engineer may also need to make sure the information will be understandable to future programmers working on the next version of the software. He may consider how to communicate information about the project and product to an organization's legal or marketing staffs, which will have particular guidelines to follow that emphasize specific information from the programmers.

In order to write effective documentation, this engineer had to understand some pragmatic considerations: how work gets done in his specific corporate environment, what documents like the one he was preparing typically look like, how the project was scheduled to proceed. He also had to understand some social considerations: the expectations of a specific project manager and the specific team of engineers who would read and comment on his work, how his documentation might be used in indirect ways to evaluate his work, how it might be used by future engineers to do new work, and how people in other departments needed to use his documentation to complete their work related to the project.

This book presents a technique for assessing the social situation of writing and then using that assessment to make writing decisions. To do this, we present a model of the social situation that you might use to generate justifications for certain textual patterns and we present a guide to the places in text where patterns are likely to be found and decisions are likely to be made. The first part of this book articulates this approach.

- *Chapter 1: The Social Situation of Text*. This chapter discusses models for understanding social environment in which communication functions. It also provides a hybrid model of the social environment, based on the rhetorical and pragmatic situation of text, that you can use to inform your decisions are you write.
- *Chapter 2: Making Writing Decisions*. This chapter discusses the writing process and the nature of text. By identifying the places where a writer has control over documents, arguments, and language, writing can be treated as an active decision-making process.

Then, in the second part, we introduce typical purposes for writing in organizations and discuss general forms of workplace documents. This section will help you more fully understand the sample workplace documents available in the online supplement to this handbook.

- *Chapter 3: Writing to Know: Informative Documents*. This chapter discusses common reporting forms and talks about the importance of drafting and deploying evidence-based arguments in documents like reports and logically arranging and attending to precise style techniques in documents like specifications.
- *Chapter 4: Writing to Enable: Instructions and Guidance*. This chapter discusses documents that instruct and enable readers to perform tasks or operate

in the workplace and covers how to deploy action-based forms of text for policies, procedures, and training materials.

- *Chapter 5: Writing to Convince: Persuasive Documents*. This chapter discusses overtly persuasive documents and considers how understanding your readers' existing beliefs and values enables you to prepare a persuasive proposal or business plan.
- *Chapter 6: Correspondence: Medium of Workplace Collaboration*. This chapter discusses mundane workplace communications like emails and describes how understanding workplace habits and goals and the work habits of others enable you to write quick and productive messages.

1

The Social Situation of Text

- *This chapter details a method considering the social context of communication, the analysis which provides the information needed to make good writing decisions.*
- *Several traditional models of writing contribute to the method expressed in this chapter:*
  - *Transmission model created by mathematician Claude Shannon at Bell Labs*
  - *Correctness model usually found in grammar books*
  - *Cognitive model of how people think based on behavioral psychology*
  - *Social/rhetorical model of communication as persuasion based on classical Greek and modern principles of social interaction*

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- *To understand the social situation of text, we suggest you consider:*
  - *The **rhetorical situation** of your communication.*
    - *What is your **purpose** for writing?*
    - *Who is your **audience**?*
    - *What is your **identity** as a professional?*
    - *What is the **context** that surrounds this communicative transaction?*
  - *The **pragmatic situation** of your communication.*
    - *What do you know about the **community** that surrounds you and your audience?*
    - *What are your **identity** and your audience members' identities in that community?*
    - *Given this community, what **generic practices** exist that might resemble those you might use? What preexisting documents match your purpose, audience, and identity?*

The Social Contexts for Technical Writing

Humans are social creatures, and communication is the means by which humans identify themselves and each other, express their needs and desires, share knowledge, and interact to achieve goals. Communication is a ubiquitous feature of human communities. It is the behavior that creates society and enables groups of people to organize and accomplish complex tasks. When working together on a task, humans in close proximity who need timely reactions from others use speech and gesture to get their message across. When humans are distributed, however, or when they need action to occur at some later time, or when tasks are complex enough that the in-the-moment nature of speech is not sufficiently organized to make work plannable or comprehensible, they write.

Writing is a visual form of communication. It relies on the manipulation of symbols into patterns and of patterns into units of written communication—texts—that are recognizable and accessible to someone in a shared language community. Writing relies on the literacy and attention of readers, who make their own meaning out of text as they read. Contemporary texts rely on visual cues as well as textual ones—layout, formatting, and design. The way texts are presented implies cultural messages about what things are important, relevant, or trustworthy to a community.

Workplace writing is often evaluated by whether or not it is functional—whether or not it can be used in the furtherance of some purpose. When a text is used in a workplace to enable someone to accomplish a task, the members of that workplace community, who share a goal and share expectations about what will help their firm reach that goal, consider that text functional. (Though we don't say it as often, a text

that makes it difficult for members of a community to reach a goal could be described as dysfunctional by those community members.) If the functionality of a text relies on the goals of community members and their ability to recognize common forms, terms, and practices, then knowledge of these goals, forms, and practices is the most reliable way to produce a functional text. *Takeaway: Workplace writing is functional.*

Because writing relies on a reader, and because both the reader and the author of text exist in a cultural context that relies on certain values and ideas, writing decisions are best made with a structured understanding of the social environment and how writing functions in it. We will use the word *situation* in this chapter and throughout this book to describe the social position of text. The term implies a position or location relative to other things, a relational way of understanding something. We mean to imply that text can only be understood relative to the social environment in which it exists and that writing, therefore, relies on understanding the social environment and recognizing how that understanding can help you plan and compose text. *Takeaway: Writing decisions rely on social knowledge.*

As a professional and a person, your sense of the customs of your workplace, of the practices of your expert community, and of interpersonal relationships and language patterns are likely more subconscious than conscious. That subconscious awareness is what we rely on when we write by ear—composing and rereading our own writing to check if it "sounds" right or "sounds" good. Even though we might not be able to articulate what we know about our social environment, this awareness is a relatively powerful tool. It enables us (some of us more than others) to imitate complex communication patterns with a reasonable degree of reliability and to generally prepare texts that people recognize.

However, when we are working at the edge of our social understanding, as happens when we enter new professional groups or work places or work with a new client whose values or goals we don't yet understand or when we deal with a problem that is unorthodox or complex, this tacit way of sounding out social rules breaks down. This is also the time when our texts matter the most to shape the actions and thoughts of others.

To get beyond sounding out text, you must assess the social environment of text. This requires dividing the social environment into components, factors, or forces and considering how those elements inform the writing decisions you make. Then, you must be able to recognize the points in text where you have the opportunity to affect your reader. This chapter focuses on modeling the social situation. The next chapter focuses on some high-yield points of control in text.

Models of the Writing Environment

Because communication is a central factor in the organization of society and the accomplishment of shared goals, theories of communication exist in philosophical tradition of almost every culture. In the modern era, anthropologists, electrical

engineers, architects, artists, biologists, and others have each used their disciplinary techniques and tools to discuss how humans communicate, convey, express, or share meaning. We believe that writing—that is, composing a text—is a process of recognizing the social and linguistic environment of that text and then making decisions about which words, structures, and arguments to deploy. A systematic approach for doing this is found in the latter half of this chapter. First, however, we will discuss the models that underlie that approach as an understanding of them will make you better able to consider and customize the advice in this book.

Transmission Models

In our everyday workplace environment, we often talk about writing as a transaction and, whether we realize it or not, use terms from a mathematical and communication engineering tradition. A worker encodes a message in writing and transmits it, and a recipient receives and decodes it. The recipient's ability to understand that message is based on how accurately it was encoded or maybe on how well-tuned it was to match the wavelength the recipient is or on the keys the recipient has. Sometimes, the channel carrying the message is complex. If a message has to be relayed through a third party, like a project manager, then the fidelity of the signal may degrade as it is repeated.

Communication scholars and social scientists today tend to call this a *transmission model of communication* because it relies on the same terminology that is typically used to discuss electromagnetic signaling. When Claude Shannon, a researcher at Bell Laboratories, articulated this model in 1948, he called it a mathematical model and represented its basic structure with the box diagram shown in Figure 1.1 [1].

Shannon developed this simple communication model to suggest how humans and computers could communicate and to indicate how probability could be used to mathematically describe the points at which that communication could break down. At the time, the goal was to translate human language into the binary mathematical language that machines used, so that they could work on natural language problems and then send back mathematical results that were translated back into human language. *Takeaway: Shannon was modeling human–machine interaction.*

Shannon's model was just a starting point for a larger conversation about using probabilistic approaches to considering message entropy—the decay of the fidelity messages—and to considering how the constraints of natural language (that is, languages that were not designed but developed organically) could be leveraged to establish reliable human–machine interactions.

When taken as a model of human-to-human communication, the transmission model has some problems. Humans are not machines. And the model doesn't account for human inconsistency or sources of misunderstanding, social disruptions to the model that are not reducible to signal concepts like noise or other fidelity problems. It doesn't account for humans' subtle and complex assignment of meaning to language. It doesn't represent the larger relationship between the sender and receiver

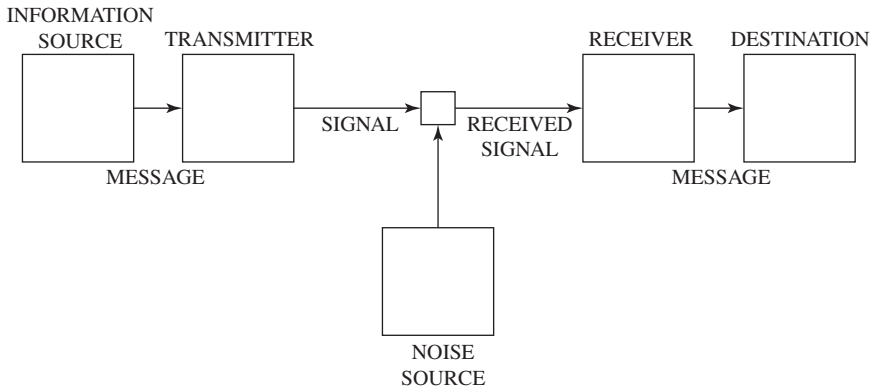

FIGURE 1.1. Claude Shannon's "Schematic diagram of a general communication system" [1]. This diagram represents a transmission model of communication where the mathematical value of a communicative message is affected by decoding, transmission, environmental noise, and encoding.

or give advice about how that relationship affects the channel or the messaging environment. It doesn't directly take into account the persuasiveness of messages or how the credibility of a message is established. *Takeaway: Humans are not machines.*

The model's failure to model human cognition and social behavior isn't surprising; it wasn't Shannon's goal when he wrote the 1948 article. (In fact, quite early in the article, Shannon dismisses the notion of a message's meaning as "irrelevant to the engineering problem".)

In everyday practice, people communicate in unintended ways and even learn about their own intentions *through* communicating with another person. But, in a way, the vocabulary of the transmission model is hard to escape (sender, receiver, message, channel, background, noise, etc.) and the basic pattern of the model is generally descriptive of the way we often think of communication. Concepts like "fine tuning" a message or providing background information so that the reader (receiver) will "correctly" understand (with fidelity) an argument are easily expressible using this vocabulary and logic. And, as a baseline, this model is a useful framework for considering that there is an audience for communication and that the audience has a role in the communication process. (Though, that role may be better articulated via a social logic than via probability.) *Takeaway: Transmission terms are foundational but limiting.*

Correctness Models

Correctness models of writing assume that there is one best way to use language and that good writing is writing that matches certain universal criteria. Strong writers, as judged by a correctness model, are masters of the preexisting patterns that texts

may take and of a number of idiosyncratic rules about which word should be used at which time. While writers are still responsible for making decisions, the choices they make are constrained by some external standard of what is correct. And their way of making decisions, especially when developing as writers, is to use reference guides or to solicit advice from authorities.

Many grammar and style books prepared with the correctness model in mind offer plenty of highly specific, prescriptive, and universal advice, based on an idea that certain patterns in English grammar are more pure, original, or attractive than others. Other guides, like those that index citation practices and make authoritative statements on punctuation and word usage, are less interested in purity and have been created out of a social decision that standardizing certain writing conventions within a field has some value. For example, the *Publication Manual of the American Psychological Association* (or APA) is a guide published by a professional society for those publishing in the behavioral and social sciences. *The Chicago Manual of Style*, on the other hand, is a guide originally published by a press itself. Both of these guides have evolved over time to become comprehensive authoritative guides to a generally correct form of writing. The Institute of Electrical and Electronics Engineers (IEEE) rules for formatting citations are included as an appendix to this handbook.

These resources have some value, as professional communities (and the members of the public and business communities they interact with) tend to rely heavily on patterns of grammar, style, and usage that appear in publications and in conversations across the language community. Correctness-based resources can be useful for choosing idiomatic or generally acceptable words and expressions, for choosing how and when to punctuate or paragraph, and even for choosing reliable starting places for formulaic documents. A correctness-based resource that is seen as authoritative in a specific environment is a baseline for writing effective documents. *Takeaway: Correctness-based resources are useful starting points.*

Corporate style guides and templates that help to enforce consistency of usage and format in documents across a distributed company are important to creating a brand image, which may be, on the whole, more valuable than the nuanced variation of a particular technical term or product name. A style guide written for use in your company may be an excellent resource for choosing which words to use or deciding how to organize a report. If others in your workplace follow the guide as well, it will make your documents look normal to those from that workplace.

Few corporate style guides, however, contain sufficient depth to address writing decisions that go beyond superficial concerns. A professional in a workplace situation armed with only the correctness model is often forced to extend that model to make rules about complex writing practices that correctness, as a concept, is ill-suited to handle. It's one thing to devise rules for which terminology to use at which time. It's quite another to develop elaborate and specific templates for sections of documents which need to be prepared to respond to dynamic situations or to develop standard patterns of sentences and paragraphs to use in writing to clients. In most situations, rules that are specific enough to be followed are too specific to be useful all the time,

whereas rules that seem to describe every situation are too general to be usable to make specific decisions. *Takeaway: Correctness has its limits.*

While a correctness-based resource may help you to know *how* to write in a structural sense, it might not help you understand *what* to write in a meaningful sense. You could make a perfectly correct statement at an inopportune time, with inappropriate information, to someone who disagrees with you, or in other ways that would render your grammatically correct and consistently worded statement inappropriate or even harmful. As Gregory Shafer noted, "Language correctness, like reality itself, is contingent on context, audience, and power" [2], [3].

Cognitive/Behavioral Models

Cognitive models of writing explore how behavioral and cognitive psychology can be used to understand the production and reception of written communication. Researchers who espouse a cognitive model observe writers and users of texts, often in controlled environments, noting how they produce or navigate texts, where they hesitate or get confused, how they overcome problems, and what kinds of behaviors help them cope with the complex problems of reading and writing. Sometimes these researchers use brain scans or eye tracking, or ask users of websites to talk through their decision-making processes as they work. The goal of this research is to explain how humans communicate and, sometimes, to articulate how human communication (like writing) can be designed to best suit humans physiological and psychological needs.

Technical professionals who deal with product development, especially with software and interface design, may use techniques based on cognitive models to evaluate the usability of their products or interfaces. Usability, or the degree to which something can be easily used or learned to be used, can be measured by observing sample users who are trying to perform actions or can be evaluated by reasoning through the logics and tasks a user may want to perform. *Takeaway: Some experts use measurements to assess humans' ability to use texts.*

Usability approaches and terms like effectiveness, efficiency, and ease of use can be applied to written products, like instructions or guidebooks, as well. Researchers who study instructional design and accessibility, for example, may time users completing each stage of a task or may use think-aloud protocols in which test subjects verbalized what was going on in their minds as they used instructions to complete a task. These approaches are designed to gather data for usability testing in product design and development. Web design and human–computer interaction expert Jakob Nielsen advocates this approach as "the single most valuable usability engineering method" because it "serves as a window on the soul, letting you discover what users really think about your design"[4].

Cognitive researchers and linguists who are interested in literacy have also studied what makes some texts or expressions seem easier to understand than others, a quality they call *readability*. The ability of readers to read and comprehend a text,

and the rate at which they can read it, can be affected by a number of things including visual elements (like the style, size, and spacing of type) and linguistic ones (like the complexity of vocabulary and the length of sentences). *Takeaway: Others measure readers' mental ability to access, retain, and understand text.*

The analysis of adult reading skills and of how reading relates to the complexity of texts was of interest to newspaper publishers and reading educators throughout the twentieth century. Depression-era social theorists like Douglas Waples, who were intensely concerned with who was reading and whether a poorly educated changing workforce had access to appropriate reading materials, began a decades-long debate about what made a text readable [5]. Using cognitive models, psychometricians and reading educators like William Gray, Rudolf Flesch, and Edgar Dale developed tests for assessing the readability of text so as to promote writing in "plain English" [6]–[8]. Writing handbooks, publishing software, corporate best practice guidelines, and reading and writing curricula are still sometimes prepared with the conclusions of readability research in mind.

The act of writing has been the subject of a cognitive research as well, and theorists who study composition often talk about the process that writers undertake or the way a writer's brain is able to formulate and manage ideas and translate them into written expression. Cognitive models that focus on the writer help explain a writer's thought process from a behavioral perspective by describing mental actions that a person takes when crafting a text. *Takeaway: Many models for the text composing process rely on cognitive theories.*

Linda Flower and John Hayes, for example, call composing a "distinctive thinking process" in which writers seek to achieve a hierarchy of goals [9]. Based on psychology and linguistics, their cognitive model represents the act of writing as a process with three major elements:

- The task environment, which includes "things outside the writer's skin, starting with the rhetorical problem … and eventually including the growing text itself."
- The writer's long-term memory, which is where "the writer has stored knowledge, not only of the topic, but of the audience and of various writing plans."
- The writing processes of planning, translating, and reviewing, "which are under the control of a Monitor." The monitor "functions as a writing strategist which determines when the writer moves from one process to the next."

In this process model, writers go through stages of planning, translating, and reviewing not in a linear path, but in an iterative manner by repeatedly circling back through the stages.

Social/Rhetorical Models

Social models of writing assume that writers make choices based on their understanding of what is appropriate in their situation and within their community. Writing then

becomes a strategic process; it requires a writer to parameterize the situation, to consider the values of the community, and to observe and reflect on existing examples of communication or on evidence of relationships and of community members' personalities. The ability to articulate features of an audience or the social situation of text is necessary to consciously adopting a social approach to writing, and so researchers who articulate social models for communication are often interested in describing the communities in which (and the occasions when) communication take place.

Articulations of social models for communication can be found as far back as the dawn of writing and many scholars of social models today use these traditions as ways of considering current social practices and communication topics [10]. In particular, scholars who study rhetoric, or the effective or persuasive use of language, often relate contemporary observations about communication back to classical texts, Greek and Roman philosophical writings from the era when popular participation governance made educational discussions and theories of speech giving, persuasion, and linguistic arts practical. Rhetoric in these texts is often described an art or a skill of recognizing the features of the social environment and thereby arguments that can be made persuasively, and a knowledge of the forms language and argument may take. *Takeaway: Social models of communication originate in many cultures and eras.*

Classical rhetoricians like Aristotle and Cicero emphasized the importance of selecting arguments based on the specific audience being persuaded. They gave advice about what kinds of evidence might be useful to support different kinds of arguments. They discussed how to establish credibility. And they suggested procedures for preparing and organizing communication. At the same time, they were articulating a systematic way in which communication and persuasion worked in society.

Contemporary scholars in this tradition consider how texts are similar in superficial ways, how they are prepared and deployed within a community, or how they relate to community values or embody actions that enable communities to get things done. At the same time, they describe how texts can be produced by new community members, how one member of a group goes about convincing another member of an argument, and how professionals use communication to accomplish complex tasks.

Contemporary scholars like Karlyn Kohrs Campbell and Kathleen Hall Jamieson have suggested that social groups rely on the repetition of recognizable communicative acts in order to function and to establish group identity [11]. These regular acts, called *genre*, appear as texts that have customary uses, similar argumentative constructions, or common superficial linguistic features. Carolyn Miller has gone on to argue that people develop genres as a response to practical needs. In other words, genres of documents suggest situations and goals that people regularly seek to address through their communications. A person who recognizes one of these reoccurring goals knows what form is expected in response—what genre is appropriate in that situation. Miller described genre as "the conventions of discourse that a society establishes as ways of 'acting together.'" These genres "change, evolve, and decay"

depending on the "complexity and diversity of the society" [12]. *Takeaway: In persisting communities, communication is more regular.*

The concept of genre, like the advice of the classical rhetoricians, relies on a model of the actors in a social situation and their relationships. A social situation, of course, can be described in different ways in order to emphasize the roles and importance of different elements. Any analysis of the elements in a situation will include the audience for a communication and the author of the communication (which are not coincidentally the two actors in Shannon's mathematical model).

A social model can be built around the community in which communication occurs. John Swales, for example, has suggested that genres are the product of particular kinds of communities in which members who have a common purpose and regular relationships need to perform the same kinds of actions again and again. The repetition in such an environment encourages the regularity of features in texts until the regular features themselves begin to take on meaning [13]. They can also be built around the communicative transaction. Lloyd Bitzer has suggested that communication is the timely act of a communicator to an audience to alleviate some pressure (an exigence). In Bitzer's model of the rhetorical situation, it is the audience who is being persuaded, the exigence which causes the actor to communicate and the constraints under which that actor can act which make up the communicative environment [14]. *Takeaway: There are different ways to model the social.*

Some analyses of the situation consider how the document or text itself has a degree of agency in the situation. A report, just by its existence, stores some meaning, has some authority, and exists independent from its author. Some analyses consider social or cultural forces in which an author is set. A corporate environment or professional culture can certainly influence the way an author creates text as well as the way an audience receives or understands text. Some analyses identify the sources of motivation for a communication that are external to the author—orders, client requests, public demand—or the pressures felt by an audience as they access a text—urgency, long-term goal, even the lighting in the room where they are reading.

This Guide's Approach

Models like those in the previous section are ways of describing, critiquing, and approaching everyday communication practices, and each contributes to the hybrid model for making writing decisions presented in this book. Writing in a workplace setting involves strategically deciding what arguments, forms, and words will best achieve your goal as a communicator. Writing decisions can be made using a rhetorical approach, considering how you might advance your argument persuasively given your sense of the social situation. They can also be made pragmatically, observing the communication around you and imitating the forms, arguments, and words that seem to match your communication conditions. When used in combination, these approaches inform one another and form a robust technique for making writing decisions.

When you write, consider the *rhetorical situation* of your text. Use the following questions to break down the social environment in which you are communicating:

- What is your *purpose* for writing? What pressures (or exigencies) are motivating you to write (like a workplace requirement to report quarterly or a problem that requires the action of another to address)? What needs to be done and how could your text help to get that done? What would achievement of your purpose look like?
- Who is your *audience*—the person(s) that you are addressing that may act on your behalf or may acknowledge your communication thereby enabling you to relieve that pressure? What do they know or believe, and what are their interests, preferences, needs, and motivations?
- What is your *identity* as a professional and with respect to the audience who you are trying to persuade?
- What is the *context* that surrounds this communicative transaction? What features of the environment or of the way in which your message is sent inform how your audience may receive or perceive it?

While these questions will enable you to prepare communication that are tailored to your purpose and the motivations of your audience, they rely on a personal social logic at the expense of attention to the habits and traditional practices that people commonly use to identify what is appropriate in a workplace. Using only these questions in a workplace might lead you to prepare a status report or a proposal that deeply considers the needs of your audience but does so in a way that is unrecognizable to your audience. For example, the regular use of a form, even a poorly designed form, can increase efficient identification of information for readers who are familiar with that form. The repetition of specific workplace patterns for texts, even at the expense of some purpose or audience considerations, is often more valuable to community members who need to be able to quickly identify the kind of action you are taking in your text.

When you write, you should also consider the *pragmatic situation* of your text. Use these questions to identify practices of the larger community in which your writing is situated:

- What do you know about the *community* that surrounds you and your audience? What are your identity and your audience members' identities in that community? How do these relative roles relate to cultural or social conventions maintained by the community that might govern how your text should be created, transmitted, or received?
- Given this community, what *generic practices* exist that might resemble those you might use? What preexisting documents match your purpose, audience, and identity? How were they constructed, what form do they take, and how were they received? What authoritative resources, like style guides, are available?

An analysis of the pragmatic situation alone may tell you quite a bit about your community and the practices of its members, but may not enable you to make writing decisions specific to your immediate purpose. Using only the pragmatic situation to write a status report, for example, may lead you to find and analyze existing status reports from previous projects but may not help you choose which features from which reports you might want to imitate. On the other hand, the pragmatic situation may help very little when you are trying to prepare a text that has a unique purpose or that is unusual in some particular way which will require significant deviation from existing texts.

Used together, the pragmatic situation can give you boundaries for normal documents (when the action you are trying to take is normal) and the rhetorical situation can help you make choices within those boundaries. The remainder of this chapter discusses further the parameters of these situations. The next chapter discusses the points in text where these parameters can be used to make decisions.

The Rhetorical Situation: Purpose

The *purpose* of your document is the reason you are writing it. What do you want your audience to do in response to your document? What do you intend to accomplish? A well-defined purpose can be a potent tool to evaluate specific writing decisions. It can be used to evaluate whether information is necessary in a document or used to justify one organization over another. For example, if the purpose of a procedural document is to "enable users to assemble a device reliably a single time," then that purpose may justify using a stepwise procedural setup without any background information about the device's design or history. A guide written for a technology sales professional, on the other hand, may include this kind of information if its purpose is to "provide procedural and background information to sales professionals who need to seem knowledgeable in the field."

It's not unusual, of course, for workplace documents to have multiple purposes, often related to the multiple audiences who will read a text. In the case where some purposes call for a certain decision while others call for another, you will have to prioritize purposes or create structures that satisfy both. An executive summary at the beginning of a technical report, for example, satisfies a need to "provide a quick and action-oriented summary of work to executives." Were this purpose to be the primary consideration throughout the report, it would likely conflict with a need to "produce specific and reproducible data that is contextualized by error information". *Takeaway: Documents often have multiple purposes.*

Some workplace documents are overtly persuasive; not only is the writer intending to persuade, but the readers expect the document they are reading will try to persuade them. Whenever you propose an idea or make a recommendation, your goal is to get the reader to agree with you. To do this, you represent your problem or solution in terms and parameters that the audience appreciates and that concern them.

You will also need to include the information necessary for your audience to take action. Funding requests, for example, need specific details about what activities

will be accomplished, the costs associated with them, and income (if any) that can be expected as a result of the activities. While funding requests rely on quantitative arguments, you can also address non-monetary qualitative issues that are important to your readers, such as potential for improved water quality or wildlife habitat. If you know what your audience values, you can include information in your document that addresses these values.

In a way, the purpose of all functional writing is to seek agreement, approval, or participation. To get your reader to do something—understand a concept, take an action, whatever—you have to convince the reader that you are knowledgeable and that the intended goal is either reasonable or inevitable. Even a description of a process is an exercise in approval seeking. If important details are omitted or trivial details included, if measurements are inaccurate, or if graphical representations are misleading, the reader may lose faith in your expertise and good will. *Takeaway: All functional writing is, in some way, persuasive.*

Some writing though, is not overtly persuasive. In most cases, documents that report activities or results are perceived by readers as objective or factual. Authors of these documents use conventions that an audience will accept as standard and represent their assertions in terms of accuracy rather than reasonableness. One key to writing a successful reporting document, however, is to choose which information to include, which to exclude, and how to present information to meet your audience's needs. In making these choices, you are shaping your information and interpreting it; this is an inevitable outcome of writing.

People writing on technical subjects are not always aware of the impact of their choices about what to include and what to leave out, sometimes insisting that they are just "telling it like it is." But even the decision to "tell it like it is" involves decisions about what is relevant, sure, and true and what is not.

Technical professionals often use analysis—the process of breaking something into its parts and explaining what those parts say about each other—as a means of non-overt persuasion, to justify why a position is valid or to support claims about how a position fits into a context of knowledge already accepted by the audience. David Rosenwasser and Jill Stephen describe the process of analysis in this way: "To analyze something is to ask what that something *means*. It is to ask *how* something does what it does or *why* it is as it is" [15]. They suggest that most written analysis relies on five argumentative considerations. *Takeaway: Analysis is a hallmark of engineering writing.*

1. Suspend judgment. It is usually important to establish features of the subject or mechanisms by which it works before actually discussing its implications or evaluating its effectiveness.
2. Define significant parts and how they're related. Ask not just "what is it made of?" but also "how do these parts help me to understand the meaning of the subject as a whole?"
3. Make the implicit explicit. Articulate assumptions with rationales for how those assumptions can be justified. If a device or process is not already well

understood by the audience, you'll need to name components and explain how they interact.

4. Reveal patterns. Meaning is typically associated to patterns and to systematic or anomalous exceptions to patterns.
5. Keep reformulating questions and explanations. Analytical logic is often expressed in terms of seeking and finding or trial and error. Posing questions that are normal to your audience enables you to answer those questions in a way such that you can go on to ask questions that further your argument. [15]

For analysis to be persuasive, it is especially important that it follow pragmatic conventions. Professional communities have expectations about when and what kinds of analytical information are necessary to support which kinds of arguments or assertions.

Analytical text, in this sense, functions as support for higher order (and possibly more overtly persuasive) purposes. The main purpose of a site visit report, for example, may be to persuade a project team that they should write a bid of a certain size for construction of a warehouse for a client. To accomplish this purpose, you may write several sections with subordinate purposes—suggesting that the client's site needs soil treatment, suggesting that the client's site needs grading, suggesting that permitting may be a problem. To support these sub-purposes, sections might be composed of non-overtly persuasive analytical arguments—data about soil chemistry, observations about runoff, and excerpts from city planning policies.

In a technical workplace, document purposes also typically exist within the larger context of a project. A document you produce may be needed so that members of your team can plan around existing infrastructure or procure new equipment. Because of this, you should consider if claims or analysis in your report, made for one purpose, would be useful to support other project goals. Appending research done while working but that you didn't find necessary to make your argument might enable another project worker to accomplish their goals faster. Likewise, including comments about what is known and unknown, about what needs to be done and where further information might be found, or about the basis of professional opinion might be helpful to a reader who has a goal beyond one that your document anticipates. *Takeaway: Purposes exist within a larger workplace context.*

Here are some questions you might ask about your purpose to help you make decisions about what to include in your document, what to exclude, and how to present your ideas:

- What was the situation that led me to write this document?
- What do I want my primary reader to do or think after reading this document?
- What do I intend to accomplish with this document?

- Do I want my primary reader to change his or her mind about my topic after reading my document? If I do, how will I help the reader make that change in opinion or attitude?
- Do I need approval or recognition for my work to continue?
- How do I want to present my analysis of a project or situation in the document? Does my primary reader already have established ideas about my topic that affect my analysis?

The Rhetorical Situation: Audience

Audience is a complex term for a variety of reasons. Even when you are writing to one person, you have to make assumptions about what that person knows, believes, and prefers. If you know that person well, this might be easier to do than if you don't know the person at all or only know them by their position in a company. That's not necessarily the case, however.

You can never completely predict how a person will read a text: what associations that person will make with certain arguments, approaches, or phrasings, and even what the reader will skim rather than pore over. It is also difficult to be certain how a person understood an earlier document and how that relates to how that same person will read another document. Life experiences change people—and therefore change your audiences—from day to day and even from minute to minute. In fact, sometimes a person that you know well will have different expectations from your text than someone you don't know, which may actually make writing more difficult. *Takeaway: People are not predictable.*

For many workplace documents, you are addressing multiple people at once and those people have different interests and concerns. You are also less likely to know specific things about the person you are addressing when that person is outside of your organization or not someone you work with on a day-to-day basis. While the term "audience" is singular, referring to the complex of the people who will read or be influenced by your document, it is really plural in its indication of the background knowledge, needs, and expectations of these people. You may write to one primary audience (for example, your supervisor who you need to act on your behalf or approve your work). But many other secondary audiences may read your document as well: accounting staff, legal staff, government agency representatives, and co-workers. Still others may be influenced by your document: co-workers, stockholders, attorneys, clients, and even the general public.

One general strategy is to keep a primary audience in mind as you write, but to check over your text with secondary audiences in mind, considering where they might find your text problematic. For example, you might write a proposal to a client outside your organization, but revise your text to reconsider certain writing choices based on the fact that that proposal will need to be approved by your supervisor. *Takeaway: Prioritize and consider audiences systematically.*

To do this, you will need to know something about your audience. When possible, you will want to gather specific information about your audience and their needs and beliefs. This is a research task. Ideally, you will want to speak with audience members yourself, ask them what they value, what they know about your product or goal, and ask them what they find convincing or useful. It may help to observe them doing a task or take note of the words they use for things. For example, if you are writing a user guide for a piece of manufacturing equipment, you may be able to visit a shop floor to see how the workers will interact with the equipment and to talk with them about their needs and concerns. If you are writing a report to someone in a decision-making role in your organization, you can talk to others about what kinds of issues the decision-maker regards as important.

When an audience is not directly accessible, explore prior documents or media that relate to your topic and your intended readers. For example, if you wanted to write a proposal for research funding to the National Science Foundation (NSF) in the United States, you could visit the NSF website to learn such important information as its mission statement, what types of projects the NSF funds, specific projects funded in the past, and biographical information for the NSF staff who are likely to read your proposal. This information would help you better understand whether the NSF would be interested in your idea and may help you articulate your idea in a way that seems to fit in with its mission. *Takeaway: Consider existing texts when you don't know your audience.*

When a document's audience is large and you can't anticipate who individual audience members will be, you may need to create general audience categories. Knowledge of an audience is only useful when it can be related to the communication task at hand; so categories of users or readers should be created relevant to your communicative purpose. For example, if you were writing a set of instructions for a software program, you might think of your audience as made up primarily of people who have not used the software before ("new users"). You might also identify a secondary audience of "prior users" who are already knowledgeable about the software program. *Takeaway: For complex audiences, use categories.*

Having a secondary audience in mind may lead you to make different decisions about how to structure your instructions. If you think your "prior users" might have a high tolerance for reading information out of order or information that is abstract or comparative and that they might make up a small fraction of your readership, you might decide to make small boxes at the end of each procedure stating how that procedure has changed since the previous version of the software. On the other hand, if you think that "prior users" might be a significant portion of your readership and are likely to go through procedures quickly and miss the subtle ways in which they are different than in a previous release, you might put notes or flags in line with procedural steps where attention should be paid to differences. Placing these flags in a way that won't disturb "new users" use of the document would be key.

The details of an audience category that make it useful for writing decisions can be generated by discussing the typical users with experienced members of your

workgroup or, when possible, by observing or interviewing model users and extrapolating what the larger user population might look like. Neither approach is particularly reliable for dealing with the idiosyncratic needs of individual users, but when a document audience is sufficiently large, it's unlikely that you'd be able to accommodate all those individual needs in one document anyway.

Of course, audience categories like these should be created and described relative to the particular situation you are addressing with your text. But when an understanding of a particular technology or technical concept is integral to understanding the argument made in a document, a general distinction is often drawn between experts and non-experts. *Takeaway: Expertise is a common categorical observation.*

Non-expert readers are not familiar with the details of your topic, although they may be familiar with similar technical topics. When writing for non-experts, you want to consider which terms and concepts will be new to them so you can relate these new ideas to ideas they are likely to already be familiar with. Herbert Clark and Susan Haviland have called this approach the Given-New Contract [16]. They suggest that a writer should present new information in the context of existing (or "given") knowledge. If this context is well designed, they suggest the reader should be able to "compute from memory the unique antecedent that was intended" thereby connecting new information to existing knowledge to understand the new knowledge.

In practice, you can employ this strategy by first establishing known information with your reader, then relating new concepts to that known information. Once the new information is related and explained, it becomes given/known information and you can relate the next piece of new information to that given/known information. By continuing to relate new information to already known information, you can help a reader to understand new concepts incrementally, one new piece at a time.

You might also want to consider whether these people may already hold opinions about your topic, even though they may not be familiar with the details you will present. To meet these readers' needs, you can define terms and describe concepts with which they are unfamiliar. If you were writing instructions for a heart monitor to be worn by patients experiencing heartbeat irregularities, you would probably assume that not all patients are familiar with the medical terms for these irregularities. You might provide definitions in context (for example, "This monitor can detect irregularities in your heart rhythm, such as *tachycardia*, or 'rapid heartbeat"') or omit specialized terms altogether ("This monitor can detect irregularities in your heart rhythm, such as rapid heartbeat"). You can also include illustrations or other graphical information to help readers understand your concepts visually. When writing for non-expert audiences, it may be helpful to explain your reasoning and justifications in more detail than would be necessary for readers who are experts in your field.

Expert readers may be very familiar with the details of your topic and want you to convince them that your ideas are significant in relation to your shared professional field. These readers will want to know the details of your ideas in order to evaluate your reasoning and come to their own conclusions about your topic. Although you need to include technical information for these readers, you also need to consider

that they are very familiar with your topic and will consider you to be unprofessional or a novice if you include too much elementary information about your topic. For these readers, you need to include technical details without adding too much basic information that makes you sound like you have only an introductory knowledge of your field.

To sound professional for expert readers, you should use standard technical terms and exclude definitions of these terms that are commonly used in your profession. You should refer to standard equations and formulas that you would expect other experts to know. If information is usually expressed in graphical forms, such as charts, diagrams, graphs, etc., you should include these graphical elements in your documents as well. Expert readers are likely to want details about your methods, data, and analysis to understand your ideas and draw their own conclusions about them.

Another way of understanding the complexity of audience is to use the roles audience members play inside and outside your organization to create a schematic that relates audiences to each other. Organizational charts and project management hierarchies can tell you a lot about who is nominally in charge of what, and what responsibly and concerns workers in those roles should have. In describing a workplace for their 1976 book on technical reports, J. C. Mathes and Dwight Stevenson represented communication in technical organizations as layers of mangers and technical professionals who manage and communicate in regular ways. Placing the writer at the center of a circular diagram, Mathes and Stevenson suggested segmenting audiences based on organizational distance—the closest audience being the people you work with, the next ring being those you work for, the following ring being those in your organization, the following being those in the client's organization, and so on [17]. This egocentric approach, as they called it, enables the writer in an organizational context to consider how their communication passes through layers of audiences that might stop their text or might be affected by their text. *Takeaway: Audiences can be categorized relative to organizations.*

While their approach is revealing, Mathes and Stevenson's diagram itself is unavoidably general. Engineers and technical professionals work in a variety of organizational conditions and service a variety of constituencies. The egocentric diagramming approach is most informative when used to diagram a specific writing situation. Even though diagrams of one workplace or project may fail to explain another, characteristic diagrams could be created to express (or normatively represent) typical work patterns in an organization. Figure 1.2, for example, is an application of the egocentric approach to create a characteristic diagram for a client-oriented engineering project.

This model contains three broad categories of audience (gateway, target, and regulatory) that are not only arranged by organizational distance but by their relationship to each other. This diagram depicts audiences inside an organization or project team—including a manager, an editor, and a corporate legal team—as having a restrictive role on you and your team's communication with a client. This audience may stop you from complaining to a client or promising them results that you cannot be sure to accomplish. On the other hand, if you are trusted to communicate with the client

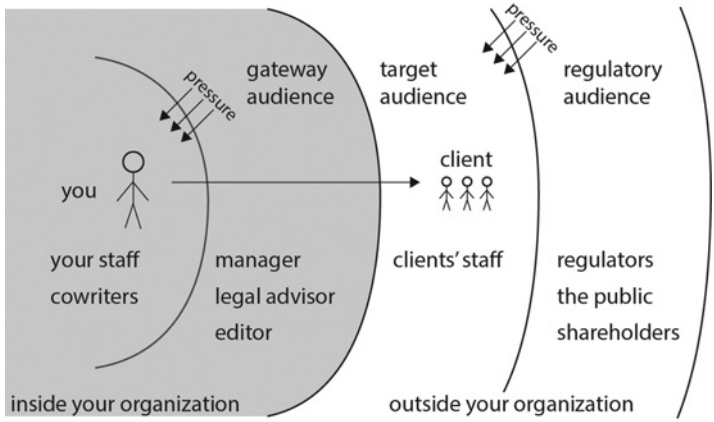

FIGURE 1.2. Diagram of a client-oriented engineering project made using Mathes and Stevenson's egocentric approach. This diagram models the different relationships various audiences have with a document produced for a client. Different kinds of pressure may affect the message different ways.

directly, this group of audience members will likely receive the backlash from actions that they would have stopped. The target audience, your client and their technical staff are the primary goal of your communication. But they have their own outside pressures coming from audiences beyond them—regulators, for example. While

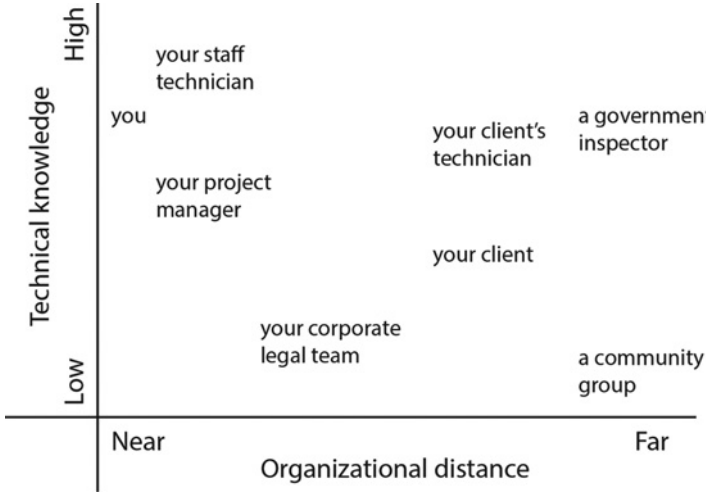

FIGURE 1.3. Example of audience groups positioned in two dimensions. This chart represents categories of readers as they might be evaluated based on their technical knowledge and organizational distance.

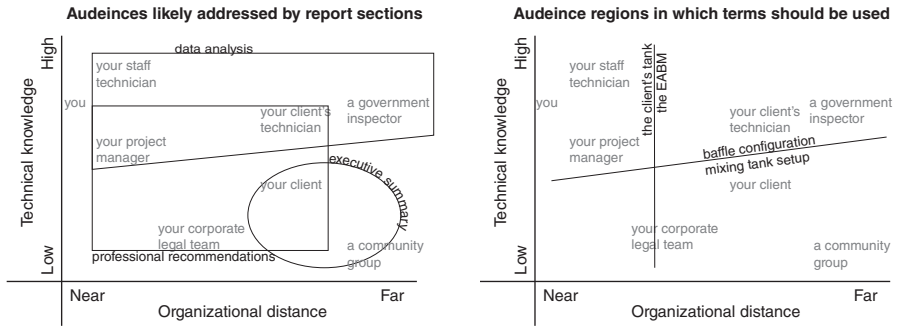

FIGURE 1.4. Example representation of how audience groups might be connected to document sections and word choice. Writing decisions can be tied directly to considerations of audience.

regulators of your client might not be your audience, *per se*, they inform how your audience is likely to consider your arguments or receiver or accept your work.

In that a diagram like this sets up the power dynamic of multiple audiences, it could be used to help consider how you might subsection or subtitle a document so different readers can find what they need. It might also help you revise arguments or statements with the idea that they must be acceptable to a certain audience, or that they might be seen by another. This audience breakdown, however, tells you something different than the categorical breakdown which might help you select which technical terms to use or how to divide up procedures.

Combining a schematic view of audience with a category understanding of audience, you can make observations that might help you to make granular writing decisions, like what kinds of arguments should be made in certain parts of a documents or what sections should contain technical terminology. Figure 1.3, for example, is a two-dimensional representation that shows hypothetical audience groups in terms of their expertise with regard to a particular project and their organizational distance relative to the team completing the project. This graph is then used as a template in Figure 1.4, which contains space-filling and segmenting layers that indicate how document sections might be keyed to the hypothetical audiences and which terminology may be appropriate for them. Taken together, these diagrams suggest how vocabulary might vary across a document.

The Rhetorical Situation: Identity

The *identity* of an author is the way an audience views the author of a text, their expertise, their motivations, and their feelings. Your identity as a trustworthy writer shapes how you produce your document and how it will be received and used. A

document written by an author that an audience views as a trusted expert may require less background, less justification, and less mitigation on claims. Just as you use what you know about your audience to frame your message, your audience will use their knowledge of you to understand your message.

One of the reasons sales documents are overtly persuasive—declaring up front that they are trying to sell the audience something—is because they are written by sales staff. An audience reading a sales pitch may see the author as honest or dishonest, as genuinely enthusiastic about a product or as conniving, but the audience knows that the salesperson is motivated to sell. Where the audience is savvy and self-sufficient, sales is an adversarial relationship that can only be overcome through relationship building, turning the identity of the salesperson looking to make a deal into the identity of the trusted vendor who has their client's best interest at heart. The successful pitch written by the former will likely look appreciably different than the successful pitch written by the latter. *Takeaway: Audiences' expectations are partly based on who you are.*

Your identity, of course, can be established independently of the audience of your document. Your professional associates, your work history, your education, your personality, your appearance, the language you use, and your standing within your profession all affect how credible your readers believe you to be and how likely they are to be persuaded by your ideas.

But probably the largest influence on an audience's perception of your identity is your immediate relationship with them. If you have a good relationship with an audience because you have worked with them successfully in the past, then they are simply more likely to give you the benefit of the doubt. Strained relations, on the other hand, likely make your audience less likely to want to agree with you or work together. Your audience's attitudes and beliefs regarding your topic may affect their perception of you, as in the case of an industrial manager who feels anxious about an inspection. Other times you may have a strained personal relationship with your reader, as in the case of addressing readers with whom you have recently engaged in a lawsuit.

Analyzing your past experiences with your intended audience can help you develop a strategy for finding a common ground from which to begin your communication. Without this common ground, your communication will be ineffective. Rhetoricians Richard Young, Alton Becker, and Kenneth Pike set out a useful maxim for understanding the importance of common ground to the act of communication:

> The motive for communication arises from an awareness of difference and a desire to eliminate it or at least to modify it. But there can be no interaction between writer and reader and no changes in their thinking, unless they hold certain things in common, such as shared experiences, shared knowledge, shared beliefs, values, and attitudes, shared language. Things that are completely separated from each other cannot interact; this is as true of human minds as it is of anything else. Change between units can occur only over a bridge of shared features. Shared features, then, are prerequisites for interaction and change. [18]

In an interaction with a client or a consumer, you represent not only yourself but your organization. When a customer has had trouble in the past assembling products your company has produced, they will read the instructions you write with that trouble in mind (even if you didn't write the previous instructions). Consumer documents and sometimes documents to clients or vendors that come from a company do not have personally identifying marks, so your writing in these documents is the voice of your company. *Takeaway: An audience may see you as an institution.*

When representing your organization, you may think about how your views and ideas fit into your organization's culture. Does your organization have a mission or goal statement that is in harmony with your ideas and the values of your audience? If so, you may foreground that organizational mission in your document. On the other hand, if your ideas are in conflict with your organization's mission or objectives, you might discuss this situation with people inside your organization before sending your document out, especially if there is no clear review process for your work.

You do not want to surprise people in your own company with statements in your document that contradict the organization's objectives or work practices. In fact, working internally, you may be able to incite change within your organization. You may be persuasive within your organization and help to move it into new areas, like new product lines or expansion into the international arena. But if you find yourself in a situation where you cannot agree with your organization's mission and cannot effect change internally, you may need to rethink your relationship to that organization.

The Rhetorical Situation: Context

In the rhetorical situation, *context* forms the various environmental and macro-social considerations that are not identifiably connected with the nexus of identity/exigence/purpose or with audience but which, nonetheless, affect the way the audience receives and perceives communication.

A larger corporate culture that contains both the author and audience of an internal corporate document, for example, could be considered context as it is shared by the author and the audience but is not possessed by or unique to either. (In this case, context seems to do the duty that the term community assumes in the pragmatic model.) The weather or lighting conditions under which an audience member may have used instructions could also be considered context (for example, a manual for fixing tractors might be used in the dark in a muddy field). Context, in many ways, corresponds to features of the channel and noise in Shannon's mathematical model.

Context also includes the requirements for publishing in a trade magazine that influence a position article you write, the features of your workplace word processor setup that won't allow you to share reports with linked rather than embedded graphics via your content management system, and the standard fonts, margins, and colors that documents leaving your corporation always use that disrupt your ability to format a particularly informative graph.

Governmental and legal regulations can affect how you need to explain your ideas, the review process for your document, or the type of ideas you can put forward

within a situation. If you are in an organization that has strict government oversight, such as the pharmaceutical industry, your documents might be the primary way of conveying that work is being done according to regulations, so expressing work in terms of these regulations is key. If you are working on government contracts, you also need to strictly comply with their proposal and reporting requirements. Since legal regulations impact virtually all aspects of technical writing, your organization may have requirements for legal review of documents.

The relationship between your organization and other institutions can also impact your writing decisions, especially if you are writing for audiences outside your organization. In considering your writing situation, think broadly about the professional and societal context of which your document will be a part. If your organization is in danger of being second-sourced on a large government contract, your managers are probably motivated to show that government agency that they can handle the entire contract. Those managers would not welcome a suggestion, for example, that you cannot meet a deadline. Or if your organization has recently been involved with an environmental accident that was widely reported in the news media, your documents may be under closer public scrutiny than usual. In one sense, all of your "on-the-job" writing might be subject to a court order, and thus available to others. An example of this legal scrutiny of internal documents took place when tobacco companies were involved in class action lawsuits and internal documents became part of the public record. You should always keep legal requirements in mind as you write on your job.

The Pragmatic Situation: Community and Genre

In the context of the pragmatic situation, community is the observable organization of people around a set of workplace practices, communication practices, beliefs, and/or goals. A community of people may form around a craft or skill, such as a community of professional welders; around a common mission or goal, such as a corporation or a labor union; or around a set of beliefs, practices, or approaches, such as a religious or political group. Members of communities have some way of recognizing each other, like through the use of shared terminology or the knowledge of a process or practice. They also have some way of deciding who is in the community and who is not, like through educational credentials, inclusion on a payroll, or participation in a ritual.

John Swales has called communities that form over a common goal and that establish regular roles and patterned ways of interacting "discourse communities." Because these communities have members with regular and repetitive behaviors and responsibilities, they tend to adopt a specific *lexis* (a set of specialized terms that enables them to communicate rapidly and meaningfully) and to develop habitual patterns for those individual communications that represent regular action [13]. These habitual communications, Swales called genre. Appropriate use of lexical markers and genre become a way of recognizing community members. *Takeaway: Over time, messages in communities tend to regularize.*

Because communities sustain themselves by maintaining a regular stream of new members, members' education includes education about lexis and genre in with the

rituals and skilled practices of the community. For example, when a technician takes a job at a new company, they learn the terminology that people at that company use (lexis), the forms they fill out, and the formats of reports that they write (genre), at the same time that they learn laboratory practices and safety procedures and the typical places where employees eat lunch and what they tend to talk about when not talking about work. As they learn these things, they become members of the community. Sometimes, a learning period is even declared officially and community membership (employment or a regular job title, for example) is not bestowed until the learning period has been successfully completed.

Lexis and genre are useful as markers of community membership because they are observable. And, because they are observable, they can be noticed and accounted for as you prepare documents within a community. Put another way, they form a boundary for typically acceptable action, an array of possible actions that can be taken. But they often do not enable you to select a specific action (for that, you need the rhetorical situation) and they are often not as concretely authoritative or tailored to your specific needs as you would like.

Because the idea of a genre is developed over time through the repeated performance of similar rhetorical actions, a genre tends to be an average of or a collection of practices rather than a concrete one. Final reports to clients over the last several years may appear superficially the same, but some may include certain kinds of data that others omit and some may have extended discussions of the problem while others mention it in only a cursory way. This is likely because of the variety of people writing the documents (identity) or because of the variety of clients' demands for what the documents include (audience). This "final report to client" genre, then, has some variability. Locating the best combination of practices within a genre is a strategic approach to using the pragmatic situation to limit your choices and the rhetorical situation to make those choices. *Takeaway: Regular communicative acts have some variability.*

The opposite orientation of these situations can be articulated as well. If genre is a composite of varied examples, its boundaries can be thought of in terms of tolerances that can be used to constrain rhetorical choices. Writing then becomes a process of making rhetorical choices in a controlled environment—choices should suit your rhetorical purpose without violating the tolerances of the genre.

These two articulations are useful in understanding how texts in organizational settings are regulated. When texts are produced in organizational settings by many people (especially people who are distributed), pre- and post-production norming are often required to get those texts to look and feel as though they are the same.

The most common method of post-production norming is editing; an editor checks work after it is written, pointing out where it deviates from the desired style or structure and returning it for correction or simply correcting it. The most common method of pre-production norming is the promotion of a template (a tool which aids in the construction of the document like a file with the correct fonts and margins pre-loaded) or style guide (a collection of rules about what to write, how to write it,

and what visual choices to make). A resource like a style guide, while a correctness model resource, is often written as a conscious attempt to codify generic action and expectations that are shared in genres that coexist in a certain community-supported environment.

Communities often maintain different communication *venues* where different classes of generic action occur. A professional society, for example, may publish reference books, research journals, trade magazines, and an e-mail newsletter. Navigating these different venues (Swales called them "mechanisms of intercommunication") and choosing the right one for the document you've written is an important part of participating in the professional community. While this might be less obvious in a workplace, professionals often have to decide when to send an e-mail and when to make a phone call, or when to write a proposal for a project change and when to simply submit new work to a contingency budget. *Takeaway: Communities maintain venues for generic messages.*

Venue is like Shannon's channel in this way, community mechanisms of intercommunication are designed to accommodate regular community behaviors. When an irregular behavior is warranted, however, sometimes there may be no obvious venue for it. Professional societies that divide their research journals by subject matter may have a hard time deciding where to publish research that involves more than one subject. Similarly, an online troubleshooting ticket system may offer four options to categorize a problem so as to route tickets. When none of those options match how a user of the system would classify the problem, the user might have to choose one path in order to proceed even if it doesn't reflect his or her problem.

The pragmatic situation requires an empirical approach. Looking around your workplace and looking at documents like the ones you are preparing, you can draw conclusions about writing decisions you might make. Some general questions you might ask include:

- What are the names of documents similar to mine and how do those names indicate their purpose or their relationship to each other and to members the community?
- What is the general arrangement of the argument in this document and how is that arrangement advertised?
- How/where does this document get published/delivered? And how does that affect the document's composition?
- What specific words or phrasing patterns do people in my community use and on what specific occasions?

These questions, however, express only general considerations. For a discussion of what you might notice when looking at text from your community (including lexis), you'll want to read the next chapter. For a discussion of what you'd want to notice when looking at documents and their argumentative contents, you will want to read Part 2 of this book.

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2

Making Writing Decisions

- *This chapter describes text as a mechanical system and presents writing as using knowledge of that system (and knowledge of the social situation) to make strategic decision that involve choosing words, phrases and arguments and arranging words, phrases, and arguments.*
- *Different decisions need to be made at different levels of a text.*
  - *At a macro level, the arrangement of sections and selection of titles are important ways of advertising and presenting the argument a document is making.*
  - *At a micro level, the selection and careful arrangement of words and phrases signal local arguments and contribute to tone.*
  - *Between the macro and micro level, paragraphs, lists, and other textual features serve intermediate argumentative functions especially useful for making specific kinds of arguments.*
- *Active, decision-oriented writing is about having a purpose you'd like to achieve, being aware of the mechanisms available in the writing environment, and having a sense of how your audience may respond to patterns you deploy.*

The IEEE Guide to Writing in the Engineering and Technical Fields, First Edition.
David Kmiec and Bernadette Longo.

Introduction

The previous chapter of this handbook discussed the social environment in which writing exists and presented tools (the rhetorical and pragmatic situations) for using that social environment to make writing decisions. This section addresses some mechanical principles of writing with the goal of identifying some of the different kinds of writing decisions that can be made at different levels of a text.

Writing is often thought of as an art. And professionals who write a lot often have a hard time articulating their processes. But most professional writing relies on learning and repeating relatively few patterns and identifying places where strategic phrasing or terminology might make a document more persuasive or more credible.

In general, writing can be thought of in terms of decision-making because natural languages have fixed numbers of preexisting terms and have a limited number of ways of arranging those terms into composite structures. (This is the observation that Claude Shannon was relying on when he asserted that probabilistic approaches could be used to mitigate miscommunication between humans and machines. For more details on Shannon's communication model, see Chapter 1.)

Professionals use only a specialized subset of terms and structures from the natural language community in which they are situated as well as some terms that are specific to their professional community or workplace. Active, decision-oriented writing is about having a purpose you would like to achieve, being aware of the mechanisms available in the writing environment (given the language, software tool used to write, your organizational and professional community, etc.), and having a sense of how your audience may respond to patterns you deploy. At its heart, it's the Shannon model—encoding and decoding—but the introduction of meaning complicates the process and is critical to writing in a technical workplace.

A rhetorical approach, like the one adopted in this book, is about understanding people, understanding the language, and giving in to probability. Treating the act of writing as a decision-making act involves using an understanding of social environment in which a text will function as a way to justify mechanical choices. When writing this, you might have thoughts like these:

- If I phrase it this way, then I think my reader is likely to find this information more believable.
- These list items are long, and I'm going to go on to discuss one point further, so I'll position it at the end of the list. I think I will need to repeat more of the grammatical structure in each of the list items to make it obvious how the separate list items require different kinds of actions.
- Given how much my reader knows about this topic, I think brevity is more important than detail here, so I'll leave out some of this clarifying phrasing and connective language.

- While my argument seems to be progressing this way, maybe I should disrupt the parallel arrangement here to emphasize this point so that the reader will be more likely to notice it and not read it as a "normal" part of the argument.

With practice, these are the kinds of rationales that you should be able to articulate when you consider the texts you write, rereading them to see if they are composed effectively. With this goal in mind, this chapter will cover the kinds of effects you might want your writing to have and how those effects integrate into your rhetorical purpose. At the same time, it will discuss how sentence level, mechanical elements of writing relate to those effects.

Document Structure and Granularity

In the simplest sense, the act of writing can be broken down into choosing words and choosing the arrangement of words. A language, in this sense, is the set of all the words you might choose from (*lexis*) and a set of rules whereby those words can be combined to make intelligible structures (*syntax*). Like building blocks, those structures can then be combined further—sentences can be combined to make paragraphs, and paragraphs can be combined to make documents.

The decisions that need to be made when writing differ at the different levels of a text. Making writing decisions about the organization of sections in a document (the macro level) requires a different thought process and knowledge of different patterns than making decisions about the order of clauses in a sentence (the micro level). Decisions at the macro level are often about arrangement and relate to the larger argument and purpose of the document and to generic conventions within the community. Decisions at the micro level are often about the emotional effect a particular phrasing is trying to create and about the connectivity of thoughts at a mechanical level and the conventional usage of words.

At the macro level, documents and their subsections have relationships that are implied largely by titles, headers, format, and navigation aids. At the micro level (the level where phrases and sentences are formed and related), syntax is perhaps most complex. A reader must not only recognize words but categories of words and their functions in expressions. Writers at this level rely on regular sentence patterns and on punctuation, repetition, and linguistic cues to indicate structure. In rhetorical terms, the macrostructure of a document is the mechanism by which the document's purpose is enacted. And the microstructure is the mechanism by which that macrostructure is enacted.

- Macro level decisions to determine a document's purpose
  - Organization of sections and subsections
  - Relationships among parts of an argument

  - Formatting
  - Navigational aids
- Micro level decisions to carry out a document's purpose
  - Choosing words and phrases in sentences
  - Recognizing the function of words and expressions
  - Writing in regular sentence patterns
  - Including linguistic cues to indicate the structure of an argument

An effective workplace document makes an argument or serves some kind of workplace function. Arguments, like documents, are hierarchical things. Persuading a potential client to accept a proposal for work may involve persuading that client that they have a problem, persuading them that you have a solution, and persuading them that you are capable of performing the work required. Three sub-arguments must be made, then, to make the main argument. Each of these sub-arguments, however, relies on a series of sub-arguments as well. In order to persuade a potential client that you are capable of performing work, you might need to meet some standard of evidence required (implicitly) in your professional community; you might discuss work you have done in the past, the qualifications of your staff, and the time and resources you have on hand to complete the project. The argument that your staff is qualified, of course, also has sub-arguments. Each staff member, each of their qualifications, each of their past achievements might be discussed in turn. *Takeaway: Documents (and arguments) are hierarchical.*

At some point, this argumentative hierarchy gets to a lowest level of granularity. Individual sentences, like "Four of our staff members have advanced degrees," become the smallest granules of an argument. If the argument is expanded or contracted, granules expand or contract accordingly. In a more elaborate and larger-scale proposal, the sentence mentioned may be expanded into a paragraph detailing the degrees of each of the four staff members—as the argument is expanded, the lowest level pieces of information become categories for a new sub-level of statements. (In an even more elaborate proposal, the four staff members' degrees might be discussed over four paragraphs or four pages.) In a briefer proposal, on the other hand, the sentence in question might be collapsed with several other statements about staff training and education into a more general statement about the entire staff being appropriately trained and educated. The degree of this expansion and contraction is often referred to as a document's depth or level of detail.

As was suggested in the previous chapter, the elements that make up your argument are dependent upon the situation. Likewise, the depth of description, amount of argumentative signaling, and the volume of text dedicated to any portion of an argument are as much based on conventions in your field and what you think might be most persuasive to your audience as they are on the details of the argument you are making. Expansion and contraction of an argument, in other words, are

not necessarily uniform. It's not uncommon for an argument to be thoroughly detailed in some places and for argumentative points to be taken for granted in others. *Takeaway: Use the situation to decide text features.*

Effective workplace documents rely on a rhetorical structure just as much as they do a mechanical one. The rhetorical structure of a text does not necessarily map easily onto the sentences, paragraphs, and sections of a document, but it is just as much composed of hierarchically nested units. Documents that can be talked about mechanically in terms of sections, paragraphs, and sentences can also be talked about rhetorically in terms of arguments and movements and claims and evidence.

Because argumentative elements overlap, however, and operate cross-functionally (to support multiple purposes or to provide signals to different audiences) it might be necessary to consider several situational elements when making a discreet mechanical writing decision. For example, it's possible that a claim made in a report might be appropriately limited using a buffer word like "may" when that claim is presented to a technical professional in a client's firm. But that that buffer word might appear too strong for management of that firm (who might also be an audience of your document). Separating material for management and technicians (a macro strategy) might be one way to deal with this problem. Finding a word that seems to satisfy both audiences or explaining the claim using alternative phrasing (a micro strategy) might be another way. Larger arguments made in a document are made up of subordinate arguments that rely on text structures in non-uniform ways. As such, an acute sense of the purpose of text at both the macro and micro level is always important when making decisions.

That said, we will be talking about the macro and micro levels of the document separately in this chapter. The discussion that follows will consider the kinds of decisions that you might make when organizing a document at the highest level so as to support your argumentative purpose. Then, the next section will discuss the mechanics of supporting arguments at the lowest level or granularity by creating felt effects in the reader. It will then discuss the structural intermediates where these levels meet—how elements of texts like paragraphs and lists form intermediate structures that package smaller arguments that support larger ones. Finally, it will discuss some implications for the practice of writing (the actual process of getting words on the page or screen) rather than the technique of writing.

Arranging Text at the Macro Level

When discussing how to prepare a speech, Aristotle separated the act of coming up with the arguments for the speech (invention) and organizing those arguments (arrangement). Invention is undeniably both a creative and social act; it relies on both an intimate knowledge of the audience and your purpose as well as an understanding of what they expect and what they have seen. Arrangement, of course, relies on these rhetorical and pragmatic considerations as well. But arrangement is more constrained

because elements of a text (a document, a speech, an argument, etc.) have to come in a certain order. They have to be presented with some relationship to each other, even if that relationship is only implied by the medium in which they are delivered. Paper documents are limited by space, size, contrast, and other elements we often refer to as format or typography. Even the most abstract electronic means of delivery (like cloud-based navigation) requires some kind of organization in order for a user to be able to access it and understand it.

The arrangement of a text is therefore one of the key ways of affecting how an audience perceives its usefulness, its logic, and its relationship to other texts in the community. Gross arrangement—the order and hierarchy of the largest sections of text in your document—is probably the most obvious macrostructural technique for creating an effect in your reader.

Even the most regular generic documents typically have two or three ways they can be divided into sections and arranged. The résumé that a professional prepares when looking for a job, for instance, often features a section that relates to work experience and another that relates to education. When a mid-career professional prepares a résumé, the work experience section is usually placed in the front of the document, before sections discussing the professional's education, skills, or association memberships. Early career professionals, whose primary qualification for an entry level position is their education, tend to write résumés that have an education section high on the first page, before any discussion of their work experience. In these documents, an education section may even be followed immediately by a skills section, if no relevant work experience exists. A work experience section that describes a work history unrelated to the technical field of the early professional is often buried at the end of the document. While these résumés have relatively the same content, the sections have been arranged to foreground the more impressive aspect of the applicant. This is a macrostructural decision that corresponds to the documents' purpose, to represent the author as qualified. *Takeaway: Sectioning influences how a document is understood.*

Important ways of emphasizing certain arguments within a document include the grouping of arguments or sectioning of text to structurally advertise arguments, the position of arguments in key (often first or last) positions, and the amount of text associated with an argument. Both the rhetorical situation and the pragmatic situation should be considered when arranging argumentative sections of a document. A proposal that contains a long background section may suggest to the reader that the background described is important in understanding the problem. It may also suggest to the reader that the author is not aware of some generic convention in which a background section should be limited to a certain size. Professionals who write reports that contain a list of options for solving a problem often feature the option they intend to recommend in the last position of the list and sometimes provide extra details about that option. If an audience is looking for that list and the ensuing discussion to seem objective, favoring one option with a key position or with extra details early on may make the document seems suspect. On the other hand, if an audience is looking for an

expert recommendation and trusts the author, they may appreciate the early signaling of the recommendation that will follow.

Sectioning and Heading Sections

At a certain point, a document becomes too long to be easily intelligible or navigable without an expressed structural breakdown of the argumentative sections in the text. Sectioning a document gives the writer an opportunity to give chunks of text informative labels typically called headings. A reader can use headings to navigate a document, decide what to read or not read, or even get a general sense of the larger document's argumentative structure.

In some workplace environments, a professional might write five pages of paragraphed text before considering whether or not the document should be broken into named sections. In other work places, documents that are longer than two pages might unquestionably call for sectioning. In a workplace where a three-page internal proposal might not usually be sectioned, a three-page e-mail might be. Practices in your workplace, the complexity of your argument, the medium used to transmit a document, and a document's purpose or context may influence whether you decide to subsection a document or not. *Takeaway: Long documents require structural cues.*

When deciding if you should subsection your document, you might consider the following:

- Are there other documents in your workplace that are like your document? Are they sectioned?
- Is your document longer than your audience may expect, or is it longer than is typical for this document type?
- Is your document unusual for your workplace? Does it make an atypical argument or have an unconventional organization?
- Is the intended audience for your document likely to have a hard time following your argument? Are they likely to want to read only a particular part of your document?
- Does your document contain references internally to other parts of the document? Or are future documents likely to need to reference portions of your document?

Sectioning a document involves identifying argumentative units of similar scope or size that have some logical relationship. In research reports, for example, sections are often named using scientific argument terms that research communities tend to recognize, like "Method," "Analysis," and "Result." By using those headings, the author of the document is claiming that a conventional logic underlies his or her work. Other general heading sets (like "Scope," "Procedure," or "Approach") are common

in engineering writing, and individual workplaces have typical patterns that match the kinds of documents they prepare. *Takeaway: Sectioning logic may be conventional.*

Sometimes sections that declaredly begin or end a document (like "Introduction" and "Conclusion") have the specific function of relating the core portion of the document to the project or environment in which the document is meant to function. These *framing sections* usually preview or review content elsewhere in the report and connect that content to beliefs of practices in the community that would not otherwise appear in the report. Because of this, they might make arguments that would not be found elsewhere in the report, like justifying why the work being done is important or discussing the implications or future of work being done.

When a standard set of headings is not available or preferable, you may try to section your document based on the general argument you are making. If some sections seem longer or more complex than others, that's not necessarily a problem. If that complexity matches the complexity of your argument or that length occurs where you feel your reader needs more information or justification, it's probably a sign that the content of your document is appropriate for the situation. If those things are not in proportion, on the other hand, you might consider whether your text needs editing or whether a long or complex section needs to be subsectioned further. *Takeaway: Sectioning logic may depend on your specific argument.*

Sectioning is, in some ways, an all or nothing decision. Once a section heading appears in a document, most readers will assume that the remainder of the document is sectioned. In fact, publishing and typographical conventions don't typically afford any way to signal that paragraphs of text are meant to come between or after, rather than within, a section. Sectioning, then, is a way of portioning the complete contents of a document, and section headings are a kind of outline of the document's contents or argument. *Takeaway: Sectioning should be comprehensive.*

Relatively short documents that are sectioned sometimes begin with some introductory text that is outside of the section structure and that explains the purpose and organization of the document. When this is the case, this text usually appears on the first page of the document, between the document's title and its first section heading. (See example (1) below for an outline of headings in a short document that has introductory text.) In a long document, however, where a title page may be used and where sections may begin on new pages, text without a heading would likely be missed by the reader who is navigating the document using its headings or may confuse a reader who opens a bound document to its first page to see text with no heading specifying what that text is about. When documents are longer, introductory text usually appears in a framing section called something like "Introduction," "Background," or "Purpose."

Documents that warrant sectioning often warrant multiple levels of hierarchical sections. In a complex research report that is written to describe several experiments and where several sets of data are collected and analyzed, a single "Method" section may be too unwieldy to be navigable. The same logic applies to determine whether you should subsection as used to determine whether to section. Breaking down a

section further is sometimes more complicated than breaking a document down into initial sections. Use your sense of the argumentative structure of the section to create subsections and then consider how well they balance. *Takeaway: Many documents require levels of nested sections.*

A subsection is often preceded by introductory text that explains the purpose of that section or its role in the larger document and the content of that section. This introductory text helps orient readers to the internal organization of the section and provides an opportunity to present synthetic information that headings alone cannot. In example (2), the section headed "Potential Solution Models" includes introductory text before the first subsection heading.

(1) Shorter Report
(Introductory text)
Problem Characterization
Potential Solution Models
Findings

(2) Longer Report
Introduction
Problem Characterization
Potential Solution Models
…(Introductory text)
…Model 1
…Model 2
…Model 3
…Comparison of Models
Findings

Like sectioning, subsectioning once begun does not typically end. So there is usually no equivalent space for section-level text at the end of a subsectioned section to summarize the subsections that that section contained. When a conclusion is necessary to synthesize subsections, it is usually placed in a final subsection that is given a generic heading (like "Conclusion") or a heading that reflects the finding or key discussion point. In example (2), the section headed "Potential Solution Models" includes three obviously sibling subsections ("Model 1," "Model 2," and "Model 3") and one final framing subsection ("Comparison of Models"). *Takeaway: Different relational logics can govern sibling sections.*

Subsections more so than sections are sometimes created to distinguish between similar items rather than to advertise a logical progression. In a complex research report that has multiple methods, the "Methods" section might best be broken down into subsections containing each method with headings that name them accordingly. A "Potential Solutions" section of a report that gives recommendations may similarly have subsections for different options, presenting the recommended option among others that have been discarded even when the recommendation has been declared at the front of the report. Subsectioning, in this way, can create an air of objectivity or thoroughness or some other feeling that supports your general purpose for the document.

While subsection headings may be written to reflect the subject matter of subsections, they are just as often overtly reflective of the rhetorical purpose of subsections. Even when headings aren't overtly written to make claims, the structuring of

sections can reveal persuasive intent and help you make your argument more compelling. Below are four different arrangements of subsections that might come within a section on "Desalination Techniques." *Takeaway: Sections should be headed with purposive headings.*

(3)
Thermal Techniques
…Multi-Stage Flash Distillation
…Multi-Effect Distillation
…Vapor Compression Distillation
Membrane Techniques
Electrodialysis
Reverse Osmosis

(4)
Cost Prohibitive Techniques
…Thermal Technologies
…Electrodialysis
Potentially Cost Effective Techniques
…Vapor Compression Distillation
…Reverse Osmosis

(5)
Thermal Techniques
Electrodialysis
Reverse Osmosis

(6)
Thermal Techniques
Membrane Techniques
…Electrodialysis
…Reverse Osmosis

In example (3), "Desalination Techniques" is broken up into two subsections "Thermal Techniques and "Membrane Techniques," suggesting that the section is arranged by the physical or scientific basis of the technique. Example (4), on the other hand, uses a different system to categorize the techniques. Which organization you might choose would depend not only on the purpose of your report, but also on how conventional it is in your workplace to make assertions like those in example (4) in your document. In many business settings, these assertions would be welcome in headings as they indicate how the elements within that subsection should be viewed with respect to a project or decision at hand. Some technical workplaces, however, would value the idea that example (3) seems to impartially present headings without noting the impending analysis.

Examples 5 and 6 also rely on the physical or scientific nature of the technique to organize the section, but do so in a way that shows that the impartiality that might be associated with example (3) is less about the headings' content and more about how the terms are arranged relative to each other. Example (6) is suggesting that "Thermal Techniques" are similar enough to not warrant breaking out into subsections, while "Membrane Techniques" are more different from each other. Example (4) is suggesting that "Thermal Techniques" can not only be considered all at once, but that they are collectively of equivalent weight to a discussion of "Electrodialysis" or of "Reverse Osmosis." Of course, neither example (5) or (6) would be good choices for a document that, after the model suggested by example (4), intends to discuss Vapor Compression Distillation as at least a potential approach.

Lower level headings in procedural documentation often are used to declare the objectives of procedures or even as a set of high-level steps. This makes procedures easier to reference elsewhere in the document and is a tactic for preventing procedures from getting too deeply nested. A set of sibling headings like those in example (5)

could just as well have been the steps of a procedure. *Takeaway: Sectioning also enables the grouping of procedures.*

(7) Replacing the Retainer Fastener
…Opening the Control Shield
…Dismounting the Retainer Subunit
…Removing the Fastening Bracket
…Reinstalling the Fastening Bracket
…Mounting the Retainer Subunit
…Sealing the Control Shield

(8) Opening the Control Shield
1. Dry all exposed surfaces using…
2. Apply heat to remove the first…
   a. Set approved heat lamp to…
   b. When lamp has reached the…
   c. Allow to rest for 5 minutes…
   d. Peel away sealing film layer…
3. Undo the lip fasteners as shown…

Using headings this way enables the procedures within the section to be written using little hierarchical depth. The bulk of the procedures for "Opening the Control Shield," an excerpt of which is shown as example (8), would have occurred at a third level of indentation were the subsections in example (7) made the first level of procedure. The depth of procedural sectioning is a constant concern when producing complex procedural information in highly regulated industries or when producing procedures that will be electronically manipulated and delivered for use in the field.

Aids for Navigating and Understanding Document Structure

Headings are probably the most obvious navigational aids to complex documents. Most documents that are sectioned contain headings printed in a larger font, a darker or colored typeface, or surrounded by extra whitespace so that they can be easily be found and read by the reader who is scanning a page.

The usefulness of headings is, to some degree, based on the way headings are phrased and the expectation that a reader brings to a document. Generic, label-like headings (like the "Introduction," "Method," "Analysis," "Findings" of a research report) are useful when a reader already understands the genre of the document (and knows, therefore, what kind of information would be in the Analysis section versus the Findings section). *Takeaway: Headings can be generic or specific.*

In less regular documents, however, headings may have more of a role in informing readers of the content of the section they head. In this case, phrasal headings that indicate the information in (or argument made in) the section help the reader establish a sense of the document's larger organization and decide what to read. That said, even in a generic document where the reader knows the conventions of the genre, a heading like "Statistical interpretation of access control data" is just more informative than a heading like "Analysis" and most readers would welcome being told up front what they will find in a section. Whether a phrasal heading like this is appropriate, of course, is dependent on the conventions of the workplace.

In long documents, there may be dozens or hundreds of pages in between high level headings and a variety of conventions are used to help the reader navigate. Section numbers, page numbers, tables of contents, and indexes are ways of fixing locations within the text and allowing readers to used content-based lists to find information and navigate to those locations. *Takeaway: Some documents rely on numbering and navigation aids.*

A table of contents is an important resource for a large document. Readers accessing a table of contents for the first time are often looking to understand the underlying argument or content model of the text. They are trying to understand the logic behind how the document is broken up so that they can go on to make judgments and assumptions about where certain kinds of information should be located. Expert readers, especially, come to a table of contents with their own understanding of how the kind of information the document contains should be organized and very often form a first impression of the document by studying the way headings are ordered and nested and the vocabulary they use. While it's not uncommon for a long document to have section headings nested four or five levels deep, a table of contents often shows only the levels that seem to express the structure of information without becoming so finely detailed as to seem unusably long or complex. Specialized tables of contents are sometimes prepared for certain document features like figures, tables, or procedures.

An index, usually found at the end of a print document, is an alphabetical list of topics in that document and the page or pages on which that topic is be referenced. For a user searching for a specific word or phrase, an index will be more useful than a table of contents. This is especially the case if that topic is not a topic by which the document is organized but rather a topic that appears throughout the text. A software reference manual, for example, may explain a particular feature in one part of the text, but then may mention it again and again, providing operational details as its use context changes throughout the book. A well-designed, thoughtful index may tell the reader not only the pages throughout the document on which the feature appears but may also subcategorize page numbers to give some additional context for the feature's appearance.

Page numbers, of course, are useful in a print document for identifying where things are and for getting a sense of how long discussions, sections, or chapters are. Page numbers are often maintained in electronically distributed documents that use linked navigation with the idea in mind that someone may print the document to use it (or because, in some sectors, the tradition of page numbering is so strong that a document without numbers might violate community expectations).

In procedural documents, where sections of a document are often extracted from larger documents for use, it is not usual to number pages by the chapter rather than running numbers through the entire document. A 200-page maintenance manual numbered by section may have page numbers like 1-1, 1-2…1-28, 2-1, 2-2, etc. In this scheme, the first number represents the section number (or chapter or unit number, the name is immaterial) and the second number represents the page number within that section. One advantage of numbering this way is that readers looking

at page numbers as they flip through a print book always know which section they are in. And when figures and tables are numbered with this convention, readers can immediately tell the section to which they belong. Another advantage is that updates to published books can be sent out in sections. If several pages of important procedures are added to Section 2 of a 500-page manual, a new Section 2 (and perhaps a new table of contents) may be sent to clients. If print manuals are kept in binders, the client can discard the old Section 2 and insert the new Section 2 seamlessly. (Were page numbering run through the document rather than done by section, this would not be possible. The pages added to Section 2 would then affect the page numbers in all of the sections that followed and the whole book would have to be reprinted.) *Takeaway: Heading and page numbers may include chapter numbering.*

Page numbers enable not only navigation from a table of contents or index, but enable navigation between points within the text as well. Cross-references—phrases which indicate other parts of a document that a reader should read—rely on page numbers to direct readers. Large suites of documents that rely on extensive cross-referencing or rely on the citation of very specific portions of text (like policy documents, legal documents, or elaborate sets of networked procedures) often additionally featured numbered headings and even numbered paragraphs.

Because headings are a label for a section and because sections are nested, these numbers often rely on some punctuation-based convention (as section page numbering does). Numbered headings can be useful in deeply sectioned documents to give readers a sense of how deep they are. Users can compare section and paragraph numbers in a document, for example, to see that Subsection 5-2.3.1 and Subsection 5-2.3.4 are part of the same parent section or to see that Paragraph 3-6.2.4 and 3-6.2.6 have precisely one paragraph between them.

Creating Effects with Lexis and Syntax at the Micro Level

At the lowest level of a text—the level of words and sentences—the argumentative promises made in section headings are fulfilled. A section heading may advertise that a section contains data analysis but the data analysis is actually communicated in the choice of words (lexis) and the arrangement of those words into meaningful analytical expressions (syntax).

For some, writing at the micro level can seem more intimidating than organizing an argument at the macro level. The seemingly endless possible words and combinations can be especially confounding when operating from the point of view of a correctness model. This is because a correctness model largely doesn't tell you what you should write about or how you should write it, but rather warns against arrangements or words that are inappropriate.

Pragmatic and rhetorical approaches to writing at this level can help make writing more accessible. These approaches rely on the idea that the vocabulary actually used in workplace documents, though sophisticated, is actually quite limited and repetitive.

They also recognize that, although text is perhaps the most structurally complex at the micro level, the bulk of sentences are made up of the same dozen or so basic mechanical arrangements of clauses and phrases, and those patterns are largely related to local affects you are trying to achieve with text.

Writing at the micro level is about identifying the immediate purpose of a sentence as it relates to the sentences around it and establishing an argumentative momentum across a section or text. Your goal is to provide the reader structural and linguistic cues so they come away from your text with a sense that your propositions follow one to the next, that certain parts of the text are the important parts, and that you've diligently prepared your argument in an accessible and efficient form. Together, these effects combine to provide the argumentative "flow" that a reader senses as they read a document that moves along steadily and unambiguously from point to point. Use the following parameters to evaluate the accessibility of your argument:

- *Unity* is the feeling that units of text share a common topic. Technical arguments rely on detailing the features of something—a problem or a piece of equipment—and then relating that thing to a larger process or problem at hand. A reader must understand how units of text relate to the topic or topics current in the text. A portion of text that doesn't exhibit unity seems out of place to the reader and thereby cannot be integrated into the larger argument.
- *Coherence* is the feeling that units of text have logical relationships to each other. More than just bearing on the same subject, elements of an argument interact with each other in order to create a synthetic logic that supports a conclusion. A reader must be able to tell how argumentative elements relate to each other in order to appreciate the logic that underpins an argument.
- *Emphasis* is the feeling that some units of text are more important than others or that some units contain the primary thread of the argument while others do not. Technical arguments rely on a combination of assertions and details. While some text is meant to continue the argument, other text is meant to support that text or to offer mitigation. In order to follow and understand the nuance of an argument, a reader must be able to tell which text contains the primary articulation of the argument and which text is meant to accompany it. *Takeaway: These parameters enable access to your argument.*

This suite of effects is useful for assessing whether a reader can follow an argument, but it does not encourage a writer to consider how individual words or their arrangements may create emotional effects in a reader unrelated to the argumentative point made. To evaluate readers' personal connection to your text, consider the following parameters:

- *Clarity* is the feeling of confidence that an argument is being understood or that modifiers can be attributed without ambiguity. Texts in which complex

arguments are made rely on words that indicate argumentative transition. Sentences in which complex points are made rely on regular arrangements of words. Readers who recognize these words and patterns may be more confident that the meaning they assign to text is the one intended by the author.

- *Concision* is the feeling that precisely as much text as is needed is being used to make an argument. Technical arguments are often accessed by readers who are looking to quickly understand a conclusion. Additionally, voluminous detail (especially when not marked as such) can seem overwhelming to a reader who is struggling to follow an argument. And the volume of text and its readability are factors in whether an audience member has a favorable impression of the argument being made in the text and the author of the text.
- *Tone* is the mood created by the words you choose and their arrangement. While documents written by technical professionals vary considerably in purpose, they typically try to create the same several feelings in the reader, including authority, expertise, urgency, objectivity, and trustworthiness. Readers of any text respond emotionally to words and their arrangement, and a writer must anticipate the way a reader will feel and choose words and patterns accordingly. *Takeaway: These parameters enable emotional connection to your text.*

These effects combine to create the emotional and authoritative climate in which your argument is perceived. In this suite of effects, the followability of the argument is largely a sub-concern of clarity, while the mood created by the text and the brevity and density of text form the remainder of the set of considerations.

These lists of course are not mutually exclusive. They are two different ways of dividing up the same set of textual characteristics and impacts. You will want to use them in combination to make writing decisions. The following sections discuss how effects from both of these suites can be related to choice of words in a text and the arrangement of those words.

Lexical Technique: Word Choice, Technical Terms, and Hedges and Boosters

Word choice is one of the most obvious writing decisions made when producing a document. A more or less aggressive word, a more or less certain word, or a word that simply has the right or wrong quality can dramatically influence the way a reader feels about text. The idea that words have fixed definitions (a hallmark of correctness models) is not particularly useful when using words that an audience is likely to misperceive. The separation between *denotation* (the dictionary definition of a word) and *connotation* (the feelings and social implications that come with a word beyond its definition) is immaterial when the effectiveness of a document depends on a reader's perception. If a word affects your audience in a certain way, there is no use resisting it. *Takeaway: Word choice is a fundamental lexical consideration.*

Of course, anticipating how a word or phrase will make your audience feel is challenging. The rhetorical situation suggests that words should be chosen with your audience and purpose in mind. It helps, then, if you know your individual reader(s) well. When you don't, knowing how a type of audience is likely to perceive a word is the best substitute. The pragmatic situation, in that regard, suggests that certain words are typically used in your writing environment in certain regular ways and that those words are the safest—that they will probably affect your audience in predictable ways.

Members of technical and professional communities have their own *lexis*, their own subset of terms from the natural language community in which they are situated that they feel are more or less appropriate. Included in a community's lexis are also *technical terms*, specialized words and phrases not used in the natural language community that are used to achieve specific meanings.

The bulk of the words in a technical discussion in English, for example, come from typical conversational English. Even though they might not seem specifically chosen, the number of these typical words is often quite limited. Alternative words that would be just as suitable in a casual conversation are often excluded or considered less appropriate. When discussing published research findings, for example, researchers in a particular R&D division might regularly use the word "stated" instead of "said" in their reports. The word "said," which in conversational English might be a suitable synonym for "stated," may begin to sound out of place. When professionals suggest that terms sound professional or unprofessional, but have only a vague sense of why, they are responding to this phenomenon. *Takeaway: Typical words can be used in technical ways.*

In addition to a subset of conversational words, technical discussions hinge on particular vocabulary and on specialized technical phrases. Technical terms, when used correctly, allow professionals with specialized technical knowledge to communicate about complex concepts in a shorthanded way. Some technical terms are specialized words that only professionals in a certain field or company use (and that aren't used in the conversational language at all). Others are specialized redefinitions of common words. A chemical engineer, for example, may have a more specific definition of the word "turbulent," for example, than the typical airline passenger. *Takeaway: Other technical words are unique to a community.*

It's notable that, a word like "significant" (as used in: "may contribute significantly to" or "is not significantly different than") likely means something specific to a specialist whose profession involves statistical approaches or design calculations based on fine measurements. At the same time that professional, as a human being, is also equally capable of using the more mundane version of that word (meaning simply "a lot" or "a non-trivial amount") in casual conversation, especially when away from the workplace. The context and presentation of technical terms that have counterpart meanings in conversational language is important when preparing a workplace document for an audience that might not share your technical expertise. As such, technical terms are sometimes defined early in a document or written with

special typographical conventions (like bold or italic font), and some documents even set aside sections for lists of terms used.

In addition to allowing a writer to communicate in a rich and shorthand way with other technical professionals, technical terms are part of the performance that a writer gives for an audience to show that he or she has expertise or belongs to a community. Correctly using technical terms when communicating with another specialist is a way of signaling your intellectual kinship and trustworthiness. The use of specialized technical terms in front of non-specialists is a way of signaling to them that you have an expertise that they don't.

Of course, it's easy to go too far. If you make your writing unintelligible to your reader or use technical terms unnecessarily, you may simply confuse your reader or make them think you're showing off. The non-specialist who encounters a technical term may not appreciate subtleties of its meaning and likely does not know if the term brings extra or more precise meaning than an alternative term they might know. In technical consulting service environments, non-specialist clients often bring in their most specialization-literate staff member to read proposals or listen to sales pitches and evaluate their propriety for decision-makers.

The technical and conversational connotations of the terms exist within a spectrum of things you might consider when choosing words. In many cases, choosing a noun is less an act of identifying something than it is of naming that thing, asserting that it is in a certain category or of a certain type. Consider the following set of example sentences. *Takeaway: Choosing nouns involves making assertions about things.*

(a) Outlet B-17 may be emitting *the solvent*.

(b) Outlet B-17 may be emitting *the toxin.*

(c) Outlet B-17 may be emitting *the pollutant.*

(d) Outlet B-17 may be emitting *the compound.*

(e) Outlet B-17 may be emitting *the substance.*

The nouns which end these sentences have been chosen to illustrate how category terms implicate certain ways of classifying or identifying things. The term "solvent" in sentence (a) classifies the substance released (into a stream or into the air, presumably) in terms of its industrial use. The term "toxin" in sentence (b) refers to the substance's effect on living things, and the term "pollutant" in sentence (c) refers to the substance's place in the environment. These three words may each be referring to the same thing, but they have different implications and probably cause different levels of alarm. On the other hand, using a technical term like "compound" in sentence (d) is an easy way to make your writing seem clinical, even when you're talking about something dangerous. The term "substance" in sentence (e) is probably the most noncommittal term, suggesting little more than that the solvent is composed of matter.

None of these terms, of course, are necessarily inaccurate. The substance emitted may indeed be a solvent, a toxin, and a pollutant. In an internal corporate document, a term like "solvent" may be more informative than a term like "toxin" if the audience is familiar with the factory processes but not with the health implications of the substances used in it. (An audience that is unaware that the solvent is toxic may not even recognize that these words refer to the same thing.)

Phrasal modification may be used when more than one choice of noun is desirable because you suspect an audience may need extra categorical information or because you have a diverse audience. Sentence (f), for example, has a secondary purpose of reminding a corporate audience member reading the report that the solvent is toxic. Sentence (g) may be useful for an outside reader or a corporate reader unfamiliar with the exact plant processes who might wonder why the plant was handling the substance at all.

(f) Outlet B-17 may be emitting *the solvent, which is a toxin*.

(g) Outlet B-17 may be emitting *the toxin, a solvent used in the dying process*.

It's notable that the term "Outlet B-17" (the noun that doesn't change in this set of examples) is a proper noun, a name. Names also have implications (consider the difference between the word "outlet" and the word "waste pipe"), but those implications, as they are fixed in the name of the thing, are much less likely to have immediate impact in the document when the name preexists the argument. (Though, when an issue is contentious, names often become a rich linguistic battleground. Citizens affected by a solvent leak are unlikely to use the name "Outlet B-17" for long if they feel their concerns are not being addressed. Instead, they will use the term "waste pipe.")

Nouns, of course, are not the only word in the sentence which can be varied. In technical documents, verbs are often carefully chosen to match specific community-associated meanings. Linguists like Ken Hyland and others have written extensively about the use of verbs in environments like research publications and how professionals with different disciplinary backgrounds tend to select words that have meanings specific to those disciplines. When arguing about work, about what is known, and about what is evidenced by data, some of these professionals regularly use a word like "imply" where others use the word "suggest." (And, it's not just habit; those professionals would be uncomfortable using the other word or would find it inappropriate.) *Takeaway: Verb use tends to vary by community.*

Verbs can also imply judgment and indicate community membership. Consider, for instance, the sample sentences below.

(h) At the height of flooding, the outlet *emitted* 500 gallons of pollutant.

(i) At the height of flooding, the outlet *leaked* 500 gallons of pollutant.

(j) At the height of flooding, the outlet *spilled* 500 gallons of pollutant.

(k) At the height of flooding, the outlet *gushed* 500 gallons of pollutant.

Without a community context to study, it's hard to tell whether the verb "emitted" is a standard industry or workplace term. The verb "leaked" in sentence (i) may be just as acceptable in some workplaces. Often if terms like "leaked" are considered unprofessional, there is some rationale as to why, like an educationally acquired disciplinary preference or a shared sense that the term is imprecise. It's not a coincidence, however, if words associated with liability (or commonly used by the public or news media to discuss blame) are avoided in corporate settings. Sentence (j)'s verb "spilled" is another of these words, although media savvy companies have more and more begun using these words as alternative to traditional public relations cover words like "released." Regardless of the workplace, it's unlikely that sentence (j)'s verb "gushed," which draws attention to the high volume of pollutant emitted would be a choice sanctioned by professional community members.

The verbs in sentences (h)–(k) could be considered to exist along dimensional spectra, having various implications in terms of volume of pollutant released and fault of the company involved. (For example, for some audience, "leaked" could be thought of as implying low volume and moderate fault, where "spilled," for that audience, might imply a higher volume but lower fault.) It's not unusual to find that the meaning you'd like to express doesn't match the likely interpretation of any available verbs, especially after some verbs have been pragmatically screened out as inappropriate. Modifiers play a significant role in supplementing or clarifying the domain of a verb. Consider the following sentences. *Takeaway: There may be no verb that expresses your precise meaning.*

(l) Outlet B-17 conforms with regulatory requirements.

(m) Outlet B-17 *fully* conforms with regulatory requirements.

(n) Outlet B-17 *largely* conforms with regulatory requirements.

(o) Outlet B-17 *barely* conforms with regulatory requirements.

Sentence (l) contains no adverb modifier. As such, it represents the act of conforming as black or white, yes or no. The introduction of adverbs to sentences (m)–(o), however, challenges this conception, introducing the idea that there are degrees of conformation. Adverbs like these are sometimes called hedges and boosters. *Hedges* diminish the effect of a word or clause with respect to some dimension. *Boosters*, on the other hand, magnify the effect of a word or clause. The words "fully" in sentence (m) and "largely" in sentence (n) clarify the degrees to which the outlet meets requirements. As "fully" suggests the highest possible degree of conformation, it's a booster. The word "largely," somewhat ironically, is a hedge—though the word indicates that the outlet conforms to a large degree, the implication is that the outlet, in some ways, does not conform. The word "barely" in sentence (o) is also a hedge, but this time one that indicates that the outlet does conform but in a minimal way. (It's notable that nouns can be modified using the adjective form of hedging and boosting words too. Think of the difference between phrases like "cost," "reasonable cost," and

"considerable cost.") *Takeaway: Hedges and boosters are modifiers that diminish and amplify.*

Hedging words		Boosting words		Attitude words
about	possibly	actually	in fact	appropriately
almost	seemingly	always	never	disappointing
essentially	suspected	Certainly	obviously	interestingly
largely	uncertain	clearly	undoubtedly	preferably
mostly	unclear	definitely	well-known	understandably

In addition to adverb modifiers, a special class of hedging and boosting auxiliary verbs called *modals* help to create the specific conditions under which a verb exists or functions. English modals include words like can, could, may, might, shall, should, will, would, and must (as well as phrases like needs to, has to, and ought to). Consider the following sentences.

(p) Outlet B-17 *should* be brought up to code.

(q) Outlet B-17 *must* be brought up to code.

(r) Outlet B-17 *could* be brought up to code.

(s) Outlet B-17 *will* be brought up to code.

The word "should" in sentence (p) implies a value or social obligation is at issue, that the outlet ought to be improved. It allows for the fact, however, that it not be. The word "must" in sentence (q) implies a need, perhaps urgent or irresistible, a requirement more than a responsibility. The word "could" in sentence (r) implies that it is possible to bring the outlet up to code, without saying if it should be done or will be done. (Used in this model, the modals "may" and "might" would also express probability. In a different sentence context though, they are useful for expressing permission, as in this example: "Our license says that we *may* operate without upgrading the outlet.") Statement (s), which uses the word "will," is the only statement that promises action. Because of the specificity with which they modify the domain of the verb, modal words are often subject to regional usages and legal definitions. Policy statements and specifications sometimes begin with in-document definitions of word sets like "shall/should/may" in order to indicate which elements of a rule are required and which are simply desirable.

In most technical workplace communications, hedging is especially important to establishing the right quality or quantity associated with a noun, verb, or larger textual unit. Especially in research and development environments, careful discussions of data tend to be filled with words that restrain the applicability or certainty of a conclusion. A pragmatic approach to choosing the words you should use to hedge and choosing how often and what to hedge would be to look at the documents in the environment in which you are writing and see which hedges they use and where

they tend to use them. *Takeaway: Hedging is important when limiting certainty or probability.*

As you look at texts, you may notice that it's not only nouns and verbs but whole expressions that need to be parameterized by the hedges. Consider the following example.

(t) I believe that Outlet B-17 is emitting the pollutant.

The words "I believe" in sentence (t) don't just provide a way of interpreting the verb; they provide a way of interpreting under what conditions the whole clause ("Outlet B-17…pollutant.") is to be read, and they act as a significant structural component of the sentence. This hedge operates at a higher syntactic level than those discussed previously. It relies on the structure of the sentence to convey modification rather than modifying the immediately adjacent word.

And, because there are multiple constituents in the remaining clause that could be "believed," this sentence has an ambiguity problem. In other words, it is unclear whether this sentence is suggesting that the author believes that it is Outlet B-17 (and not another outlet), or believes that it is emitting (rather than not emitting), or believes that it is emitting the pollutant (as opposed to emitting some other discharge). This ambiguity, though, is attributable to the arrangement of the clauses and modifiers in the sentence more than the words chosen.

Syntactic Technique: Modification, Clausal Arrangement, and Discursive Cueing

Nouns and verbs, while perhaps the key components of written expressions, are only a fraction of the words in a text. Choosing them carefully and supplementing them with single-word modifiers (also chosen carefully) are necessary but not sufficient for creating a readable text, a followable argument, and an appropriate tone. To make complex arguments, words have to be combined into larger units and those units must be, in turn, made to modify each other.

The sentence—a clause-based expression that seems to stand independently—is the basic unit of expression in texts. So an awareness of basic sentence mechanics is necessary in order to make active decisions about writing at the sentence level. The good news is that sentences in English function in a mechanical and predictable way. Once you know a few elementary building blocks and some requirements for how they can be assembled, you can write long and complex sentences and recognize patterns in the sentences you read.

Modification and Simple Sentences Sentences are probably the lowest unit of text evaluated in terms of completeness. In fact, a sentence is often defined as a unit of text that "expresses a complete thought." This philosophical definition of a sentence, though, is a little hard to use to evaluate sentences in real writing. The

meaning of one sentence oftentimes depends quite directly on the meaning of those around it. And, honestly, the completeness of a thought is not what most readers are looking for when they read a sentence.

There are certain mechanical features that make an English sentence recognizable, however.

- Sentences have a verb, a word that refers to some kind of action or state of existence. This is probably the one observation that is indispensable, even in the briefest sentence.

  (1) *Run*!

- The verb in a sentence is associated with some noun, a concrete or abstract thing that is doing the action or being described by the state of existence.

  (2) The *earthquake* occurred at 19:03.

- Depending on the verb, the sentence may require an additional noun to be considered complete. Some verbs, for instance, connect an actor and something being acted upon.

  (3) The analyst measured the *fractures*.

- Some can also connect to a recipient of the action.

  (4) The analyst sent his manager the *data*.

Each of these examples is recognizable as a sentence because each seems to be able to exist independently. The feeling that a reader gets that a sentence is complete is based on the presence of a verb and the appropriate terms that that verb requires and on the reader's recognition of that verb and the pattern deployed. In this way, the completeness of a sentence is less about the completeness of a thought than it is about the satisfaction of a reader's mechanical expectations. *Takeaway: A verb may require 0–3 nouns to seem complete.*

Luckily, these expectations are relatively regular and there are a limited number of patterns that readers recognize. The observations above about verbs and the nouns associated with them form the core of the pattern, and the word we used to describe a meaningful unit of text that contains at least a verb and its requisite nouns is a *clause*. (Sentences (1–4) are said to be *simple* sentences because each is composed of just one clause.)

Clauses can be thought of as having two parts: a subject and a predicate. The *subject* portion of the clause is defined the primary noun that the verb requires and contains any modifiers associated with that subject noun. The *predicate* portion of the clause is the remainder; it is defined by the verb and other objects and modifiers associated with that verb.

In English, the subject noun typically precedes the verb, (though technical writing often relies on passive voice, a sentence construction pattern that violates this expectation). In sentence (4), the subject is "the analyst." That is because it is the "analyst" that is doing the action that the verb ("sent") suggests.

The subject portion of the clause that makes up sentence (4) contains only one modifier: the word "the." A *modifier* is a word or group of words that add information or restrict the meaning of a noun or verb. There are different kinds of modifiers, each of which has its own typical modifying position and regular internal structure.

In sentence (4), the word "the" is a kind of single-word modifier sometimes called an article. Articles help to establish specificity by allowing the reader to determine if, in this case, a specific analyst is being referred to or whether one among a population is being discussed (consider sentence (4) again with the subject "An analyst"). The subject of sentence (4) could, of course, support other modifiers. *Takeaway: There are different kinds of modifiers.*

(4) The analyst sent his manager the *data*.

(4a) The *certified* analyst sent his manager the data.

(4b) The analyst *from GTech Consulting* sent his manager the data.

In these examples, the noun "analyst" is being modified by an adjective (4a) and by a prepositional phrase (4b). In English, single-word modifiers like adjectives and articles typically precede the noun they modify, where phrasal modifiers tend to follow it. *Phrases* are groups of words that function together to express complex or relative concepts but, unlike clauses, do not have a subject/verb structure.

There are several types of modifying phrases in English, each with a prescribed structure that makes them recognizable. A *prepositional phrase*, the type of phrase found in sentence (4b), begins with a preposition (in this case "from") and ends with the noun that is that preposition's object. Prepositions are a select set of words that declare the relationship between the noun being modified and the noun modifying it. Because they are associating two things, many prepositions are spatial (e.g., above, beyond, in) or indicate possession or origin (e.g., of, from, by). Other types of modifying phrases include appositive phrases (that contains a synonymous noun as in "The analyst, *a former research scientist*,") and participle phrases (that use the –ing form of a verb to create a modifying form as in "The analyst *standing the closest* was shocked.").

The verb and the other nouns in sentence (4) can also acquire modifiers. The nouns in a sentence that are not the subject nouns are typically called *object nouns*, whether they are contained in modifiers like prepositional phrases or associated with the verb in the predicate. Object nouns and subject nouns do not always receive the same weight in an expression and don't take the same pronoun form (e.g., the subject pronoun "he" and the object pronoun "him"). Consider the following revisions to the predicate of sentence (4).

(4) The analyst *sent* his manager the data.

(4c) The analyst *immediately* sent his manager the data.

(4d) The analyst sent his manager *from the corporate office* the data.

(4e) The analyst sent his manager the data *about the fracture*.

In that the remainder of the predicate could be thought of as a modifier of the verb, the single word modifiers associated with verbs often look a little different than those associated with nouns. Phrasal modifiers like prepositional phrases, however, can modify either nouns or verbs. Sentence (4c) contains the adverb "immediately." The modifying prepositional phrases in (4d) and (4e) are associated with the nouns which precede them. But where the modifying phrase in (4e) occurs at the end of the sentence, the modifying phrase in (4d) comes amidst the nouns associated with the verb, creating the potential for an alternate understanding of the sentence as a reader reads word by word.

Connectivity and Ambiguity Modification relies on the placement of words and phrases in nearby and recognizable positions, creating an implied relationship. As has been noted, adjective modifiers typically occur immediately before the noun they modify, while phrases typically occur after. Some phrasal modifiers, like participles, can be separated from the noun they modify. When a sentence contains several nouns and several modifiers, however, modifier positions begin to encroach on each other or overlap and relationships can be ambiguous. This is especially true when the structure of the sentence is complex or when a reader comes to the text with a problematic understanding of the subject at hand. Keeping modifiers adjacent to the nouns they modify makes a correct reading more likely. When a noun already has a modifier before and after it, it should not be modified further. If you have three or four modifiers for a noun, you might consider using multiple sentences or clauses to achieve your purpose. *Takeaway: When possible, modifiers should be adjacent to their objects.*

A more temporary kind of ambiguity occurs when a verb's object nouns are adjacent and modified. The reader of sentence (4) who is reading left to right does not yet know that there is another object ("the data") in the sentence as he or she reads. This provides a temporary opportunity to misread the sentence. Consider sentences (4) and (4d) in their truncated form:

(4) The analyst sent his manager the data.
The analyst sent his manager…

(4d) The analyst sent his manager from the corporate office the data.
The analyst sent his manager from the corporate office…

As the sentence reads left to right, it is possible to understand it as complete before reaching the end and, thus, it's possible to form an alternative idea of what happened. As we know from the whole sentence, however, the analyst did not send his manager, he sent the data. This misreading is alleviated by the reader's encounter with the next object "the data." The difference between sentences (4) and (4d) is not that one may be misread and the other may not; the difference is that in sentence (4) this potential problem is alleviated right away, while in sentence (4d) it is prolonged. While reading sentence (4d), the reader is suspended in the possibly misread

state while additional modification ("from the corporate office") is being added to the reader's understanding. *Takeaway: Readers' ambiguity may clear up as they read.*

Nouns that are the objects of a verb are modifiers of that verb and can be communicated via a prepositional phrase just as well as by position. Using a prepositional phrase to communicate one of the verb's objects, in this case "the manager," allows us to restructure sentences (4) and (4d) as follows:

(4) The analyst sent his manager the data.

(4f) The analyst sent the data *to his manager*.

(4d) The analyst sent his manager from the corporate office the data.

(4g) The analyst sent the data *to his manager* from the corporate office.

The structure of sentence (4g) avoids the extended possibility of misinterpretation that was a feature of sentence (4d) but creates a new ambiguity problem. The final prepositional phrase in sentence (4g) can be read two different ways: as associated with the immediately previous noun ("manager") or as associated with the verb ("sent"). In other words, the analyst could be sending the data from the corporate office, or the manager could be from the corporate office.

Forced to choose between sentence (4d) and (4g), you might choose prolonged potential misinterpretation over the modifier ambiguity. The real problem here is that we have tried to layer too much information into too simple a sentence pattern. The simple sentence can only support so many connections before relationships between elements become ambiguous. To clarify the ambiguity in sentence (4g), we could write it as two sentences. *Takeaway: Simple sentences can only handle so much information.*

(4g) The analyst sent the data to his manager from the corporate office.

(4h) The analyst sent the data to his manager.
The analyst sent the data from the corporate office.

or

(4i) The analyst sent the data to his manager.
His manager was from the corporate office.

Alternatively, we could use a more complex sentence form, one that allows multiple clauses.

Clausal Relationships and Complex Sentence Patterns The simple sentence is a stable and recognizable vehicle for the expression of simple concepts, but it doesn't allow for much complexity. More sophisticated sentence patterns, however, can communicate specific relationships by combining multiple clauses in ways that advertise their relationship to each other.

The simplest way of combining clauses is by compounding. A *compound* is the arrangement of two or more similar grammatical elements often with a marker of their logical relationship. Compounds create concise expressions where the repetitive portions of clauses can be omitted. And they are rhetorically important because they produce a synthetic expression that often communicates more than just the sum of its parts.

Compound sentences are formed by conjoining independent clauses with a coordinating conjunction, a word that expresses a logical relationship between the two clauses without prioritizing one over the other. *Takeaway: In compound sentences, clauses are of equal weight.*

(5) Girder flanges throughout the structure were buckling, and several columns had noticeable fractures.

(6) The emergency response crew marked the buckling flanges with florescent paint, but they did not install column stabilizers.

Sentence (5) is made up of two independent clauses that have been conjoined with the coordinating conjunction "and." This sentence pattern implies that the two clauses should be understood together, as corroborating pieces of evidence, perhaps, or as similar items in a list. The conjunction "but" in sentence (6) communicates a tension between the two clauses that make up that sentence. It indicates that the second statement should be understood as being in contrast to the first. In this case, it could imply that the severity or danger that the first clause suggests ("buckling flanges") is limited ("did not install stabilizers"). Of course, removed from its context, the meaning of the statement is hard to appreciate. In the context of a larger discussion about the urgency of the response crew or about the appropriateness of the crew's work, sentence (5) might suggest that the crew did not complete its work because of time pressure or that it was negligent for not taking the further step of installing stabilizers.

Conjunctions like those in sentences (5) and (6) are the key element in establishing relational information and making one sentence out of two otherwise independent clauses, thereby implying a close relationship. But conjunctions can be used to compound elements within a clause also—to join multiple subjects to a single verb predicate (as in (7a)) or multiple predicates to a single subject, as in (7b). They can also be used in phrases to join noun elements in phrases or even prepositional connectors, as in (7c). *Takeaway: Use conjunctions to compound clauses into a sentence.*

(7) The flanges were cracked outside the heat affected zone.

(7a) The *girder flanges and column flanges* were cracked outside the heat affected zone.

(7b) The flanges *were cracked* outside the heat affected zone *and exhibited* buckling in several instances.

(7c) The flanges were cracked *inside and outside* the heat affected zone.

While none of these sentences use conjunctions to relate independent clauses, they contain compound phrasal elements which allow for significant structural variation and information hierarchy.

When groups of phrasal elements can be compounded into lists, the syntactic parallelism of list items is an important aid to readers. *Parallelism* is the repetition of a grammatical structure in a way that signals to a reader that elements are comparable or belong to a group. Repeating slightly more of the grammatical structure of list elements than necessary can help a reader navigate, especially if a list is long or complex. The examples in the table below illustrate four different repetition patterns that might be used to make lists from a similar sentence.

(8)	The visible evidence of damage was significant enough for the supervisor to	
(8a)	schedule inspections by a	professional engineer, seismic damage analyst, (and) certified safety official.
(8b)	schedule inspections	by a professional engineer, a seismic damage analyst, (and) an authorized safety official.
(8c)	schedule inspections	by a professional engineer, by a seismic damage analyst, (and) by an authorized safety official.
(8d)	schedule	an inspection by a professional engineer, an inspection by a seismic damage analyst, (and) a visit from an authorized safety official.

In example (8a), the list is made by conjoining noun objects of the preposition phrase that begins with "by." In example (8b), the article modifier is repeated with each list item as well. In this example, the word certified has been changed to authorized necessitating the repetition (since the word authorized calls for the article "an" rather than "a"). In example (8c), the list is formed by repeating the entire prepositional phrase. The repetition of the preposition makes example (8c) arguably more emphatic than example (8b). In example (8d), the verb's object noun and modifying phrase are repeated to make the list. This enables the writer to choose different object nouns for variety (or out of necessity if the word "inspection" isn't appropriate for each case) or possibly to repeat the same object noun for emphasis.

Not all syntactic units have to be joined as equivalents. Whereas compound sentences have two or more clauses of equal weight, *complex sentences* have a main (independent) clause modified by a dependent clause. This uneven emphasis is achieved by the use of subordinating conjunctions, words that express how the clause that follows can be understood relative to the main clause. Consider these examples. *Takeaway: In complex sentences, the clauses are not equivalent.*

(9) *Though* the column was damaged, it maintained its structural integrity.

(10) Emergency response workers had damaged the plaster with their equipment *before* the analyst arrived at the site.

In sentence (9), the main clause is the latter one "it maintained its structural integrity." The earlier clause in the sentence has been made dependent on the later one by the addition of the subordinating conjunction "though." In this sentence, the latter half is the primary message while the earlier half provides detail or mitigation. In a discussion of structural integrity or a recount of failures within the building, the damage described in this sentence would not be a distraction from the main argument. In sentence (10), the first clause is the main one and the second clause provides a detail about when the damage occurred.

Subordinating conjunctions enable whole clauses to be set in unequal relationship to each other just as coordinating conjunctions enable whole clauses to be set in equal relationship to each other. Subordinate clauses become modifiers of the dominant clause they are associated with. And can function to limit the clause or to clarify its domain. *Takeaway: Subordinating conjunctions make one clause dependent on another.*

The ambiguity in example (4g) revolves around one of the objects of that sentence's main clause: the manager. This ambiguity can't be efficiently resolved by the use of a compounding, because the subject of this subordinate clause is already an object in the main clause. And a trial of subordinating conjunctions, like the "though" in (4j), seem to create an implication that's not necessarily intended. Sentence (4k), however, uses a relative connector that attaches a clausal modifier directly to the object component of the main clause in question.

(4g) The analyst sent the data to his manager *from* the corporate office.

(4j) The analyst sent the data to his manager, *though* his manager was from the corporate office.

(4k) The analyst sent the data to his manager, *who* was from the corporate office.

The subordinate clause in sentence (4k) is usually referred to as a *relative clause*and modifies a component of the main clause rather than the main clause at large. Relative clauses are signaled by their subject nouns like who, what, when, where, why, that, and which (though these nouns they are omitted from the sentence). Sentence (4l), for example, contains two relative clauses. The new one, the one that modifies "data" omits the subject

(4l) The analyst sent the data *(that was) needed for the analysis* to his manager, who was from the corporate office.

Using these three clausal patterns and phrasal modification, it is possible to construct elaborate and intricately structured sentences. Sentence (11) is a *compound-complex sentence*, so called because it makes use of both clausal patterns.

(11) While emergency repairs were underway in the basement, the analyst was photographing the fractures and the recovery team was packing equipment.

(12) Though there was still work to be done, all of the crews had left for other locations when the aftershock occurred and the building collapsed.

In sentence (11), the main clause is the one that is compounded. The subordinate clause, then, modifies the compound main clause. In other words, the clause "While…basement" applies to both of the clauses "the analyst…fractures" and "the recovery team…equipment." Sentence (12) begins with a subordinate clause and ends with a relative clause that is compound—making use of all three clausal patterns.

It's notable that any of the four clauses in sentence (12) could be written as the main clause (though networking all four may be difficult in other orientations). In the context of a larger unit of text, the meaning of a preceding sentence and following sentences are effected by their relationship with this sentence. Besides logically connecting information to create informative or argumentative points, the emphasis and mood of text can be significantly affected by manipulating which clause is dominant and what the expressed relationship between the clauses is.

Using Clause Patterns to Create Emphasis When clauses are combined in different ways, they create different patterns of emphasis. Readers are likely to view clauses combined by coordination as associative (in the same way numbers added are associative). In part, this is for lexical reasons—a word like "and" does not seem to indicate priority in simple compounds like "toluene and benzene." It is likely due to the fact that the clauses in a coordinated system retain the features that make them structurally independent. Two independent clauses jointed by "and" or "but" apparently could be broken into two sentences.

When one clause is subordinated to another, however, this is not the case. The addition of the subordinating conjunction makes the subordinate clause dependent on the dominant one, and so a reader is likely to assign meaning to a subordinate clause with respect to the meaning of the dominant clause. And, of course, most subordinating conjunctions—despite, although, while, unlike, because, as if—indicate this relationship. Consider complex sentence (13). *Takeaway: Clause patterns can be used to direct emphasis.*

(13) Though there have been no problems with compression during trials, new piston rings should be installed before deploying the rover.

The first clause in this sentence is subordinated to the second one. Reading this sentence among others, a reader will likely see the second clause as delivering the argumentative information relevant at that point of the document and see the first clause as providing information relevant to understanding the second clause. There is a complex relationship between these two clauses and their mechanical association implies a number of things.

First, it implies that "problems with compression" are in some way related to "piston rings." This implication functions on the identity of the nouns in the two

clauses and relies on a reader's assumption that the clausal nouns should have some unifying relationship in order for them to be in the same sentence. (Imagine if the sentence had ended with a suggestion to clean the windows of the vehicle rather than replace the rings. The implication would be nonsensical.) The more rudimentary form of a complex sentence like this one (without an implication like this one) could be written like sentence (14), which has a similar structure to sentence (13) but makes a more literal connection. *Takeaway: Clause patterns can be used to imply connections.*

(14) Though there has been no wear to piston rings during trials, new piston rings should be installed before deploying the rover.

The second implication in sentence (13) is that there is an appropriate threshold at which maintenance should be performed or parts should be replaced. And that the ring replacement is not obviously past that threshold where the action advocated by the sentence seems warranted. By prefacing the dominant clause with the subordinate one, the author is suggesting what that threshold would be: a compression problem. In sentence (13) the threshold (evident "wear") is perhaps more obvious. The subordinating term "though" is essential in communicating this particular pattern. Either sentence (13) or (14) written with the word "because" instead of the word "though" would suggest something quite different.

The third implication in these sentences is less obvious when the sentences are abstracted from their context, as they are here. Sentence (13) is mechanically arranged to suggest a course of action and uses a subordinate clause to justify or support that action. Consider sentence (15), which is a rewrite of sentence (13), in which the emphasis is shifted to the other clause.

(13) Though there have been no problems with compression during trials, new piston rings should be installed before deploying the rover.

(15) Though new piston rings should be installed before deploying the rover, there have been no problems with compression during trials.

While suggesting the same action, sentence (15) is mechanically arranged to report about the likelihood of compression problems as the primary point of the sentence. In a sense, these sentence patterns favor different rhetorical purposes and might be more effective in different contexts. Sentence (13) might appear in a paragraph or section discussing maintenance actions to be taken before deployment. Sentence (15), on the other hand, might appear in a discussion of the deployment of the vehicle that emphasizes its durability and that is meant to reassure a reader that any maintenance suggested is routine or that the vehicle is unlikely to fail even if the maintenance is not done ("should be" rather than "must be").

This last implication—that one clause is the one of issue and that another is included for support or context—is particularly important in considering larger

textual structures like paragraphs or when considering how a reader might move through a series of sentences and identify a coherent argument. At the sentence level, however, clausal syntax patterns, like hedging and boosting lexical markers, are a way of communicating precisely the right amount of doubt or certainty, praise or blame, commitment or ambivalence. By pairing clauses that oppose each other on some shared dimension, a tension can be created that can be balanced for subtle effect.

(16) Although it must be diluted, silage can be disposed of by land spreading.

(17) Although silage can be disposed of by land spreading, it must be diluted.

Assuming "diluted" has a negative implication (because of the potential cost or use of resources), "diluted" in sentences (16) and (17) is set against "disposed of," a positive thing or potential goal. While these sentences, then, acknowledge the same possibility, sentence (16) is arranged to support of a "land spreading" approach and sentence (17) is arranged against it. Recognizing emphasis patterns in sentences (16) and (17), however, is not as simple as determining which cause is dominant. A number of other factors may influence the way these sentences are read, including the order of clauses and the distribution of nouns and pronouns into the clauses.

The order of clauses matters because reading is, in part, a linear activity. A reader reading deliberately (as opposed to skimming or scanning) encounters and considers clauses largely in the order they appear on the page and develops an understanding of argument as they move through sentences that come one after another. In this system, the latter term in a sentence is more likely to correspond to the direction in which an argument is developing. (Similarly, in a narrative, things which happen chronologically later tend to come later in text). In the absence of a cue to the contrary, a reader is likely to privilege the last thing they read, thinking of it as slightly more emphasized than earlier things. Consider the following examples of coordination. *Takeaway: The order of clauses matters in terms of emphasis.*

(18) Silage can be disposed of by land spreading, but it must be diluted.

(19) It must be diluted, but silage can be disposed of by land spreading.

Though sentences (18) and (19) are compound sentences, they seem to have slightly different implications—the latter clause seems to be the more salient one. For example, a reader encountering sentence (18) at the beginning of a paragraph may continue on expecting the paragraph to be about dilution (how it can be done, what it might cost, why it is a problem, etc.), whereas a reader similarly encountering sentence (19) may expect the remainder of the paragraph to be about land spreading.

A compound or complex sentence cannot be written without this observation about arrangement (or others like it) coming into play. Some order of words in a sentence is, after all, inescapable. An assessment of what happens as these patterns

interact is required to appreciate the effects of syntax. Consider the complex sentence (16) again along with sentence (20) rewritten with the order of the clauses reversed.

(16) Although it must be diluted, silage can be disposed of by land spreading.

(20) Silage can be disposed of by land spreading, though it must be diluted.

Sentence (20), like sentence (16), seems to favor land spreading, the action articulated in the dominant clause. But in sentence (20), the detracting subordinate clause gains some additional weight for being in the latter position. As such, sentence (20) may be considered slightly less supportive than sentence (20). Subordination, as a syntactic pattern, could be said to be a stronger force than order.

Of course, the two considerations are not mutually exclusive; in fact, they always co-exist. If subordination is a syntactic mechanism for mitigating the strength or domain of a main clause, then order is a syntactic mechanism for buffing either the main clause or the effect of the mitigating subordinate clause. With just these two techniques in mind, we can make a simple matrix of possible sentences like that in Table 2.1.

The clauses in this example each expresses the benefit of a water treatment method. One clause advocates for microfiltration by pointing out that it "requires no chemical additives." The other advocates for flocculation by pointing out that it "is inexpensive." The values assigned to syntactic elements in this table are just illustrative. They rely on a scale constructed a scale of 1.0 to −1.0, where the end points represent a full endorsement of one method with no admission of the other. A subordinate clause is significantly weaker than a dominant one in this system (0.4 as opposed to 1.0), and the clause in the latter position receives a small bonus in the appropriate direction (0.2). While these magnitudes are certainly up for debate (and likely effected by the rhetorical situation as much as the language community), assigning values in this way illustrates the spectrum of emphasis effects made possible by considering just two arrangement techniques.

Making a writing decision given this analysis, an expert may, for example, subordinately acknowledge the cost effectiveness of flocculation while going on to advocate microfiltration. This is the approach taken in sentence (T2). The expert choosing this approach may do so because he or she thinks that advocating for microfiltration without mentioning flocculation at all would make it seem as though other options haven't been considered. (The expert may be especially wary of this if selling a microfiltration solution.) The expert may be aware that certain members of his audience are attracted by flocculation's low cost and want to acknowledge them in the statement. Subordinating flocculation and putting the subordinate clause in the first position in the sentence creates the strongest support for microfiltration short of omitting mention of flocculation altogether.

You might notice, there is no neutral expression in this table. As clausal order is unavoidable, even the compound sentences of these contrary expressions carry some vague preference. If these sentences exist in the context of a paragraph, it is

TABLE 2.1.

[ID]	Sentence		Net effect
T1	Microfiltration requires no chemical additives. *Unmitigated sentence represented as positive.*		1.0
T2	Though flocculation is inexpensive, *Subordinate: −0.4*	microfiltration requires no chemical additives. *Independent +1.0; Strong position: +0.2*	0.8
T3	Microfiltration requires no chemical additives, *Independent +1.0*	though flocculation is inexpensive. *Subordinate: −0.4; Strong position: −0.2*	0.4
T4	Flocculation is inexpensive, *Independent −1.0*	but microfiltration requires no chemical additives. *Independent +1.0; Strong position: +0.2*	0.2
T5	Microfiltration requires no chemical additives, *Independent +1.0*	but flocculation is inexpensive. *Independent −1.0; Strong position: −0.2*	−0.2
T6	Flocculation is inexpensive, *Independent −1.0*	though microfiltration requires no chemical additives. *Subordinate: +0.4; Strong position: +0.2*	−0.4
T7	Though microfiltration requires no chemical additives, *Subordinate: +0.4*	flocculation is inexpensive. *Independent −1.0; Strong position: −0.2*	−0.8
T8	Flocculation is inexpensive. *Unmitigated sentence represented as negative.*		−1.0

always possible to manipulate their environment to indicate that no emphasis should be read in. Imagine sentence (T4) or (T5) following an equalizing statement (like "Both approaches seem to have benefits.") or by a declarative statement (like "I have no preference for either approach.").

In fact, argumentative context or surrounding text generally has a powerful influence on how a statement might be interpreted. You might imagine any of these statements after a sentence like "Cost must be our top priority." or in the midst of a discussion about operational cost savings. In this context, a sentence like (T2) would seem out of place, and a sentence like (T7) would seem unambiguous. *Takeaway: Consider how patterns will sound given the situations.*

Noun-Based and Verb-Based Emphasis Considerations Clausal relationships and order, of course, are not the only ways to vary compound or complex sentences. When a multi-clause sentence contains the same noun more than once or when adjacent sentences repeat the same noun several times, a pronoun is conventionally used to make the repetition of the word less obvious. A clause that contains a pronoun can be thought of as receiving less emphasis than the paired clause containing the noun it refers to. All other things being equal, emphasis seems to shift in sentences (21) and (22) to slightly favor the clause with the noun. *Takeaway: Nouns and pronouns can be used to create emphasis.*

(21) *Logs* are a good alternative to riprap because *they* can create both a stable riverbank and additional habitat edge.

(22) *They* are a good alternative to riprap because *logs* can create both a stable riverbank and additional habitat edge.

This is an observation that can also be applied across separate sentences as well, when considering how emphasis might be distributed at the paragraph level. Notice that the choice to repeat a noun where a pronoun would usually be used might have an equalizing effect or could serve to emphasize the parallel structure of the clauses (as in "*Logs* are a good alternative because *logs* can create…").

Nouns and pronouns used in alternation are not always readily interchangeable. When several nouns are being used concurrently in an argument, it can sometimes be ambiguous which noun a pronoun refers to. There are also syntactic considerations for the placement of modifiers when nouns and pronouns are switched. In sentence (23), for example, the modifier ("along the upper canal face") would have to be moved with the noun to the latter clause. In some cases, this may magnify the effect of the emphasis; in other cases, it might create modification problems.

(23) Though the riprap along the upper canal face was properly graded, it has caused erosion problems downstream.

(24) Though it was properly graded, the riprap along the upper canal face has caused erosion problems downstream.

The unequal size of clauses in sentence (24) likely contributes to the emphasis on the (dominant) second clause as much as the presence of the noun. Patterns like these typically overlap in ways that make it hard to identify what specific properties of arrangement most contribute to an effect created in text. And, of course, it is up to the reader to recognize the pattern (or, at least, to feel the effect) as they read. *Takeaway: Clause size contributes to emphasis as well.*

The term *content* is sometimes included in schemes for describing text because the elements that are essential to an argument at a particular point play a significant role in determining what mechanisms are available for constructing sentences with appropriate emphasis. When presenting a multi-part solution to a problem, you may regularly use sentence patterns that are quite different than you would if you were presenting a single approach. The former may require more listing, more attention to parallelism, more argumentative cuing, and simply more volume.

Community habits around these argumentative elements are part of the pragmatic model. Some discussions (or some communities' ways of discussing) are simply more verb-oriented than noun-oriented, for example. Correctness-based admonitions against certain size clauses, certain syntax patterns, or certain arrangements of modifiers are only useful if they are ascribed to by the community in which you are writing. Advice to use the active voice rather than the passive voice, a hallmark of composition handbooks, is often poor advice given the expectations and priorities of audiences for technical documents. In a *passive construction*, the subject of the sentence is receiving the action from the verb (rather than doing it); the "riverbank" in sentence (25), for example, is being "scoured." Sentence (26), on the other hand is *active*; the "ice packs" are doing the "scouring." *Takeaway: The "appropriate" voice is based on community conventions.*

(25) The riverbank had been scoured of vegetation by drifting ice packs prior to the recent 50-year flood event.

(26) Drifting ice packs had scoured the riverbank of vegetation prior to the recent 50-year flood event.

Deciding between these sentences is largely a pragmatic consideration. In many communities, sentence (25) would simply be considered "more professional" than sentence (26). In others, sentence (26) may be preferable. Of course, the containing paragraph or argument may matter as well. Amidst a discussion of the effect of last winter's ice, sentence (26) may be the better choice. In a discussion of scouring along a section of the river, on the other hand, a sentence that creates a noun out of the verb, like (26), may even be more effective.

(27) The *scouring* of the riverbank of vegetation by drifting ice packs occurred prior to the recent 50-year flood event.

Sentence (27), of course, has a verb ("occurred"), but it is a verb that is created, in a way, to occupy the syntactic gap left when the old verb ("scoured") was made

the subject. The fact that the event described in the sentence happened at all—which is the information that the word "occurred" brings to the sentence—is not really new information or information exclusive to that word. "Scoured" in sentences (25) and (26), however, contributes significantly to the content of the sentence.

The use of a verb as a noun in this fashion is called *nominalization*. In English, the bulk of words are fluid; they can be converted readily between nouns, verbs, and even adjectives (e.g., "the *scoured* riverbank"). Deploying the word "scouring" as a subject associated with the verb "occurred" in sentence (27) might be useful in a discussion of scouring or, more specifically, of the different instances of scouring along the riverbank and when they occurred. (Sentence (27) could be understood as clarifying the order of events or as distinguishing between this instance and some other instance of scouring that occurred amidst the 50-year flood event.)

Passive voice and nominalization are particularly useful when an actor is not known or is immaterial to the argumentative point being made. Sentence (28), for example, is a passive construction which, unlike sentence (25), does not contain an actor noun in an object position. *Takeaway: This verb-oriented form is common in technical writing.*

(28) Straw matting had been installed as a temporary measure.

(29) (Someone) installed straw matting as a temporary measure.

As such, sentence (29), an active voice restatement of sentence (28), would require the introduction of an additional noun into the sentence. ("(Someone)" of course could be "a crew hired by the municipality," "the home owner," or even "Bert.") This is useful when actors are politely left out of a sentence or when trying to avoid articulating blame, as in sentence (30) or (31).

(30) The netting laid to protect the toe had been installed incorrectly.

(31) Mistakes were made.

Corporate use of sentences like (31) to avoid responsibility is, to some degree, what gives the passive voice a bad name.

Intermediate Structural Units and Argumentative Movement

To say that a paragraph is made up of sentences is not to say that it is an argumentatively effective paragraph or a cohesive one. To say that a section of a document is made up of paragraphs is not to say that the paragraphs support the organizational or argumentative structure of that section.

In between the macro and micro level in a document, there is an intermediate level at which units of text are grouped into larger units that are not given headings or marked for navigation like subsections but instead depend on a reader's reading

comprehension and scanning strategies. The most textually dense grouping unit at this intermediate level is the paragraph—a block of text that functions to group statements that have some logical relationship so that they can be understood together. Less textually dense alternatives to paragraphs at this level are lists, tables, pictures, illustrations, charts, graphs, and diagrams. Each of these can be used effectively to make argumentative points and each requires specialized literacy to access. *Takeaway: Paragraphs visually cue larger argument structure.*

Paragraph Cohesion and Paragraphs as Structural Units of a Document

A paragraph is a group of sentences that relate to each other. In a series of paragraphs, the sentences in one paragraph should relate to other sentences within that paragraph more than they do to sentences in other paragraphs. Paragraphs, then, seem to have identities that can be related to each other and can be assembled to support argumentative movement.

The internal interconnection that supports the identity of a paragraph is called *cohesion*. Cohesion is sometimes described as the product of the unity of topic or topics among the sentences of which a paragraph is composed and the coherence of those sentences to each other. This is an actionable observation that can be used to revise paragraphs pre-laid out to support an argument (when planning at the macro level) or to divide long tracts of text into reasonable paragraphs when considering text from the micro-level up.

Unity among sentences in a paragraph is primarily created by the repetition of nouns or noun phrases. Extended discussions, if they are on a single topic, tend to rely on the same noun or several nouns again and again. It's not necessary for each sentence in a paragraph to have the same noun (or a representative pronoun) as its subject, however. Nouns or noun phrases can also evoke a feeling of unity if they are inherently related (e.g., "thirty-five percent of the population" and "the remaining sixty-five percent") or that have some established relationship (e.g., "machine oil," "paraffin wax," and "tar" might be associated with the category "petroleum by-products"). *Takeaway: Unity is mainly established by repetition.*

Coherence among sentences is created through stated and implied relationships. One of the primary methods for creating coherence is the use of *metadiscourse*, words that declare the organization of or relationship between units of text.

however	furthermore	likewise
on the contrary	therefore	similarly
in other words	Finally	and then
next	in conclusion	for example

From a syntax point of view, these words and phrases are word or *clausal modifiers* or *conjunctions*. They have a special semantic function, though, in that

they address the reader about the text itself. They are called metadiscourse because they are discourse about discourse—the same way that metadata can be defined as data that describes other data. *Takeaway: Discourse cues can be used to advertise connections.*

Metadiscursive terms are signposts for a reader. They mark places where the argument changes direction. They tell a reader the relationship between textual unit. Like headings for sections, they mark off subsections of smaller units of text. As such, their location is critical to their effectiveness. The term "however," for example, is generally positioned between the two argumentative units it is relating, as in sentence (31). Even when being used to relate simple sentences, however, the word can be placed in at least three positions.

(32) The lot was properly graded. *However*, the storm drains were clogged.

(32a) The lot was properly graded. The storm drains, *however*, were clogged.

(32b) The lot was properly graded. The storm drains were clogged, *however*.

The difference between these three sentences is not the elements the metadiscursive term is connecting, it's the distribution of emphasis. In sentence (32a), the subject of the second sentence, now separated from its verb by the metadiscursive term, is emphasized. In sentence (32b), because the conjunctive effect of however is delayed, the emphasis points forward to the presumed result of the conflict in the next sentence.

The phrase "for example" has similar placement possibilities. But, because it is less of a conjunction and more of a modifier of the thing to which it is attached, it communicates emphasis in a slightly different way. When attached in the final position, as was the word "however" in sentence (32b), a metadiscursive modifying phrase like "for example" seems to create a natural stop in the logic, allowing for a new argumentative point to begin or a for a paragraph or complex sentence to end. *Takeaway: Different types of cues offer different possibilities.*

(33) The flooding was caused mainly by debris that had collected from offsite. Leaves from nearby banana palms were found obstructing Grate Inlets 2 and 4, for example.

When placed in the last position, as in sentence (33), the backward-facing modifying force of "for example" is, in a way, a break on the given-new arrangement of phrases.

Considering their paragraph context more broadly, a metadiscursive term like "however," when used in the middle of a paragraph, may indicate that two sentences are set against each other or that the sentences of the first half of the paragraph are set against those of the second. Likewise, a term like "for example" may indicate that the whole latter portion of the paragraph is to be understood as an illustration of

what had been described in the previous sentence or in any amount of text from earlier in the paragraph. Paragraphs are often formed around coherent sets of sentences accordingly.

When a metadiscursive marker appears at the beginning of a paragraph, it is typically understood by a reader to extend to the paragraph as a whole. This is especially the case when a paragraph begins with a so-called *topic sentence*, a sentence which most closely represents the purposive subject of the paragraph.

While the identification and composition of topic sentences is a common exercise in early composition education, not all paragraphs have (nor all paragraph organizations support) topic sentences. The paragraphs most likely to have a topic sentence are those that introduce an argumentative point and then go on to support it with specific details or examples. Paragraphs arranged around a description of an event or phenomenon, though primarily composed of sibling or hierarchically related details, often contain one key statement that associates those details under one topic. *Takeaway: Topic sentences are important for some kinds of paragraphs.*

A paragraph that details a cause and an effect or a problem and a solution, though, relies on a balanced relationship between the constituents. And in a paragraph that relates chronological constituents, order is often the relevant consideration rather than the dominance of one statement. Paragraphs that rely on balance or order, though, may still have crowning topic sentences that summarize or reference the paragraph's logic. When that is the case, these sentences typically come at the beginning of the paragraph. They may also come at the end if they express a relationship that relies on a newly introduced topic. The end position may also be a position of stress for a topic sentences that expresses the conclusion of arranged logical elements.

Section or document level logic communicated through paragraphs to the scanning or skimming reader comes primarily from subject nouns and metadiscursive terms in initial first-sentence positions. Consider a set of five paragraphs that begin with the following phrasings.

(34) Flooding during the recent rain event…
Evidence of drop inlet obstruction, however…
In fact, runby was measured…
Additionally, flow velocities…
While significant flooding was recorded, trunk line expansion…

The expert reader who scans the five paragraphs represented by example (34) would likely be able to anticipate not only the conclusion of the section but also the arguments used to support that conclusion. *Takeaway: Use paragraphs to highlight logic users may scan for.*

One common multi-paragraph logic is the paragraph-level list. Paragraphs affixed with words like "first," "second," and "third" or like "primarily," "another," and "finally" are easy for scanning readers to navigate even when items in the list are of uneven volume. (For instance, it may be that the first and third items in a list are

each three paragraphs long while the second item is two paragraphs. Readers can navigate a list like this if you use terms like those mentioned only where list items change.)

When possible, parallel construction at the paragraph level makes lists of rationales or features more obvious and more easily comparable. For example, three options presented in three paragraphs would be more readily comparable if those paragraphs were organized similarly—placing cost information at the beginning of each paragraph and effectiveness information at the end, for instance, or placing pros at the beginning of each paragraph and cons at the end.

Additionally, short framing paragraphs positioned before and after a list or other argumentative group of paragraphs to introduce it or relate it to the larger purpose of the section can draw attention to the structure or relationship of a series of paragraphs. An introductory framing paragraph may even be a single sentence or end in a colon so as to call attention to its purpose (e.g., "The site plan found that flooding could be attributed to the following factors.").

Structures Other than Paragraphs

While this guide doesn't address graphic design or the construction of tables, diagrams, or other visual data sources, these elements are often embedded in paragraphed subsections, at which point the paragraphs around them play a significant part in introducing, interpreting, and integrating them into the argument being made.

When the location of an inset (like an illustration or a table) can be controlled, the text above it and below it can be written relative to the inset. The paragraph before an inset may function solely to articulate the argumentative point for which the inset is valuable, supplying an assertion in a topic sentence, for example, and then stating that that assertion depends on data in a table found below. The paragraph that follows the inset, then, should direct readers' attention to the features of the inset that make it argumentatively persuasive and articulate an interpretation of these features and how they support the point being made. These paragraphs frame the inset the same way paragraphs used to begin and end sections may frame the argument in that section. *Takeaway: Framing is a key strategy for integrating non-textual elements.*

The interpretive latter frame for an inset is often considered particularly important in technical writing. It is typically not enough to simply include an inset supporting an argumentative point without also saying how it supports your point. Graphs and tables can be interpreted in different ways by professionals, and they often have features additional to those on which you are relying. A graph with a slowly dampening oscillation late in its dependent axis may also have a steep decline early in that axis. While you may be relying on the former part of the graph to argue about for a control approach, your reader may be looking at the latter part of the graph and struggling to understand how that connects to your argument. *Takeaway: Interpretive text influences how readers view an image.*

In addition to interpretive text following an inset, insets often feature callouts, labels, and descriptive titles and captions. These elements can be used to express observations to readers who are scanning the text and viewing the inset without reading the text around it or to viewers who are seeing the inset reproduced out of its document context. Captions usually contain the relevant details of the figure, details that may have been acquired by a prolonged study of the figure anyway (e.g., "Comparison of options based on cost"). Captions sometimes additionally contain information about how data was collected or compiled, sources used, or the limits under which the information is applicable (e.g., "Valid only for models A and G.")

Depending on your writing situation, it may be appropriate to title or caption insets with a more assertive message or with a message that is related to the purpose of the figure (e.g., "A comparison of options based on cost shows Option 6 most effective."). The phrasing of titles and captions is largely a pragmatic consideration. Assertive phrasing—that makes a statement about what the inset means rather than declaring its contents—is a useful technique for encouraging readers to understand the argumentative value of an inset. In some professional settings though, this kind of phrasing is seen as unprofessional or subjective. You will want to look at insets similar to yours in the documents similar to the one you are preparing to decide what is typical in your community.

Inset elements cannot always be placed in the flow of text where they belong. Illustrations that are a certain size, for example, may need to be flowed onto another page. Some corporate publishing guidelines even require that graphics appear aligned to the top or the bottom of pages, fall on only left hand pages if documents are printed two-sided, or be held for an appendix. It's not unusual to end an introductory framing paragraph with a reference to the element and where the reader can find it. This phrasing is usually standardized across a document or, in the case of branded documents, across a library of documents. *Takeaway: Publications may require graphics to be distant from text.*

In relatively short documents, simple phrasing like "See Figure 3" may be enough for a reader to locate the target of the reference. Referring to a diagram found in another manual or in a set of online help files, however, may be more complicated. When insets are located outside of their argumentative context, explanatory captions and titles become that much more important.

Citations and Other Intertextual Statements

Citations are direct references to other texts and are part of a broader category of statements referred to as *intertextual* because they imply or reference the logic or specific details from other texts. Sometimes in complex workplace documents (especially those that are published), you will need to refer to data collected by or the methods used by another professional or to arguments that have been made in previous publications. (See the Appendix for more information about IEEE Citation formatting.) Citations in research articles, research-oriented proposals, white papers, and

published reports may be overt or subtle depending on community conventions, on the purpose for citing, and on the style adopted.

(35) Data collected by Warren and Johnson suggests that applying a tensioned stabilizer should enable us to reclaim 0.7% of product waste [9].

(36) Applying a tensioned stabilizer should enable us to reclaim 0.7% of product waste [9].

Sentences (35) and (36) both refer to another text. Using the IEEE inline citation format, the "[9]" that comes at the end of the sentence would indicate that a reader should find entry number nine in a references list at the end of the document (or the end of the section, maybe, if the document is book length). This syntax of sentence (35) is sometimes called *integral* because the sentence relies on some research-oriented noun (in this case, the names of the researchers) in order to be well-formed. Similarly, the syntax of sentence (36) is *nonintegral* (or sometimes *parenthetical*) because the citation does not influence the syntax of the sentence.

While nonintegral statements are more typical in many technical fields (including in their research writing), the nonintegral syntax also has the effect of making the statement seem to be something with which the author agrees. Whereas in sentence (36) it seems as though the author is suggesting the stabilizer will function to reclaim waste, sentence (35) distances the author from the assertion a little, suggesting that someone else would claim that but that he or she is not necessarily extending his or her credibility to cover the claim. The degree of this agreement can, of course, be controlled by normal means, like modal modifiers and by verb choice.

Another implication of integral syntax is that provides the opportunity for the names of those involved in the external discussion to be presented in the text. Using integral syntax to disagree with someone else's findings, for example, allows you to mention them by name as you disagree, something that can be seen as aggressive or effective depending on the community. You can also use integral syntax to mention an important person or a professional who the audience will likely trust. If Warren and Johnson, the data collectors presented in sentence (35), were the foremost experts in the field or had a reputation for being successful at business or trustworthy professionals, then phrasing the sentence this way may function to extend their credibility over your argument.

Most intertextual statements are more subtle than direct citations. Everyday business correspondences exchanged between clients and company representatives are full of phrases like: "it is our policy to" and "your website clearly states." These statements make it clear that arguments depend on the details of documents external to the one they are in. In this environment, integral syntax can serve to communicate blame or fault as well as credibility.

(37) Your operator told me that the setup would be administered by a technician.

(38) I was told, by your operator, that the setup would be administered by a technician.

(39) I was told that the setup would be administered by a technician.

(40) I understood that the setup would be administered by a technician.

In sentence (37), the client uses integral syntax to point out that it was the company's operator who promised the setup. A client using this phrasing is communicating that they feel that they were promised something by a representative of the company and that, if there was a miscommunication, it would be the company's fault. Sentence (39), on the other hand, has a more passive claim to fault and doesn't directly implicate the operator. Sentence (40) goes even further; by changing the verb, the client is now admitting that it may be their fault.

While sentences (39) and, especially, (40) may seem weak, these are often the sentence forms used in a polite communication, especially when the client may feel like their request will be fulfilled anyway by a company that values customer satisfaction. In the case where good will is being preserved or depended on, sentence (36) might seem overly aggressive. In the case where some balance of assertive and the polite passive is necessary, an integral statement which displaces the operator from the subject position and into a phrase (as sentence (38) does) can come across as less aggressive but no less precise.

Implications for the Process of Writing

When you need to produce a document in a workplace, you might begin by considering whether or not that document is a generic one. If it is, there should be documents around you that were prepared by others (or even yourself) with a similar rhetorical situation that you can use as models for writing. Find several documents if you can. Study their argumentative organization, the words they use, and the non-textual elements they contain. The goal is not to average the features in these documents, but to get an empirical sense of the domain they exemplify.

Any genre has a certain amount of variability, and examples of a genre are, in a sense, elements of set with a domain of features socially prescribed by the community. For a document to be a member of that set, it has to meet certain rhetorical and/or superficial requirements. If a document varies too much from typical set examples or if it violates certain required elements, it won't be recognized by members of the community as belonging to the set. Empirical investigation, studying examples of a genre, enables you to learn these tolerances so that you can keep them in mind when you write. *Takeaway: Consider how rhetorical and pragmatic considerations interact.*

When a writing situation does not correspond to a generic form because it is ambiguous or unusual, it can be hard to know where to start. Without a pragmatic model, the rhetorical situation is your guiding tool.

If the document you are preparing is short (like an email or a brief report), you might begin by trying to articulate your purpose in a couple sentences. Write the sentences as though you were addressing your audience and telling them directly

what you would like them to think or do. If you have multiple purposes or constraints on your purpose, you might need to write several sets of sentences and then look for relationships between them. *Takeaway: Start with the purpose(s).*

Then, try creating a list of argumentative points associated with each purpose. What are the things you will need to tell your audience, what are the things they will require, what are the things they want to hear? Arrange these points into a sensible structure and consider how much text it will take, how deeply detailed you should be when discussing each.

At this point, you can probably plan your document out paragraph by paragraph. Try to articulate the point of each paragraph, use logical metadiscourse to plan how your paragraphs will argumentatively connect. Then, start with the paragraphs you're most comfortable with. Don't feel compelled to write the beginning of the document first. If you run into a problem writing a particular portion of the document, you might return to the pragmatic approach and look for documents or advice about that kind of argument even in places where the purpose is different.

When you are done writing, read what you've written from the beginning and interrogate the writing decisions you've made. See if you can justify your own text in terms of the rhetorical and pragmatic situations. The technique in this book is a technique for composition, but it is also a technique for revision. Remember, revision is not a process of error detection. It's a process of recognizing and revisiting choices made while writing. *Takeaway: Revise by interrogating your writing using the situations.*

When they write, some professionals, because they are thinking about the best wording for an argumentative point or the best way to explain a technical detail, cannot think clearly about emphasis patterns or the coherence of argumentative propositions. Of course, for some, it's the other way around. Revision is your chance to go back through your document and consider decisions with respect to different structural elements or with different audiences or purposes in mind than the one you had when you were writing. *Takeaway: Also, reconsider elements emphasis, coherence, and tone.*

In many workplaces, professionals are often asked to read each other's draft documents before they are sent to a manager or a client or submitted for archiving. Editing the works of others involves recognizing the situation of their document and trying to communicate where you think the choices they've made could better meet that situation. It's important to consider the identity of another professional when editing his or her work as it may lead them to make decisions that would be different than you might make given your identity. It is also important to respect stylistic difference in their document. If your only reaction to a piece of text you feel compelled to comment on is "I wouldn't say it that way," you might stop to ask if the way they say it presents a problem for the audience or is atypical for the community, or if it's simply a personal preference.

When providing feedback, try to associate your comments with the problem you feel like you found in the text. You might suggest a different word because is more

in line with a certain rhetorical purpose or a typical usage or you might suggest an argument be left out because it's not relevant to a certain audience. Justifying your feedback in terms of the elements of the rhetorical and pragmatic situations enables the writer to understand why you're suggesting the change. *Takeaway: When you review an associate's work, explain your thinking.*

Additional Reading

R. E. Berger, *A Scientific Approach to Writing for Engineers and Scientists*. Hoboken, NJ, USA: Wiley-IEEE Press, 2014.

A. Crismore, *Talking with Readers: Metadiscourse as a Rhetorical Act*. Bern, Switzerland: Peter Lang, 1989.

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K. Hyland, *Metadiscourse: Exploring Interactions in Writing*. London, England: Bloomsbury Academic, 2005.

R. Bell Markels, *A New Perspective on Cohesion in Expository Paragraphs*. Carbondale, IL, USA: Southern Illinois University Press, 1984.

R. E. Young, A. L. Becker, and K. L. Pike. *Rhetoric: Discovery and Change*. Boston, MA, USA: Houghton Mifflin Harcourt Press, 1970.

II

Writing Documents

Introduction

The sections that follow discuss some general communicative forms found in the workplace, arranged into sections by their larger rhetorical purpose. Each section contains

- a discussion of that purpose and its role in the workplace environment
- a discussion of rhetorical considerations important to communicating that purpose
- a discussion of typical documents that are mainly associated with that purpose

One goal of these sections is to give you a framework for identifying the writing practices that seem authoritative in your particular workplace. This is not a catalog of formulas for documents; rather, these are characteristic forms for familiar workplace documents. Given the general scope of this book, a detailed catalog could never be both usefully specific and sufficiently general to be used by *all* engineers and technology professionals. Some companies put together style guides with information about document structures, language usage, and even workflow practices. If a correctness-oriented document like this is prescribed for (and respected in) your workplace, then you should find and use it to supplement the guidelines in this book.

Another goal of these sections is to discuss some rhetorical considerations relevant when generating and styling content in these formulaic situations. Aristotle suggested a multi-part approach for giving a successful speech. The first part of this approach was invention. Invention, coming up with the elements of an argument (or with "content" as we tend to say), relies on a keen understanding of the rhetorical and pragmatic situations. Strategies for inventing vary as your purpose varies, and so each of these chapters will present strategies for inventing that particularly suit the larger purpose they take as their topic. (Of course, many of these considerations are conceptually broad, and a consideration in one chapter may be relevant to the kind of writing discussed in another chapter as well.)

The IEEE Guide to Writing in the Engineering and Technical Fields, First Edition.
David Kmiec and Bernadette Longo.

After inventing arguments, Aristotle suggested arranging those arguments in ways that would have the most impact and then stylizing them so that they sounded persuasive and were memorable. Arrangement and style are the considerations you will find in the latter half of each of the following chapters, where typical subsections, considerations for order, and specific lexical and syntactic considerations are discussed.

The main goal of these chapters, however, is to provide a starting place for you to consider your pragmatic situation. These sections rely on the assumption that engineering and technology workplaces, which exist within the context of larger business and social communities, inherit characteristic practices of those communities and that knowing those practices and how they might be customized is one way of composing in specific workplaces. In other words, we are suggesting that specific work sites' concepts like politeness, professionalism, or appropriateness are made up of practices from the equivalent cultural concepts in the discipline, the industry, and the society as well as specialized practices that are specific to the company, department, or worksite. (This is much the same way that a specific lexis is made up of a subset of words from the natural language as well as technical terms.)

We are also suggesting that these more general and more specific communication patterns are one way that community members recognize each other. Using (even pronouncing) technical terms correctly is one of the key ways that members of expert communities recognize another member and those employed in a corporate setting recognize discourse from their workplace. Similarly, using correct data to support the correct kind of argument in the correct kind of document suggests that you know the communicative conventions of a field or worksite and are more likely to be trustworthy.

In most modern management structures, decisions are made based on the contributions of a number of people with different areas of expertise. Clients of technical firms often get information in a document that has been carefully designed to be seamless, but is actually synthesized from multiple departments or interdisciplinary project teams. Because organization structures continue on after a project is completed (and because the same people in the same configurations are doing the same kinds of work again and again), a regularity naturally arises in the way work is discussed and communicated. This regularity is useful for both the author and the reader because the expectations that come with it make producing and accessing the document more efficient. The documents become recognizable and comparable by their generic form and communication patterns.

One of the main ways the culture of an organization supports regular communicative interaction is by developing a system of names for its members and their communications. Labels within an organization like director of operations, project manager, design engineer, form 115, phase report, or design proposal bring with them expectations for people in that organization. These labels themselves communicate information about what the employee should do and what the document should contain.

As a new employee, these terms are useful because they give you a start on understanding the communication patterns in your workplace. Learning the names of things—whether positions, organizational departments, or documents—helps you navigate the workflow and become adept at using the cultural tools available to get your work done. The first documents you prepare in a workplace will likely be modeled off of existing ones. In fact, in many workplaces, the main way people create report is by finding an old report with a similar structure and either manipulating its contents or using it as a pattern for the new report.

In order to be accepted, the documents you prepare in the workplace must look enough like similar documents to be recognizable and yet must afford you the rhetorical space to be effective. Figuring out which elements of a document are generic and which are special to that document, however, requires looking at several examples. If all the internal design proposals at your company contain a coversheet with a costs section, then it is likely that an internal design proposal without one will be viewed as incomplete. If only a few design proposals contain a section assessing the impact on other projects, though, it might be that this section is not required for the document to seem complete. It might be that that section should be included only when the situation calls for it.

At the same time, it is not unusual for a professional to have positions or opinions that do not fit well into the form prescribed by previous examples of a generic document. Technical projects are idiosyncratic; they often require new ways of thinking and new expressions of typical argumentative points. Adding a background section to a document that does not typically have one, or adding a cost section to a document that is usually focused on feasibility, may make your document less recognizable to your audience. In the best case, they will be curious about the content of this unexpected section and be glad you included it; in the worst case, they will reject the document as unprofessional and think that you do not know the conventions of your workplace.

Expectations associated with generic documents supply a starting place for writing a document, as well as a constraint on the document you might write. These expectations are specific to sites, fields, organizations, clients, and sometimes individual managers. The chapters that follow this introduction discuss some typical forms these generic expectations might take. They also discuss the things you should consider as you look to sample documents in your workplace for inspiration.

3

Writing to Know: Informative Documents

- *Informative documents play a crucial role in providing information to those that do not have it and need it. They also establish a place where multiple parties can record their agreement on work being done. Events can be recorded in different ways and from different points of view.*
- *The purpose of an informative document is to communicate information that an audience will find to be accurate, complete, significant, and authoritative. Record information in a way that is accessible to future audiences such that they can understand what has been done and why.*
- *Audiences for your document may have differing interest in and technical understanding of your topic. As the writer of an informative document, you need to understand what will constitute acceptable evidence to your audience and how much of it you will need in order to make your assertions seem authoritative.*
- *Typical informative documents*
  - *Reports*
  - *Specifications*

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David Kmiec and Bernadette Longo.

Introduction

The documents discussed in this chapter are used in the workplace to communicate information or to store knowledge, so they are often called *informational* or *informative* documents. Informative documents play a crucial role in providing information to those that do not have it and need it. They also establish a place where multiple parties can record their agreement on (or version of) the details of work being done.

Informative documents are generally thought of as factual and objective. After all, these documents are supposed to record events, provide details of analyses, and demonstrate how recommendations are based in actual needs. But events can be recorded in different ways and from different points of view. For example, failures can be expressed as successes by reporting details selectively or applying different standards for analyzing the outcome.

As the writer of an informative document, you select which details you include and in which contexts you present them. For your document to seem authoritative, you need to establish a credible factual tone without coming across as overtly persuasive (the way you might in a proposal). Informative documents derive authority from the fact that they seem logical, as though any competent professional would have reached the same conclusions or made the same observations.

The Purposes of Informative Documents

The superficial purpose of an informative document is to communicate information that an audience will find to be accurate, complete, significant, and authoritative and/or to record information in a way that is accessible to future audiences such that they can understand what has been done and why. Documents like reference materials and records are often written with the purpose of capturing a specific sequence of events, expressing relationships between things, or tabulating observational data. *Takeaway: A superficial purpose is communicating information.*

Inasmuch as these documents are used to plan new work or to investigate how previous work was done, they have influence on the workplace. So, while the immediate purpose of preparing a record of a site visit may be to capture and store measurements made at the time, the larger purpose over time of such a document may be to contribute to a larger pool of data such that an informed redevelopment decision can be made, to serve as a reference by which future measurements can be evaluated as normal or abnormal, or to suggest the diligence of the organization monitoring the site in case of lawsuit. *Takeaway: Recording information also enables accumulation of data.*

From an organizational point of view, informative documents could be thought of as being written in order to create a physical (or virtual) object that represents a narrative or description of work that one or multiple parties can agree on. Consulting firms and clients often send final project reports back and forth several so as to

agree on language before the report is considered "complete" or before the report is delivered. The people involved in this process, representing those agencies, can be seen as negotiating the authorized account of what a product or service looked like over the course of the relationship or at its final point. *Takeaway: An argumentative purpose is working toward consensus*

In a contentious contracting environment, that same final report might represent the narrative or description espoused by one particular party, unilaterally declaring details that the other party might dispute or disagree with. This might be the case when a firm prepares a report describing a cost overrun that was the result of a client missing deadlines or detailing a failed project in which a vendor supplied inadequate services. Locating blame in text—making that blame concrete—fixes the position of one party in a dispute and lends that position credibility. (Think of how someone might say, as evidence to support a claim: "Well, it was written in their report.") *Takeaway: Another purpose is to declare a position.*

Sometimes reporting is less about communicating with the declared audience of the document and more about the visibility of the communication that is occurring. Regulatory agencies often require companies to hire auditing firms to evaluate the safety of their workplaces or products or their attendance to environmental regulations. In such cases, auditing companies prepare reports not to the regulatory agency but to the firm being regulated. *Takeaway: Often these documents are also about performing for observers.*

These reports inform the firm about any problems or about their ability to stand up to regulatory scrutiny. Some even assure assistance in the case of regulatory action. When a regulator begins investigating a firm, that firm might then point to these auditing reports to suggest their compliance. In this case, the report itself might take the form of a communication that is directed to one audience (the client) while it has really been prepared for the purpose of acting in front of another audience (the regulator).

Though informative documents are typically prepared for some purpose that meets larger organizational goals, it is important to note that they also have a significant impact on the way their preparers and signatories represent themselves within the organization. Technology professionals, engineers, and professional workers who perform services or prepare intellectual products use informative documents to evidence the work they have done within an organization. *Takeaway: These documents also represent work.*

An industrial engineer who studies and optimizes a process in March is unlikely to receive much credit on his or her annual performance evaluation in October if that effort is not documented somewhere, even though the corporation is probably benefitting from that improved process. The manager who oversees this engineer may not know the change had been made or may think the change was something that required little work, or maybe all parties have forgotten the work even took place. In an organizational environment where professionals are scrutinized for their contribution and productivity, informative documents are artifacts where the professional can lay claim to work.

Occasions for Preparing an Informative Document

When you complete an analysis, make a design change, or finish a project, you are often responsible for communicating about that work to people who are not familiar with it. When small increments of work are completed as expected, they are usually communicated through brief messages—the kind you would find in the last chapter of this handbook, "Correspondence." However, when a significant milestone in a project is reached or when knowledge of the work done will prompt some decision about future work, a more substantial document is typically prepared. These substantial documents represent the findings and expertise of their authors and provide others involved with the project an opportunity to agree to or challenge the work being done, as the documents are circulated among project stakeholders.

Informative documents are also prepared when professionals with regular or reoccurring responsibilities do work, make changes to a process, or encounter something out of the ordinary. Engineers who go on site visits or maintain equipment or communication infrastructure often document configurations and capture observations about their work environments that their professional expertise suggests may be useful at some later point. Also, documents about work processes are prepared to bring new workers up to speed or to facilitate the delegation or reassignment of work.

Audiences for an Informative Document

Typical audiences include

- People associated with the document (such as managers, team members, security experts, and the in-house legal counsel)
- Technical staff and people with particular expertise (who may have extensive knowledge of your topic, who may be valuable in communicating to the managers of the project, and who may be internal or external to your organization)
- Managers (who may not have much expertise with your particular topic, but who can be final decision-makers)

Audiences for your document may have different interest in (or technical understanding of) your topic. When you make decisions about what information to include in your document or how to present that information, you will want to consider the needs and goals of these different readers.

The first people who are likely to see your document are people within your organization who are associated with the document, are contributing to it, or are represented by the document. In a technical services or product development environment, a manager of some kind—a project manager or head of an organizational unit—often reads, edits, revises, and critiques reports before passing them on to other organizational units or to clients. Your team members, peers, or members of your

staff may also read and comment on a report before it reaches its intended audience. In environments where security or liability are institutional concerns, a report may be read by legal counsel or a security expert before it is released. *Takeaway: Internal contributors and colleagues are both collaborators and audience members.*

Technical staff will have extensive knowledge about the details of your project and can have input into the decisions you make about how to conduct your work. Readers with specific expertise, internal or external to your organization, are unlikely to read the entirety of a long document. To access your document, they rely on informative headings and scanning for key words. They often read charts and tables first and will read a more general conclusions section to see if they find it objectionable before or after finding the page or two of specific text that they feel compelled to read given their technical expertise. *Takeaway: Technical experts view your document through their expertise.*

These readers will decide on the technical accuracy of your project and will evaluate your analysis of findings and recommendations and pass their opinions on to their organizational supervisors. This means that you might get notes back from a technical reader on your staff or in your agency, but that a technical reader in another organization (like that of a client for whom you are doing services) is more likely to give feedback to his or her organizational manager than to you.

Depending on the politics of the environment, getting the support of the technical experts who are expected to evaluate your work is crucial, as they are likely to advise managers on the final decisions regarding your project's success. To get the support of this audience, you'll need to consider what they find persuasive. You may need to understand the argumentative conventions that a particular discipline or practical community uses to show that methods and data are accurately reported and that analysis follows logically from your data. If you have anything that is unusual or unexpected in your methods or data, you'll want to explain those anomalies in a way that they will find acceptable.

Very often, there is a class of managerial reader in your target audience who has little technical knowledge about your project and is mostly interested in the "bottom line." As these readers are generally busy and are unlikely to read thoroughly or understand some of the technical arguments in your document, longer documents often contain some kind of abstract or summary with key points from the text. Interestingly, this kind of reader, who may access the document the least, is often the one that makes the final decision as to whether your findings or recommendations are accepted, whether payment for your work will be released, and ultimately whether your project was successful. *Takeaway: Non-expert managers have their own interests for reading.*

Creating a special section in your document (like in an executive summary or cover letter) enables you to address managerial readers directly. In this section, you can reorganize the logic of your argument so it suits their interests, you omit technical details that you suspect they won't value or understand, and you can make direct statements about the social and organizational implications of your report, like stating

that some finding or action "satisfies the contractually required analysis" or "suggests that phase two of the project will have to be reevaluated."

Beyond these readers are those who neither contribute to your document nor are directly addressed by it but who may, for some reason you have or have not considered, read it. A report submitted to a client may, in the future, be forwarded by that client to another agency with whom they are contracting for additional work. It may be read by an agency that is auditing or regulating that client. It may be read by lawyers who are sifting through boxes of papers retrieved in the discovery phase of a lawsuit. If your client regularly contracts with a government agency or municipality, it may even be read by members of the public or investigative journalists who are following up on an incident or considering the effectiveness of publically spent funds. It's not necessarily possible to anticipate the needs of these readers, and in fact you're probably not being employed to write your report to suit their needs anyway. But this extra class of audiences is something to consider when you're preparing a delicate, sensitive, or proprietary message or providing your professional opinion or assurance in a way that might incur liability. *Takeaway: Consider also potentially unintended readers.*

Key Communication Strategies When Writing to Know

Understanding What Constitutes Sufficient Evidence to Support a Claim

As the writer of an informative document, you need to understand what will constitute acceptable evidence to your audience and how much of it you will need in order to make your assertions seem authoritative.

Informative documents deal with the past, with things that were measured or were witnessed, and with questions about whether something exists and what its properties are. When they contain declarations about the present (reporting the current state of the problem or project), they rely largely on information that was gathered and reported in the immediate past. When they claim to be about the future (stating planned work outcomes or compensation), they largely represent agreements and concerns expressed by contributors to some past negotiation.

This mode of discourse is what rhetoricians call *forensic*; it's the kind where evidence is used to establish (or prove) positions, and where positions that are sufficiently proven become facts. Forensic arguments happen in the courtroom, among other places, where a determination of guilt and innocence rely on parties trying to establish a compelling picture of past events. (And, in fact, engineers and technological professionals do participate in trials sometimes as expert witnesses. For example, when a bridge or building collapses, forensic engineers are the specialists who determine the causes after the fact.) *Takeaway: Evidence is key to making forensic argument.*

But more broadly, the evidence-based style of persuasive logic in the courtroom is the underlying logic of the informative document. Reports concluding a successful 5-year project, detailing the causes of the failure of a piece of equipment or a structure, or explaining the reasons why the fabrication of a component will be delayed all seek to establish a similar compelling picture of past events in order to convince readers of the legitimacy of the claims made.

Just like in a courtroom, the standards for the type of evidence accepted and for the sufficient amount of evidence required are set by the social situation in which the report is to be persuasive. What is a fact to a chemical engineer in a power plant may not be recognized as a fact (or at least the same kind of fact) to someone in business or in scientific research or in a government regulatory body. The engineers writing to an audience that is made up of these diverse groups will need to present their findings in such a way that the audience is persuaded of their authority. To do so, they will have to understand what things these diverse audience members understand to be evidence and will have to devise a logical structure that enables each audience member to access the document. *Takeaway: What qualifies as evidence depends on the situation.*

Structuring Evidence in Your Document

While presenting the right kind of evidence is central to writing persuasive informative documents, that evidence must be presented in a structure that enables the varied audiences of the document to access the logics and evidence intended for them.

Informative documents can vary significantly in scope. In the smallest documents, assertions, and supporting evidence might be broken down into paragraphs or items in lists. If they are large, they require subsections and sometimes navigational aids like page and figure numbering and tables of contents. White space and typographic cues, structural parallelism, and logical metadiscourse help readers navigate long and complex documents and follow hierarchical arguments. Titling sections with their intended audience in mind can often help direct readers to the places in a large document where their concerns are addressed. (Titles like “Engineering Breakdown” and “Financial Feasibility Analysis” may be more effective in driving readers to the right section than less directive titles “Equipment Breakdown” and “Feasibility Analysis.”) *Takeaway: Argument structure depends on scope.*

Large documents may also begin with brief summaries of the contents of the document. These summaries are prepared with the expectation that readers will likely not read the larger report and reveal the concerns that the document was meant to address as well as its key findings or conclusions. The organization of these summaries is customary. Executive summaries beginning business reports, for example, tend to begin with the salient business conclusions—a project has been completed, a retrofit needs to be ordered, etc.—and proceed to break down technical and financial information that supports this conclusion. Abstracts of research reports, on the

other hand, tend to mirror the organization of the papers they are attached to, beginning with the motivation or purpose of the research and ending with findings and implications. *Takeaway: Argument structure depends on rhetorical situation.*

- Typical organization of executive summaries
  - Salient business conclusions
  - Technical information that supports those conclusions
  - Financial information that supports those conclusions
- Typical organization of abstracts
  - Brief background of project
  - Methods
  - Findings
  - Implications

In any sized document, evidence and the conclusions drawn from evidence must be placed strategically. Readers should be able to find claims and should be able to associate claims with the sets of evidence supporting them.

Where evidence and claims are located depends not only on the scale and rhetorical purpose of the document, but it also depends on community and worksite-specific customs. In some reports, evidence may be presented along with claims; in others, it may be included in a separate data section or appended to the end of the report. When there are compound sets of evidence, such as calculated values that rely on equations and sets of data, it might be that established portions of the evidence (such as standard equations or large data sets) are appended or are included only by reference to some common or published text outside of the document. *Takeaway: Argument structure depends on pragmatic convention.*

The organization of claims and evidence can also depend upon the degree to which claims are contentious or expected by the reader. Claims that are contentious or dissatisfying to the reader are often accompanied by evidence immediately within the body of the document. In the absence of obvious community conventions, the proximity of evidence to the claims it supports could be thought of as related to how expected those claims are.

Establishing Expertise

Producing an effective informative document requires that you associate the right kinds of evidence with your claims, then organizing those claims and sets of evidence in a way that readers will expect and can navigate. But a variety of subtle linguistic cues are just as important to establishing your expertise or credibility with readers.

After analyzing these communication objectives, writers must determine how to meet them while maintaining an honest relationship to the material in the report. Sometimes the need to meet communication objectives can conflict with the findings; in these cases, the writer needs to honestly represent the findings in a way that the audience will be receptive to. For example, you may be writing a report on the feasibility of adding a third production line to an automobile plant. Your client feels this is an important step toward increasing the company's profits, which have been sharply declining for six quarters. In your research, you have found that the company cannot raise the funds to add this production line and, even if they could, the increased production would not lead to increased sales. Your report should honestly report these disappointing findings to your client in a way that the client will believe. You need to break this bad news to your client while continuing to maintain a relationship of trust and good will.

By fulfilling audience expectations, writers are more likely to persuade the intended readers that the project team has successfully accomplished the project and that the findings set out a reasonable and necessary solution to the problem. The decision-makers will see the writers as being credible professionals. *Takeaway: Establishing credibility is persuasive.*

Questions for Analyzing Existing Documents

When looking at sample documents from your workplace environment, you can use these questions to help you analyze your writing situation:

- What kinds of evidence are presented to support claims in this document? In what quantities?
- Are certain claims associated with multiple sets of evidence?
- Are different kinds of evidence presented as more or less valid? Reliable?
- Do some kinds of evidence seem to warrant accompanying evidence?
- Is error discussed? If so, is it associated with evidence collection, the evidence itself, or the reliability relationship between the evidence and the claim?
- Where are evidence and claims presented in the document?
- What mechanisms are used to connect evidence to claims? (e.g., proximity, cross-references, logical metadiscouse, headings)

Some Typical Informative Documents

Reports

Reports are a primary way that knowledge is generated and shared among colleagues. In some respects, a report functions simply as a record of the work you completed or

as a statement of your expert opinion on the project. However, a report also serves other functions:

- It helps your team to create shared understandings of the processes and outcomes.
- It serves as a reference for people who work on similar projects in the future.
- It helps to establish professional standards for similar kinds of work.
- It serves as a record of your work for professional review.
- It functions as a legal document in case of disputes about the project contract or outcome. *Takeaway: Reports are a key way work is communicated.*

Reports address objects that exist or existed and events and activities that happened or are continuing to happen. As such, they are primarily about the past and about that immediate past that connects to the present. Even reports that present design options or feasibility studies—documents which have obvious use in the present to decide the future—rely on extrapolation from criteria established in the past. Because reports are about what has happened in the past, they are not overtly persuasive like proposals. Authors of reports use a matter-of-fact style to represent their interpretations as reasonable, necessary, or even preferable.

While you may have created products or measurements during the course of your investigation, it is the written report—not the products or measurements themselves—that explains your ideas to other people. In the report, you communicate the significance of your findings and argue for their importance as a professional working among other professionals. *Takeaway: Reports represent professional actions.*

Purposes of reports can differ widely even though they all document something that has already occurred, such as your research or the outcome of your project. In some cases, you want primarily to inform your audience. For example, in a progress report, you might list the activities you accomplished during the reporting period without much analysis of their significance. In other cases, you want to analyze information in addition to presenting it. If you wrote a report on the outcome of a set of soil analyses, for instance, you would present the results and discuss to what extent those results have significance for your project.

In still other cases, you more directly want to persuade your reader but not overtly sell them a solution. For example, a report might recommend a course of action but using evidence to suggest that it is the most cost effective or most efficient than other options. In this example, the line between an informative document, like a report, and a persuasive document, like a proposal, is that the report treats the recommendation as a fact that is evidence-based, whereas a proposal is overtly persuasive. These concepts, however, are fluid. *Takeaway: Most professional documents are persuasive.*

And, of course, these purposes overlap. When you write a recommendation report, you are also informing your reader and analyzing the information before

coming to your recommendation. In a way, even a report intended primarily to inform is also an example of persuasion because you must convince your reader that you are trustworthy and competent while also presenting information that is relevant to your situation.

Types of Reports Reports and reporting conventions, of course, vary widely from sector to sector and workplace to workplace. The following are terms that seem to have reasonably established meaning across workplaces, probably because of the nature of the beginning-middle-end project cycle and because of the nature of information storage and modern managerial impulses within organizations to document and improve operations.

PROGRESS REPORT/INTERIM REPORT/PHASE REPORT You use progress reports to record the activities you have accomplished on a project during a specified reporting period. If a project is long or complex, sometimes different kinds of progress reporting documents are built into the project's documentation plan. For example, a site or product development initiative that occurs over multiple years may have annual reports or quarterly reports (names for the time frames they represent). It may have goal reports at certain key points in the project and interim reports at points in between those goals. Or, in addition to more informal monthly and weekly reports it may have more official phase reports that re-articulate the events of a particular span of activities that represents a coherent piece of the project.

Progress reports become a permanent record of how a project was accomplished. In some instances, these reports enable another person to take over your project if you are reassigned. Often these reports are considered appropriate if they contain enough information to enable another person to understand and recreate your actions, but not so much that they become detail-laden. Progress reports can have legal standing if you enter into litigation, as establishing what actions happened when is often of issue. *Takeaway: These reports also function as a record.*

Some suggested content for progress report memos follows:

- State the time period for which you are reporting your activities.
- Refer to earlier reports and project management document if necessary and conventional in your workplace.
- Report your accomplishments during the reporting period in enough detail to enable someone else to recreate what you have done. Include dates, times, names of people with whom you worked, as well as information for people with whom you met or corresponded. If you received bids, procured data, or developed intellectual products, include information about how those things were documented and can be obtained, as well as what their current status is.
- Report any problems you encountered as you carried out your activities. This is not an admission of your failure, but a record of issues to address in the future.

Include information about how you addressed problems or how you plan to or would recommend doing so over future reporting periods. Then report on those outcomes in future progress reports as relevant.

- Set out your plans for the next reporting period in enough detail that your reader can determine whether you have accomplished these plans.

FINAL REPORT/HANDOFF REPORT/PROJECT REPORT A significant culminating report is typical at the end of a large or complex project. This report often contains a narrative of the project that rearticulates the initial problem being addressed and justifies the work that has been completed. Sometimes this report contains a blow-by-blow recount of project work—including drafts, mistakes, and unplanned occurrences—while other times it contains only the final form that a product took or the final outcome of an intervention or service (like some final data or the final state of some newly developed process). Sometimes this report is intensely technical and contains appendices with all of the data and calculations and drawings made throughout the project, and other times it is more like a communication between the managements of firms rearticulating their goals and values and the general outcome, while maybe referencing where technical details can be found. Conventions of the workplace and, in a consulting situation, the desires of a client drive the content of this report.

One technique for writing a final project report is to begin by carefully reviewing any initial project proposals, contracts, client communications, or project management documents that set out an agreement for your project activities. Collecting requirements, needs, and desires from the documents will enable you to detail how you met these obligations, accomplished the agreed-upon tasks, and fulfilled the agreed-upon terms of your project. If your agreements specified report sections, topics, necessary attachments, or other required information, you should follow these specifications to prepare your report. *Takeaway: These reports often review known events.*

If you are unsure about how to structure a final report, find one that was previously written for a project within your organization that is of similar scope. You may be able to find this type of document in the files of completed projects or by asking your supervisor or one of your colleagues for samples of their reports. Make sure that your report reflects your organization's format and style, which you can emulate from samples of previously effective reports.

You can often recycle information from previous documents (like interim reports or an initial proposal), but you'll want to adapt that text. Most reports discuss actions and events that occurred in the past tense but make statements about current operating conditions or the existence of a final product in the present tense. So, you can cut and paste sections from previous documents into your report, but you will want to carefully edit the report to be sure that it is a coherent presentation of your information at the completion of your project. *Takeaway: These reports can contain text from previous documents.*

FEASIBILITY REPORT/COST-BENEFIT REPORT/PROFESSIONAL OR TECHNICAL RECOMMENDATION In some situations, you may be asked to use your expertise not to implement a solution but to decide what course of action should be taken (or if any should be taken at all). The criteria used to make this kind of decision are often partly made up from professional standards (like safety and feasibility) and partly made up from the motives or desires of the person asking for the analysis (cost, duration, efficiency). The report may be prepared quickly based on articulated wants and resources or it may be prepared at the culmination of a long period of study, experimentation, and design. Some engineering firms provide advice in this manner exclusively and others use this kind of report as an opportunity to recommend services or products that they can provide. (As such, ethical sensibilities about giving advice and ways of justifying recommendations are often customary and professional organizations and companies often have procedures or practices specifically related to these kinds of communications.)

Leslie Olsen and Thomas Huckin set out five criteria with which to evaluate the feasibility of a proposed solution [1]:

- *Effectiveness*: Is the solution effective? Will it solve the problem posed? Why? How do we know?
- *Technical Feasibility*: Can the solution be implemented? Does it require technology or resources that are unavailable? How do we know?
- *Desirability*: Would we want to implement the proposed solution? Does it have any undesirable effects? Does it have desirable effects? Why? What are they?
- *Affordability*: What will the solution cost to implement? To maintain? Is this cost reasonable? Is it affordable? Will it reduce costs in the future? Why?
- *Preferability*: Is the solution better than or preferred over any other possible solution? Why? *Takeaway: Technical opinions are often evaluated in these terms.*

These criteria address different aspects of feasibility: technical, economic, social, and ethical. In deciding whether or not to implement a solution, all of these considerations may come into play.

DESIGN RATIONALE REPORT/POST-MORTEM As the name implies, this report contains the reasoning behind a design, justification of design decisions, and a description of the principles on which design decisions were based. It may also contain an enumeration of rejected designs and approaches. Having a record of design decisions may be useful for demonstrating your expertise or for justifying your recommendations when presenting project ideas to current clients. This record can also provide important information for future designers who might modify the current product, such as software developers working on later releases of a product who may not understand why a particular feature was coded in an atypical way.

Wang, Farooq, and Carrol suggest organizing a design rationale report to answer these questions [2]:

- What are the toughest design problems you faced?
- What alternatives did you consider for solving these problems?
- What were the pros and cons for each of these alternatives?
- What alternative did you choose and why did you choose it?

In industries and workplaces where design rationale reports are common, they are often started at the end of a project and, as such, tend to capture only the exiting logic of the product and only the largest or most recent decisions. In a long or complex project, it may be difficult to remember a small but important decision made months earlier or to keep track of the dozens of smaller adjustments that were made to accommodate a certain feature working a certain way. The best way to produce a thorough design rational report is to work on the reports throughout the project. If small decision justifications are prepared as needed throughout the project (or even periodically as progress reports are prepared, for instance), these reports can be collected to form the body of a design rational report at the end of the project. *Takeaway: Gather information throughout the project.*

Research Report Research is done in a variety of work sectors and is the chief responsibility of a certain segment of engineering and technological professionals who are charged with characterizing materials, testing potential solutions, and considering the efficiencies of various mechanical and industrial configurations. Experimentation and testing are typically the work described in the report and so the report is more about findings and an explanation how they were determined than it is about a recommendation for a particular action. Whether the professionals doing research call themselves scientists or engineers is, to some degree, a matter of organizational culture; either way, they are likely to discuss their findings in a report that becomes the new common knowledge of the organization and that may be relied upon for future decisions.

One common structure for a research report is the IMRaD model. (IMRaD stands for Introduction, Methods, Results, and Discussion, the names of generic section of a scientific report in that model.) This model, which comes out of the research publication tradition, relies on sections that mimic the moves of the scientific method (which roughly could be described as a process of declaring a hypothesis that's grounded in existing knowledge, doing an experiment and collecting observational data, and analyzing data for conformity to the hypothesis).

This organization may or may not apply to research findings that are being circulated for internal corporate needs, however. Readers of corporate research reports will likely want findings and the degree to which those findings are reliable without having to read about your method. Capturing the method may be important for

recreating those findings later or so that a colleague with similar technical knowledge can evaluate your process, but for an audience looking for the outcome of research it's a distraction. Because of this, some research reports in organizational settings are prepared in the IMRaD form but with a table of contents directing readers to the parts they need, some are prepared with a separate cover letter that gives the results orient audience what they need without reading the report, and some don't rely on the IMRaD model at all but invert that structure or break the parts of it down into separate reports (like a research results report and a research setup report). *Takeaway: Consider what the research report may be used for.*

Parts of a Report Sometimes you may have an initial proposal or contract that specifies required sections or elements for your final report. In these cases, exactly follow these specifications. In other cases, the report format is left to you.

The elements described here are those found in many reports, even though the sections may have different names. For example, almost all reports contain a section that introduces the context of the problem; here we call that section "Introduction," while others may call it "Background" or "Foreword."

When you write headings for the sections of your report, you have the opportunity to summarize main ideas for busy readers. These summaries of the main ideas in sections of your report help readers understand your main idea in each section and in your graphical representations of information. They function as signposts that guide your reader through your writing. If you title the first section of your report "Introduction" it doesn't really add to the reader's understanding of your ideas. (In fact, the reader probably already assumes this first section is an introduction because it comes first in the report.) Using a key idea for a section name, such as "New Air Pollution Standards Ban Coal-Burning by 2020," sets up the problem that you will address and creates a sense of significance for your client. *Takeaway: Specific titles can be useful for readers.*

TITLE PAGE The title page should include this information:

- Descriptive project title (the same as on your proposal, if applicable) that says what you have done relative to your subject
- Names of all project team members, indicating what job titles they held on the project, if appropriate, report submission date
- Person and organization receiving the report

The title page can also include this optional information:

- Project beginning and completion dates
- Total amount of project funding
- Brief abstract

ABSTRACTS AND AUDIENCE-SPECIFIC SUMMARIES The abstract is placed either on the title page or on the page following the title page. This is probably the most important part of your report, since it is the section that everyone will read. Decision-makers can form strong impressions of your project after reading only the abstract, so be sure it accurately represents the information in your report.

The abstract summarizes your report, not the project itself. In other words, briefly include the main ideas from your report as a document; do not simply describe what happened with the project.

Most often, you will write the abstract after you have completed your report. Since it is such an important section of your report, leave enough time to draft and revise your abstract. As you draft the abstract, revisit the values and motivations of the decision-makers. Which of their concerns are most central to your project? How does your project address these concerns? Think carefully about why the decision-maker should find your recommendations appropriate for the problem and implement them.

The abstract should include these items:

- Brief background to emphasize the significance of the problem
- Problem statement
- Brief description of the project and its objectives
- Beginning and completion dates
- Brief description of financial information
- Foreseen problems/questions that decision-maker might have and responses to them

TABLE OF CONTENTS A table of contents should be included for longer reports with many sections, graphics, and appendices. This table of contents is a glimpse of the entire report and shows the reader the big picture of the report at a glance. If you write section heading and subheadings for your report that state the main idea of those sections, the table of contents can provide a great deal of information for busy readers who may not want to read the entire report.

The table of contents should list the sections and sub-sections of your reports, along with the page numbers where these sections begin. List your appendices in the table of contents.

If you have many graphical illustrations, you may want to include a table of figures after your table of contents. Each of your tables, figures, illustrations, and other graphics should have a number and a descriptive title under it. List these numbers and titles in the table of figures, along with the page numbers on which these figures can be found.

INTRODUCTION The introduction provides background for the problem that prompted your project. It should orient your reader to the situation and context surrounding the problem, as well as create a sense of significance for the problem

and for the project. As you think about the significance of the project, reflect back on your evaluation of the report's rhetorical context. Who are the decision-makers? What do they think is significant about the problem?

Introductions usually begin by stating a rationale for the problem and project. Providing a history of the problem can accomplish this goal. You can review how other people have addressed the problem, most often through past research and professional articles on the problem. *Takeaway: Introductions often review project history.*

Once you have reviewed the history of the problem, you can identify gaps in past attempts to address the problem. In other words, you identify what other people's work has left undone that has led to the current problem.

Finally, your introduction states how your proposed project will fill the gap left in other people's work and solve the problem. This leads you to the next section, which is a detailed description of your project. *Takeaway: Expressly state your document's purpose.*

If you wrote a proposal for your project, much of the introduction from that proposal will fit into the introduction of your report. Be sure that the information in the proposal introduction is still relevant to the final project. Sometimes projects change in midstream and the proposal introduction may not reflect these changes at the final report stage.

OBJECTIVES The objectives section sets out how you or your team will accomplish the project's goal. The objectives that you articulate also serve as the evaluation measures of your project outcomes, to determine where your project has achieved its outcomes and where it has fallen short.

In many technical and scientific fields, objectives and outcomes are quantified. To write operational objectives in one of these fields, state project outcomes in terms that can be concretely measured. For example, you can count frequency of occurrences of an indicator of success, for example, telephone calls to your support staff. Or you can determine a change in quantities or frequencies of an indicator, for example, decrease in telephone calls to your support staff. Or you can account for changes in incomes, expenses, or profits.

If you have written a proposal for your project, you probably included these objectives in that document. You should use these same objectives for your report to evaluate how well you achieved your project's goal.

THEORY, APPROACH, METHODS, DATA, ANALYSIS Specific technical details of an approach, of a physical system, or of a product or project are found in the middle sections of a report. These sections might have generic names, like "Method" or "Data Analysis," or specific names, (like "Toxicology Analysis" or "Preliminary Results of Clinical Trial T-17").

In many technical and scientific fields, readers expect a specific pattern of sections and subsections. For example, they may expect to see data presented separately

from information about analysis or collection method or a discussion of equipment used. In other fields, combining the discussion of one or more of these pieces (often the data and analysis) is more appropriate. To find out what is appropriate for your field, look at reports written by your colleagues or published in journals of your field, or ask around. The following discussion assumes that each piece is discussed separately. *Takeaway: Some reports discuss these elements together.*

In the methods section, include sufficient details for decision-makers, and especially technical staff, to understand what you did in your project that led to your data, analysis, findings, and recommendations. Technical staff will want to evaluate your methods in order to better understand your results. The most difficult aspect of writing this section is including the details technical staff will need to make in their evaluation. You might have a colleague read through this section to be sure you have included enough information. If your methods are unusual, include a justification for them.

In a data section, include the details of the findings that resulted from your activities described in the methods section. When you present your data, you will probably need to graphically represent your findings to make your data easier to understand. Present only the data in this section without much interpretation of what it means.

After presenting your data, include a section in which you explain your analysis of the data. Remember, data does not speak for themselves; you need to explain what they mean. Presenting a detailed explanation of your analysis of the data is especially important because technical staff will look at the data carefully and could come up with different interpretations than you have. Technical staff could even come up with interpretations of your data that conflict with your recommendations. If you do not thoroughly explain what you saw in the data and prepare the case for your recommendations, you increase the probability that technical staff will disagree with your findings and your recommendations.

Findings and Recommendations The conclusion of your report includes your findings and, if appropriate, your recommendations, both of which should logically follow from your data and analysis. After you have explained your interpretation of the data, you can then clearly state your conclusions or findings as they relate to the project objectives and goal.

To state your findings, take the objectives from earlier in the report and show how your data relates to those objectives. For example, if your objective was to decrease customer calls to the telephone support staff by 10% in 3 months, you can count the number of calls, compare it to the number at the beginning of the period, and calculate whether you have met your objective to reduce the number by 10%.

Not all reports make recommendations. If making recommendations is appropriate for your report, do so after you have set out your findings. In the example above, if the support staff calls had been reduced by 12% in 3 months, you would have probably recommended that the solution be implemented as tested during the project. If the

calls had been reduced by 5%, you would probably have recommended some other solution be tested based on the negative result. Include enough detail to adequately explain your reasoning to decision-makers.

Your recommendations will probably have a price tag with them and you need to clearly and accurately forecast costs associated with implementing your solution or with further testing. If your recommendation is contentious, you may need to take extra care to justify costs or make costs seem reasonable, as professionals often argue against work they disagree with by suggesting that it is too resource intensive for the suggested benefits (even when resources are not really the reason they want the work stopped). *Takeaway: Consider whether your message is contentious when explaining costs.*

SOURCES Documentation of your sources is important if you have used materials prepared by people outside your project team or have included findings from other people's research. You can include this documentation in a Works Cited or References section at the end of your report, or in footnotes within your report.

If you have used a graphic prepared by someone else, you may need to get that person's written permission to use that graphic. In this case, you will want to include a copyright statement in your report either below the graphic or in an associated caption.

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If you did not have to obtain permission for the material, you can include a traditional citation such as this:

B. Longo, "R U There? Cell Phones, Participatory Design, and Intercultural Dialogue," *IEEE Trans. on Pro. Comm. vol.*57, no. 3, pp. 204–215, Sep. 2014.

The citation should include all the relevant information necessary for someone using your document to find that source. The exact format of the citation may not matter in an internal document or working document, like a progress report. If your document is leaving your organization, however, or if it's being published, you will want to consider if there's a particular format that your organization uses. You may want to adopt the format prescribed by a professional community or trade association.

A comprehensive guide to IEEE citation formats (as well as usage and abbreviation recommendations) can be found by searching for the IEEE Editorial Style Manual on the IEEE website.

APPENDICES Appendices to your report are where you put material that is relevant to your project, but too detailed to include in the main sections of your report. For example, if you wanted to show the calculations leading to one of your findings, you would put them in an appendix rather than include them in the methods section. Or if you had tables of data points that technical staff might want to evaluate, you

would put them in an appendix because most readers would find that information confusing.

Specifications

A specification document defines requirements for a product or service in terms of its outcomes or attributes. A focus on outcomes, rather than a step-by-step narration of a project, enables technical professionals to make agreements with, for example, a client that does not have the expertise to know how to complete the project alone and therefore is unable to dictate how work be done. A client that needs a software solution, for example, may be able to articulate the function they need software to perform without being able to specify how the program should go about performing that function.

Specifications are an articulation and prioritization of needs in terms that enable technical professionals to use their expert discretion to best meet those needs. Specifying work details that are immaterial to or nonexclusive to achieving a result may enable a worker in a certain situation to complete a task, but ultimately not useful. Described needs and desires enable the technical professional to use their expertise to offer suggestions and customize solutions. A shop procedure, for example, may be written to require a part be made to have a shape, fit, or finish without specifying the tools used to make the part or the processes used to finish it.

Types of Specifications

TECHNICAL SPECIFICATIONS This type of document should provide enough concrete details so that the outcome of the project would be the same, regardless of who worked on the project team. Ideally, a future project team with entirely different people should be able to work from the technical specifications and come out with the same product as the original team.

Project managers use technical specifications to determine the resources necessary to complete the project successfully. For example, the specifications should include details about necessary materials and equipment to determine a budget for these items. They should also include details that will enable the project manager to determine how many people will be needed on the project and when they can expect to deliver the finished product. Technical specifications might also specify how the work done on the project is related to past work or work done in various segments of the organization.

Your technical specification document can also be the starting point for other related documents, such as patent applications, technical presentations, or manuals.

FUNCTIONAL SPECIFICATIONS This type of document provides details about what a new product should be able to do and how people will use it. For example, if you are on a team that is developing a new piece of computer software for a client, you would

define all the functions performed by the software, constraints on these functions, and the software's intended appearance. Functional specifications are usually written from the user's perspective and do not typically describe any details would not be apparent to someone using the product. This document may also include descriptions of user tasks or usability criteria.

Other members of your team will use functional specifications to guide the design of the product. Your original version of the functional specifications may need to be revised as your team changes the design or finds new constraints during the design process.

Members of your design team will use the functional specification document as the basis for developing other project documents, such as test plans, help screens, or user documentation. If your team is developing a software product, the functional specification document serves as a guideline to developers as they write programming code.

Parts of a Specification Document Advice for writing engineering specifications is often found amidst advice on technical contracts and legal writing for technical fields. This is because, as Paul Fitchett and Jeremy Haslam have suggested [3], contract agreements in engineering are a collection of interconnected legal documents (like liability agreements), business documents (like project management timelines), and technical documents (like drawings and the specification itself). The specification in this collection functions as a technical reference, the enforceable extension of a contract, without being a contract itself. It can therefore use conventions of technical and professional discipline rather than of the law, but it is often carefully and deliberately written.

The elements described here are those found in many specification documents, even though the sections may have different names. A pragmatic approach, using existing specifications and contracts documents as a model, is the most reliable approach to creating a new document in a mature corporation. Without a model, however, you might consider that the purpose of a specification is to be an enforceable work agreement, much like a contract. And that, as a technical professional, defining your technical terminology that of your client often forms the basis on which mutual understanding can be reached.

Introduction or Overview The first section of the specifications should orient your reader to the situation and context surrounding your project. If your team wrote a proposal for your project, some of the introduction from that proposal will fit into the introduction of your specifications. For example, you might want to include information about the problem being addressed or the need for the project. Be sure that the information in the proposal introduction is still relevant to the project. Sometimes projects change in midstream and the proposal introduction may not reflect these changes in the technical specifications.

An introduction to your specification document will probably include information about the project's purpose, scope, and deliverables. It may also include definitions of terminology or concepts that you will use in setting out the specifications, as well as information about other documents that relate to the specifications.

WORK PROCESS This section of your specification can describe how your team will go about analyzing the design problem, discovering relevant information, and recording these steps of the design process. This section of your specifications can describe how you will develop a model or prototype of the final deliverable. Project managers can use this section to determine a timeline for the project, as well as the staffing and resources that will be needed at points along that timeline.

DESCRIPTION OF CURRENT PRODUCT If you are writing functional specifications, you will want to include information about the current state of the product. This description will provide a context for the details of the product's function that you will address in your specifications. You will want to include information about the product's features that you will be testing. For example, if you are developing a website, you would want to specify functions of site navigation as one of the features in your specifications. In addition to the product's features, you will probably include information about the type of people you foresee who will use this product and the environments in which they will use it. You might write personas and scenarios in this section of your specification.

DESIGN CONSIDERATIONS This section of your specifications sets out project design objectives and constraints. Design objectives are usually performance characteristics that can be measured, such as throughput rate or process yield. Constraints are limiting factors, such as cost, space, safety concerns, environmental impacts, or waste production. Other design considerations can include safety, recyclability, durability, aesthetics, energy use, etc. The design considerations you cover in your technical specifications document will depend on such things as your workplace situation, your organization's purpose for the project, your potential audience's concerns, legal guidelines, or any number of other topics.

TECHNICAL DETAILS In this section of your specifications, you will provide information about the project's technical considerations. For example, you might cover how the component your team is designing needs to be compatible with other components in an existing system. You might also include information about physical attributes of the product your team is developing. The information you include in this section depends on the nature of your project—its requirements and constraints. It is likely that you will include graphic illustrations of your information in this section, such as schematics, diagrams, graphs, tables of information, etc.

You might have a section on requirements, providing details on the hardware, software, database, performance, and security requirements.

If you are writing functional specifications, you will include information about each system feature that is addressed in your project. One way to communicate this information is to list each feature with information describing the feature, its stimulus/response sequences, and its functional requirements. You want to show how the features relate to each other and to other elements in the system.

POLICIES AND MANAGEMENT Your organization may have existing policies that cover administrative concerns that relate to your project. For example, your organization may have guidelines about how information is managed and stored. Your organization also has an administrative structure that governs how people report within the organization and how they interface with people outside the organization. In this section of your specifications, you should set out any relevant policies and procedures that relate to the management of your project and the working relationships among your team members and other people working on the project.

TEST PLAN Developing a test plan based on design specifications is necessary for the successful acceptance of a project's deliverables. Although your team may be required to develop a full test plan as a separate document, you should at least give on overview of the plan in your technical or functional specifications.

A test plan should describe the test process and criteria for testing a project deliverable. You should include the scope of the testing, which are the features that will be tested and features that will not be tested. The test plan also describes the testing methods, data that will be gathered, and the testing environment.

REFERENCES In this section of your specifications, you will list any resources you used to prepare the document. This will enable other people to retrieve information from the sources you used.

APPROVAL This section of the technical or functional specifications reflects the approval process that the document must complete in order for the team to proceed with the project. This section should include space for necessary signatures, dates, etc.

Special Lexical and Syntactic Considerations in Specifications

Because specifications have a close relationship to engineering contracts and project management documents, they often inherit language practices from those documents. Specifications, for example, sometimes use defined nouns like "Client" and "Acting Engineer on Site (AEoS)." These nouns are defined at the beginning of the document, always written with a capital letter, and sometimes even written in some kind of mechanically constrained way (like without articles "a" and "the"). In this usage, these words stop being the common words (like "client") and start becoming tokens of some specific meaning or responsibility that can be used in mathematically logical

ways without fear of misinterpretation. (This kind of safeguard against misinterpretation, it is notable, doesn't rely on the objectivity of the language. Instead, it relies on the fact that parties have formally agreed to read the document a particular way that isn't usually available, which can make these documents seem rigid.)

Modal modifiers are often carefully controlled in specifications documents. Some sectors rely on specially pre-defined sets of modals and exclude all others as non-meaningful. You might see a specification, for example, that is based on the words "may/should/shall" or on the words "may/must." These words are often defined at the beginning of the document and may be written with a special typographical convention (like an underline) throughout the document. A definition of a modal word can be quite specific to the project. For example, the word "may" could mean that a contractor provides a service at his or her discretion, or it could be used to allow a range of non-purposive ways in which a function could behave (as in: "Action menus may prompt for the closure of open palates."). Modal words may also be defined with respect to each other, in which case sets of words like may/should/shall are often represented as a hierarchy of priorities. *Takeaway: Common words often have special meanings in specs.*

Active and passive constructions can be used to indicate where action is required or to remove the need to act from a party. The active phrasing "The Client will note defects before 19 Mar 2012." suggests that the client has a deliverable in the process, which is their list of defects. On the other hand, the passive phrasing "Defects must be noted by the Client by 19 Mar 2012." suggests that defects are at issue and the client is expected to notify the vendor if there are any.

References

1. L. Olsen and T. Huckin, *Technical Writing and Professional Communication*. New York, NY, USA: McGraw-Hill, 1991, p. 280.
2. J. Wang, U. Farooq, and J. Carroll, "Does design rationale enhance creativity?," *Hum. Technol.*, vol. 6, no. 1, pp. 129–149, May 2010.
3. P. Fitchett and J. Haslam, *Writing Engineering Specifications*, 2nd ed. New York, NY, USA: SPON, 2002.

4

Writing to Enable: Instructions and Guidance

- *Instructions and guidance documents enable people to accomplish a specific task. They also represent the relationship that you want to establish and maintain with your audience.*
- *The purpose of an enabling document is to communicate to your reader the way they might reliably accomplish a task. Identifying a set of goals that readers might have allows you to specify which uses your document is intended to support and to develop a structure for your document that meets diverse needs.*
- *Audiences for your document can be people who use your product or service, mass market consumers, private clients, or members of your organization. In addition to having their own purposes, familiarity with your product, and reading style, users of your enabling document will also have a use context that contributes significantly to how they access your text.*
- *Instructions can be tested for usability either by formal protocols or by simply asking someone who is unfamiliar with your instructions to execute them while you watch.*

The IEEE Guide to Writing in the Engineering and Technical Fields, First Edition.
David Kmiec and Bernadette Longo.

- *Some typical enabling documents*
  - *Manuals/guides*
  - *Instructions/directions/procedures*
  - *Tutorials and training materials*
  - *Policies*

Introduction

When the documents discussed in this chapter are used in the workplace to enable people to accomplish a specific task (take a measurement, assemble an apparatus, or operate a piece of equipment), they are instrumental in helping people get their work done. When used outside of your organization, they not only help people engage with your products and services but they also represent the relationship that you want to establish and maintain with your customer. From the general statements of values and concepts made in policies, to the conceptual advice offered in guidance documents, to the specific task-oriented actions in instructions, these documents are an important way that your organization shapes its internal processes and interacts with its consumer audience.

As the writer of an *enabling document*, you select what information to include and you organize that information in chunks that are easy for your reader to follow. You establish an authoritative tone by selecting the appropriate explanatory context and by consistently presenting imperative information in a logical and visually obvious structure that guides the reader through a thought process or activity. Instructional documents derive authority primarily from their logical organization and from the way that organization seems to meet a reader's need for completing an unfamiliar task one step at a time.

The Purposes of Enabling Documents

The immediate purpose of an enabling document is to communicate to your readers the way they might reliably accomplish a task. In most cases, though, a reader who is using your product or engaging with your process is doing so for some larger purpose or need. For example, someone reading instructions for their new mobile phone probably wants to use it to make a phone call or send a text message, not to learn the technical details of the phone.

The diversity in readers' goals for using instructions poses an interesting challenge to preparing an effective enabling document. Identifying a set of goals that readers might have allows you to specify which uses your document is intended to support and to develop a structure for your document that meets diverse needs. As an IT professional, for example, you might write a procedure for people in your

organization to follow as they scan for and collect files for archiving. Employees of your organization might use a portion of your procedure when they perform other operations, like collecting files to provide as project team members change, or scanning for files to delete in an effort to clean up their digital work environment. Considering these uses might lead you to subsection your instructions or to include notes or warnings at key steps specifying how to diverge from the instructions (or discouraging readers from diverging). *Takeaway: One purpose is to detail specific tasks.*

In fact, sometimes the diversity of context or of users' goals is the central factor in preparing an enabling document. Many enabling documents used in workplaces are designed to support standardized action or decision-making. Professionals who manage and maintain complex infrastructural systems, programmers who write applications that interact with third-party platforms and operating systems, and designers who deal with machines interacting with the human form all rely on best practices recommendation documents known by names such as *guidance*, *guidelines*, or *standards*. These documents are often produced by regulatory agencies like the Environment Protection Agency or Occupational Safety and Health Administration, standards groups like the International Standards Organization, or by corporations like Microsoft or Intel who maintain a software package or manufactured technology product with features that are central to other professionals' designs. *Takeaway: These documents also maybe intended to standardize actions.*

Inside an organization, procedural documents that specify how documents should be archived, how decisions about resource allocation should be made, or how labor should be accounted for are key to the operation of large scale enterprises, and they shape the effectiveness of organizational management. Policy documents, which detail the general practices of an organization and declare relationships, goals, and responsibilities, often contain discussions about best practices that serve as targets for (or boundaries for) appropriate action without specifically discussing how to act in every possible situation. Because organizational dynamics can be complicated, specific procedures are often written with more general policies in mind. *Takeaway: They also may articulate general ways to act.*

Organizations want to create a productive work environment that operates in a predictable way because management believes that employees function better in a regularly run workplace. They also want to minimize the costs associated with employee turnover, workplace injuries, and civil action. Enabling documents in these cases—from single purpose instructions to broad policies—have the primary purpose of enabling users to take actions in accordance with standardized specifications. From an organizational point of view, the purpose for facilitating user action outside the organization is also varied. Companies want users to be able to use the products that they purchase because they believe customers who have a good user experience are good for business. They also want to minimize returns or calls to customer support and to shield themselves from liability when a customer attempts to operate or assemble a device the wrong way. *Takeaway: And they can be deployed internally and externally.*

Occasions for Preparing an Enabling Document

When you introduce a new product or process, you are often responsible for explaining its functions to its intended users and providing those users with reliable and appropriate methods for operating the product or implementing the process.

Consumer products that require assembly or have complex features customarily come with assembly and/or operating instructions. Durable goods (goods that have a lifespan like vehicles and appliances) may also come with maintenance instructions. How these documents are delivered depends on the nature of the product and the way the product is packaged and purchased. While complex computer programs might come with a separate manual of operating instructions or might refer users to a dedicated instructional website, they might also embed help within the interface itself through online help or through contextual signals like tooltips. *Takeaway: Manuals often accompany consumer products.*

Engineers and technical professionals often participate in the production of consumer instructions even if they do not fully develop them themselves. Companies that produce consumer goods often have a staff of professional technical writers who prepare final documents for publication. Technical writers work with product developers to understand the product and the needs of the consumer and then work to deliver documents in a way that assures organizational standards and best practices are being met. In other words, for any enabling documents that leave your company for consumer use, your work may be in a partnership with a professional writer.

When products and processes are prepared for private clients rather than the general public, enabling documents are likely to take a form of the client's choosing. In these cases, identifying how the client plans to use the product—something which has probably been part of project specifications and agreements already—is an important step in organizing product documentation and deciding which kinds of operations need instructions. When asked, a client will often tell you exactly what tasks they need instructions for and how much context they would like built into their documentation. *Takeaway: Private clients contract for products or work processes.*

Enabling documents are also prepared to manage internal organizational processes and workplace practices. Organizations use procedures to describe how people carry out routine tasks. Procedures help to standardize operations and ensure consistency in the processes carried out in your organization. Having written procedures can also help to ensure that your organization complies with legal and ethical business practices. Written procedures are like instructions for how people in your organization conduct business. *Takeaway: Organizations use procedures to regulate work.*

Audiences for an Enabling Document

The people who use your product or service may be mass market consumers, private clients, or members of your organization. They may have technical

knowledge of the product they are using or may have no understanding of how it works. Readers who have no familiarity with your process or product may be likely to misread or misunderstand instructions. Because they don't understand the underlying logic of your process or product, they may get several steps further into an operation before realizing they are unable to continue, and then they must retrace their steps or give up entirely. On the other hand, readers with some understanding of the principles that underlie your instructions may use them partially, combining them with their own intuition in order to complete a task. For instance, people who are mechanically inclined often use instructions to guide their own intuition when assembling a device, just as people who cook regularly often see recipes as more suggestive (of proportions or methods) than authoritative. *Takeaway: Users may not understand your product.*

Even when users do not feel the impulse to ad-lib, they are unlikely to read a set of instructions or an instruction manual in its entirety. When instructional documents contain more than one operation, you should not assume that people will read the portions of the document that do not immediately pertain to the operation they are trying to complete. A section of warnings located at the beginning of a maintenance manual is rarely read by readers seeking to perform a specific operation located in the middle of the manual. *Takeaway: Users may not pay attention or read carefully.*

Because of this, manuals and other collections of instructions and procedures often contain a significant amount of redundancy—repeated warnings, repeated language about how to perform minor functions or operations that are required to complete larger tasks, even repeated diagrams and explanatory text. A successful instructional document appears authoritative to the reader because it anticipates readers' understanding of the process being done and provides appropriate context to make the actions taken seem sensible at the point of the document where the reader actually reads.

Key Communication Strategies When Writing to Enable

Anticipating a Document's Use Context

Users have their own purposes, varying degrees of familiarity with your product, and individual reading styles. As well, they will also have a *use context* that contributes significantly to how they access your text. A use context is the set of environmental and social factors that motivates the user to pick up your document and use it at the moment they do. Installation or assembly instructions that come packaged in flat-pack furniture, for example, have probably been written with the idea that users will be in a home, office, or maybe retail space, and that they will have access to appropriate lighting and enough floor space to lay out the pieces side by side and to rotate them as needed. The instructions might be written so that a consumer can assemble the

furniture alone, or the instructions may specify that a helper is required. The kit that comes with the instructions may include wrenches so as to assure the consumer has appropriate tools.

Instructions for assembling flat-pack furniture or for installing a program or for creating a user profile are typically not written with the idea of urgency or danger in mind. Instructions for assembling equipment that is heavy or has sharp edges or electrical connections, for mixing chemicals or fuel additives for use in an agricultural setting, or for operating fire extinguisher, however, must be written with an awareness of how someone might attempt to complete the task at hand, an awareness of the environment in which they might be completing that task, and with a sensitivity to the urgency or emotional state they might be under when performing the directed operations. *Takeaway: Some users are working under pressure.*

Your sense of the use context of an enabling document may lead you to consider communicating through graphics more than text. It may lead you to consider the vocabulary you use or the visual cues you use to indicate actions and warning material. It may also lead you to consider the way your steps are subdivided and the way the instructions you are writing fit into the organization of the larger document containing them.

The following are some questions you may ask when considering how the use context of your enabling document might affect its composition:

- In what environment would someone ideally perform the operation I am describing? What variations in this environment might affect the ability of a user to perform the operation? How might this variation be mitigated by informational text? By changes to operational steps? By publication medium and format of text on the page/screen?
- Does the product or process pose any risks or dangers to people or property that environmental adjustment can mitigate? Are any components flammable, noxious, or carcinogenic? Are components sharp, hot, bright, loud, or particularly heavy? Is electricity involved? Are supplementary materials required to perform the operation hazardous (like lubricating grease applied to bearings or acetone used to prepare a surface)? Under what circumstances might minor risks become more serious? How might the environment be arranged to mitigate accidents (e.g., working in a dry or well-ventilated area, wearing protective garments, ensuring others are present during the operation)?
- What factors of the environment might damage the product or disrupt the process? Does the user need to take steps to avoid exposing the product to heat, light, moisture, or static electricity? Should the user close applications that may conflict with a software operation before beginning the procedure? Should a user only perform the operation with his or her device plugged in or unplugged?
- Should the product or process only be used in certain circumstances?

Affirmative answers to these questions may lead you to consider adding steps, warning text, or pre-procedural specifications or to change the format or delivery of your instructions. Be realistic though. Many potential problems are normal problems and will be addressed in a normal way by your audience. Technicians who routinely do repair or maintenance work on HVAC systems located in basements or utility closets often arrive equipped with a flashlight. A few sentences at the beginning of a set of maintenance instructions specifying adequate lighting will likely encourage this user to skip to the next visually relevant portion of the document. It's important to inform your user of potential failure-inducing conditions, but cautioning users too much can make your procedures long and unwieldy, making users more likely to skip potentially important text. You may want to research instructions with a similar scope when considering how much detail you include. *Takeaway: Avoid unwarranted advice.*

Deciding How Much Background Is Warranted

Background is text that gives context for instructions and procedural steps. Depending on the expectations of your reader and the document's use context, the background contained within a procedure (or before or after it) may be minimal or extensive. How background is integrated into a procedural document may also depend on what kind of background it is, in other words, how it relates to the procedure.

For example, a procedure for appropriately shutting down equipment may derive, in part, from a safety policy or a manufacturer's guideline. In this case, the procedure may simply reference the document from which it derives in a small blurb of text that comes at the beginning. Or, if there is a specific safety topic on which the procedure depends (or if the user should apply that safety technique in only a particular part of the procedure), then a more directive statement may be warranted. In this case, if the safety policy is readily available to workers through corporate training or resources, a note may be placed in the procedure telling the user to follow the guidelines in the relevant section or part of that related document. If the policy document is not something that the worker is likely to retrieve or read, a caution statement may be placed in the midst of the procedure just before where actions warranting the safety technique are likely to be done. This caution may contain a short summary of the safety actions to be taken or may reproduce a portion of the manufacturer's guidelines verbatim. The safety information may also be built right into the procedure as a step or a series of subordinate steps. If the technique is required throughout the procedure, the procedure may begin with an instruction to seek out the reference safety document or to complete a corporate training module before performing the procedure. *Takeaway: Be realistic about a user's access to safety materials.*

These different placement options provide more or less room for background text, and make background text seem more or less integral to the procedure itself. The way background text is easily integrated into the procedure itself in some of these placement options also makes it apparent that what is background and what is

essential to the procedure is fluid. In part, that's because the background considered in this example could be operationalized into steps.

When background is more descriptive of how something functions behind the scenes or when it rationalizes why one method of doing something may be preferable (especially in opposition to the way a user may expect to do it), it is often harder to position in the procedure without it seeming like an interruption or a distraction. In those cases, the larger organization of the document in which the procedure is located can often be manipulated to support the logical inclusion of background information. If a series of procedures is contained in an operating manual, for example, subsections can be used to pair descriptive operating information with procedures. This enables users who want to skip this information to do so without the risk of missing procedural information—which is preferable to users attempting to skip this kind of information and accidentally skipping a procedural step. *Takeaway: Alternative sectioning may be more effective.*

If you are tempted to include extended discussion of system operations amidst procedures, you might look to see if there are generic documents in your community that provide examples to support such a practice. There is a fine line between including context and writing a document that is a mixture between a technical report, a textbook, and an instruction manual—a document rarely called for in practice.

Testing the Document with Users

After you have revised your instructions, do some usability testing on them. You can conduct formal testing or merely ask someone who is unfamiliar with your instructions to execute them while you watch. Based on this testing, edit your instructions again to clarify places where your tester had trouble understanding your instructions.

Build Testing into Your Work Plan Projects that involve product development and release, whether to a client or the public, work with tight deadlines. Documents like instruction manuals tend to be written near the end of a project after features are set and interface decisions are made. During the planning phase of the project, allocate time for testing into the time set aside to produce instructions. The time you spend doing even simple testing will help you revise your instructions to make them more effective.

Test with a Range of Users Test your instructions with a range of users who are more or less representative of people who will use your product or process. If your instructions will be used by people with a range of expertise, make sure that you select testers who represent users who are familiar and those who are unfamiliar with your kind of product. If you can gather as few as three people to test your instructions, you will gain a great deal of information to help you revise for greater effectiveness. If this isn't possible, have someone from your workplace or team try to use your instructions before you decide that they are finished. Information you may take for granted can

seem foreign to another person. Of course, the more people who test your instructions, the more information you will have to revise and improve the instructions.

Gain Permission If you are using testers from outside your organization, you will want to gain their permission to participate in the test. Your organization may have a particular procedure for selecting or screening testers. Then, when you sit down with your tester, you may want to provide a written explanation of your test for your tester to read before beginning to work with your instructions. You should consider whether you may need a tester's signature on a release of liability before you organize the test.

Provide Testers with Context You want testers to have a natural experience as they perform your operation. If they were actually consumers or workers performing a task, they would have a reason for doing it, they would understand the goal of the process, and they would probably know what other operations are possible or what larger device or system the operation they are performing belongs to. Provide this information for your testers.

Do Not Interfere Do not prompt users as they work through your instructions. It may seem natural to say things like "The switch is on the other side" or "Just connect that piece with one of the bolts." If the testers can't figure out those things without your help, you have just uncovered a place in the instructions that needs revision and clarification.

Communicate in an Organized Way Just because you don't interfere doesn't mean you can't communicate with testers. At a critical point in an operation, you might ask testers things like "What are you thinking now?" or "Tell me what's going through your mind." In some settings, testers are instructed to constantly comment on their thoughts as they work through the instructions. This "thinking aloud" can provide valuable information about how testers read the instructions, engage with an interface, or orient themselves to the task. That said, interacting with testers can distract them from the task and make them more conscious of you watching them work. Before beginning a series of tests, plan how or if you will communicate with the testers and tell them what you plan to do.

Look for Problems Pay attention to what does not go well as your testers work through the instructions. As mentioned above, do not help the tester complete the task. But do note where your tester has problems completing the task and even ask the questions mentioned in the previous paragraph. These problems will indicate where you need to concentrate your revisions.

Look for Successes Note what goes well as the testers work with the instructions. Successful instructions—ones that your tester followed easily—can provide

clues to how you might revise other less-successful sections. They might even reveal something about the product, like which interface patterns testers are comfortable with.

Make Notes Watching testers intently is important but, if the operation they are testing is long or complex, you may forget about pauses or hesitations you noticed earlier in the procedure. And, after watching several testers, you will certainly lose track of which ones had which problems. On the other hand, writing out long notes can lead you to miss important information. Plan ahead of time what kinds of things you will write down and how you will record them. You might even want to prepare a form (with the numbers of steps or with time marks) so that you can make simple, regular marks as notable actions occur. Or you may consider video recording the tests so that they can be dissected later.

Conduct a Post-Test Interview Question your tester after completing the test to find out what your tester thought and how accurate your observations were. For example, you could say something like this to find out more about a problem section: "It looked like you were unsure how to put those two parts together. What were you thinking there? How could the instructions have helped you more there?" Or you could ask, "It looked like it was pretty easy for you to put those two parts together. Were the instructions clear in that place? Were you already familiar with these parts from another project you completed earlier?" Your tester may bring previous knowledge to your task that helped to accomplish the task despite the instructions.

Revise Revise your instructions based on the information you gathered from your testers. You may find that you only need to reword instructions or add some more descriptions of consequences. You could also find that you need to reorganize your material or break your instructions down into more basic steps.

Product release schedules are often aggressive and, once a product is ready for market, incomplete instructions are not likely to keep it from going out. Instructions stored online have the advantage of being able to be dynamically updated as the product appears in stores. Products that require printed manuals or products that get turned over to private clients at the end of a contract, however, are often shipped with less than optimal instructional information. If an instructional testing cycle is long or warrants significant changes, you may run out of time to completely reorganize your document or to test it again before release. In this case, make notes and finish any retesting work while it is fresh. You can publish amended instructions on your product's website or sometimes you may even contact customers who register their product directly if you have concerns about an operation you've suggested. You might also save notes about changes so that when a new run of manuals is published, the documents can be updated and shipped with future products. *Takeaway: Consider time to test instructions when planning.*

Questions for Analyzing Existing Documents

When looking at sample instructional documents from your workplace environment, you can use these questions to help you analyze your writing situation:

- What kinds of audiences are addressed? How are varied audience groups or goals handled?
- How much background information has been included and where is it included (e.g., in a blurb before a procedure, within the steps themselves, through note boxes in the margin or between steps)?
- Does the organization have a standard format for presenting instructional documents? Are there standards for how complex individual steps can be or how many levels of sub-procedures are allowed? For introductory text or procedure naming conventions?
- How are instructions delivered to users? Are they published in print or online or adapted into videos or animations? Are instructions printed and sent with a product, delivered within the product (as is often the case with software), or are users required to seek instructions out online?
- How is warning or hazard information handled in instructional documents?
- What internal approval procedure exists for instructional documents?

Characteristic Enabling Documents

Manuals/Guides and Other Documents That Primarily Contain Instructions/Directions/Procedures

Instructions are a set of steps someone might take to achieve a certain outcome. They are often sequential, written in the imperative voice (as commands), and may be accompanied by graphics or notes about what a user may see or hear as they successfully complete an operation. Though instructions can be written in paragraph form, when written to guide operations performed on or with technical products or services, they are often composed as structured lists.

The terminology for instructions and individual instructional items varies. Obviously the term instructions is plural; you might call each of the individual actions that make up a set of instructions an instruction. In some workplaces, the word used to describe a single instruction is “step”; in some, it is “action.” Sometimes the larger instructional list is called “a procedure” instead of instructions—this term has the benefit of being singular which is useful in workplace discussions where people tend to talk about “a set of instructions” as a single thing (and where the term “instructions” seems unsatisfactory and “an instructions” seems ungrammatical). A few workplaces use the term “directions” as an alternative for instructions; this term is often used

when referring to navigational commands (like "turn left") but does not have to be used in this sense. Some military, emergency response and governmental units use other terms like orders, directives, and commands or use acronyms that represent extended phrases. Use the terminology established in your workplace (or your client's workplace) and people will be more likely to understand you and to believe that you know what you're talking about.

Types of Manuals/Guides The features of instructional documents are highly related to the objective those instructions are intended to fulfil and are often governed by corporate templates or style guide to conform to branding. Some instructional documents are named after the occasions in which those documents (and its contained instructions) are used: installation guide, assembly/disassembly manual, repair guide, etc. In some sectors, these documents have specialized names like FAQ (frequently asked questions), SOP (standard operating procedure), guidance, guidelines, technical publication, or bulletin.

Structuring Manuals/Guides Assembly instructions or other single operations may sometimes be published or distributed to clients or organization members as a procedure with only a title or a blurb about the action to be completed. However, products with several functions or settings often require several procedures to appropriately detail their operations. In this case, procedures are collected into documents like manuals and guides.

Both novice and expert users are typically more concerned with the task they are trying to accomplish than about the product or process they are using to accomplish it. If a suite of instructions for a sophisticated mechanical device like a modern multifunction dishwasher is organized by the features of the device or the buttons on the control panel rather than the functions, a user may be at a loss for where to look to find the instructions that tell them what they would like to do. If a user knew the right button to push to start the process, they probably could have figured out the operation themselves and not looked at the instructions. *Takeaway: Consider user goals when organizing.*

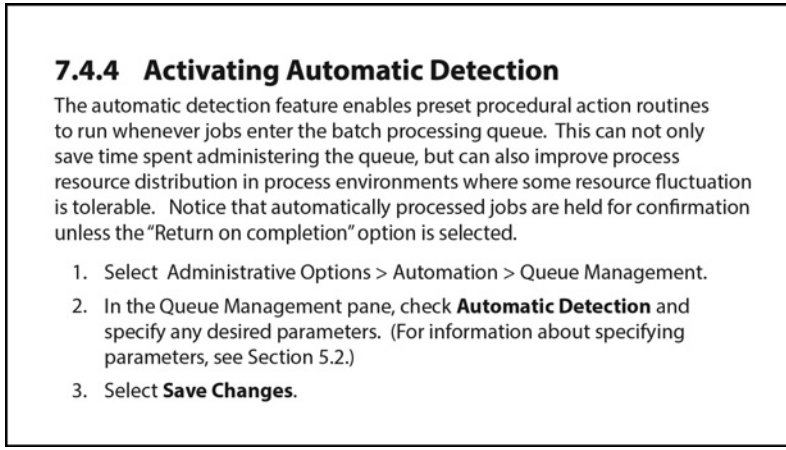
When writing a manual, organizing sets of instructions around tasks that a user might perform enables users to refer to a list of section headings or procedure names to find the procedure they need or, at least, a procedure which seems to be similar. It also enables authors of these manuals to write consolidated procedures. Depending on how the interface on that modern dishwasher is set up, you may be able to write one procedure for "Running a wash cycle" where the final step is to select from a list of options rather than writing three separate procedures for "Running a standard wash cycle," "Running an eco-friendly wash cycle," and "Running an express wash cycle." That said, a dishwasher with separate buttons for each of these three might enable a user to activate these cycles in one press, obviating the need for instructions at all. In a simple device, the amount of information and feedback designed into interfaces can complement or displace the need for printed instructional material.

In a small manual with several procedures, creating subsections to group similar procedures helps readers to digest the structure of the document and encourages them to consider the few operations they are likely to use regularly. Some manufacturers even ship appliances with two smaller booklets—one for installation, one for operation and maintenance—with the idea in mind that the first book is only useful when the device is first set up and can be discarded after. The second, smaller book might be less intimidating to a user who feels a device is complicated. *Takeaway: When possible, create small, well-sectioned manuals.*

In a manual that contains complex operations, however, sectioning and subsectioning are indispensable. Construction equipment, production machinery, and sophisticated power tools require deliberate and informed operation to ensure safety and success of the tasks undertaken. The large manuals that accompany these devices are often sectioned into macro-tasks like use, repair, maintenance, and storage before being subsectioned into more specific operations a user may want to perform. Although large manuals may be indexed, contain glossaries of terms and acronyms, and even contain foldout drawings, flowcharts, or concept maps, the task orientation of these manuals is reinforced by their organizational structure. *Takeaway: Often large manuals are organized by task type.*

On the other hand, some complex instructional documents are not task-oriented. Reference guides for software packages are often organized according to a product's features rather than the tasks a user performs. These guides often provide descriptions of the logic of the interface and operational capabilities of the software before going on to provide procedures for doing the operations implied by items in the interface or in menus. Some would suggest that, because software is a complex tool that enables a user to achieve a goal, a certain broad mastery is necessary in order to formulate tasks to be done using it. That said, contemporary software manuals are less likely to be relied upon for immediate task-oriented help than web resources or in-program contextual help features. In this sense, the software manual's logic is reasonable as it is only one part of a multi-resource use initiative (just as the interface on the dishwasher in the earlier example provided instructions layered into the interface).

Structuring Instructions/Directions/Procedures Unless they are simply written out in paragraph form (unusual in modern documents), individual procedures are broken down into steps and those steps are listed in the order they are to be performed. To make the logic visually obvious, steps are numbered and whitespace is used to set them apart. When procedures are short and surrounded by background text, procedures are often indented and a gutter is run between the number and the text of the step so that any text that runs over one line will align with the text as it wraps rather than with the number (see Figure 4.1). When procedures are several pages long, they are often not indented and individual steps that are several lines long are often forced to say together on one page.



7.4.4 Activating Automatic Detection

The automatic detection feature enables preset procedural action routines to run whenever jobs enter the batch processing queue. This can not only save time spent administering the queue, but can also improve process resource distribution in process environments where some resource fluctuation is tolerable. Notice that automatically processed jobs are held for confirmation unless the "Return on completion" option is selected.

1. Select Administrative Options > Automation > Queue Management.
2. In the Queue Management pane, check **Automatic Detection** and specify any desired parameters. (For information about specifying parameters, see Section 5.2.)
3. Select **Save Changes**.

FIGURE 4.1. Instructions are often indented with a gutter between the step number and the text of the step. The gutter, an uninterrupted vertical white space, helps the reader find where steps begin and end.

ORIENTEERING INFORMATION Even a simple procedure typically begins with a title or label of some sort and, if warranted, some pre-procedural text. This text is sometimes called orientation or orienteering information. Orienteering information can help your user understand the "big picture" surrounding your instructions and the task to be accomplished. It may also

- Explain what a product or process does in a useful way to ensure that you and the user of your product have the same expectations for that product.
- Define terms or symbols that you use in the procedure or that are used in the interface or on the product your user is working with.
- Set out specifications for successfully accomplishing a task or state the outcome of the instructions in more detail than the title for the procedure does.
- Describe how to use the instructions if the instructions are complicated, or require repetitions of the same tasks, or require users to make decisions based on feedback.
- Specify materials or products necessary to complete the task at hand, like tools, time, assistance from a partner, or available memory on a computer.

STEPS Steps are often said to represent a single action, and many of the procedural steps you see in manuals describing simple operations will be written in active voice, beginning with a single active verb and the predicate associated with that verb.

(1) Apply surfactant to thoroughly coat.

However, use of this pattern depends upon your audience. Operations that involve short related actions are often grouped into one step, especially if they are to be performed by an expert technician. When the actions are to be performed immediately in sequence, a compounding conjunction can be used to connect them (as in step 2). Making one action into a modifier of the other, on the other hand, can indicate that the actions should be performed simultaneously (as in step 3). *Takeaway: Step structure indicates priorities and sequence.*

(2) Affix label and remove any trapped air.

(3) Affix label, removing any trapped air.

When steps contain two verbs as these do, it is particularly important to consider their sequence. A good rule of thumb is to write the step so that the terms occur in the order they would in separate steps. Consider the following:

(4) Add chromating reagent dropwise to the coating mixture, while agitating.

(5) While agitating, add chromating reagent dropwise to the coating mixture.

Even though this step is short, someone reading step 4 may add the reagent before seeing that the solution should be agitated during the addition. Ordering the verbs the way they are in step 5 may produce a more reliable reading.

Of course, if actions are to be performed simultaneously (as in step 3), the order of the terms doesn't really matter. In that case, consider which of the actions is the main action in order to decide which to make into a modifier. Written in the reverse relationship, step 3 would imply that air removal not the fixation of the label is the primary action and step 5 would imply that agitation, rather than the addition of the reagent, was the primary action.

(3) Affix label, removing any trapped air.

(6) Remove trapped air while affixing label.

(5) While agitating, add chromating reagent dropwise to the coating mixture.

(7) Agitate while adding chromating reagent dropwise to the coating mixture.

While the order of verbs in steps 6 and 7 may not prevent the reader from performing the action, it may make it harder for the reader to understand the immediate purpose of the step or to identify the general trajectory of the procedure as they scan. Scanning is a very important part of navigating a procedure, especially when the procedure is long or complex. A user may not remember what step he or she is on, but will likely be able to identify verbs and their associated nouns quickly without rereading whole steps.

Aside from using the containing document's sections and headings to make complex sets of procedure navigable, complex procedures are often abbreviated by the use of technical terms or by references to standard procedures or procedures published elsewhere. *Takeaway: Technical terms can express complex operations.*

(8) Recrystallize the product with 20 mL Dioxane.

(9) Measure sample concentration using Field Titration Kit. (See FTK manual for guidance.)

In step 8, the term "recrystallize" indicates a process that is assumed to be in the repertoire of the reader (a process that would require at least five steps if explained). The regular user of a procedure containing step 9 may also have mastered the procedure they are directed to in FTK manual, but this instruction provides new workers access to further instructions and protects the instruction writer from having to explain (and assume liability for) a product he or she didn't create.

Complex procedures often have steps that are more naturally grouped or may need to be repeated or skipped. Redirection instructions enable authors to navigate complex procedures that require decision-making or observational input. The subordination of some steps to others enables users to perform repetitive subroutines or simply to package complex sets of operations without being overwhelmed. Consider the following procedure:

1. Search the AMTCo Index using the customer's Customer Id or SSN. If the customer is already has a user account, go to step 2. Otherwise, add a new user account as follows:
   a. Open the User Services Control Pane by selecting *Users* > *Interfaces* > *Control Pane*
   b. Select the *User* tab.
   c. Select *Create New User Account*.
   d. Enter user information into the User Profile Data Sheet.
   e. Select *Assign Id*.
2. Access customer's User Profile and select *Current Balance*.
3. If the customer has a credit balance, then refer to the procedure "Issuing Funds" on page 98 of this manual. Otherwise print a customer statement by selecting the *Print Statement* option.

This procedure is an example not only of procedural subsectioning but also of how subsectioning and redirection instructions can be used to maintain an orderly progression through an operation. The five-step subordinate new user account setup procedure is likely located in another part of the larger manual, but, because it's not complicated or long and because it has to be done in order to continue, repeating it

as a subprocedure here enables a user to create the account or skip to the next logical step without leaving the page. Indenting the subprocedure and numbering it with letters rather than numbers makes it visually obvious where to pick the procedure up if you're skipping it. (Had the five substeps (a)–(e) been numbered in line with the main procedural steps, a user would have to scan down to find step 7 to continue.) On the other hand, the procedure for issuing funds (not shown) may be complicated or may require getting an agent who follows different procedures. *Takeaway: Subsectioned procedures can be more accessible.*

Good visual design is essential to effective instruction. To help readers find the various types of information, include sufficient white space in your document design. If you don't crowd information on your pages, readers can identify instruction steps, warnings, background information, and so forth more readily. This easy identification allows expert readers to find only the steps they need to take, without reading more than they need to. *Takeaway: Visual cues like white space are helpful for users.*

Consistent designs for each type of information can also help readers visually identify the information that is important for them. In the immediately previous procedure, for example, names of buttons and options to be clicked on or touched were italicized while names of screens and forms were simply capitalized. The word "select" was also consistently used as the verb indicating users should act by clicking a mouse, keying a response, or touching a touch screen. Using consistent terminology is especially helpful for novice users, who are learning the basics about your product and may become confused easily if you use many different terms.

Applied throughout a book, consistent conventions make it easier for users to scan procedures for which button they should press next or what screen they should be on. Remember, users often turn to procedures after they are halfway to their goal and stuck; many users start a procedure by scanning down to find where they should start or to see the name of a screen or dialog they should be working toward. Preferences for certain words and formats are often part of a corporate style guide if instructional documents are often published in a workplace. *Takeaway: Consistent terms are helpful for novice users.*

When you edit your instructions, you might ask yourself questions like these:

- How much action should one step contain? Are the procedures consistent in how they break down actions or do some steps require significantly more effort than others? (This may not be a problem; it may be necessary given the task your user is completing. But being aware of this pattern is an important part of considering whether steps should be broken down further or subprocedures should be written.)
- Is the layout consistent? Is the same type of information consistently presented throughout the instructions (steps, consequences, discussion of steps, etc.)?
- Do I consistently use syntax patterns to express complex or related information or options?

- Have formatting and visual cues (like bolding, intending, etc.) been applied consistently?
- Have I used the same terminology throughout the instructions? Have I consistently called things by the same names?

If your organization lacks a style guide but values a consistent look and feel in their instructions, these questions could also be helpful to assess existing examples and to make yours similar.

GRAPHICS, TABLES, AND ADMONITIONS Graphical representations of a mechanical setup or interface or of how an object should look after a particular step is executed can help readers determine where they should be manipulating a device or if they have successfully completed a step. In processes that require the user to look for visual feedback—like change in color in a chemical process or a certain pattern on a gauge or display—graphics showing what happens when your reader completes a numbered step will allow them to immediately know whether they can proceed to the next step, without reading textual explanations. As such, graphics are especially helpful for people who do not have strong language or reading comprehension skills. (Some operations are often done based on non-sensory feedback such as the adjustment of valves until they make certain sounds or the tightening of nuts until they reach a certain tension. While graphics can't help with these, they are worth considering as referents as they are often a function of users' expertise.)

When graphics are small and pagination is not a concern, graphics that represent the end product of completing a step generally follow the step, while graphics that represent the state before a step may come before or after. If a graphic appears in a place where it is not the most logical (such as a graphic that shows the before state after a step is completed or a graphic that shows an outcome that falls on the following page), use a reference to direct your user to that graphic. *Takeaway: Position small graphics logically in the text.*

(10) Connect cables A and B using the enclosed adapter as shown in Figure 7.

Figure numbers and captions can be safer references than phrases like "as shown below," especially when the instructions you write may be translated and reformatted. A similar notation can work for instructions that require users to look up information in tables, especially when, because of length or shape, tables need to be located in another part of the manual. When complex mechanical procedures like the disassembly, maintenance, and reassembly of large machines are supported by reference graphics that show all of the pieces in the device in articulated form, a note at the beginning of the procedure may be appropriate. When diagrams like these use callouts to number parts, those part numbers can be used in procedures to sufficiently abridge the procedure and to avoid the problem of having to establish a common

vocabulary for part names. *Takeaway: Use captions and references to locate large graphics.*

Sometimes it's important to stop a procedure to warn a user about an upcoming complex operation or about a danger. In this case, formatted admonition statements that combine a graphic with a word like danger, warning, or caution to offset a message are used. Order is important. If you would like someone to use caution when performing an operation, you must tell them before you instruct them to do that operation. Notices that indicate there is physical danger or that improper technique may destroy property or cause injury are effective if they are read before a user acts. Consider the following example. *Takeaway: Place warnings before procedural steps.*

> **Warning:** Ensure the protective seal is in place and don an approved safety mask before disconnecting the outer container wall. Devices subject to retrofit 213 contain cadmium stabilizers which are carcinogenic and potentially toxic if inhaled in significant quantities. In case of inner container wall breach, apply supplemental protective seal and proceed directly to incident control for decontamination.

Notice how the warning text states not only what the danger is but how to prepare for it, how to recognize the severity of the danger as conditions vary, and what to do if certain dangerous conditions manifest. The terms danger, warning, and caution are typically used to indicate the same types of dangers and governing bodies and labor and standards organizations have issued lots of guidelines to this effect. The American National Standard Institute (ANSI), one agency that has crafted standard symbols and interpretations of these terms, recommends the following usages:

- DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. The signal word "DANGER" is to be limited to the most extreme situations. DANGER should not be used for property damage hazards unless personal injury risk appropriate to these levels is also involved.
- WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. WARNING should not be used for property damage hazards unless personal injury risk appropriate to this level is also involved.
- CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. CAUTION without a safety alert symbol may be used to alert against unsafe practices that can result in property damage only. (Standard Z535.3) *Takeaway: Consider customs for admonitions in your workplace.*

Notice that the term CAUTION is sometimes used to signal potential property damage rather than injury and is often used in mechanical documentation to advice people that certain actions, if performed incorrectly or out of sequence, would damage a product.

Writers of instructions often use a similar visually interruptive technique to include useful information about a product or process or shortcuts for completing operations. These admonitions are often called Note or Notice or, in some cases, Tip. (Though, some makers of heavy equipment reserve the term Tip to indicate that there is danger that a machine may be unstable and that an operation may cause it to tip over and crush the operator.) Since they do not present a safety concern, notes can be placed after an instruction or before. The benefit of placing them before is that the user may read the note and perform the operation that follows in an optimal way. The drawback, however, is that you have to be able to articulate the way to optimize the action before actually telling the user to take the action. Because of this, notes are typically placed after a step.

Tutorials/Training Materials

A tutorial or training manual is different from an instruction manual in that it is written with the assumption that the user of the manual is not only a novice but is also using the manual as a way to learn an appropriate technique or an authorized approach for completing a process. Though a training manual is often made up largely of procedures, it's not uncommon to have sections of text that resemble textbook pages or sections of organizational or reference information to study.

The procedures may also be consciously linked with the idea in mind that a user should use them in sequence. They may even be written to walk a user through doing a task as it applies to a particular sample as opposed to how it may be done in the abstract. For example, a software training manual may have a user build mock files as they go. Selecting a procedure from the middle of such a series would likely be impossible to complete as actions in the procedure are dependent on those in a previous one. *Takeaway: Training procedures may be presented in sequence.*

Training procedures written in the style of a mock exercise are also not literally applicable after the training, but can be powerfully usable as a reference to a user who has completed the training successfully. Instructions that have a user load and modify a sample file are a model of the action that user would take to modify another file. The user who recognizes this model relationship can look back at the training procedure to remember the steps they followed before and can use it to extrapolate what they should do (replacing, for example, the file name of the mock file with the name of the one they now want to modify). If the training was recent, they may even remember doing the exercise. They may remember where they got confused or temporarily stuck before, and this memory may make them aware of pitfalls as they complete the operation for real. In this way, a training manual has a complex usage that makes it quite different than a user guide.

Types of Training Materials Training materials come in all media forms imaginable and in long and short forms to accomplish a variety of needs. Software tutorials are sometimes built right into programs; instructional videos or slideshow presentations relating to operations and corporate values are found in practically any workplace of large enough scale to have concerns about liability, fraud, or efficiency.

Special Considerations for Instructions in Training Documents The presentation of procedures in a training document may differ from those in other kinds of manuals. Given the larger purpose of the document, it's not uncommon to break instructional steps down further to contain more simple actions and fewer compound actions. A procedure that may be eight steps in a typical workplace procedure reference may be 10 or 12 in a training manual. Extra Note admonitions (and subtypes of Notes) are also typical. Sometimes spacing is increased to allow users to make notes on procedures.

This is not always the case, however. When training materials are designed to introduce a new process or procedure to experts (especially they are likely to find the process normal and intuitive), procedures may be written in a style that is more like those written in references. In fact, experts are often better able to follow steps that assume more, and they will get frustrated when actions are broken down too far or when training progress seems trivial or slow. (If you notice test users completing actions before being instructed and then realizing that they need to skip steps to complete the procedure, this might be the issue.) *Takeaway: Don't caudle expert users.*

Procedures written for training often include significantly more information about the feedback someone following the procedure will receive. Training materials may even contain explanations or justification about why certain steps are organized in a certain way or why certain approaches are taken. Finding a regular way to place this information in the procedure without making the procedure too visually complex is important. Specialized page layouts can be a solution. Training documents sometimes reserve side columns or even facing pages in a bound manual to place pictures or diagrams, references to reference works, or added information and justification boxes.

Procedures that will form the bulk of an employee's day-to-day operations are often the focus of training. A sizable number of rarely performed operations exist in any work environment, but guiding a trainee through all of these may be overwhelming, especially when training a new employee. Noting the presence to these tasks and referencing workplace process documents and guides is sometimes the best way to address non-routine tasks.

For tasks that you expect employees to internalize and develop accuracy in quickly, memory devices and job aids (like notecards, process diagrams, and quick reference sheets) can give the employee something to take away from training. In the case where these tasks require one component that may take longer to learn than others—a significant number of settings to check or a catalog or product numbers or names to remember—a checklist or a quick reference table can be invaluable to boosting accuracy while getting started.

Training procedures sometimes rely on contrived events or pre-created items to create a context for action. A procedure which responds to a customer inquiry and that requires using customer data to advance requires a model inquiry and mock data to be practicable. Creating partial files, intermediate products, and even damaged apparatuses to accompany these procedures will be required. Constructing training that enables a user to use the product of one procedure when beginning another is one way to minimize the amount of supplementary material needed for training. A long and complex series of tasks, however, can be abbreviated by removing some repetition or processing time by creating a series of files or objects to use as starting places. For example, a trainee may have completed several procedures learning how to build records in a database, but requiring trainees to do the operation 100 times in order to build the record set that would be required for data analysis procedures that come next is not reasonable. Having a prepopulated database that the users can switch to for certain procedures avoids this problem. *Takeaway: Training materials can rely on prepared models.*

Policies

Policies address an organization's high level vision, providing guidance for making decisions and achieving outcomes. A policy document establishes key principles and responsibilities, sets fundamental requirements and limits, and allocates responsibilities. A policy document is a concise, formal statement of principles which indicate how the people in an organization will act in a particular area of its operation. Within an organization, a policy provides members of the organization with the approved way of operating in relation to a particular matter.

When viewed from outside an organization, a policy document can be considered a declaration of the values, goals, and priorities of an organization. In a dispute or when demanding service, customers and clients will often invoke a company's policy as evidence that they deserve what they are requesting. When companies are scrutinized by the media or by potential competitors or partners, it is often their policies that are quoted in reports. When professionals apply for competitive positions at a firm, they often articulate how they align certain corporate values (found in policy statement) as a way of suggesting that they are the right candidate. *Takeaway: Policy documents are political.*

Types of Policy Documents Policies are intensely specific to the organization and the goal organizational leadership is trying to meet by composing the policy. As with other kinds of enabling documents, you could make a long list of modifier-based policy names of varying levels of specificity: employment policy, customer satisfaction policy, person information privacy and protection policy, biohazard handling policy, etc. While the name of the policy often declares the topic its contents are meant to regulate, these categories are always ambiguous. Most policy documents

begin, after some kind of articulation of the identity of the organization, by describing what that modifier (privacy, safety, etc.) means.

Parts of a Policy Document *Title*. The title of the document should reflect the content of the policy. When organizations have a large framework of policies, sometimes policy documents that appear freestanding are actually assumed to be part of this collection. Interestingly, they often don't use a word like "policy" in the name. For example, a safety oversight group at a large manufacturing organization could have policy documents titled like these: *Emergency Operations*, *Workplace Hazard Assessment Criteria*, and *Employee Safety Awareness Standards*.

*Purpose***.** Include a brief statement of the purpose of the policy, which may include a basic explanation of the reason for the policy if that is not apparent. For example, you might include information that the Board of Directors voted to establish or change a policy at a particular meeting, or that the policy is required by a legal statute. This can help your reader understand the policy in a wider context.

*Scope***.** You might want to include a statement about whom or what is covered under the policy. Examples could be "all employees" or "technical support telephone calls."

Responsible Party. In this section, list units, departments, or job titles that are responsible for administering or enforcing the policy. You might want to include a contact phone number or e-mail address for a unit, but do not include names of specific employees (as they may leave the company or move to another sector).

*Definitions***.** In this section, provide definitions for any terms in the policy that are uncommon, have a particular meaning, or that your organization interprets in a particular way. When you are writing a policy, you want to use these terms consistently across your document and any other related policy documents. If you are working at a large organization with many policies, there may be a glossary of terms to use that are already well established.

Policy Statement. The policy statement itself usually ranges in length from two sentences to a paragraph. This statement should not be something that is frequently changed. It is rather general and is written for longevity. The statement provides a rationale for the policy and what it intends to accomplish. It reflects the philosophy of the organization, the standards it adheres to, and its objectives. You might include a statement of how this policy relates to the organization's core mission and values. This sample administrative policy statement addresses the organization's value in fairness, as well as setting out guidelines for posting job openings: "This policy has been established to ensure consistency of all external advertisement of job openings. External advertisements are supplemental to internal postings and recruiting policy requirements."

*Plan***.** Sometimes policy documents contain or are associated with a specific actionable document that indicates how a policy will be applied to the workplace over a period of time. When a policy has been developed in response to an incident or perceived problem or in an effort to actively shift corporate behavior from an old

way of doing things to a new one, declaring specific actions or changes in behavior, how those actions or behaviors will be monitored, and how and when the change will begin and become normal creates a tangible transition period for organization members by giving them vocabulary to use and events to witness and identify with the larger goal. When successful, a plan can make a policy seem more real in the workplace. When unsuccessful, a plan can be evidence that a policy initiative has failed.

Special Considerations for Procedures in Policy Documents Written procedures include the steps necessary for people to comply with an organization's policies. When writing procedures, you should include sufficient detail that others will readily understand what they need to do on the job to meet the policy requirements. You might think of this document as the "how to" section of a policy manual that guides people's decision-making and behavior. Procedures are often presented as mandatory actions or requirements, so modal verbs or modifiers (like must, shall, should, may) are often used. They are sometimes written with a third person subject than in the imperative form, in an attempt to achieve a tone that is authoritative and factual (and unimpeachable) rather than commanding (and, therefore, arguable). For example,

Imperative: Report any incident or injury to IRCC at x5087.

Imperative with Modal: Any incident or injury should be reported to IRCC at x5087.

Non-imperative: The contractor will report any incident or injury to IRCC at x5087.

In an organization, people are likely to be familiar with the context and even the action to be performed. So procedures that are more specific to organizational operations are often quite abbreviated, articulating only the things that were of issue when the policy was drafted and avoiding mundane specifics that might trap later users into a way of operating that is not only unproductive but also immaterial to the larger concern the policy was meant to address. The statement above, for example, might be given more permanence by replacing "to IRCC at x5087" with "to the designated incident response team," especially if this team is likely to change or be renamed over time. That said, a user of the latter phrasing would need to know what the designated response team was and how to contact them in order to follow through.

5

Writing to Convince: Persuasive Documents

- *Persuasive documents are used in the workplace to present information in a way that will convince your reader to agree with your ideas or take an action. They play a crucial role in providing information to those who need information in order to make a decision.*
- *Persuasive documents are used to bid for work, acquire funding, sell services, or suggest a project should be completed in a certain way.*
- *Audiences for your document will be reading your proposal critically. As a writer of a persuasive document, you must identify what your audience likely believes and appeal to them in an organized way, leading them to see your requests as legitimate and in their interest.*
- *Some typical persuasive documents*
  - *Proposals*
  - *Business plans*

The IEEE Guide to Writing in the Engineering and Technical Fields, First Edition.
David Kmiec and Bernadette Longo.

Introduction

The documents discussed in this chapter are used in the workplace to present information in a way that will convince your reader to agree with your ideas or take an action. While all writing is to some degree persuasive, documents like proposals have a declared goal of convincing the reader, so they are often called *persuasive documents*, and they play a crucial role in providing information to those who need information in order to make a decision. When they are written as an appeal, they are a place for you to articulate your position. When they are a collaborative endeavor, as they can be between a longstanding vendor and client, for example, they can function as a place where multiple parties can record their agreed-upon work arrangement and the worth of that work.

Persuasive documents, of course, are not only persuasive. They often present significant data about a situation, review existing positions and approaches, and discuss—sometimes directly—your expertise and suitability for a task. Readers look for feasible ideas, details of analyses, and a detailing of how the proposed work will result in actual benefits. A thorough and expected argument is itself a persuasive technique, as it suggests to the reader that you are legitimate. And data, of course, can be recorded and presented in different ways and from different points of view. For example, failures can be expressed as successes by reporting details selectively or applying different standards for analyzing the outcome.

The Purposes of Persuasive Documents

Most often, the purpose of the documents discussed in this chapter is to persuade decision-makers to approve and fund your proposal or business plan. In many cases, you might be preparing one of these documents in response to a Request for Proposal (RFP) issued by a funding agency or a governmental agency wanting to complete a project. In these situations, your purpose is to clearly address the requirements of the RFP and to show that your team is highly qualified to complete the proposed project.

In other cases, you might be developing a proposal or business plan that you will use to approach potential funders. In these situations, your purpose is to convince the reader that your proposed project addresses a significant need, to explain how this need aligns with the mission of the reader's organization, and to show that your team is highly qualified to complete the proposed project.

To accomplish these purposes, you must

- Provide information that meets the needs of the various readers
- Present your information in conventional formats that show that you are familiar with expectations for professional documents
- Address foreseen problems and shortcomings

- Provide a complete and realistic forecast of activities and outcomes
- Listen carefully to the concerns and suggestions of potential audience members in your development process

Occasions for Preparing a Persuasive Document

Independent technical professionals who have an idea for a product or a business and need capital to turn that idea into a reality write proposals for business loans and capital investment. Professionals in research organizations, especially those that partner with government or organizational funders, write proposals requesting funds for the equipment and overhead needed to support their work.

While proposals are often written by entrepreneurs and consultants to acquire work or funding, they are also frequently prepared inside organizations as an attempt to record, regularize, and handle the large amount of data and complex arguments necessary for the decision-making process. Internal proposals may advocate for products, features, training, or equipment. They may simply suggest that a current practice be reconsidered, or they may present fully formed ideas about new policies and processes. *Takeaway: Internal proposals rely on connecting organizational culture.*

Engineers and technical professionals often have a unique way of seeing infrastructural and logistical problems, especially in situations where old legacy systems have continued to function, unaudited, to serve new and different corporate missions. In workplaces composed of people from a variety of professional backgrounds, though, people can have different ideas about what the problem is and how to address it. They may have difficulty seeing the "big picture" beyond their own area of expertise. IT professionals, for example, can often look at old network configurations or information management processes and design improved processes that are customized, more efficient, or add security or functionality that would significantly improve productivity or quality of life for workers. Such a change, however, cannot be undertaken by only one person in a large organization, especially when it affects the infrastructure people use to do day-to-day operations. An internal proposal, in this example, would be an opportunity for an IT professional to lay out the changes necessary and to justify the costs associated with equipment, labor, and disruption to the current process in terms of the benefits of doing the project.

Outside of an organization, persuasive documents are used to bid for work, sell services, or suggest a project should be completed in a certain way. In some sectors, even when it's the client who initiates contact regarding a service, it is typical for the client to request a bid as an official offer to be accepted before writing a contract. As these documents represent the firm, rather than the individual professionals who wrote them, they often are subject to significant internal scrutiny, are prepared by regularized preparation practices, and contain specialized marketing-style text that promotes the firm and their accomplishments. *Takeaway: For external proposals, consider the values of your audience.*

Audiences for the Persuasive Document

Although you might write a proposal or business plan for only one type of audience, audiences for these documents are generally mixed. This means that you have multiple audiences, each of which has slightly different needs for information and reasoning. These audiences can include managers, technical staff, and staff at funding agencies. The information below describes some characteristics and concerns of the primary audiences for documents that convince people to accept your ideas. *Takeaway: Proposals begin work or change, so audiences are complex.*

Managers often have the authority to make final decision on whether to accept your proposal or not, although they may rely on technical and/or financial experts for input into their decision-making. Managers generally oversee many projects simultaneously and want "bottom line" information rather than technical details. Because managers juggle a number of projects and responsibilities, they probably will not have time to read your proposal thoroughly from start to finish; rather, they will skim for the information they need to know in order to make a decision on whether to proceed with your project or not. Managers tend to look for this kind of information in a document:

- An overview of the project in the project summary
- Answers to their questions about the project's feasibility in the project summary
- Projected costs in the budget section or a forecast of financial benefits
- Schedule for completion in a timeline
- Evidence of how each member of the team is qualified to successfully complete the project

Technical experts may have authority to make final decision on whether to accept your proposal or not, but they are more likely to have input into a manager's decision on whether to accept your project. These specialists will understand technical details of your project and may be familiar with other similar projects. They look for details that thoroughly explain your ideas so they can evaluate your ideas for themselves and then compare their analysis to the benefits you claim will be forthcoming. Technical specialists tend to look for this kind of information in a document:

- Technical details in your description of objectives, proposed activities, and project schedule
- Evidence of whether your budget is realistic
- Evidence of whether your team is qualified to successfully complete the project

Staff members at funding organizations are likely to be combination of managers and technical experts. These people will first review proposals to eliminate those that do not comply with the organization's Request for Proposals (RFP) guidelines (if

an RFP was issued). People within the funding organization will have authority to make a final decision on whether to fund your proposal or not. In addition to the item that managers and technical experts look for in a text, staff members at a funding organization will also determine how well the proposal addresses the specifics of the RFP and how well the proposed project aligns with the organization's mission.

Managers, and others with little time, may pause over illustrations embedded in the text, hoping to understand the main ideas of your proposal. For this reason, don't include illustrations just for the sake of having them. Instead, illustrate concepts or ideas that are important to the main ideas in your proposal. Sometimes technical experts closely examine the body of proposals to evaluate the writer's expertise and qualifications. For this audience, illustrations need to be both accurate and reflect the conventional methods of representation within your discipline.

Key Communication Strategies When Writing to Convince

Designing Your Argument to Consider the Audience's Preexisting Beliefs

Moving your audience to act requires recognizing what the audience currently believes, then tailoring your argument to advance their beliefs along a line of logic that you draw.

Persuasive documents are what rhetoricians call *deliberative documents*. They deal with the future, with decisions to be made, and with the possible and probable outcomes of those decisions. In order to justify the actions they suggest, they connect details from the present to patterns (technical, historical, etc.), suggesting that the present state can be converted to some desirable future state only (or at least most effectively) through the proposed action. *Takeaway: Consider your audiences' beliefs and goals.*

A professional writing a compelling persuasive document must understand the way the intended audience views the present state of things, what things they value, and what they might want for the future. A client who values network security may be more likely to read a bid or hear a pitch from an IT services provider that seems similarly concerned or that seems to have some kind of specialized security expertise. Firms that sell services and compete for contracts often use what they know about their client's believes and priorities to choose which solutions to offer and to guide their proposal writing process.

Using this approach to craft a persuasive document can be complex. Sometimes, it's hard to know what your audience believes. And even when you do, it's not just about what your audience believes but it's about what they are prepared to accept. Some persuasive documents require significant education (even re-educational) components. *Takeaway: Some proposals have educational components.*

That said, recognizing your audience's way of understanding the world in order to be persuasive is a thoroughly rhetorical approach and, as such, strategies have been

developed that can be applied to help organize persuasive documents. In some ways, understanding the structure of beliefs that underlies action is at issue.

The following is a list of questions, based on a classical rhetorical technique called *stasis theory*, a rhetorical procedure for inventing arguments to persuade. *Takeaway: These questions consider belief and willingness to act.*

- *Is It?* Does something exist? Is there a problem? Did something happen?
- *What Is It?* What are its attributes? What are its parts? What is it a part of?
- *What Is Its Value?* What effects does it have? Who does it affect? Is it good or bad for something or someone? (How good or bad?)
- *What Should Be Done About It?* Should anything be done at all? What action will solve a problem? How might an opportunity be taken advantage of?

In this system, each question relies on the previous. This system suggests that you cannot convince people to act on a solution to a problem if, for example, they do not believe that a problem exists. It would be hard to convince clients, for example, to undertake an expensive environmental remediation process if they didn't believe that their soil was contaminated. (Though, they might agree to undertake the project while not accepting the existence of a contaminant if they were persuaded by some other benefit, such as better community relations or relaxed regulatory oversight.)

Likewise, it would be hard to convince a client to commit to a particular solution if they understood the parameters of the problem differently than you do. A construction supplier that is concerned about existing mercury levels in their soil may be looking for remediation without recognizing how their ongoing cement production operation could be causing the problem. An environmental services provider hired to do remediation might take the opportunity to sell additional consulting services, offering to help the supplier alter their manufacturing procedures to limit future contamination. To sell the additional services, the environmental services provider would have to persuade the supplier that the contamination is related to the manufacturing process and that alterations to their process would be effective in preventing recontamination.

As this example suggests, the entire set of stasis questions above may not be necessary. If a client is already aware of a problem and has come to you for help, you may need to include only the latter moves in your communication. That said, it may be customary in your field to include all four moves even when one, two, or even three are already accepted. In this case, the volume of text associated with the already agreed upon moves is often less, and that text is written in a conformational tone, stating the problem as a fact that is agreed on rather than seeking to prove it exists, for example.

On the other hand, sometimes the full argument is required, especially when making an unsolicited pitch or when challenging a standard or existing practice. A

professional engineer who suggests a specific change to a long-standing process or procedure in a complex industrial workplace, like a manufacturing facility, may have to deploy the full four-move argument. Consider the following extended example of how a process engineer might suggest making changes to an existing assembly line setup because the configuration of equipment may cause a safety problem.

First, the engineer will have to show that there is a problem: the setup of a production line, which has operated for several years uneventfully, is potentially hazardous. Organization members who are familiar with that line and who think of it as successful may not be prepared to admit that it has potential problems without evidence. The engineer will have to decide what kinds of evidence would convince the relevant decision-makers and consider what kinds of arguments they find persuasive. (So far, this is a forensic argument, the kind that might be found in a report.)

Next, the engineer will have to associate that problem with characteristics of the process: the speed and configuration of belts which move parts near a materials collection point create a potential for a snag. If the engineer plans to convince decision-makers to adopt a particular solution, it's not enough just to identify a problem and support its existence with evidence. The problem has to be defined in terms of the parameters that will form the basis of the solution logic.

It may be possible to articulate a problem in several ways—in terms of the position and shielding of the collection point and the geometry of the belt set up or in terms of how workers service the collection point. Choosing which parameters to use when articulating the solution can foreground your solution explanation and make it seem logical and convincing. It may even be necessary to expressly list parameters of the problem and to include parameters that, while relevant, will not be featured in the solution. This is especially the case if alternate solutions are possible or if the solution the engineer is proposing is unusual.

Next, the engineer will have to make a case for the degree of hazard the problem poses: significant equipment damage could occur, and, given the proximity of attended workstations on the floor, workers could be injured by projectile debris. Just because a danger exists, it doesn't mean that decision-makers will be willing to act. Workplaces, especially manufacturing workplaces, are always potentially dangerous. An untrained employee could be hurt in any number of ways around a belting system like the one in this example. That's why employees are trained, floors are marked with lines, gates are positioned, drums, gears, and other moving parts are guarded from causal contact, and employee work paths are specifically planned so they can navigate without having to cross under or climb over hazards like cables.

The engineer in our example may argue that the danger of equipment collision caused by items from a collection point is more significant than the typical danger in the environment because ricocheting objects thrown from the system could cause damage and injury throughout the plant, and because the suddenness and randomness of the projectiles is not something workers can prepare for. Depending on the audience and corporate culture, this narrative of significant potential danger could be compelling.

In many business settings, though, quantifying problems and solutions is the easiest way to convince an audience. One way of quantifying the chaos that might ensue in a disaster is to price a hypothetical incident. Calculating the cost of machine downtime, of replacing equipment, of scrapped parts, and of treating injured workers provides a dollar figure, and thereby a sense of magnitude, to associate with the problem. (Notice that values that are hard to quantify—like workers' long-term welfare and the ethics of asking worker to labor in a dangerous environment—are easily left out of a calculation like this one.) This dollar figure can then be compared directly to the price of implementing a solution, something the next move of the argument may require. *Takeaway: In technical environments, numbers can be persuasive.*

Finally, the engineer will have to persuade decision-makers to act and to act in a particular way: lower the height of a series of belts so that they operate below an existing barrier that separates them from the materials collection point. Having prepared the rest of the argument, justifying this solution involves relating it back to the features of the problem and the degree of the problem already established. It may be important to talk about other possible solutions, especially when there is an obvious or less expensive alternative solution, or when dealing with a suspicious audience or an audience that's disinclined to act. Highlighting the problems or deficits of alternative solutions with no apparent balance can be risky.

A reader who favors a particular solution that you have dismissed may be inclined to argue if you only state what the problem is with that solution. Presenting, instead, the benefits and drawbacks of each allows the engineer to recognize the viability of some solutions while still asserting that a certain solution is preferable. In addition, presenting a well-considered logic for decision-making, by pricing all of the options or by ranking them according to categories that relate to their pros and cons, allows you to assert your expertise and to show that the problem has been fully considered. *Takeaway: Discuss rejected solutions on their merits.*

Using the Terms and Values of the Audience to Articulate a Shared Goal

To be persuasive, you must choose the facts you present as evidence, the kinds of arguments you make (e.g., economic, efficiency, safety, innovation), and even the words you use based on your knowledge of your audience's values, goals, and understanding of the current problem environment.

Information about these things can be found in public declarations made by your intended audience (like expressions of values on their website and in their corporate policies) and in communication documents like Requests for Proposals (RFPs), and e-mails back and forth regarding the project. If a potential client uses a certain vocabulary in these documents or seems to express a certain concern or rely on a certain parameter to assess a problem, it may resonate with your reader if you adopt these concerns and this vocabulary as you communicate your own message. Even if your understanding of a problem is different (which is often the case when a business

calls on a technical professional for services), relating your terms and concerns to the words they use may make the reader feel well understood, which in turn may make them feel more confident in your competence. *Takeaway: Values are expressed in texts produced by your audience.*

When you know little about an audience, you may need to rely on the general values and terms of the professional community. Relying on the regular terminology and arguments that experts in your community use will make you seem like one of those experts. An audience in your own community that recognizes these terms will be more likely to find you credible. An audience from outside your community, however, may be confused. This isn't entirely a bad thing, though, as long as that confusion can be converted into conversation and education.

If you are being hired for your expertise, the client will likely have some tolerance for the professional practices and language of your community. The faster you can learn about your audience, though, the sooner you can begin building their confidence in your partnership. Pair your regular arguments and terms with conditions and questions about their business and their setup. For example, businesses that are small enough to maintain only an IT support staff often contact IT consulting firms to help them undertake significant infrastructural expansions. To put together a request for a quote, they may rely on their in house support staff to tell them what needs to be done. A professional at a consulting firm, however, may wonder if the specific solution they are requesting will meet their needs. (In a consulting environment, just giving a client what they want often backfires; the solutions non-expert clients request do not improve their business processes the way they anticipate. When this happens, they will blame the consultant.) The professional looking over the request for quote may respond with questions that gather information about what problem the company is trying to respond to, how and why they chose the specific solution they ask for, and what they expect the outcome of implementing that solution to be. *Takeaway: Be both technical and accessible.*

Interactions like these are important not just because they enable you to understand a client's needs but also because they give you the chance to observe the language your client uses and the way your client describes the problem. Using this language and describing the problem back to the client in a way that makes sense to them makes you seem competent. Being able to take their problem and apply the terms of your profession in a coherent way to articulate a solution for them (and the outcome they want) inspires confidence.

It is important to consider your integrity as an expert in this process. It's easy to sell a client a solution that won't work for them when they are asking for it. Once you establish a relationship, it's also easy to abuse a client's trust and sell them products and services they don't need. Because consultants and clients have differing goals, it's often easy to persuade your way into provide services that, while legal, are unsatisfying or unethical. In some sectors, professional associations have codes of ethics for consultants and corporations have vetting procedures to evaluate contracts and requirements. These codes and procedures can be a resource for understanding

behaviors that people consider problematic in your field. *Takeaway: Keep your professional integrity in mind.*

That said, you may need to be alert even when you and a client are working toward a common goal. As discussed in the last section, an audience may find one reason for acting more compelling than another. The competition between priorities should always be an opportunity to reflect on priorities. To many corporate managers, safety may be more important than production speed, and an argument that recognizes this—that advocates altering a process to sacrifice production speed for the sake of safety—may be well received. That is not to say, however, that those managers do not value production speed as well and wouldn't prefer a solution that maintains production speed while improving safety conditions.

In fact, it's rarely black and white. Concepts like safety come with attached ideas like probability—just because an accident can happen doesn't mean it will. And production speed, in most manufacturing environments, is a timely value. In industries that make quickly changing consumer products, where products become obsolete quickly or where profit margins are tight, the solution to a safety problem may be burdensome enough to cause the discontinuation of production. Pricing safety in this kind of environment often means not only calculating the potential costs of an accident but factoring in the probability of an event in the short lifespan of the product run. *Takeaway: Consider the implications for humans when you plan.*

As this can be a shocking argument when articulated directly, writers often mask the implications of their arguments by using terms that neutralize the humanness of concerns (like the word "event" in the last sentence of the previous paragraph) and using arguments that seem to equate effects to human workers with effects to machines and corporate balance sheets. Converting the pain and suffering caused by an injurious workplace accident to a dollar amount so as to make it comparable to the cost of a process improvement is a to dehumanize workers so that they may be comparable to machines, money, or other resources. It may seem merely strategic when you are trying to argue that a safety measure should be taken, but what happens when the calculation comes out the other way—when it's clear that losing a few low wage workers to injury may be more economically profitable than shutting down a production line? Using pricing as an analytical technique to support a safety measure at one point makes it seem acceptable to use pricing to support unsafe decisions later. As a professional, you should always be aware of the language and arguments you are making in order to persuade.

Assuring Outcomes and Benefits without Seeming Unrealistic

Persuasive documents are, in some way, aspirational texts. One of the most persuasive elements of a proposal might be an articulation of the outcome of the project. Proposals often present a vision of a future state in which problems are resolved, processes are efficient, businesses are profitable, or employees are safe and satisfied, and they make promises to your readers about your abilities to deliver on these visions. If you

know what a client wants, it's easy to write a proposal promising them an outcome that's ideal. There are a couple problems with this approach.

The first is that you might not be able to fulfill your promise. Different fields have their own customs, but the legal contracts that begin work, in most fields, contain specific deadlines and descriptions of work to be completed. These dates and the text of these descriptions, while often negotiated extensively before written into the contract, oftentimes originate in the proposal for work. The discussion of outcomes and deadlines in your proposal should be conservative. In some sectors, ranges are provided rather than fixed dates and costs. In others, fixed dates and costs are provided but are annotated with lists of reasons why that date might change. In sectors where contractors are expected to be able to provide firm numbers with no excuses, the convention is to inflate a quote by a certain percentage to account for problems—no one ever complains about a project finished early or under budget. What is expected or considered ethical may be codified by professional societies or by the presence of technical terms used around contracting (like "fixed-price" or "standard markup") which lend a practice credibility (or serve to house negative connotations). *Takeaway: A conservative promise is easier to keep.*

The other problem with proposing idealistic outcomes is that the audience you are trying to persuade may not find you believable. Some companies, in order to win competitive bids, quote low prices or promise fast completion knowing that overruns and delays will inevitably happen. This is the case especially in sectors where there is loose regulatory oversight or where few contractual penalties are exercised for late work (often because legal proceedings are costly enough to make violations of small contracts not worth pursuing). In environments like these, an unusually cheap price or short turnaround time can seem suspicious. This doesn't mean you shouldn't propose a timeline that's shorter than expected, a low cost, or a superior product if you can actually deliver it. In fact, sometimes clients have unreasonable expectations that actually work in your favor (expecting a service to be more expensive than you typically charge). Whether this comes from their lack of knowledge of the sector you are in, from a sense that their problem is more complicated or unusual than it actually is, or from experiences with a past consultant who overcharged, a client who expects less than you can deliver or who expects to pay more is a gift, an opportunity to do good work for fair compensation and so by earn their loyalty and appreciation *Takeaway: Idealism can make you seem non-credible.*

Questions for Analyzing Existing Documents

When looking at sample proposals or business plans from your workplace environment, you can use these questions to help you analyze your writing situation:

- What kinds of audiences are addressed in documents similar to the one you plan to write? How are the values of those audiences accounted for in the way the proposal is written (e.g., terms, arguments, etc.)?

- How do writers usually create a sense of significance for the problem they are addressing with their project?
- How is the firm or corporation bidding for the work represented? Are previous projects discussed? Staff biographies or company histories included?
- How much information about the problem has been included (as opposed to the proposed solution)? How and where in the document are connections drawn between the problem and solution? How and when is supporting evidence presented?
- Are alternative solutions considered and dismissed? Are options given?
- How are cost, time, and parameters of the outcome hedged? What kinds of statements are not hedged?

When you begin writing a persuasive document, carefully review any in-house proposal guidelines or other specifications for the type of document you are writing. Follow these guidelines carefully and show that you have included all the required information for your project or idea as described in the guidelines. If the guidelines indicate specific sections or information to include, page lengths, font size, or necessary attachments, follow the guidelines to the letter.

Part of your analysis of the decision-makers who will read your document should include research into the background and context that led to the Request for Proposals (RFP), if one was issued. What is going on in that organization that led them to perceive a problem and send out the RFP? How have they defined this problem and what assumptions are they making about an appropriate solution? How will the proposals or business plans be evaluated? Who has been successful in submitting proposals to this organization in the past? Who will be likely to also submit proposals to the current RFP? These people and organizations will be your competition for the decision-making process. Analyzing your writing situation by researching the funding organization and context for past and current RFPs will help you choose what information to include in your proposal or business plan, and what information to exclude from it. *Takeaway: Things you know about the organization can help.*

If your document was not solicited, you should nevertheless investigate the context within which the decision-makers will read your proposal or business plan. Will the decision-makers want to read your document? Will they agree that a problem exists? If not, what would it take to convince them? Are they under any pressures from above or outside that will influence how they will understand your ideas? Have the decision-makers passed judgment on similar ideas? If so, what were the outcomes? Would the decision-makers need to seek approval of higher authority? If so, ask the same questions for these higher level decision-makers.

If you are unsure about what a successful proposal or business plan looks like, find a similar document that was previously written for a project that received funding. You may be able to find this type of document in the files of completed projects at your workplace, or you might ask your supervisor or one of your colleagues for

samples of their documents. You want to be sure that your document reflects your organization's format and style, which you can emulate from samples of previously successful proposals or business plans.

Typical Examples of Persuasive Documents

Proposals

You could find yourself writing proposals for a variety of reasons:

- To suggest an improvement to an existing process in your organization
- To gain approval to begin a project assigned to you by your supervisor
- To participate in a competitive Request for Proposals (RFP) process for outside funding
- To negotiate a project with an internal or external client

In any of these situations, your proposal needs to include information and reasoning that will persuade your readers to approve your ideas and proceed with the proposed project.

When writing a proposal, you address an audience that has some authority over you, at least in the context of the proposal's subject. The audience has the power to accept or reject your ideas, which could mean your project becomes a reality or not. In this context, the purpose of the proposal is to win the audience over to your way of thinking.

Some proposals are not solicited at all, but are written to determine whether someone is interested in your idea. You might write this type of proposal to someone in your organization to test an idea. Or you could submit a brief, unsolicited proposal to an external organization to see if there is enough interest in your idea for you to take the next step and develop a full, formal proposal for funding. These preliminary, unsolicited proposals are sometimes called *concept papers* or *white papers*.

Other proposals are written in response to Requests for Proposals (called RFPs). Organizations issue RFPs when they have determined that they will fund one or more projects in an area that is important to their organization. For example, the National Science Foundation (NSF) regularly issues RFPs for contract work and for grants and awards. (You can see examples of this information at http://www.nsf.gov.) These RFPs tell you what kinds of projects the NSF is interested in funding and how to apply for these funds. Many other funding organizations issue RFPs to give people a chance to bid on contracts or propose projects for grant funding. *Takeaway: An RFP should influence how you structure a proposal.*

All proposals seek approval of ideas. In some cases, the approval comes in the form of money. A researcher, for example, might be awarded funding to conduct an

investigation. In other cases, the approval might be permission to move forward with a project. For instance, a software developer might propose a new feature to a cross-functional team before beginning the actual coding.

Parts of Proposals Sometimes RFPs specify the required elements of submitted proposals. In these cases, follow exactly these specifications. In other cases, and when you are writing an unsolicited proposal, the format is left to you.

The elements described here are those found in many proposals, even though they may bear different names. For example, almost all proposals contain a section that introduces the context of the problem; here, we call that section "Introduction," while others may call it "Background" or "Context."

In many cases, your proposal will first be evaluated on whether it adheres to guidelines. A proposal that graphically calls attention to the presence of required elements (for example, through headings) will be more likely to be approved at this first stage than one that is hard to navigate visually. Headings and subheadings also help your readers to follow the logic and overall structure of your proposal. Write informative headings that represent the main idea of that section of your proposal. For example, instead of calling the first section "Introduction," summarize your idea in that section: "Growth of Electronic Trading Threatens Client–Broker Relationship." *Takeaway: Use formatting to make clear any required parts are included.*

FRONT MATTER Depending on their size and scope, a proposal that is delivered on paper can be bound with an attractive and informative cover. Before the body of the proposal, it may contain a title page that has relevant identifying information (like the name of the organization, the date, and description of the project in title form) and navigational aids like a table of contents or list of attachments or drawings. If a bound proposal is mailed, it's often shipped in a nice envelope with a cover letter that's warmly and proudly written and that encourages the reader to "please find [the proposal] within," discussing some highlights of the project and its outcome and when work could begin. Often, particularly nice paper is used.

Many modern workplaces have digital equivalents to this ritual. Even in the most casual of workplaces, a proposal that may have gone back and forth to the client several times in draft form, once completed, is often sent attached to a ceremonial "please find [the proposal] attached" e-mail. (If you find yourself participating in this ritual, be sure to send the most up-to-date version of the document with all the changes accepted.) In a way, a cover letter, a title page, even the utilitarian table of contents (often still included in a .pdf proposal despite its searchability) is a frame meant to make the proposal look its best.

PROJECT SUMMARY (OR EXECUTIVE SUMMARY) The project summary is usually placed either on the title page, on the page following the title page, or immediately after any tables of contents. This is probably the most important part of your proposal, since it is the section that everyone will read. Decision-makers can rule out

your proposal after reading only the project summary, so make sure your summary completely reflects the information in your proposal.

This section summarizes your proposal as a document, but does not summarize the project's activities. In other words, briefly represent the main ideas from your proposal document; do not simply describe the project itself. Most often, you will write the project summary after you have completed your proposal. Since it is such an important section of your proposal, leave enough time to draft and revise this summary. As you draft the summary, revisit the values and motivations of the decision-makers. Which of their concerns are most central? How does your proposal address their central concerns? If you are writing an unsolicited proposal, the summary will probably determine whether the decision-maker reads any further. Think carefully about why the decision-maker should both care about the problem you have identified and be confident that your solution is worth considering.

INTRODUCTION The introduction provides background for the problem addressed in your proposal. It should orient your reader to the situation and context surrounding the problem, as well as create a sense of significance for it and for the proposed project. As you think about the significance of the project, reflect back on your evaluation of the proposal's rhetorical context. Who are the decision-makers? What do they think is significant about the problem? What do they need to know in order to see the problem as you see it, or to at least accept your vision as reasonable?

Introductions usually begin by stating a rationale for proposed project. This can be done by providing a history of problem. You can review how other people have addressed problem, most often through past research and professional articles on the problem.

Once you have reviewed the history of the problem, you can identify gaps in past attempts to address problem. This means that you identify what other people's work has left undone that has led to the current problem.

Finally, your introduction states how your proposed project will fill the gap left in other people's work and solve the problem. This leads you to the next section, which is a detailed description of your proposed project.

PROJECT DESCRIPTION The project description builds on the problem statement and proposed solution in the introduction. In this section, you look at the project as a system of related issues and activities. To do this, you break the project into categories of activities and describe them. Examples of these categories would be research, design, testing, etc. Do not describe the project chronologically in a "first we will do this and next we will do this" logic.

Include sufficient details in this description for decision-makers, and especially technical staff, to understand each activity category. The most difficult aspect of writing this section is elaborating sufficiently on your ideas. Be sure you explain your proposed project to someone who is not familiar with your ideas. You might

have a colleague read through this section to be sure you have included enough information.

OBJECTIVES The objectives section sets out how you or your team will accomplish the project's goal. The objectives that you articulate will also serve as evaluation measures of project outcomes, to determine where your project has achieved its objectives and where it has fallen short. By carefully stating your project's objectives, you will also set up criteria for evaluating success at the end of the project.

In many technical and scientific fields, objectives and outcomes are quantified. To make operational objectives for a proposal in one of these fields, state project outcomes in terms that can be concretely measured mathematically. For example, you can count frequency of occurrences of an indicator of success, for example, telephone calls to your support staff. Or you can determine a change in quantities or frequencies of an indicator, for example, decrease in telephone calls to your support staff. Or you can account for changes in income, expenses, or profits.

Suppose that you set out the following objectives to be achieved by your project's end date:

- Customer calls to support staff will decrease by 50%.
- Responses of "satisfied" or "very satisfied" on customer product satisfaction survey will increase by 30%.
- Support staff overtime costs will be reduced by 40%.
- Responses of "satisfied" or "very satisfied" on support staff job satisfaction survey will increase by 20%.

By setting out measurable objectives for evaluating your project, you can more readily determine where your project succeeded and where it could have done better. For example, you could find that the first three objectives in the above example were met, but the last was only increased by 5%. In this case you would have identified an area that needed a different approach than was attempted in the project. Perhaps the staff needed more time to become more satisfied with their jobs. Or perhaps another project is needed to address that problem.

If your field does not usually represent findings mathematically, or if the goals of your project cannot be represented in this way, represent your objectives qualitatively. For example, your objectives might be to understand contexts, meanings, and particular circumstances. Suppose that you are writing a proposal to develop materials for a local public health campaign against smoking. In this instance, your objectives might be to understand the lifestyles of smokers in a particular community so that you can better target these smokers in your materials.

ACTIVITIES AND TIMELINE The proposed activities and timeline section provides details of how the objectives will be accomplished. This section needs to include

minute and copious details of project activities in order for the decision-makers to fully understand what you are proposing to do. You need to persuade them that you know what needs to be done and that you can do it.

In this section, set out a sequence of activities and their projected outcomes. Again, include sufficient details for your readers to clearly understand what you are proposing to do. Also, identify which members of your project team will carry out each of the proposed activities and when each activity will be completed.

In addition to an explanation of your proposed activities in words, include a graphical representation of your timeline to make your project easily understandable. Most often proposals include a Gantt chart or a calendar for this purpose.

BUDGET The budget should be complete, truthful, and faithful to guidelines set out in the RFP or other instructions for preparing the proposal. Budgets are usually represented in tabular format, showing categories of expenses. You can also show in-kind contributions or discounts from your organization or from other sources that serve to lower the cost of the project.

QUALIFICATIONS The qualifications section includes biographical statements for all team members to show that your team is experienced, professional, and capable of successfully completing the proposed project. You generally do not include full résumés in this section, but instead highlight team members' experience that is relevant to the proposed project and state their roles in the project. If résumés are requested, tailor them to the proposed project and funding agency by highlighting each person's experience that is directly relevant to the proposed project.

APPENDICES Appendices can be included for background information that is too detailed for the proposal body. Before including appendices, though, check the RFP and adhere to guidelines for appendices set out in that document.

In most cases, you will want to include graphical representations of information in the body of the proposal in the section where that information is being discussed. An exception to this practice, though, may arise if the RFP specifies a page limit for the proposal, but allows for appendices. In this case, you may need to include your graphics in an appendix to stay within the page limit for the proposal.

Business Plans

When you write a business plan, you describe how your business will achieve its goals. These documents are most often written as a proposal for a new business, but can also describe how an existing business will move in a new direction. The goal of a business plan is usually to convince someone to fund your idea or to otherwise participate in your venture. After reading a business plan, owners or investors should have a detailed picture of potential costs and risks that will impact business decisions.

A business plan is a living document that generally projects 3 to 5 years ahead and sets a course for how a company intends to increase revenues. The objectives you set out in the business plan will provide benchmarks to see if goals are being met. The business plan should help the enterprise stay on track. You should be prepared to modify and update the business plan from time to time as business conditions change.

The first step in the process of writing a business plan is to determine they target market and why they should want to buy from your organization. Clearly state the benefits that customers in your target market have from dealing with your business and how your business is aligned with their needs.

Be sure to understand what makes your business stand apart from other similar businesses. What does your business have to offer that stands out from the crowd and meets customers' needs? Be able to clearly state how your business is uniquely situated to fill a need that is currently not being met in your target market. This will be the niche that your business will occupy.

You might benefit from doing some market research as you identify the unique niche your business will fill for your target market. You can survey potential customers to find information on areas such as these:

- In which areas are your competitors already well established?
- Which areas are being ignored by your competitors?
- What potential opportunities do these ignored areas offer for your business?

Parts of Business Plans

MISSION STATEMENT The mission statement briefly sets out an organization's purpose and defines the reason for its existence. It helps to guide internal decision-making, while also communicating the organization's mission to customers, suppliers, and the community. A mission statement needs to include this information:

- Needs and opportunities that the company is addressing
- How the business operations are addressing these needs and opportunities
- Principles and beliefs that guide the organization

Here are two examples of mission statements:

- To be the most customer-centric company in the world, where people can find and discover anything they want to buy online. (Amazon)
- We are a global family with a proud heritage passionately committed to providing personal mobility for people around the world. (Ford Motor Company)

EXECUTIVE SUMMARY This might be the first section of your business plan, but you should plan to write it at the end of your writing process. This is the section where

you highlight the strengths of your overall business plan and convince busy readers to continue reading the entire document. A one-page executive summary needs to include this information:

- Company information, including when the business was formed, names and roles of the founders, number of employees, and location(s)
- Growth highlights, including graphs and charts of financial and market highlights
- Description of your product(s) or service(s)
- Financial information, including information about your current bank and investors
- Summary of future plans

If you are starting a new business, you might not have all this information. Focus instead on your experience and background, as well as the decisions that led you to start your business. Describe your market analysis; include information about the need or gap in your target market and how your business will fill it.

COMPANY DESCRIPTION Provide a high-level review of the elements of your business in a brief statement that will allow your reader to quickly understand your business goal and its unique proposition. A company description needs to include this information:

- Nature of your business
- Marketplace needs you are addressing
- How your product or service meets these needs
- Specific customers, organizations, or businesses that your company will serve
- Advantages that will make your business a success, such as location, personnel, operations, or value

ORGANIZATION AND MANAGEMENT Provide an overview of your company's organizational structure. This part of your business plan needs to include this information:

- An organizational chart representing the structure of your business, along with a narrative description of the decision-making and reporting structure
- Information about the legal structure of your business and ownership information, including profiles of the members of your management team
- If you have a board of directors, include their names, backgrounds, positions on the board, and extent of involvement with the company

SERVICE OR PRODUCT LINE This section should describe your service or product, emphasizing the benefits to your target customers. This section needs to include this information:

- Information about the specific benefits your service or product has over your current competition, described from the perspective of your target customers
- Statement of the current stage of development of your product or service and its life cycle
- List of existing, pending, or anticipated copyright, patent filings, or legal agreements
- Explanation of research and development activities, including plans and anticipated results

MARKET ANALYSIS This section should demonstrate your knowledge of the industry and market you plan to enter, as well as your research findings and conclusions. A market analysis needs to include this information:

- Description of your industry, including its current size, historic growth rate, trends, and major customer groups
- Distinguishing characteristics of your potential customers, including their critical needs, demographics, and seasonal purchasing trends that might impact your business
- Market profile, including size of your target market, data about annual purchases, and forecasted market growth
- Information about the market share percentage and number of customers you expect to gain and the logic behind this forecast
- Definition of your pricing structure, gross margin levels, and discounts
- Analysis of your competition by product line or service, including market share, strengths/weaknesses, importance of your target market to competitors, opportunities and barriers for your entry into the market

MARKETING This section should focus on the marketing strategy for your business, including these strategies:

- Market share or the percentage of sales volume you expect to achieve in relation to your competition
- Growth or how you will build your business, including increasing your staffing, acquiring other businesses, or finding new markets for your product or service
- Channels of distribution, such as building an internal sales force, working with distributors, or selling through retailers

- Communication for reaching your customers, such as advertising, public relations, personal sales, printed materials, and electronic media

CASH FLOW STATEMENT This statement should account for the revenue and expenses over a designated period of time, like a quarter or a year. It will allow you to understand your current and future needs, as well as how cash flow will impact your company's growth. It covers where the money came from (or will come from) and where it went (or will go). A cast flow statement is one part of the financial documents required to manage a business, along with a balance sheet and income statement. A cash flow statement is usually organized in three main sections:

- Operating activities, such as sales of goods or services
- Investing activities, such as sale or purchase of an asset
- Financing activities, such as borrowing funds or selling stock

FUNDING REQUEST This section should provide specific information about what funds your business needs and how the funds will be used. Be sure to address any questions you know your potential funders will have about this funding request in the narrative that will accompany your financial information. You may find it helpful to represent some of the information in this section through charts and graphs. Include this information in your funding request:

- Your current funding requirement and the time period it will cover
- How you will use the funds you receive, such as capital expenditures, operational expenses, debt retirement, or acquisitions
- Your strategic financial plans, such as buyout, acquisitions, or debt repayment
- Projected funding requirements over the next 5 years
- Prospective financial data for the next 5 years that matches the projections in the other statements of this plan, such as forecasted income statements, balance sheets, cash flow statements, and capital expenditure budgets
- Analysis of your financial information, such as a ratio and trend analysis for your financial statements

APPENDIX You may find that you want to include additional information in an appendix that does not fit into other sections of the plan. You might also use this section to include additional information for some readers, but not others. Having additional information in a separate appendix section will allow you to easily include or omit this information as you distribute your business plan to different readers. Your appendix might include this information:

- Personal or business credit history
- Résumés of key management personnel

- Letters of reference
- Product pictures
- Details of market studies
- Licenses, permits, or patents
- Legal documents
- Contracts
- Building leases
- List of consultants, including your attorney and accountant

6

Correspondence: Medium of Workplace Collaboration

- *Correspondence documents are used to share information, to request action, or to manage work. It is also difficult to separate work itself from texts used to collaborate. Correspondence is the workhorse of most organizations.*
- *The purpose of correspondence can be to request work to be done, promote ideas, train others to function within the organization, pass along information from one party to another, record decisions, set agendas, and establish or maintain relationships. Correspondence can also serve a self-protective and legal function by establishing a paper trail of evidence.*
- *Audiences for your document may be internal or external to your organization, which determines what kind of correspondence is appropriate in a particular situation. Communication strategies when writing correspondence rely on understanding personal relationships, feelings, and the timeliness and tone of the communication.*

The IEEE Guide to Writing in the Engineering and Technical Fields, First Edition.
David Kmiec and Bernadette Longo.

- *Some typical correspondence documents include*
  - *Letters, memoranda, and e-mails*
  - *Pre- and post-meeting documents, including announcements, agendas, and minutes*
  - *Social media*

Introduction

Collaboration within an organization often relies on written communication. In part, this is because collaborators in modern workplaces often work on multiple projects at once and with different groups of collaborators. In addition, they often work asynchronously, and the teams they are on might be distributed around the globe. Collaboration within an organization also relies on written communication because the tasks completed in modern workplaces are complex and are often related to other initiatives and tasks in ways that collaborators know about only partially.

Correspondence is the word we will use in this chapter to describe those timely, mundane written documents that enable work to be done in an organization. Traditionally, discussions of correspondence in the work place have often relied on a discussion of two key documents—letters and memoranda—the former being a more official document between an organization and another or a person, the latter being an internal document that, while still authoritative, is meant to express something within an organization. In the paper-based workplace, there are of course all manner of notes, notebooks, files, and texts that were neither letters nor memos and in contemporary workplaces, where a mixture of paper and electronic texts are used in idiosyncratic ways, there are as many types of documents as there are workplaces.

Correspondences which are meant to share information, to request action, or to manage work are, in some ways, impossible to separate. An e-mail meant to communicate some recent data or decision may also be the document that signals a particular project task has been completed and that another should begin. Meeting notes included in a calendar announcement in your corporate e-mail are both informative correspondence and a goal-setting message for an upcoming meeting. Changes to an updated schedule of work for a project that is falling behind can be delivered via a memo while the "official" work plan is updated to leave no trace of the change in schedule.

In many modern work sectors, especially those that produce intangible or intellectual products, it is also difficult to separate work itself from texts used to collaborate. Workplaces that produce design schematics for clients or that develop code often do important design work right in the collaborative tools which are used to manage projects and communicate work product. The distinction between *communicating work* and *doing work*, which is always debatable as we have discussed in

the introduction to these last chapters, is especially problematic when it comes to the documents discussed in this chapter.

The Purposes of Correspondence

You might think of correspondence as the workhorse of most organizations. Through these documents, individuals and units within a single organization request work to be done, promote their own ideas, train others to function within the organization, pass along information from one party to another, record decisions, and set agendas. Between organizations, or between individuals and organizations, correspondence helps to define relationships. *Takeaway: Correspondence can be incidental or official.*

Sometimes, these relationships can be official and contractual. A letter or memorandum of understanding (MOU), for example, embodies a formal agreement between two or more parties, establishing a partnership or a mutual accord on an issue. But correspondence is often about establishing a personal relationship, and about communicating shared needs and establishing a sense of good will, reciprocity, and diligence. And e-mail following up with a client about a problem they experienced shows that you and your company care. A letter sent to inform an organization member of a raise or promotion is a token of organizational praise. Similarly, the corporate-wide memo telling staff that there will be no more once-per-month birthday cake is a signal to employees who value that opportunity to congregate and celebrate together that management isn't concerned with their happiness. (It alternatively may be a relief for those employees who don't like having to sing happy birthday to people they work with.)

Correspondence can also serve a self-protective and legal function by establishing a paper trail of evidence. Even if the trail is in electronic rather than paper form, correspondence can serve as evidence of requests made, of information sought or given, of warnings issued, or of points agreed upon. The workplace documents you routinely produce constitute a record of your activities, which can not only be used publicly (e.g., in court to support a patent claim) but can also be used internally to your company to evaluate your value and productivity as an employee. *Takeaway: Correspondence is a key source of evidence.*

When you write correspondence, your goal is to convince your audiences that you are credible, that the information contained in these documents is reasonable, and that you recognize their values and needs even as you ask them to perform a task for you or provide you with information. When you are passing along information or making the kind of requests or assertions your audience expects, credibility can be established by simply using the right terminology and composing a message that looks and sounds professional. Sometimes, however, authors of correspondence are asserting unexpected things or are requesting an action from the reader. Establishing credibility then also requires that the author anticipate and answer reader's questions,

"Why should I believe this?" or "What's in it for me?" or "Why should I take this action, this way, at this time?" The key communication strategies in Chapter 3, "Writing to Know" and Chapter 4, "Writing to Enable" address these questions.

Occasions for Preparing Correspondence

Not all written documents are large undertakings. Workplaces function on the rapid exchange of short messages. A manager inquires about the status of a test before an afternoon meeting with executives. A professional asks where he or she might find current materials information necessary to evaluate a design. A shop worker wants to confirm they have the correct specifications before beginning an operation. An analyst visiting a site sends a message asking for instructions when they find the site is not as they expected. Workplace efficiency depends upon the ability of organization members to quickly produce intelligible messages and to attentively reply.

Of course, the distinction between correspondence and the other kinds of documents described in the previous chapters are not clear cut. The strategies in those sections often apply to these documents just as well. For example, if you're e-mailing a client in an attempt to persuade them to take some action, then reading Chapter 5, "Writing to Convince," will be beneficial.

Audiences for Correspondence

When writing to collaborate, it may be especially helpful to consider whether your audience is in your project team, organization, or collaborative circle or outside of it. The divide between internal and external is the distinction that generally determines the form that a correspondence will take. In workplaces where professionals communicate internally through an instant messaging system, they may communicate externally (with clients and vendors) by e-mail. That said, there are internal and external considerations even within a workplace. Those professionals may use an instant messaging system with members of their organizational unit or team, but not with members of other organization or not with upper management. *Takeaway: A sense of organizational distance is key.*

When collaboration is done on paper, letterhead (paper with company name, information, and logo at the time) may be set aside for mail leaving the organization while colored envelopes are used for mail circulating within the organization. When collaboration is done electronically, shared file spaces, intranets, messaging systems, and corporate e-mail account are often set aside for internal work use only, while electronic collaboration with clients may be done through specifically set up online or cloud-based drop boxes or partitioned server spaces. In some workplaces, special e-mail accounts are even set up for sending messages to and from a client to make sure

that workers don't accidentally forward or copy clients on potentially embarrassing or proprietary messages.

Internal collaborative communications don't just exist within the context of a corporate culture, they make up the most robust picture of a corporate culture. Unlike authoritative statements (which are less dynamic and more narrowly prescribed) like the corporate mission statement, policies, logos, etc., collaborative communications are dynamic, frequent, and voluminous. In some workplaces, employees forward personal banter or send dozens of e-mails a day with short bits of information and requests. In others, e-mail is seldom used to connect socially, e-mails are drafted to be longer and more substantial, and the act of sending frequent small e-mails is seen as disruptive or immature. *Takeaway: Understand corporate culture is important.*

When writing to audiences internal to your organization, you are representing yourself as an individual and as someone holding a particular position. Consider your position relative to your audience. In the organizational hierarchy, who (if anyone) is higher up in the chain of command? What knowledge does each of you hold? What responsibilities does each of you currently have? What other factors (such as personality or organizational history) are likely to influence the way that you and your reader view this correspondence?

Communication between an organization member and a client, however, is almost always more restricted and more planned. This is, in part, because clients have their own organizational cultures that cannot readily be accounted for. But it's also because an e-mail that leaves the organization and goes to a client becomes a representation of that organization as well as of the professional who sent it. This is part of the reason why project-heavy organizations have designated project leads who are (or assign someone to be) a single point of contact for a client.

External audiences may include people you know well and those with whom you are unfamiliar. External communications like letters and external e-mails work by leveraging an existing relationship or by forging some kind of temporary relationship. When requesting extra resources from a client, for example, you may begin a letter by reminding the client of the project goals you share and of the successes of your partnership so far. When informing a regular customer of a new product, you may begin by reminding that client of products they have bought before. And, when submitting a bid to a client that you have never worked with, you may begin with a statement of how your identity and expertise are related to their needs, implying that a relationship would be not only possible, but productive. In each of these cases, further argumentative material relies on the communication first establishing a relationship between you, your firm, and your audience.

When writing to an external audience as a professional, you are acting as a representative of your organization. This may mean you need to consider the goals and values of your organization and the extent to which they accord with your own. You personally act to establish or maintain a relationship with your audience through your correspondence. If you want to keep your lines of communication open, you want to maintain a good relationship with your readers. This means that you want your reader

to trust your honesty and view you as a believable person. It also means that you are the agent by which your audience is being related to your company, so you should be comfortable with your company's larger goals where that client is concerned. *Take-away: To external audience you represent your company.*

Key Communication Strategies When Corresponding

Consider Workplace Roles and Official and Unofficial Relationships and Responsibilities

The complexity of a collaborative correspondence (like an e-mail inquiring about project work in progress) may vary dramatically based on the relationship between the writer of the e-mail and the audience. While a writer who is new to an organization may not know the recipient, most internal communications are written between people who have work histories, who know each other's personalities, and who have opinions about each other's competency, reliability, and trustworthiness. In an e-mail to a colleague whose competence you trust, you may elaborate on some technical information, expressing doubt or asking that person to use technical expertise to correct any perceived errors. For a colleague you feel less capable, you might leave any ambiguity out, and you would certainly not encourage them to use their best judgment.

In addition to being shaped by personal perceptions, a message asking someone to act is shaped by organizational roles, the sense of the appropriate motivations and responsibilities of each party within the organization. In order to correctly position your communication in organizational terms, you may consider these things.

Establish Context Usually, there is a history for every project. By considering this history before you write, you can maintain or establish good relationships built on common experiences and expectations with your audience. For example, if you were writing a progress report memo for your client, you might first determine when you last reported and what was in that previous report. You could then reference that previous report when beginning your current one, addressing issues that were left in question at the time of the previous report. You may also review key points of the previous report, especially points that will be valuable to you as you go on to make points in the current document.

Find Common Ground For you to be believable and trustworthy, your intended reader must feel that you both share some knowledge, values, attitudes, etc. In order to increase the probability that your audience will find you credible, use language and refer to experiences that your audience will feel comfortable with and will share with you. By establishing a common ground with your reader, you can begin your correspondence from a shared standpoint. Once you have this common ground,

you can incrementally ask your reader to move to a new position or understanding that you will suggest through your correspondence.

Determine the Appropriate Format The first decision you will make as you plan your correspondence is whether you should communicate by paper or electronic media. When companies have official business or want a communication to seem important or ceremonial, they send letters. The paper letter is a form that establishes or reinforces a personal relationship between a corporation and a client, customer, vendor, or employee. For an internal audience, letters are more personal than other paper messages like memoranda; they are also more formal. Letters can also have contractual standing, as they are often signed in ink (sometimes called a "wet signature"), and they include important symbols of identity like corporate logos and emotional cues like warmly phrased greetings and closings (e.g., words like *Dear* in the salutation and *Sincerely* in closing).

E-mails and paper memos are primarily used for disseminating or reporting information to people within your organization. E-mail is frequently used to correspond with people outside the organization with whom you have an ongoing relationship, such as clients or subcontractors. E-mails and memos are designed to communicate efficiently, so you do not need to include salutations, closings, or personal information as you do in a letter. Paper memos can seem more official simply because they are tangible, but they can also seem impersonal when sent to many people at once. If you are sending a hardcopy memo, you also do not sign your name, though sometimes people initial beside where their typed name appears on the "From" line to indicate that they have seen and approved the message before it was distributed.

Determine Who Needs to Be Copied You may find that you need to distribute your copies of your correspondence to more people than those directly addressed in your message. In this case, you will want to send copies to them. In deciding who needs to know what's in your correspondence, consider these types of questions:

- Do supervisors or colleagues need to know what you are saying?
- Are other people involved in this project who need to know what is in this correspondence?
- Can you give positive recognition to the person addressed in this correspondence by copying people higher in the organization?
- Does this correspondence need to be part of some kind of larger record (of some project, of a policy or process, etc.)?

When paper letters or memos are sent to multiple parties, they often contain a line at the top or bottom saying who else has received the document. Of course, it was always possible to send extra paper letters to people off the distribution list

(sometimes called blind recipients). The abbreviations in e-mail CC and BCC (CC for carbon copy and BCC for blind carbon copy) originate with this custom.

When sending an e-mail to multiple parties, include only people who are relevant to the e-mail. If you are replying to an e-mail that someone else sent to multiple parties, be sure to consider whether you should reply to the sender only or reply to everyone on the chain. In a long conversation, it's not uncommon for parties included in the original e-mail (just out of courtesy or because some initial logic warranted it) to become no longer relevant to the conversation. Professionals often find it impolite to edit "CC" lists, removing people who no longer need to be included, because there's the chance that person may feel slighted. Of course, sometimes people that no longer want to be included in a discussion will reply into the discussion to ask to be removed, and this sometimes makes people feel awkward too. The best practice is to limit conversations to exactly who needs to be included and to begin new e-mail chains as discussions develop and change topic. *Takeaway: Who you reply to or copy matters.*

Though an e-mail may appear the same in their inbox, some recipients of e-mails are sensitive about whether or not they are mentioned in the "To" field or the "CC" field. Generally, you will want to use the "To" field for people you expect to reply and the "CC" field for people you do not expect to reply. That said, if you are messaging a large number of people, it's not unusual to put most of the names in the "CC" field and a particular name, perhaps a project manager, in the "To" field. Some companies establish addressable distribution lists for commonly e-mailed sub-organizations. (An e-mail sent to Org_all@companyname.com, for example, may go to everyone in that organization.) When these lists are available, be sure to use them for e-mails that are department-wide.

While you can use the "BCC" field to blind copy people on a message, it's often better not to. Blind copying someone on a message means that the people who visibly receive the message are not aware that another person has a copy of it. This can sometimes cause mistrust if, later, it is revealed that that person was included. Also, blind recipients do not receive replies to e-mails, so blind copying someone into a conversation is often less effective than simply telling them what is being discussed. Blind copy is sometimes used when an e-mail recipient's address is to remain anonymous, as when an introduction is made but when the person sending the e-mail doesn't want to expose a recipient's contact information without their permission.

Evaluate Target Size and Frequency of Communication for a Relationship

Your clients and coworkers are generally busy people. They have their own concerns, their own projects, and their own way of managing their workload. When you write a message requesting information or confirmation or asking for action you are interrupting their work. That's appropriate, of course. People need to interrupt each other frequently when collaborating, especially on large technical projects. As someone

who is interrupting, you can be sensitive to your audiences' workload and work habits by making your messages timely and directed. It is less disruptive, for example, to e-mail a colleague for information if you can provide them, in an organized way, a specific list of data points you need. It is more disruptive if you send several small e-mails throughout the afternoon requesting each piece of data one at a time or if you send a long discussion of what you're doing with the requests spread across the narrative.

E-mails early in a relationship, especially, should be short. A customer who opens an unexpected e-mail and find it fills the screen is more likely to be annoyed or overwhelmed than impressed by the volume of the message. If the problem is complicated and requires long explanation, your initial communication should discuss the main objective of your communication and the complexity of the problem. It might then go on to ask if the reader has the time or inclination to hear about the problem in a follow-up communication (sometimes a phone call). If this isn't a viable strategy, then attaching a report with the relevant information may be a way to make the information being communicated seem contained and organized. If you do attach a report, however, your e-mail should tell the reader exactly what is in the report, why it has been attached in the initial communication, and how they should go about reading and considering it.

Pause to Reconsider Composition, Time, and Tone before Sending

Longer more complex and less "of the moment" documents often undergo drafting, review, and generally a longer composition process than typical business communications like e-mails, instant messages, and even letter. The rapidness of a modern workplace environment relies on quick communication and the ready availability of expert attention and information. It's too easy to quickly compose and send a message that is incomplete or casual, which can do damage to the project or workplace relationships.

From an organizational perspective, the time saved in drafting an e-mail quickly is eventually lost if that e-mail requires three or four follow-up exchanges for clarification. Even worse, poor e-mails could lead to someone doing work that wasn't warranted. Additionally, quick messages that are composed in tense situations can be counterproductive. Where designs are being argued, where tasks or resources are being assigned, or where personal issues have become the object of attention, it is easy to write a quick reply that comes across as harsh or impolite or that represents a situation in an inappropriately personal way. *Takeaway: Taking time to consider a message may save time later.*

This is not to say that feelings about workplace issues should not be expressed in the workplace—people spend a significant amount of time with coworkers, sometimes more time than they spend with their families and friends. But employees (and perhaps especially employers) at most workplaces strive to maintain a certain tone and, while this tone varies from workplace to workplace, violating the

conventions of that tone can lead coworkers to question your work, your professionalism, and your role in the company. *Takeaway: People are sensitive to the tone of messages.*

Stopping to reread an e-mail before you send it may enable you to consider if it is likely to cause problems. Consider these questions when you reread:

- *Do I have other things to tell the reader of this message?* If so, consider revising the message to include that information or including a note to let the reader know that another e-mail will follow with that information. (Consider your workplace practices regarding this. While keeping separate issues in separate messages makes it easier to preserve a discussion, it may also be a practice for legal reasons, in which case you may not want to mention a follow-up e-mail.)
- *Would the message I am sending be coherent to the reader if they are looking at it while working on something other than the project or problem I am discussing?* Problems in technical workplaces can, of course, be complicated. But be sure to provide enough topic words and details (product names, meeting dates, etc.) that a reader will know what you are talking about.
- *If I'm expressing a problem, am I also asking the recipient to do something about it, making clear what I think should be done about it, or at least stating that I don't know what should be done?* Readers react in a different way when they read about a problem but aren't sure why a message has been addressed to them. If your goal was just to let them know about it and you are starting to work on it, they might begin working on the problem as well. They might message you back to ask what they should do and then wait for your reply. They might not do anything.
- *Was I angry, frustrated, depressed, or tense when I wrote this message?* If so, look for words that make your feelings clear and consider whether those are the words you mean and whether someone in your workplace not involved in the situation would use those words.

There may be some control on communications that leave the work place, like e-mails to a client, for example; it may be required that your manager approve outgoing communications. If you are allowed to communicate directly with a client, or if you are that point person, you will want to consider the timing of your communication as well. If clients' businesses keep different hours than yours, you may want to hold e-mails until the following day. If you've been asked to do work that you have specified will be completed over a certain time period, you may want to consider how messages coincide with that time period. Asking critical questions late in a project cycle may lead clients to question whether you have been working on the project as you say. Sending relatively complete results early (even if they are labeled preliminary) may lead a client to wonder why you bid so much time for the project. *Takeaway: Sometimes messages have larger political implications.*

Because most employees send dozens of workplace communications like short e-mails and instant messages each day, these messages take up a significant percentage of employees' time. In addition to being functional, employee productivity and reliability is often, in part, evaluated by how responsive he or she is to e-mail, as are an employee's organizational abilities and expertise. Drafting appropriate messages are important, but you must balance taking time to evaluate messages before you send them with allowing message writing to consume too much of your time at work.

Characteristics of Correspondence Documents

Letters, Memoranda, and E-mails

The format of correspondence is extremely important to its effectiveness. In fact, if you do not format your correspondence in standard letter or memorandum formats, your reader may not even recognize that you are writing a letter or memo and may assume that you are unprofessional.

E-mails and memoranda share many features. They each begin with information about the recipient's name, the sender's name, the date the message was sent, and the subject of the message. They are both best used for brief, informal messages. Sending an e-mail is a fast and efficient way to communicate. Unlike hardcopy memos, however, e-mails are difficult to store and retrieve. When you want to communicate a complicated idea or want your message to be an official document, it is a good idea to rely on a memorandum that can be printed to get your work recorded for future reference. You can attach your memorandum document to a brief e-mail with a summary of the memo contents or send a hardcopy through the mail for more formal purposes.

When writing e-mail correspondence, keep your message brief—ideally within one screen. If you must send longer correspondence, you can attach it to the e-mail message or, at least, warn your reader that the message is lengthy. You can also refer your reader to documents you have posted on the Web, providing the URL for that document in your e-mail message. And remember, your employer owns any e-mail you send or receive on your computer at work. Do not assume that your e-mail is private.

Parts of a Letter Letters include the following formatting elements:

- Letterhead with your organization's name, address, and telephone number, if you are writing as a representative of an organization
- Personal letterhead or your name, address, telephone number, and possibly e-mail address typed at the top of the page, if you are writing in an individual capacity
- Full date, with month spelled out (January 1, 2000 or 1 January 2000).

- Recipient's address (sometimes called the inside address), including recipient's full name, job title, and full address
- Salutation. A greeting, for example use "Dear Ms. Smith" (or "Dear Leslie Smith" if you are not sure of the recipient's gender)
- Body of the letter in short, single-spaced paragraphs
- Closing two lines after the last paragraph and followed by a comma (for example "Sincerely,")
- Signature above your name and possibly your job title typed three spaces below the closing
- Enclosures noted as "Encl." or "Enclosures" and possibly a list of the enclosed materials
- Copies listed as "cc:" with a list of people receiving copies of the letter

Parts of a Memo Memoranda include the following elements:

- A heading titled "MEMORANDUM" at the top, if this element looks graphically pleasing to you
- Your organization's letterhead, if the memo is to be distributed outside your organization or your department
- Heading with sections labeled "To," "From," "Date," and "Subject"
- If you need to send the memo to people other than those included in the "To" line, include a "CC" heading with a list of the recipients
- People's titles and organizational affiliation if your memo will be circulated outside your organization or if these affiliations will not be apparent to your readers. Including this information will also be helpful if someone needs to look up your memo from a file months or years in the future
- Your initials on the "From" line to indicate that you have read and approved the memo. A memo sent out without your initials could have been typed by someone else and sent without your knowledge
- A descriptive Subject line that summarizes the main idea of the memo
- Body with information in short paragraphs

Parts of an E-mail E-mails include these elements in common with a hard-copy memorandum:

- An automatically generated heading with sections labeled "To," "From," "Date," and "Subject"
- If you need to send the message to people other than those included in the "To" line, include their e-mail addresses as a CC that is visible to all recipients or a BCC that is visible only to you and the person blind copied

- A descriptive "Subject" line that summarizes the main idea of the e-mail
- Body with information in short paragraphs

Types of Correspondence

While there are any number of possible reasons to write an e-mail, certain purposes seem to reoccur frequently and warrant particular considerations.

Making an Inquiry In this type of correspondence, you are asking the reader to do something for you. The reader may or may not have an incentive for fulfilling your request. For this reason, your goal is to persuade the reader that your request is worthwhile. In some cases, the reader will be accustomed to inquiries of this type, which makes your job easier. For example, you may be asking that a public relations officer at a company send you information on the company. This request falls within the reader's job responsibilities. In other cases, you are asking for something unexpected or unusual, so provide more background to justify the request. For example, you may be requesting data not typically supplied by a vendor about a technology they supply that is important to your work. Because the representative of the vendor may not have this data readily and may not have provided it to anyone before, they may wonder why you need it. They may also not have the time or inclination to respond favorably to the request if they feel that a continuing profitable relationship is unlikely. In this case, you may have to provide rationale for your request or remind the representative of a contractual obligation.

Review these suggestions for making an inquiry:

- Begin by stating the circumstances that led you to make this contact, which will give your reader a context for understanding your request.
- State your request explicitly so your reader will understand what you are asking for. Make your request polite and clear.
- State a benefit that will accrue to the reader from responding to your inquiry. For example, you could be asking for more information about a continuing education workshop, which would boost enrollment for your reader's workshop. While you may not need to spell that possibility out in your letter, that benefit for your reader will provide a common ground for your request.
- Include your contact information at the end of the message and state what action you would like to take place next. For example, if you want an application sent to you, tell your reader where to send it. Or if you will follow up with a telephone call, specify that you will call within the next week—and mark a time on your calendar to do it.

Making an Application This type of correspondence is used to apply for opportunities, such as a job, a training program, an award, etc. Your primary goals

are to create a favorable impression and to convince the reader of your qualifications. Sometimes these two goals are at odds. For example, you might explain your qualifications in such a way that you seem arrogant; your reader might see that you are competent, but will doubt your ability to get along well with others.

Here are some suggestions for making an application:

- Begin by stating how you found out about the opportunity. If you can refer to a person in the reader's organization who recommended that you apply, this will strengthen your connections with the reader and, consequently, your application.
- Highlight how your qualifications fit the application requirements. If you have enclosed a résumé or other application materials, highlight the main points from these other materials that show you are a good fit for the opportunity. Do not rely on your reader to sift through your documents to discover how your qualifications meet their criteria. Instead, point this out clearly in your correspondence.
- Request a clear action at the end. If you plan to follow up with a telephone call, specify when you will call and make that call on time. If you would like the reader to contact you, provide specific information about when and how to contact you.

Making a Complaint Use this type of correspondence to request that an action be taken to remedy a wrong. This type of message requires a delicate balancing act. On the one hand, you want to make your displeasure known. On the other hand, you want to sound reasonable so that the recipient of your message will feel inclined to accept your suggestion for a remedy.

These suggestions for making a complaint or asking for an adjustment can bring success:

- Establish a common ground with recipient so you can build your case upon this area of agreement.
- Describe the circumstances leading to your complaint. Include specific details of date, time, place, and people involved.
- Determine recipient's responsibility to remedy your complaint.
- Request a clear and limited range of actions at the end of your letter. Show how your claim is reasonable in light of the circumstances. Be sure your request is something the recipient can accomplish.
- Include your contact information at the end and specify a time period during which you expect the recipient to respond to your letter.

Following Up Use follow-up correspondence to maintain contact regarding an ongoing project or request. This kind of correspondence is one of the most important

for developing good business relationships. Beyond simply keeping your contacts informed, they help to emphasize common goals, clarify points of disagreement, and establish an atmosphere of honesty and trust.

Use these suggestions for follow-up correspondence:

- Refer to your previous contacts to set a context for the current message. Your recipient may not remember the details you will address in the current message, so include pertinent details at the beginning of the correspondence. This information sets a context for the new information you will include later.
- Reinforce common goals or shared understandings.
- Include detailed information to bring the recipient up to date with the topic of the message.
- Ask for a clear and specific action and/or specify what your next action will be.
- Include your contact information at the end and specify a time period during which you expect the recipient to respond to your message or during which you will contact the recipient again.

Sending a Large Document When you send a large document, such as a report or proposal, you usually send a *short letter or memorandum of transmittal* to explain what is in the larger document. You might also ask the reader to take some action as a result of the larger document. For this reason, the letter or memorandum of transmittal often serves a similar function to an executive summary. Your goal should be to capture the reader's attention and respect the reader's need to understand material quickly.

These suggestions for correspondence accompanying a large document can help smooth the delivery:

- Begin by referring to the project or call for proposals that is addressed in the larger accompanying document. Establish a context for the reader to receive the larger document.
- Highlight the main ideas or findings from the larger document. Use the letter of transmittal to emphasize and summarize the main idea of the larger document in one or two paragraphs. The letter or memorandum of transmittal can introduce the argument you will make in the larger document and address any questions or objections you know the reader will have.
- Ask for a clear action at the end of the message. If you will follow up with a telephone call, specify when you will call and be sure to make that call on time. If you would like the reader to contact you, provide specific information about where and when to contact you.

Pre- and Post-meeting Documents: Announcements, Agendas, and Minutes

Effective meeting preparation will help your team make the most of the time spent in meetings. Rather than conducting meetings where people simply report information that could be more effectively communicated through an e-mail or memorandum, use your meeting time to work through ideas and make collaborative decisions. But having productive meetings begins with preparation that cannot wait until the last minute.

If you are setting the agenda for a meeting, begin by asking team members if they have items to include on the agenda. If you decide not to include the item, explain your reasoning for not including it. Be sure your agenda items are relevant to everyone at the meeting, or at least each person at the meeting will find the majority of the items relevant.

Minutes are the official record of discussions and decisions within an organization. Accurate, complete, and concise minutes that record the purpose and outcomes of a meeting become the organization's record for future discussions and decisions. After you write meeting minutes, distribute them to everyone who attended the meeting to ask if there are any corrections to the minutes. Usually, the minutes are officially approved at the beginning of the next meeting and this is recorded in the minutes of that meeting. Meeting minutes are often printed and compiled in a binder or file so that anyone in the organization can refer to them.

Here are some suggestions for meeting agendas:

- Instead of stating the items as phrases, state them as questions to give meeting participants enough information to carefully consider the item before the meeting.
- Say whether each item is for information only, seeking input, or wither the team will make a decision on the item at the meeting.
- Estimate the amount of time you will spend on each topic and note this on the agenda next to each topic. Be sure to allow enough time for each topic.
- Identify who is responsible for leading discussion on each topic and note this on the agenda next to each topic.

Use these suggestions to create strong meeting minutes:

- Include the reason for the meeting, where and when it was held, and the full names of people attending the meeting. Include the time the meeting started.
- Record what actions were taken on each of the meeting's agenda items, who was assigned to take the action, and the date the action should be completed.
- Record any motions and voting outcomes, including who made and seconded the motion.

- Record any decisions that were made for reach agenda item.
- Note any business that was held over for a future meeting.
- Note the time the meeting was adjourned.
- Note the day and time of the next meeting, if available.

Social Media

Social media is an important workplace communication tool for helping people stay in touch, whether they are working in different parts of a building or different areas of the world. Because messages and documents can be shared for people to work on at different times, these media help us communicate and stay engaged with one another.

Social media can include tools such as blogs and wikis as well as corporate instant messaging clients. Organizations can also set up internal sites for sharing work or contract with third-party vendors for collaboration tools. Users of these tools may connect through their work computers or remotely through mobile devices.

Communicating through social media in the workplace requires the same considerations for establishing your expertise and credibility as with other communication types. Although you might regularly use similar media informally for personal relationships, be aware that using workplace social media requires the same degree of professionalism and legal responsibility as more traditional communication media.

Appendix: IEEE Style for References

This appendix summarizes the IEEE style for citations, as of the 2014 update. Within your writing, citing sources allows readers to track down outside information. A reference list of the sources cited in the body of the text typically appears at the end of an article, a chapter, or a book. By providing a unique number to each reference, an author can refer to that same reference again and again throughout the piece.

Understand that IEEE may update its practices periodically. However, the formats and practices shown here have been stable for many years. For further information on how to fully format in IEEE style, including how to handle equations and such, please look to the IEEE page and search for "IEEE Style Manual." Some of the examples herein are taken directly from that 2014 IEEE Style Manual, which are current as of this writing; as well, we have added some examples for further clarity.

Inserting References in the Text

When you need to cite a source, do it at the end of the sentence *or* immediately after the name of the author. Number references in order of appearance in the body of the text (not alphabetically). Reference numbers appear in square brackets and inside any punctuation (like the period that ends a sentence).

Example 1:

> …as shown by Brown [4], [5].

The IEEE Guide to Writing in the Engineering and Technical Fields, First Edition.
David Kmiec and Bernadette Longo.

Example 2:

…as mentioned earlier [2], [4]–[7], [9].

Example 3:

…as suggested by Smith [4] and Brown and Rodriguez [5].

Example 4:

Wood *et al.* [7] report their findings as…

Grammatically, in-text citations may be treated as if they were outside of the syntax of the sentence, or they may be treated as nouns in their own right. However, this may impede readability.

Example 5:

…as demonstrated in [3].

Example 6:

…according to [4] and [6]–[9].

Listing References

General Rules

- List your references in order according to their unique number. References are organized in order of appearance within the written piece.
- Place reference numbers flush left; they form a column of their own, hanging out beyond the body of the reference. The reference numbers should be on the first line of the reference description and enclosed in square brackets.
- Abbreviate the given (first) name of the author or editor; it precedes the last name.
- Understand that in some cases, authorship may belong to a company or organization when no individuals are listed.
- List names of all authors, in the order of the original source, up to six names. If there are more than six names listed, use *et al.* after the first author. For non-IEEE publications, *et al.* may be used if names of additional authors are not available.

- Be careful of capitalization. For example, in article titles and chapter titles, only the first word, the first word after a colon, and proper nouns are capitalized. However, for book titles and journals, use the more traditional practice of capitalizing all significant words.
- Provide a URL with the print reference, when available. Any URL should be a direct link to the article and not the search string inside of a database.

Note: *As of this writing, the IEEE body has not issued an official stance on using DOIs in references for electronic source entries. However, if your organization requires the use of them, there are examples inserted herein to show how one might include them.*

Periodicals and Journals

The general form for citing a periodical or journal article is as follows:

> J. K. Author, "Name of article," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, pp. *xxx–xxx*, abbreviated Month date, year. [Online]. Available: URL

You should include or omit elements as they exist. Some journals, for example, may not have a volume number. Here are some examples.

1. F. Aronowitz, "Theory of traveling-wave optical maser," *Phys. Rev.*, vol. 134, pp. A635–A646, Dec. 8, 1965.
2. J. Zhang and N. Tansu, "Optical gain and laser characteristics of InGaN quantum wells on ternary InGaN substrates," *IEEE Photon. J.*, vol. 5, no. 2, Apr. 2013.
3. R. Fardel, M. Nagel, F. Nuesch, T. Lippert, and A. Wokaun, "Fabrication of organic light emitting diode pixels by laser-assisted forward transfer," *Appl. Phys. Lett.*, vol. 91, no. 6, Aug. 2007.
4. M. Ito *et al.*, "Application of amorphous oxide TFT to electrophoretic display," *J. Non-Cryst. Solids*, vol. 354, no. 19, pp. 2777–2782, Feb. 2008.
5. Y. V. Lavrova, "Geographic distribution of ionospheric disturbances in the F2 layer," *Tr. IZMIRAN*, vol. 19, no. 29, pp. 31–43, 1961 (Transl.: E. R. Hope, Directorate of Scientific Information Services, Defense Research Board of Canada, Rep. T384R, Apr. 1963).
6. S. K. Esser *et al.*, "Convolutional networks for fast, energy-efficient neuromorphic computing," *Proc. of National Ac. of Science*, vol. 113, no. 41, pp. 11441–11446, Oct. 11, 2016. [Online]. Available: http://www.pnas.org/content/113/41/11441.full

Note: *Any URL should be a direct link to the article and not the search string inside of a database.*
Note: *The IEEE body has not issued an official stance on using DOIs in reference entries. However, if your organization requires the use of them, the example below could be used.*

7. S. K. Esser *et al.*, "Convolutional networks for fast, energy-efficient neuromorphic computing," *Proc. of National Ac. of Science*, vol. 113, no. 41, pp. 11441–11446, Oct. 11, 2016. [Online]. Available: http://www.pnas.org/content/113/41/11441.full. DOI: 10.1073.

Books

The general form for citing a book is as such:

> J. K. Author, "Title of chapter in the book," in *Title of the Published Book*, *x*th ed. City of Publisher, (only U.S. State), Country: Abbrev. of Publisher, year, ch. *x*, sec. *x*, pp. *xxx–xxx*. [Online]. Available: URL

Include or omit elements as they exist. The whole book can be referenced. Otherwise, you can use subsection titles and the latter elements in the form above to specify which part of the book was used if warranted. Here are some examples.

1. B. Klaus and P. Horn, *Robot Vision*. Cambridge, MA, USA: MIT Press, 1986.
2. L. Stein, "Random patterns," in *Computers and You*, J. S. Brake, Ed. New York, NY, USA: Wiley, 1994, pp. 55–70.
3. E. F. Moore, "Gedanken-experiments on sequential machines," in *Automata Studies* (Ann. of Math. Studies, no. 1), C. E. Shannon and J. McCarthy, Eds. Princeton, NJ, USA: Princeton Univ. Press, 1965, pp. 129–153.
4. M. Gorkii, "Optimal design," *Dokl. Akad. Nauk SSSR*, vol. 12, pp. 111–122, 1961. (Transl.: in L. Pontryagin, Ed., *The Mathematical Theory of Optimal Processes*. New York, NY, USA: Interscience, 1962, ch. 2, sec. 3, pp. 127–135).
5. A. Histace, "Image restoration—Recent advances and applications," in *Super-Resolution Restoration and Image Reconstruction for Passive Millimeter Wave Imaging*. Rijeka, Croatia: InTech, 2012, pp. 25–45.
6. IEEE USA Energy Policy Committee, *2014 IEEE-USA National Energy Policy Recommendations*, IEEE USA, 20114. [Online eBook]. Available: http://shop.ieeeusa.org/usashop/product/policy/68802

Note: *Any URL should be a direct link to the article and not the search string inside of a database.*

Reports

Start with the author and title of the report. The report title appears in quotation marks. Next, place the name and location of the company or institution, and provide the report number and date (retain the month, if it is given) at the end of the reference. Retain volume and issue number before date if given. For reports cited online, ensure a year is included and add the active URL to the end of the reference.

> J. K. Author, "Title of report," Abbrev. Name of Co., City of Co., Abbrev. State, Country, Rep. *xxx*, year, volume. [Online]. Available: URL

Here are some examples.

1. E. E. Reber, R. L. Michell, and C. J. Carter, "Oxygen absorption in the earth's atmosphere," Aerospace Corp., Los Angeles, CA, USA, Tech. Rep. TR-0200 (4230-46)-3, Nov. 1988.
2. J. H. Davis and J. R. Cogdell, "Calibration program for the 16-foot antenna," Elect. Eng. Res. Lab., Univ. Texas, Austin, Tech. Memo. NGL-006-69-3, Nov. 15, 1987.
3. R. E. Haskell and C. T. Case, "Transient signal propagation in lossless isotropic plasmas," USAF Cambridge Res. Labs., Cambridge, MA, Rep. ARCRL-66-234 (II), 1994, vol. 2.
4. M. A. Brusberg and E. N. Clark, "Installation, operation, and data evaluation of an oblique-incidence ionosphere sounder system," in "Radio Propagation Characteristics of the Washington–Honolulu Path," Stanford Res. Inst., Stanford, CA, USA, Contract NOBSR-87615, Final Rep., Feb. 1995, vol. 1.
5. P. Diament, S. L. Richert, and W. L. Lupatkin, "V-line surface-wave radiation and scanning," Dep. Elect. Eng., Columbia Univ., New York, Sci. Rep. 85, Aug. 1991.
6. Linear Technology, "Standalone linear Li-ion battery charger and dual synchronous buck converter," Rep. no. LTC3552, Datasheet, 2012. Accessed on Sep. 12, 2014.
7. Bureau of Meteorology, "Bureau of Meteorology: Measuring rainfall in Australia," 2009. [Online]. Available: http://www.bom.gov.au/climate/cdo/about/definitionsrain.shtml#meanrainfall
8. GeoBasisNRW, Cologne, Germany, "ATKIS—Digitale Topographische Karte 1:25.000 (DTK25)," Bezirksregierung Koln, 2012. [Online]. Available: http://www.bezreg-koeln.nrw.de/brkinternet/presse/publikationen/geobasis/faltblatt geobasis atkis01.pdf
9. K. Kagaku, "Multipurpose chest phantom: Lungman." [Online]. Available: http://www.kyotokagaku.com/products/detail03/pdf/ph-1_catalog.pdf

Published Conference Proceedings

The general form for a paper published in a conference proceeding looks like this:

> J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, (location of conference is optional), year, pp. *xxx–xxx*. [Online]. Available: URL

Here are some examples.

1. G. R. Faulhaber, "Design of service systems with priority reservation," in *Conf. Rec. 1995 IEEE Int. Conf. Commun.*, pp. 3–8.
2. S. P. Bingulac, "On the compatibility of adaptive controllers," in *Proc. 4th Annu. Allerton Conf. Circuit and Systems Theory*, New York, 1994, pp. 8–16.
3. C. T. Meadow and D. W. Waugh, "Computer assisted interrogation," in *1991 Fall Joint Computer Conf., Proc. AFIPS Conf.*, vol. 29. Washington, DC: Spartan, 1991, pp. 381–394.
4. P. Viola and M. Jones, "Rapid object detection using a boosted cascade of simple features," *Computer Vision and Pattern Recog. 2001*, IEEE Proceedings of the 2001 IEEE

Computer Society Conference, Kauai, HI, 2001. [Online]: Available: http://ieeexplore.ieee.org/document/990517/

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5. P. Viola and M. Jones, "Rapid object detection using a boosted cascade of simple features," *Computer Vision and Pattern Recog. 2001*, IEEE Proceedings of the 2001 IEEE Computer Society Conference, Kauai, HI, 2001. [Online]: Available: http://ieeexplore.ieee.org/document/990517/. DOI: 10.1109/CVPR.2001.990517.

Papers Presented at Conferences

You may hear sessions or papers presented at a conference that are not printed afterward in conference proceedings. You can still use the information, and providing a reference helps readers to understand where the information was obtained even though they cannot retrieve it, necessarily, in print form. The general form for this citation is thus:

> J. K. Author, "Title of paper," presented at the abbrev. Name of Conf., City of Conf., Abbrev. State, year, Paper number or reference information.

Here are some examples.

1. J. G. Kreifeldt, "An analysis of surface-detected EMG as an amplitude-modulated noise," presented at the 1989 Int. Conf. Medicine and Biological Engineering, Chicago, IL, USA, Nov. 9–12, 1989.
2. G. W. Juette and L. E. Zeffanella, "Radio noise currents on short sections on bundle conductors," presented at the IEEE Summer Power Meeting, Dallas, TX, Jun. 22–27, 1990, Paper 90 SM 690-0 PWRS.
3. J. Arrillaga and B. Giessner, "Limitation of short-circuit levels by means of HVDC links," presented at the IEEE Summer Power Meeting, Los Angeles, CA, Jul. 12–17, 1990, Paper 70 CP 637.

Patents

Central to the citation of a patent is the unique number assigned by a government to the patent that makes the document universally retrievable. Use the inventor/s name,

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> J. K. Author, "Title of patent," U.S. Patent *x xxx xxx*, abbreviated Month day, year.

Here are some examples.

1. J. P. Wilkinson, "Nonlinear resonant circuit devices," U.S. Patent 3 624 125, Jul. 16, 1990.
2. T. Mei and T. Yang, "Circuit and method for average–current regulation of light-emitting diodes," U.S. Patent 7 898 187 B1, 2011, Mar. 1, 2012.
3. S. P. Voinigescu *et al.*, "Direct *m*-ary quadrature amplitude modulation (QAM) operating in saturated power mode," U.S. Patent Appl. 20110013726A1, Jan. 20, 2011.

Theses (B.S., M.S.) and Dissertations (Ph.D.)

Degrees are granted by institutions which hold and provide copies on demand and to indexing services. The general form for a citation of an M.S. thesis and a Ph.D. dissertation are as follows:

> J. K. Author, "Title of thesis," M.S. thesis, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.
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Here are some examples. As these are recent, they have online linking shown. If the work you are citing does not exist online, do not include the online information.

1. B. Lai, "An effective overlapping finite element method: The method of finite spheres for three-dimensional linear elasticity problems," Ph.D. dissertation, Dept. of Mechanical Eng., Mass. Inst. of Tech., Cambridge, MA, 2016. [Online]. Available: https://dspace.mit.edu/handle/1721.1/103439
2. Y. Xie, "Quantitative texture analysis using time-of-flight neutron diffraction and electron back scatter diffraction," Ph.D. dissertation, Dept. of Geology, U of CA Berkeley, Berkeley, CA, 2002. [Online]. Available: http://oskicat.berkeley.edu/record=b11320273~S53
3. N. Kawasaki, "Parametric study of thermal and chemical nonequilibrium nozzle flow," M.S. thesis, Dept. Electron. Eng., Osaka Univ., Osaka, Japan, 1993.

Standards

Standards are referenced using the following form:

> *Title of Standard*, Standard number, date.

Here are some examples.

1. *ISO/TS: Robots and Robotic Devices: Collaborative Robots*, ISO/TS 15066.2016, 2016.
2. *IEEE Criteria for Class IE Electric Systems*, IEEE Standard 308, 1969.
3. *Line Conventions and Lettering*, ASME Y14.2-2014, 2014.

U.S. Government Documents

U.S. government documents references follow this general form:

> Legislative body. Number of Congress, Session. (year, month day). *Number of bill or resolution*, *Title*. [Type of medium]. Available: site/path/file

Here are some examples.

1. U.S. House. 102nd Congress, 1st Session. (1991, Jan. 11). *H. Con. Res. 1, Sense of the Congress on Approval of Military Action*. [Online]. Available: LEXIS Library: GENFED File: Bills.
2. U.S. Congress. 109th Congress, 1st Session. (2005, Jan. 4). *Energy Policy Act of 2005*. [Online]. Available: https://www.gpo.gov/fdsys/pkg/BILLS-109hr6enr/pdf/BILLS-109hr6enr.pdf

Manuals/Software

Manuals can be cited as reports or as books. Providing the necessary information to locate the manual may involve providing the name of the equipment or software, the name of the company, or a URL if it's available online. In some cases, the company will serve as the author. Here are some examples.

1. L. Breimann. *Manual on Setting Up, Using, and Understanding Random Forests v4.0*. (2003). [Online]. Available: http://oz.berkeley.edu/users/breiman/Using_random_forests_v4.0.pdf. Accessed on Apr. 16, 2014.
2. M. Kuhn. *The Caret Package*. (2012). [Online]. Available: http://cranr-project.org/web/packages/caret/caret.pdf
3. Antcom, Torrance, CA, USA. *Antenna Products*. (2011). [Online]. Available: http://www.antcom.com/documents/catalogs/L1L2GPSAntennas.pdf. Accessed on Feb. 12, 2014.

A Note about URLs

The guidelines for citing electronic information as offered here are in modified illustration of the adaptation by the International Standards Organization (ISO)

documentation system and the American Psychological Association style. Those organizations suggest that URLs break across lines as follows:

- Break after slash or double slash.
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- Break "before" a tilde (~), a hyphen, an underline (_), a question mark, or a percent (%) symbol.
- Break before or after an equals sign or an ampersand (follow the same rule for the "at" (@) symbol).

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