CHAPTER ONE

Introduction

Technical writing is a fundamental skill for virtually everyone working in science and engineering—and that includes a broader range of people than just scientists and engineers. Most science and engineering activities require technical communication, whether in written, electronic, or some other form. Research, development, finance, manufacturing, and a host of technical commercial services rely on precise communication to relay complex information to a wide range of audiences for many purposes. Technical writing is the means by which such communication is produced.

What Is Technical Writing?

To define what technical writing is, it might be useful to first clarify what it is not. Technical writing is not what one does out in the meadow under an elm tree; that is creative writing (unless, of course, you are a meadow habitats specialist!). Creative writing, while challenging, is an artistic activity. It flourishes in a world of nuance, interpretation, and subtlety. Technical writing, however, is the opposite of artistic. Technical writing is writing with precision and eliminating the possibility of (mis)interpretation. Technical writing is not what most people commonly do for fun or relaxation.

Imagine, if you will, a learned, sophisticated person sipping fine wine, eating imported cheese, and watching the sunset. This person sounds like a creative writer who, with paper and pen in hand, might reflect on the nature of time as the last rays of sunlight slowly disappear over the horizon. Our creative writer might even develop a definition of **time** that goes something like this:

> **Time** is a river flowing from nowhere[1] through which everything and everyone move forward to meet their fate.

A creative, sensitive person sees an inspiring sunset, is moved to words, and writes the "river from nowhere" definition. Obviously, this approach is metaphorical. But what if someone inspired by that magnificent sunset were to write the following definition of **time**?

> **Time** is a convention of measurement based on the microwave spectral line emitted by cesium atoms with an atomic weight of 133 and an integral frequency of 9,192,631,770 hertz.

Perhaps not! It would certainly take a unique individual to be emotionally moved by a sunset and then come up with microwave spectral lines and cesium 133. The second definition of time is technical. It is designed to be objective, direct, and precise. Consequently, it lacks the emotional impact of the first definition because, as technical writing, it avoids the use of rich metaphors and figures of speech, substituting instead precise, empirical facts.

The difference between the two definitions shows the fundamental distinction between technical writing and creative writing (and all the other kinds of writing that fall in between). Technical writing is precise, objective, direct, and clearly defined.

Reducing Abstraction

In linguistic terms, technical writing is writing that displays a relatively low level of abstraction. To clarify the concept of abstraction, consider the funnel of abstraction in Figure 1.1. Here, various levels of abstraction are being used to refer to the specific merle pigmentation of your friend's new puppy, Sparky-the-Merle. Imagine that you are highly allergic and entirely unfamiliar with anything dog-related, but your friend is extremely excited about their puppy being a merle. They explain that merle is a **dog genetic mutation.** However, that does little to help you understand their excitement—"dog genetic mutation" is a high-level

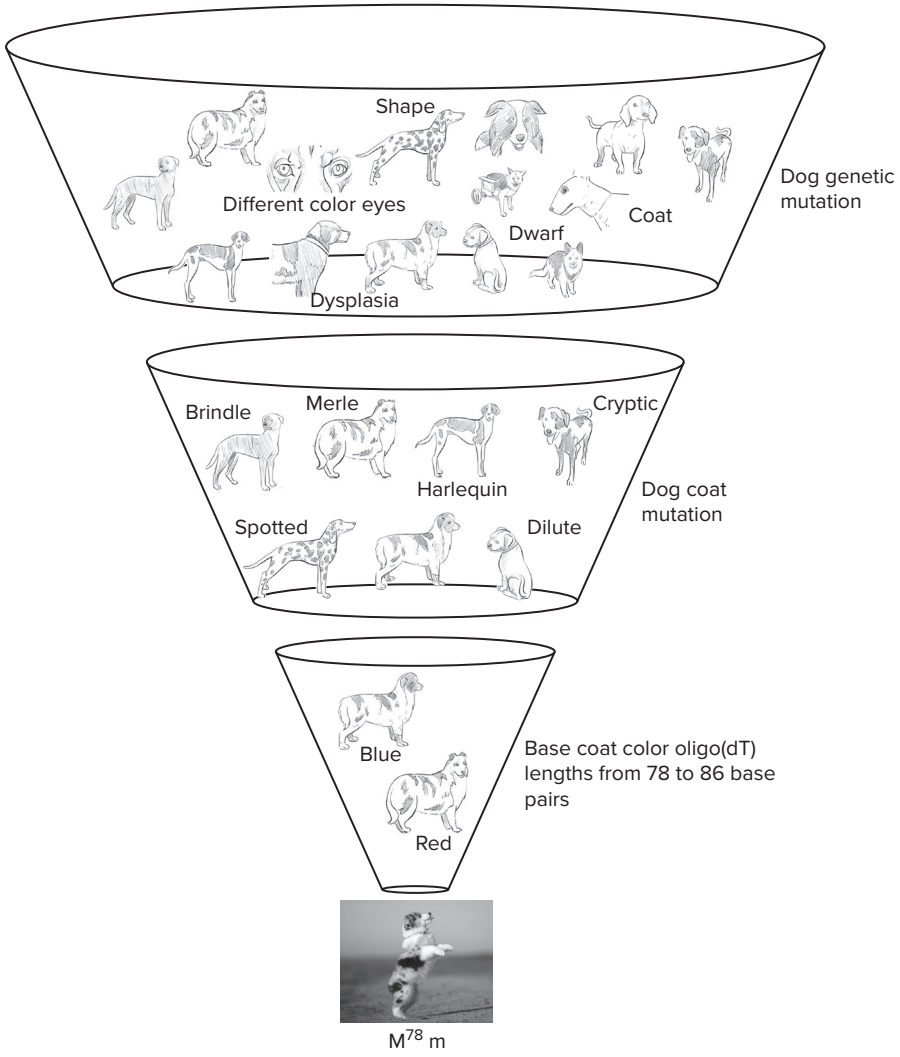

Figure 1.1
A funnel of abstraction. The high level of abstraction at the top of the funnel allows the audience to consider too many concepts or items. Abstraction is reduced through the use of non-abstract language. At the bottom of the funnel is the lowest level of abstraction, where only one concept or item is described by the language.
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abstraction and could be anything from all kinds of dog coat variations to unmatched eye color to hip dysplasia (as seen at the top of the funnel in Figure 1.1).

When you ask for more clarity, your friend explains that **merle** is a term used to describe a dog's splotchy coat, a type of **dog coat mutation,** which could mean any type of coat coloring with irregularly shaped spots. This description allows you to envision what merle means, and could include a dog with a coat that fits in many different categories of merle, such as cryptic, dilute, harlequin, or, in this case, standard. As we filter the level of abstraction, by adding some objective precision in our words, the reference becomes increasingly precise.

Imagine how lucky the happenstance that you and your friend are both geneticists, and you both quickly get to an even more filtered and precise description. Your friend refers to the pigmentation of a standard merle dog, which is described as those with **base coat color oligo(dT) lengths from 78 to 86 base pairs.** You can specifically describe the genetics of a dog's coat type by using words alone.

The lowest level of abstraction would be Sparky's actual DNA. However, we normally do not paste genetic material into technical documents; so to be precise, we must substitute something else, such as a photograph of his coat and a standard description of his genetics, which in this case is $M^{78}m$. That is why a photograph of Sparky the merle-coated dog has been placed at the narrow end of the abstraction funnel—because that is the most concrete way available to refer to it in a document.

Let's look at another example. Imagine that you need an explanation of a 33K, one-watt carbon resistor and you read that it's an **electrical device.** Not helpful. "An **electrical device**" could be anything that is electrical, from a fluorescent light, to a computer keyboard, to your phone's SIM card (see Figure 1.2). Of course, mixed in with all those electrical devices is the electrical device also referred to as a 33-kilohm, 1-watt carbon resistor, but it would be difficult to hone in on it with all the other noise of **electrical devices.**

You read on that it is a **circuit component.** That's certainly more precise, but it could mean any electrical device in the circuit, such as a capacitor, inductor, diode, or, in this case, a resistor. As the explanation becomes more precise, it includes the word **resistor,** which means any circuit component that impedes the flow of current.

The next most concrete way of describing the resistor by using words alone is to precisely label it—as we do when we give our newborn children distinctive names and government taxpayer identification numbers. In this case, the resistor is labeled a **33-kilohm 1-watt carbon resistor.**

As in the case of Sparky, the lowest level of abstraction would be the resistor itself, which we cannot paste into a technical document. We substitute the resistor with a photograph, which is why a photograph of the resistor has been placed at the bottom of the funnel. This precision, of course, assumes that the audience knows what a resistor looks like. If not, the photograph can be pretty abstract, and for that matter, so can the actual resistor.

In fact, when we write technical documents for our audience, we need to carefully consider our audience's familiarity with our topic and carefully calibrate the level of abstraction to the lowest level that will help them understand given their current knowledge of the topic. Technical writing is **not** about how well the writer understands the topic; technical writing is about **how well the writer can explain the topic to someone else.**

As one moves down the funnel of abstraction, the symbols become more precise and less vague. In effect, this reduced abstraction gives the reader less freedom to interpret meaning as they want and more like the writer intended. In creative writing, this lack of flexibility is probably not good; in technical writing, such lack of flexibility is good. The goal of technical writing is to eliminate abstraction. Simply speaking, successful technical writing restricts the reader's freedom of interpretation so that only one meaning can be concluded—the meaning intended by the writer.

What sets technical writing apart, then, is its precision. How it achieves this precision is, in fact, the art and craft of technical writing—an activity that involves definition and description; data and analysis; photographs, diagrams, and charts; and often specialized language. The goal of technical writing, then, is **not** to be creative, or interesting, or to employ rich imagery or powerful metaphors. The goal of technical writing,

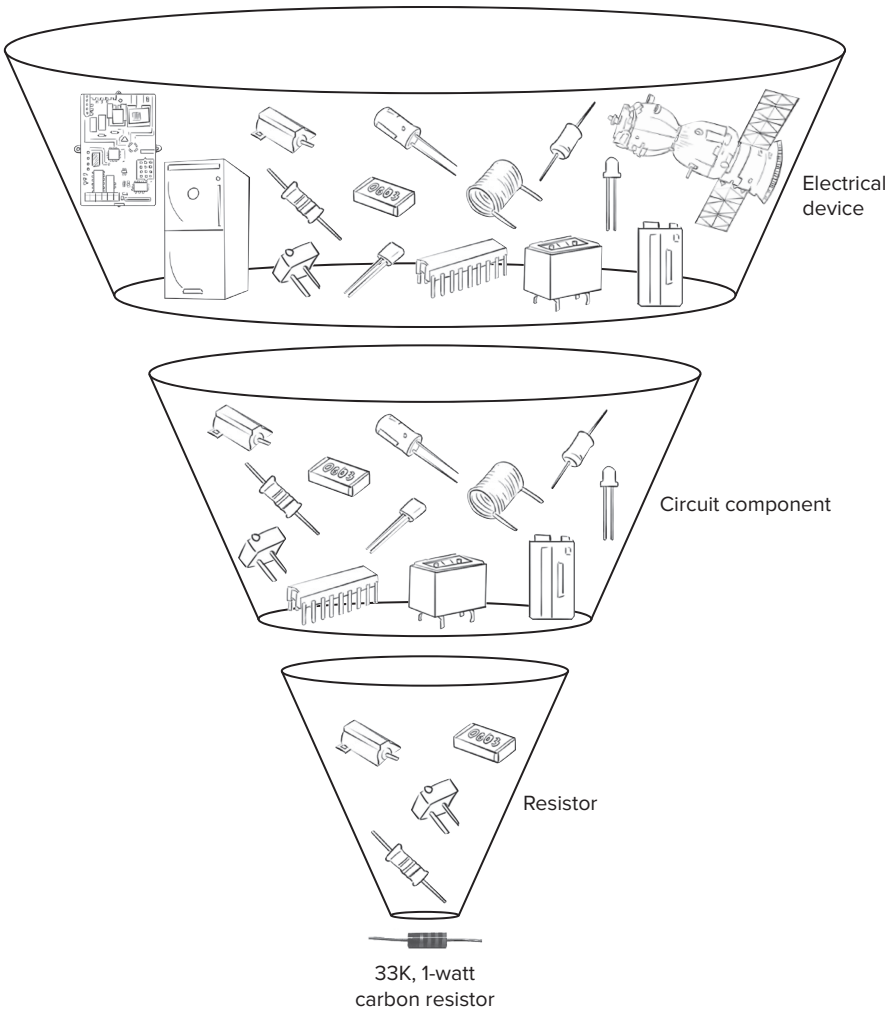

Figure 1.2
A funnel of abstraction. The high level of abstraction at the top of the funnel allows the audience to consider too many concepts or items. Abstraction is reduced through the use of non-abstract language. At the bottom of the funnel is the lowest level of abstraction, where only one concept or item is described by the language.

first and foremost, is to communicate complex information clearly and precisely for the audience and the purpose at hand. Clarity and precision are the overriding goals for any technical writer, and understanding the audience, purpose, and context is the primary consideration for achieving those goals.

Audience, Purpose, and Context

The measure of how well a technical writer has written something depends on three things:

1. how well the **reader** understands, precisely, the writer's intended meaning,
2. how well that understanding fulfills the intended **purpose,** and
3. how well the communication fits into the broader situational **context.**

Consequently, technical writing must be geared directly to its audience, purpose, and context. Remember, there is always a specific requirement for technical writing: a scientist must write a grant proposal, a programmer must document software prior to distribution, a lab supervisor must justify new equipment with a feasibility report, and an industrial engineer must convince a business manager to change work practices for the long-term health of employees.

Relating audience, purpose, and context requires that the writer consider the potential reader's knowledge, skill level, and specialization. The writer must anticipate fully responding to the needs of the reader in terms of the requirements of the situation. Let us take a closer look at each of the three separate yet interrelated components.

Audience

Technical writing is only effective if the **audience** understands the communication. To ensure that our writing is understood by the audience, we must contemplate and often even research our audience. Some things to consider include the following questions.

- How much does my audience know about the topic?
- How much background information about the topic might my audience need to understand my communication?
- How motivated is my audience to read my communication?
- What level of detail does my audience need to understand or to accept my communication?
- What are my audience's primary, secondary, and tertiary concerns?
- What concepts in my message would be better and more quickly understood with supporting visuals?
- How much documentation will my audience want and/or require?
- What format does my audience expect?
- How much time will my audience have to read my communication?
- Where will my audience use my communication and how does that affect how I should structure and format my communication?
- Will my audience be resistant to my communication? (the idea, message, topic, etc.)
- Will my audience be resistant to the communication coming from me personally?

Consider the industrial engineer who must convince a business manager to change work practices for the long-term health of employees. How will they answer these questions about the audience? For example, if there have been employees missing work because of carpal tunnel injuries, the business manager might be very receptive to a plan for reducing absenteeism. But if the same manager is struggling with immediate warranty costs caused by quality issues in an assembly area, long-term concerns like carpal tunnel may seem less urgent in the moment.

Purpose

Technical writing must fit with the **purpose** of communication, which is why you are communicating in the first place. There are several things to consider, starting with what we want our audience to do after they have read our communication. Do we want them to

- know more facts?
- better understand how something works?
- know the status of a large project?

- provide money for a project?
- assemble something?
- accept a recommendation?
- change their position on an issue?
- make a decision?
- some combination of things?

Once we have determined what we want or need our audience to do after they have read our communication, we must determine how to get our desired result.

- Do I need to inform? If so, to what level of comprehension?
- Do I need to persuade? That is, do I need to change someone's position on a topic, their belief about something, or their behavior or actions? If so, is there information that I should emphasize or highlight?
- Do I need to build goodwill? Sometimes this is a necessary requirement by itself, but other times we incorporate this into our communication which informs and/or persuades.

Again, consider the industrial engineer who must convince a business manager to change work practices for the long-term health of employees. How will they answer these questions about purpose? For example, they might need to talk with machine operators to get more information, but that means overcoming a possible mistrust of management. Once the industrial engineer has the necessary facts, they must think about how to request money from their manager. Is goodwill already established? Can they move to considering how to persuade?

Context

In addition to relating to a specific audience and for a specific purpose, technical writing must fit within the broader situational context. Unfortunately, much of the broader context is outside our control as communicators, yet we must account for it nonetheless. Context includes things like history, language, geography, politics, culture, economics—basically anything in the world that affects how our communication is received by our audience. It could be something as specific as personality: maybe someone in management doesn't really like you, and you don't know why, but you know that they immediately respond negatively to anything you suggest. It could be something like company culture: perhaps you tend to write informally and use contractions, slang, and emoticons for emphasis ☺, but the company culture is formal. It could be something historical, like a chemical accident that killed an employee over 20 years ago—it is not a topic that is actively discussed, but it lingers deep in peoples' minds. Communication does not exist in a vacuum.

Let us go back to the industrial engineer. What contextual factors might affect the engineer's ability to convince their business manager to change work practices? Perhaps a recent OSHA law was passed that mandates regulations be implemented by a certain date or a company will be fined. Maybe a competitor in the industry had a lost-time accident occur and suddenly other companies take notice. What if there is a tight job market and employees care about safety and use it to decide where to go to work?

In technical communication, the audience and purpose are almost always well defined in advance—often by the supervisor, customer, or teacher. This is because technical writing is usually commissioned by someone else for a specific purpose and audience. Normally, technical communication aims to share objective information with an interested, educated audience. Technical communication is simply communication on technical subjects that shares information in a precise way.

However, the broader contextual situation, or context, is usually outside a technical writer's control. Remember our industrial engineer who wants to convince a business manager to change work practices for the long-term health of employees? Well, the engineer did their due diligence on researching the frequency and severity of injuries, the biomechanics of how the injuries happen, and the audience's concerns. They

wrote a precise, meticulous, eloquent feasibility report. However, behind closed doors, upper management had discussed the closing down of that assembly line in the next three to four years. Despite the impressive quality of the engineer's report, it was shelved due to a factor outside the engineer's control. The engineer didn't have all of the necessary context needed to write an informed proposal.

Genre Decisions

Technical writing must work within the parameters of genre expectations in addition to relating specifically to the audience, purpose, and context. Genres are categories of things that have a similar subject matter, form, and style. You might not have heard of the term **genre** before, but it's a concept that you likely use every day.

- You are going for a run, so you listen to high-energy rock songs
- You are going for a three-hour drive, so you play podcasts on scientific discoveries
- You have had a bad day at work, so you kick back with an action movie

We all choose categories such as these, called **genres**, because we know what they are (generally speaking) going to be about, how they will be organized, and what they will sound, read, and feel like.

When we think about categories, or genres, that are understood the same way by people from all over the world, we can draw an analogy to dogs. Dogs, just like communication, have been around for thousands of years, and both have evolved with the right breed/tool identified for specific needs and jobs. When you need a mouser, you look for a terrier. When you need to herd livestock, you get a herding dog. When you need to retrieve water fowl, you choose a sporting dog. From the Chihuahua to the Collie to the Great Dane, you recognize all of them as dogs, but you also know that they do different things and have different purposes (see Figure 1.3). The same is true in communication. When you need to convey information to a certain kind of audience in a particular way, you choose the appropriate formulation. When you need to get funding for a project, you write a proposal. When you need to explain how to put that new basketball hoop together, you write instructions. When you need to get an internship or a job, you write a resumé. Each of these technical writing genres has a specific purpose or function.

However, once you've chosen which technical writing genre is most appropriate for your audience, purpose, and context, you still have many decisions to make. You must appropriately adjust the amount of content, level of detail, structure, format, tone, style, and length of each element of that genre in your particular document. Consider the farmer who needs a herding dog—what other factors do they need to consider? Well, to start, what type of animal will the dog be herding? Under what climate conditions? Will it also be a family dog? How experienced is the farmer with training dogs? How protective should the dog be?

Figure 1.3
Much like different dog breeds have specialized purposes (to hunt, to herd, to protect, etc.), communication genres have specialized purposes (to inform, to persuade, to build goodwill, etc.).
belchonock/123RF

Does it matter how loud the dog is? How much it sheds? How many years does the dog typically work? There may be other factors to consider, too, but the farmer shouldn't randomly choose one of the approximately 70 breeds in the herding group. The farmer should carefully consider as many contextual factors as they can and make strategic determinations. Similarly, as a technical writer, to communicate effectively, you will also need to make decisions about elements of the genre you have chosen.

Characteristics of Technical Communication

So, finally, to answer the question posed at the beginning of this chapter—What is Technical Writing?—technical writing can be characterized as follows:

- **Technical communication is non-abstract and precise.** The goal of technical communication is to eliminate abstraction and communicate complex information clearly and precisely to the audience at hand.
- **Technical communication considers audience, purpose, and context.** Technical communication must not only relate specifically to the audience who will be using the communication, but also relate specifically to the purpose and context at hand.
- **Technical writing deals with technical information.** Technical writing is designed to deal with technical subjects.
- **Technical writing relies heavily on visuals.** As shown in the abstraction funnel of Figures 1.1 and 1.2, a photograph or diagram may be the least abstract, and therefore the most precise, way to communicate something to an audience. Visuals—whether they are equations, photographs, tables, graphs, or drawings—are powerful tools for presenting a large amount of information effectively and efficiently. However, they almost always require interpretation or explanation in the text of the report, especially when the audience may not be familiar with their content.
- **Technical writing uses numerical data to precisely describe quantity and direction.** In many cases, mathematical equations and formulas, experimental results, and financial analyses provide the real substance of a technical report.
- **Technical writing is accurate and well documented.** Generalized, unsupported assertions have no place in technical writing. Conclusions, recommendations, and judgments are always based on clearly presented evidence or established expertise, and technical writing is always technically correct.
- **Technical writing is stylistically and mechanically correct.** This kind of correctness is far more than simply a matter of personal and corporate pride. Style and mechanics (spelling, punctuation, and grammar) often go to the heart of the author's credibility. In other words, right or wrong, fair or unfair, if you write shoddily, the reader may well perceive you as careless and your organization as a collection of people who do not care about details. Whether or not this perception is true is irrelevant. Where technical writing is concerned, perception is often more important than reality.

Notes

1. The idea of a "river from nowhere" came from the Steve Winwood song "The Finer Things," which includes a reference to time as a "river rolling into nowhere."