This International Student Edition is for use outside of the U.S.

FOURTH EDITION

TECHNICAL WRITING FOR ENGINEERS & SCIENTISTS

Leo Finkelstein Jr. • Jeanine Elise Aune • Leslie A. Potter

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Technical Writing for Engineers & Scientists

Fourth Edition

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Dedication

In memory of Dr. Leo Finkelstein, Jr. We are honored to continue his legacy.

This has been one of my favorite projects of all time due, in no small part, to the support of and collaboration with some of my favorite people. It is dedicated to Siggi for unwavering support, to my children for just being, to my pets and pony for the cuddles and chances to recharge my soul, to my mom for being my cheerleader, to my siblings for their wit and humor, and to the legendary Grandma Glenna for showing me the way to teaching and about not letting one's standards slip. And last but not least, to Leslie, for her creativity, enthusiasm, and for keeping my nose to the grindstone.

—Jenny

I have always loved language: it was difficult for me to choose between a career in engineering and a career in English. I am grateful for the opportunity to combine both interests in this book and couldn't have asked for a better writing partner—thank you, Jenny! I dedicate it to John, for all that he has done these past 30 years to make it possible for me to tackle this project; as well as to our three boys for their never-ending good humor, generosity of spirit, and willing assistance; to my parents for giving me the best of each of themselves, including my mom's amazing editing skills and my dad's spot-on advice; to my brother who supports me always; and to my in-laws whom I love dearly. Shout-out to my dogs, too, who keep me grounded.

—Leslie

Preface

Purpose

The purpose of this book is to succinctly explain the content and structure of concepts and genres common to communication in engineering and science disciplines. Much like Dr. Finkelstein did in the first three editions, we aim to avoid "the sterile, encyclopedic treatment of writing concepts" that exists in many textbooks about writing. While such textbooks can be helpful for writing instructors who want to cover all of the ins and outs of technical writing theory, concepts, strategies, and genres in writing classes, such comprehensive textbooks might not be the most useful for instructors looking to incorporate writing assignments into their already-packed classes, or for students looking for the nitty-gritty details about what they need to do to get the writing project done in their engineering and science classes.

Approach

Our approach to revising this textbook was based on our combined 50+ years of teaching experience. We have endeavored to bring our approach to teaching to *Technical Writing for Engineers and Scientists*, 4th edition.

Theoretical Foundation

Technical communication is most effective when it considers audience, purpose, and context. Audiences can be categorized in many ways, but one of the most utilitarian methods is to think of them as decision-makers, advisors, and implementors. For example, when you are writing an abstract or summary, you are typically writing for decision-makers and/or advisors. When you are researching and writing a feasibility or recommendation report, you are writing for decision-makers and advisors. When you are writing descriptions or instructions, you are most likely writing for implementors. We have considered these three categories of audience as we have revised the content in this book.

In addition to audience, technical communication is most effective when it considers purpose and context. If we have been hired by the CEO and founder of a major pasta producer to write a report on the feasibility of moving a pasta factory to the upper Midwest, and we write a description of a pasta factory and its components, we will have singularly failed in understanding our purpose. The CEO is already familiar with a pasta factory; they need an evaluation of a solution based on a set of criteria, like proximity to rail lines for shipping raw ingredients. As technical writers, we must anticipate how our communication will be used and in what context. For example, electronic instructions for an executive in their corner office have an entirely different context than those required by a worker standing underneath a molten iron transfer line in a foundry.

Restructured for Easier Understanding

Over the years, we have learned that our students do best when they can see a finished example before we get into the details—much like assembly instructions and recipes, it helps the implementor to look at a picture of the final product before they begin crafting it. Therefore, we restructured the textbook's genre chapter content to provide a definition first, followed by an overview, a basic general outline, a complete example, that example broken down into the logical moves that the writer needs to make, and if relevant, additional examples illustrating the range of that technical writing genre. The intent is that students see the overall document to "get a feel" for it before they examine the breakdown of the components in that example document.

We have also incorporated references to other chapters along with small excerpts of copied-and-pasted text throughout most of the book. We did this to facilitate the use of individual chapters rather than expecting a student to read and remember the entire book. Bonus: repetition is how we move knowledge into our long-term memory.

Analogies

Over our years of teaching, we have developed the tendency to explain new concepts and ideas to students using analogies (lightbulb moments!). In this revision, we also tried to connect technical writing concepts and genres to a framework with which (we hope!) students are familiar. While not everyone loves dogs, and some may be allergic or even avoid canines for religious

reasons, we anticipate that most everyone will at least be familiar with the concept of the dog, its multiple variations and roles in society, and purposes behind those variations. We hope that our readers find the analogies helpful, if somewhat wacky, in learning about technical writing concepts and genres.

Although we do assume that most everyone is familiar with dogs in general, we do not assume that everyone knows all of the various dog species by name, and here we took our own advice from Chapter 4 on Technical Definitions:

> **In some situations, you might need to sacrifice desired precision in your definition to achieve the required level of communication.**

To ensure that our readers clearly recognize our references to specific dog breeds and their connection to genres, we have treated dog breed names as proper nouns despite generally accepted capitalization guidelines for dog breeds. For example, in most writing situations, "border collie" would not be capitalized, nor would the "pinscher" in "Doberman pinscher." However, we have capitalized all words in each dog breed name so that readers will know we are talking about Border Collies and Doberman Pinschers as dog genres, analogous to writing genres.

Embraced Our Inner Goofy

Finally, we have tried to incorporate the same Goofy (dog pun intended) sense of humor that we try to share in our courses to make writing as fun and interesting for our students as we can. It was Finkelstein's light-heartedness and willingness to poke fun at himself that initially attracted us to his textbook, and we are more than happy to continue the tradition.

Disclaimers

As part of our attempts to be light-hearted, we have used numerous fictitious names in examples throughout the book. Any similarity to actual humans, towns, or organizations is completely coincidental.

Also, just as many sources for students writing technical reports have moved online in the past decade, so have they migrated online for authors writing textbooks. We have cited numerous websites throughout the text, including access dates, but understand that these addresses might change over time. Our intent was to provide enough information for readers to be able to

search the topics successfully even if the websites change.

Organization

We organized the fourth edition around three major sections: the first one discusses fundamental material, the second describes how to write the most common technical documents, and the third provides useful information that, frankly, does not fit neatly in the first two sections.

Section I: Fundamentals

Chapters 1 through 6 deal with basic considerations, including the component skills you will need to produce effective technical writing. Expanding on the successful approach used in the first three editions, this section includes

- **Chapter 1: Introduction** explains what technical writing is and the basic concepts needed in technical writing.
- **Chapter 2: Ethical Considerations** focuses on ethics in technical writing and includes a general discussion of ethical considerations for technical writers.
- **Chapter 3: Note-taking** provides both the "why" and the "how" of taking notes, including techniques and legal/ethical considerations.
- **Chapter 4: Technical Definitions** explains the "nuts and bolts" of writing effective technical definitions because the ability to define is one of the primary skills needed for most technical writing.
- **Chapter 5: Description of a Mechanism** explains another primary skill needed for technical writing, which is being able to describe mechanisms precisely, accurately, and at a level the audience can understand.
- **Chapter 6: Description of a Process** explains how to describe processes, that is, third-person descriptions of events that do not directly involve the reader.

Section II: Technical Documents

- **Chapter 7: Instructions and Manuals** explains how to write

instructions, or second-person descriptions for human involvement that provide specific directions so that the reader can perform a task or series of tasks.

- **Chapter 8: Proposals** explains the three necessary things that all proposals must include, provides multiple examples of informal proposals, and parses the "why" and "how" for each section.
- **Chapter 9: Progress Reports** builds on the proposals in Chapter 8, explaining the necessary elements of a progress report and showing how to construct an effective progress report.
- **Chapter 10: Feasibility and Recommendation Reports** explains how to develop objective documents that identify and evaluate solutions to problems and explains the difference between a feasibility and a recommendation report.
- **Chapter 11: Laboratory and Project Reports** explains the difference between and the purpose of laboratory and project reports, as well as their various elements.
- **Chapter 12: Research Reports** explains the focused, objective nature of research reports, the general structure, and the wide variety of content based on audience need.
- **Chapter 13: A3 Reports** shares the history of the document, templates and examples, and an understanding of the usefulness in business.
- **Chapter 14: Abstracts and Summaries** explains the purpose of abstracts and summaries and provides examples of four different kinds of summations with a focus on both academic and business situations.

Section III: Other Useful Stuff

- **Chapter 15: Style and Mechanics** highlights common issues with basic building blocks, including how style is related to mechanics (spelling, punctuation, and grammar).
- **Chapter 16: Documentation** shows examples of how to cite many different kinds of online, print, and in-person sources.
- **Chapter 17: Visuals** includes basic guidelines for when to use what kinds of visuals, as well as tips for constructing them as accurately and effectively as possible.

- **Chapter 18: Presentations** provides in-person and online presentation tips, including an example set of slides for an update presentation.
- **Chapter 19: Business Communication** provides some general guidelines, outlines, and examples for business communication.
- **Chapter 20: Communication with Future Employers** details six specific kinds of job-seeking communication, including both written (e.g., resumes) and oral (e.g., interviews).
- **Chapter 21: Team Writing** addresses important considerations for accomplishing a collectively written document, both as a student and as a professional.

We believe that our revisions will be useful to students and instructors who choose to use this book. However, we acknowledge (and appreciate!) that language and communication are always evolving and what is considered acceptable today might be adapted by tomorrow. We have done our best to capture generally accepted formulations and long-lived rules.

Being an effective technical writer continues to increase in importance. In fact, we have heard from some employers that they would rather hire good writers with average technical skills (because they can teach the technical skills themselves), than hire someone with high technical skills who communicates poorly. We would be delighted if our textbook could help students gain the communication skills that employers want.

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About the Authors

Leo Finkelstein, Jr., received a bachelor's degree from the University of North Carolina at Chapel Hill in 1968; a master's from the University of Tennessee at Knoxville in 1969; and a Ph.D. from Rensselaer Polytechnic Institute at Troy, New York, in 1978. He was Lecturer and Director of Technical Communication for the College of Engineering and Computer Science, Wright State University, Dayton, Ohio. He directed the technical writing program at the U.S. Air Force Academy while also serving as adjunct faculty for the University of Colorado at Colorado Springs. He wrote, produced, and directed technical films in Southern California and commanded a combat-documentation, photographic unit in Southeast Asia during the Vietnam War, flying combat missions as an aerial photographer. In addition, his military service included experience in both space and logistics systems. He held FCC commercial and amateur radio licenses, had a black belt in tae kwon do, and was an avid user of all types of gadgets.

Jeanine Elise Aune

Jeanine (Jenny) Elise Aune is a Teaching Professor and the Director of ISUComm Advanced Communication (AdvComm) program at Iowa State University (ISU). She has an M.A. and Ph.D. from the University of Wisconsin-Madison and has been teaching writing in the Department of English at Iowa State University since 1999. She was the Coordinator of ISU's Learning Community (LC) English links for 11 years. Her responsibilities included helping linked discipline faculty communicate their expectations for students' communication skills to English instructors, and helping English instructors re-design writing classes to help students develop

those skills. The number of LC-linked English sections more than doubled during her tenure. She has been directing or co-directing the Advanced Communication program since 2011. She has worked with stakeholders across campus to build standardized curricula for the program's four courses —business communication, proposal and report writing, biological communication, and technical communication—in both face-to-face and online mediums. These four courses are taught by ~40 instructors in ~200 sections and enroll ~4,800 students every academic year. Most recently, the online business communication course earned QM certification[1] at 97%, and the online technical communication course earned QM certification at 98%.

Leslie A. Potter

Leslie A. Potter is a Teaching Professor in the Industrial and Manufacturing Systems Engineering (IMSE) department at Iowa State University (ISU). She has a B.S. in industrial engineering from ISU and an M.S. in industrial engineering with an emphasis in manufacturing from The Pennsylvania State University. She worked as an engineer and supervisor for John Deere for seven years before joining IMSE at ISU, where she has taught undergraduate courses across the curriculum for the past 20+ years, ranging from freshman problem-solving and programming to capstone design. As part of her research at ISU, she co-developed a professional communications course within the industrial engineering curriculum. From those efforts, she has developed and incorporated substantial writing and speaking curricula that are used by many of her peers. She was the co-founder in 2013 as well as the co-chair for the IMSE Undergraduate Research program for seven years, supporting hundreds of students with writing and presenting their research. She regularly requires writing and presentation assignments in her engineering courses, and has collaborated with faculty in the Iowa State University Department of English since 2007.

[1] https://www.qualitymatters.org/reviews-certifications

Email to a Technical Writer

Technical writers must consider their audience, purpose, and situational context. The following is an example of an email that the authors of this textbook could send to potential users of this textbook.

From: JennyandLeslie@Finkelstein

Sent: Monday, June 14, 2021 1:32 PM

To: Student

Subject: Email to a Technical Writer

Dear Student,

Your decision to study a technical field is most admirable, and we applaud your fortitude and motivation in dedicating your time and effort to learning a subject that has the power to change the world. However, your knowledge and expertise can only be understood by others if you can communicate your ideas, thoughts, findings, recommendations, and preferences with both technical and non-technical audiences. It is there, at the point of communicating ideas as non-abstractly as possible, that we can support you. We hope that after reading a few pages of our not-typically-super-serious textbook, having a conversation or two with others about it, and allowing yourself to enjoy the relatively formulaic processes of technical writing, you will come to appreciate the power of audience, purpose, and context. With this note, we offer two thoughts.

First: Writing in the real world is very different from the writing you have likely done to date.

You will need to change your mindset. No longer will you write for an audience of one. No longer will you write to a teacher to show them how much you know or have learned. We must now ask you to put aside the unintended mindset you might have of, "I will write what my instructor wants." To become an effective technical writer, you must anticipate who your audience will be, recognizing that you might have multiple audience types, and why you will write for each of them. Do you wish to inform, persuade, or simply create goodwill? Ask yourself: what outcome do I need? And how can I make it happen? Then write with this at the front of your mind.

Second: While technical writing is a serious endeavor, one (and by that we include you) should not take oneself too seriously.

Accomplishment is one of life's greatest rewards. Perhaps you have already been successful in calculus, soccer, robotics, speech, origami, research, baking, dance, or gaming. You sit in our classroom—we know how amazing you are! And we know that you can be an accomplished technical writer, too. As with your other successes, it requires only a willingness to improve through practice and reflection, but this is ever-so-much-more enjoyable with a quick laugh and permission to enjoy the sometimes painfully iterative improvement process. Somewhat related, we thank you for indulging our, shall we say "quirky," sense of humor (some will say "bad"—we happily accept that). In short, we say lighten up! Enjoy the ride. And the write!

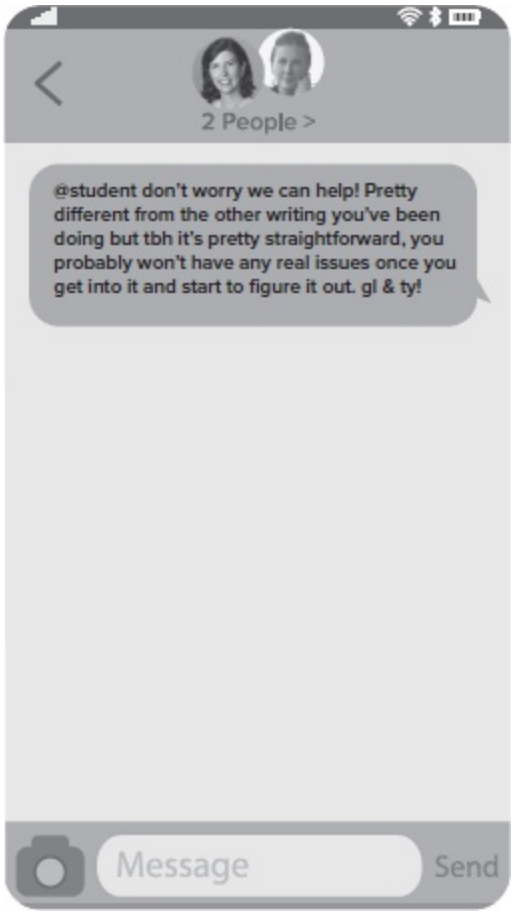
We thank you for the confidence you will place in our ability to communicate about communication, knowing full well that the initial decision was not your own, but your instructor's.

Yours very truly,

Jenny and Leslie

IM to a Technical Writer

The same information can be presented in different ways. For example, the authors of this textbook could also choose to send an IM to potential users of this textbook. The basic idea is the same, but much detail has been removed and the language is much more informal.



Acknowledgements

Acknowledging those who have helped us with the 4th edition of *Technical Writing for Engineers and Scientists* is a daunting task. While our names are listed as authors, they are only listed there due to the opportunity provided to us by McGraw Hill and the support of our families, friends, and colleagues.

Thank you to McGraw Hill for accepting our proposal for revising the textbook and giving us the opportunity to teach on a broader scale than our classrooms allow. Thank you to Shannon O'Donnell for the preliminary conversation a couple of years back about the potential for a revision of the textbook and supporting our authorship, Theresa Collins for getting us started on the process, and Erin Kamm for guiding us through to the end. In addition, thank you to Beth Bettcher for supporting our endeavor; Beth Cray for helping gain permissions; and Maria McGreal, Dheeraj Kumar, and team for getting our image plans to paper. There are so many elements, tiny details, and untold hours of work that go into creating a published textbook from a text document; hopefully, we have not missed anyone involved in that monumental task.

Thank you to our families for both their general support and specific feedback. They graciously tolerated our late nights uploading and re-uploading documents, working on laptops while watching family movies, and phone calls while out walking our dogs. They patiently listened to ideas for, and drafts of, our dog analogies. They provided honest feedback and even managed to find our excited texting back-and-forth over dinners amusing. Both Siggi (Jenny's husband) and John (Leslie's husband) provided helpful technical confirmation in their own areas of expertise, as well as IT support when needed. Thank you to Kathy Baker (Leslie's mom) for proofreading our drafts with an eagle eye. We also especially thank our oldest children, Sunneva Sigurðsdóttir (Jenny's) and Jack (Leslie's), for reviewing and commenting on sections of the textbook which, frankly, required the expertise of college-age students to appropriately address the advances of online communication platforms made since the last edition (you know, like, 'cuz we're "boomers" . . .).

Several colleagues helped inform our revision of this textbook; thank you to them for providing another level of expertise and for always being willing

to help when asked: Sarah Ryan, Frank Peters, Michael Helwig, Dave Sly, Christopher Proskey, Valerie Boelman, and Joseph Schneider. Thank you, also, to our students who provided their actual resumes for us to adapt and use in examples and exercises.

And, last but not least, we thank all the students with whom we have had the privilege to work over the years. Each and every exchange was an opportunity for us to learn how to explain concepts, provide feedback, and help motivate to improve their communication skills. We may not have always been successful, especially in those early years, but we were eager to improve ourselves, thought about how we could have done better, and to this day, still continue to learn.

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