Technical Writing for Environmental Engineers

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TECHNICAL WRITING FOR ENVIRONMENTAL ENGINEERS

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ABSTRACT

There are many kinds of writing required in the workplace, and a degree of mastery is necessary for effective and efficient communication between colleagues, clients, and managers. This book is meant to serve as a guide and tool for engineers navigating formal and informal writing in the workplace. Topics include the most common types of technical documents, the fundamentals of professional writing, the use of references and citations, and how and why engineers and other professionals should always proofread their work.

KEYWORDS

technical writing, professional writing, communication in the workplace, engineering, engineering reference

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CHAPTER 1

INTRODUCTION

Engineers, always recognized as highly trained experts, are increasingly specialized within their field. In a typical project meeting, the depth of knowledge on crucial aspects of engineering is roughly equal to the number of individuals present in the room. In practical terms, this means clear and effective communication is more important than ever. This book provides the tools and guidance you need to communicate information, thoughts, questions, and needs to a variety of audiences in a professional manner.

We begin with an overview of the most common types of technical documents an environmental engineer is likely to encounter on the job, and include sample draft outlines to acquaint you with the form and function of each document type. We begin this chapter by reviewing important considerations for technical documents. This chapter also includes a description of sections commonly used in reports to help you build custom reports.

Having reviewed the form and function of the most common technical documents, we provide a discussion of how professional writing differs from other forms of writing. This short essay explores the relationship between a piece of writing and its audience, and how you can use what you know about your intended audience to make your writing more compelling and effective.

The chapter on the fundamentals of professional writing provides a review of the grammatical conventions that facilitate effective communication. This chapter can be viewed as a point-of-need reference, and will help you avoid common grammatical errors that distract readers from the content of your writing.

References and citation styles are covered in the next chapter, in which we review the importance of in-text citations and the difference between in-text citations and the various kinds of reference lists typically appended to scientific papers and other forms of technical writing. We also

provide guidelines for how to determine which style of reference is appropriate for your project, and some tips for managing your research that will facilitate the creation of bibliographies.

The last chapter addresses the often-overlooked practice of proofreading. Proofreading is the single most effective way to improve the quality of your technical writing, no matter how formal or informal. This chapter reviews the most effective methods of proofreading for spelling, grammar, tone, and clarity, as well as the software features available to aid you in proofreading your work.

This book can be used as a general introduction to professional writing in the field of Environmental Engineering, but is perhaps most useful as a reference consulted when presenting your work to a variety of audiences. You may find it helpful to photocopy and annotate some of the checklists and tables for specific projects. Ultimately, the goal of this book is to provide the tools necessary to communicate effectively both within your field, with experts from other fields, and with clients who are certainly invested in projects, but who may not have specialized technical knowledge.

Technical writing forms the foundation of how engineers communicate with each other and with the world. Engineers need to share their ideas, innovations, and designs with others for projects to move forward. The analysis, solutions, and recommendations engineers generate during investigations into incidents need to be understood by an audience with a diverse set of knowledge and experience. Technical writing is a learned skill, one that improves with practice. Close attention to the process of writing will help strengthen this vital skill. An engineer can impact the world only as well as they can communicate their ideas.

COMMON TYPES OF TECHNICAL DOCUMENTS

Environmental engineers write a great deal: to convey information, solicit business, report on problems, communicate investigation findings, propose solutions, and inform others of their work. Engineers use technical documents as the primary method to communicate data and results. Over time, common document templates became popular because of their effectiveness and efficiency. Taking the time to understand the function of each section in a technical document will facilitate the writing process. The goal of the document and the audience will guide the report choice. This chapter covers the most common elements of reports and presents draft outlines of common report types.

2.1   WRITING CONSIDERATIONS

Focus: What should an engineer consider before writing? What style of writing is expected in a technical document?

2.1.1   UNDERSTANDING THE READER

Technical writing communicates information to the reader. To communicate effectively, the writer must consider the ability of the reader as part of the communication equation. The reader's familiarity with the subject and their ability to understand technical information and interpret data will guide the communication. The reader's abilities will heavily influence how to present test results, discussions, and conclusions in the report. Selecting language that matches the reader's ability may make the difference between a successful and unsuccessful report.

The writer also needs to anticipate the reader's expectations of the report. Effective writers attempt to understand the reader's goals for the

report. Did the reader request a site analysis to determine whether to move forward with a potential development? Or is the reader concerned about an unexpected pollutant and the cost to remediate the contamination? Appreciating these expectations help the writer decide how to frame the report and communicate results.

Understanding the reader includes acknowledging their constraints and expectations that should be addressed in the report. Gearing the information to the reader will make the final report more streamlined, effective, and ultimately more valuable. Answering the questions outlined in the checklist below, before beginning the writing process, will help with this effort.

Reader Analysis Checklist

- Who are you writing for? Who is your primary audience?
- Who is your secondary audience? Who else might read this report?
- How much technical knowledge or related expertise do they possess?
  - Can they interpret test results?
  - Can they draw their conclusions from the evidence presented?
- What is the reader's familiarity with the project?
  - How much background information is needed to appreciate the scope of the report or proposed recommendations?
- How will the reader use the information presented?
- For what purpose was the report created?
- Does the report require specific sections or have guidelines for format?

2.1.2 TONE

Technical writing is concise, specific, and precise. Therefore, the author should undertake the selection of words, phrases, and descriptions with extreme care. The writer needs to intentionally craft the report seeking to eliminate any vague terms. This process may result in additional drafts or revisions. Utilizing ambiguous words may result in misinterpretation, leading to failed designs, damage to the environment or property, and injury to others. Authors of technical documents seek to employ fact-based language and avoid words that may possess different meanings to different people. See Table 2.1 for examples of precise and imprecise language.

Table 2.1. Examples of precise language

Less precise	More precise
The day was warm.	The temperature was 100.7 degrees Fahrenheit.
We saw over 50 drilled holes from where we stood at one of the entrances.	We observed 53 drilled holes from the northeast site entrance.
Several pieces of concrete were sticking up from the dirt.	Three pieces of concrete, between 1 and 2 feet in length, were embedded in the ground.
We added more water.	We added 1.5 liters of water.

Technical documents are succinct and brevity often results from precise, accurate writing. Writers often find that the report is shorter than expected and successful writers recognize that length does not equal importance. Revising drafts for clarity and conciseness helps many authors strengthen the effectiveness of their written communication. The Purdue University Online Writing Lab (OWL) recommends interrogating every word to ensure that each provides unique value to the point. As draft revisions occur, the writer needs to seek opportunities to condense the language of the report, using fewer words, and eliminating flowery, descriptive language, or redundant words where possible. Part 5 of the Fundamentals of Professional Writing section discusses these aspects of technical writing in detail. See Table 2.2 for examples.

Table 2.2. Examples of concise language

Less concise	More concise
As a result of the previous experiment…	The previous experiment demonstrated …
These results, taken together with the previous results, mean…	The previous and current results collectively indicate….
There were a number of different designs considered.	After consideration of many designs….
There are various different methods and ways to reduce the number of different contaminants from the soil.	A number of methods exist to reduce contaminants.
As you are aware, reducing the number of containments in soil remains one of the priorities of our firm.	Our firm prioritizes the reduction of soil contaminants.
These pictures as well as the diagrams.	The pictures and diagrams…

Additional Resources

- Review Additional Examples from IEEE Professional Communication Society http://sites.ieee.org/pcs/
- Purdue OWL contains exercises on writing concisely and precisely https://owl.english.purdue.edu/

2.2   COMMON TECHNICAL DOCUMENT SECTIONS

Focus: What sections are commonly found in technical documents? What is the purpose of each section?

Technical documents contain multiple sections. Sections help orient the reader, provide an easy reference point, and create an organizational structure. Some sections, such as an introduction or a conclusion, are common across many documents. Other sections appear in specialized reports. Government reports and requests for proposals (RFPs) will contain detailed instructions on the required sections. Business communications utilize different sections than reports. Sections in reports or business letters may overlap or be combined as warranted. This section briefly overviews the different sections found in technical documents. This does not represent an exhaustive list, but a list of common sections in common reports. This section may be useful when designing a custom report or to organize the writing process.

2.2.1   COMMON SECTIONS OVERVIEW

In this section, brief outlines of common elements found in technical documents are provided. This section is intended to provide authors with a brief description and purpose of each section. Writers may pick and choose sections to create custom reports to communicate their findings.

Introduction—this section orients the reader to the purpose of the document. The purpose of the document will vary, but the introduction will clearly state the goal of the document and provide a brief statement of why the document was written.

Executive Summary—the writer reviews the highlights of the document in nontechnical language in this section. Geared for managers and nonengineers, the executive summary focuses on recommendations and conclusions.

Abstract—the writer's goal in an abstract is to briefly overview the report. An abstract helps researchers and readers decide if the document contains relevant information for their search. Abstracts appear in database search results and contain no more than 250 words.

Background—here the writer provides the scope and context of the document. This section provides relevant information for understanding the report. The background section may highlight similar contemporary problems and their solutions, a timeline of actions, applicable theory, or identified concerns.

Literature Review—this section contains a survey of the research literature relevant to the document. The literature review focuses on academic research relevant to the problem.

Procedure—the writer documents the steps, actions, and methods used to complete an investigation or analysis in this section.

Results—the writer presents an analysis of tests and observations. The results section does not include interpretation of the results, just the data.

Observations—this section documents the observations without interpretation. Observations record facts and appear independent of test and laboratory results.

Discussion—here is where the writer discusses interpretations and analysis of the results. The discussion section may also identify recommendations or proposals based on the analysis of the results.

Recommendations—here the writer clearly documents recommendations or proposals. The writer needs to offer specific, clearly worded recommendations supported by results and observations previously documented in the report.

Conclusion—the writer summarizes the report and emphasizes next steps in this section. The writer reviews important information and does not introduce new material in this section.

Front Matter—Front matter consists of small sections that appear in the report prior to the introduction section. The front matter sections serve as navigation points for the reader.

- *Title Page*—identifies the name of the report, the author, date, and publication information.
- *Table of Contents*—lists each section and subsection with the page number.
- *List of Tables*—lists the name of each table with the page number.
- *List of Figures*—lists the name of each figure or picture with the page number.
- *List of Abbreviations and Symbols*—defines the abbreviations and symbols used in the document.

Not all sections appear in all documents. Writers creating custom reports may choose which sections best serve their purpose and goals. See Table 2.3 for more information.

Table 2.3. Document sections table

Section name	Commonly found in	For more information
Introduction	All Documents	
Executive Summary	Proposals, Forensic Analysis Reports, Environmental Impact Statements	
Abstract	Environmental Impact Statements, Proposals	
Background	Reports of Investigation, Forensic Analysis Reports, Laboratory Reports, Test Reports, Proposals, Design Reports, Business Letters	
Literature Review	Laboratory Reports, Proposals, Design Reports	
Procedures	Laboratory Reports, Environmental Impact Assessments	
Results	Reports of Investigation, Forensic Analysis Reports, Laboratory Reports, Test Reports, Environment Impact Assessments, Design Reports	
Observations	Reports of Investigation, Forensic Analysis Reports, Laboratory Reports	
Discussion	Reports of Investigation, Laboratory Reports, Design Reports	
Recommen-dations	Reports of Investigation, Forensic Analysis Reports, Environmental Impact Statements, Design Reports	
Conclusion	Reports of Investigation, Forensic Analysis, Laboratory Report, Test Report, Proposal, Design Report, Business Letters	

2.3 TYPES OF DOCUMENTS AND DRAFT OUTLINES

Focus: What sections make up different types of documents?

Technical documents serve different purposes and different templates exist to meet different needs. Two main benefits emerge from utilizing draft outlines. First, the outlines are designed to facilitate the readers' understanding of the document. Organizing documents in accordance with commonly used formats ensures that all necessary sections are present. Using a draft outline also ensures that the reader does not become overwhelmed with unnecessary details. Draft outlines offer a second benefit to the writer by applying a consistent approach to the writing process. Organizing thoughts in a regular manner over time allows the writer to become more competent in that writing style.

Writers should keep in mind the importance of the introduction, executive summary, and conclusion sections. Many busy supervisors read the introduction or executive summary and the conclusion most closely. It is important to keep the writing in these two paragraphs precise, accurate, and concise. The reader will form an initial impression of the work in the introduction. The conclusion is the last thing the reader will take away. Writers can use these two sections to shape the reader's understanding of the main points.

This section divides documents into three categories: reports, business communications, and other miscellaneous types of writing. Each category contains subsections that outline specific types of reports and detailed outlines of each section.

2.3.1 REPORTS

Engineers create reports to communicate information. Reports represent the official documentation of the project undertaken by the engineer. The report documents the actions, processes, and results of the project. Different types of reports are outlined in the following subsections.

2.3.1.1 Reports of Investigation

Investigation reports present the results of an examination or inquiry. Reports of investigation may include a study of a problem or failure, an inspection of a site, an evaluation, or an investigation of concerns about safety or the environment. These types of reports convey a great deal of detailed, nuanced information. A report of investigation contains an introduction, observations, discussion, recommendations (optional), and a conclusion.

2.3.1.1.1 Report of Investigation Draft Outline

1. *Introduction*—This section begins with an introduction or a brief overview of the presenting concern. The introduction serves to orient the reader to the investigation and helps the reader situate the problem in their mind. The introduction will include a statement of purpose or a statement of problem and will highlight specific details such as location of the trip and the requestor of the report. Only a brief overview is needed as the details will be developed in the next section.

2. *Observations*—After the introduction, a report of investigation describes the observations in detail. At this point, additional details on the background of the problem may be appropriate. This may include expanding on the purpose and stating how and why this investigation came into being. Was there an accident? Concerns about a design? Why was a site inspection or an investigation requested? What problem presented itself? In this section, writers need to stay concise but provide enough information that a non-engineer could pick up the report and explain how and why the investigation occurred.

3. *Discussion*—The next section is the description of the investigation and findings. This section includes details of the investigation. For a trip report, this is straightforward. What exactly was observed? Who did the investigator meet or talk with? What factors were observed? How did the factors interact? Investigations often include teams of engineers working together. Trip reports may encompass the observations of a group of people. The writer needs to account for each member of the team's observations and actions in a well-organized manner. The writer's goal in this section is to describe the trip so that the reader could recreate it if necessary.

    In reports dealing with investigations into problems, the discussion includes a more detailed description of the issue and then provides a discussion of the circumstances surrounding the issue. The writer needs to state the history of the problem, past attempts to correct the issue, and the results of past corrections. Writers should strive to keep this section fact-based and avoid opinion.

4. *Recommendations* (Optional)—If the recommendations are substantial, writers may include a separate recommendations section. For an inspection, the writer needs to state the recommendations and the rationale for those recommendations. In a problem-based report, writers note recommended corrective action or results from

any remedial action undertaken. For an accident investigation, writers should provide a detailed analysis of what prompted the accident. This section describes the exact actions recommended.

5. *Summary*—In this section, the writer overviews the report, briefly restating the problem or reason for the investigation. The writer then highlights the results of the investigation and focuses on the findings or steps taken. The final statement details the observations or recommendations for the future.

Section Headings

Forensic Analysis Reports and Reports of Investigation contain a great deal of information on detailed topics. Overwhelming the reader with detail and analysis can ruin a good report. Section headings can help organize the report and keep the reader from becoming lost.

One strategy for organization is to move from general, broad subjects to narrower, more specific subjects.

The Table of Contents from a Forensic Analysis of Dioxin Contamination provides an example of moving from general to specific topics.

Section 2. Risk Assessment and Contaminants of Concern

Section 3. Hexachlorophene Production

Section 4. Contaminants and Locations

Each of these major sections contains subsections identifying the significance of individual contaminants.

2.3.1.2 Forensic Analysis Reports

Forensic analysis reports identify causes of problems after they occur. The goal of the analysis is to identify the cause of failure and prevent future incidents. Typically, these reports are commissioned because of property loss or personal injury. Owing to the nature of the reports, companies and industry typically publish forensic analysis reports internally.

Forensic analysis may involve interviews, laboratory investigations, site visits, field observations, and other measures to determine the cause and propose solutions or recommendations for the future. Forensic analysis reports may be utilized in legal proceedings or to determine fault in

insurance situations. Owing to their nature, these reports must be concise, use precise words, and avoid ambiguity.

Forensic analysis reports typically consist of the following structure: introduction/background, investigation, recommendations, and then appendices. In some cases, the summary and conclusions may be presented together at the beginning of the document. Depending on the purpose of the report, an executive summary may also be appropriate.

2.3.1.2.1   Forensic Analysis Report Draft Outline

1. *Introduction*—The introduction includes the background and context. This includes information about who and what was involved in the incident. A description of the location, the event, and the impact of the event is also appropriate. Finally, the introduction also contains information provided by the commissioning agency or company.
2. *Investigation*—The investigation section contains an account of interviews, site visits, laboratory tests, and results. The subsections of this area will be guided by the investigation itself. Section headings that reflect the topics investigated rather than a chronological timeline of actions facilitate the reader's understanding. The investigation section challenges even skilled writers.
3. *Recommendations*—The recommendations section contains clear and concise recommendations supported by justifications drawn from the investigations section. Challenges to recommendations commonly occur, so writers need to carefully select each word or phrase in this section.
4. *Appendix (Appendices)*—The appendix or appendices contain supporting documents. See the Optional Reports section later in this chapter.

(side bar adapted from Forensic Analysis of Dioxin Contamination and Dioxin Sources at Centredale Manor Project Superfund Site. July, 2012. EPA Archive).

Procedure

The procedure section of a laboratory report presents unique challenges. A writer's goal in this section is to provide enough detail so another individual can replicate the experiment, but avoid a step by step account of each action. One way to strike a balance is to

assume that the reader understands how to perform standard tests in the field. However, any assumptions or calibrations made when conducting the tests which may alter the test results are important to document.

For example, consider an experiment to determine if salted or unsalted water boils faster. To boil water, it is standard procedure to heat it over a heating source. Details that would affect the outcome of the experiment include the salinity of the water, the starting temperature of the water, and the heat setting. An example procedure section could read as follows:

Dissolved 10 grams of salt into 1 liter of water. Heated water to 220 degrees over a Bunsen burner set on low. Water starting temperature was 10 degrees Celsius.

New or altered standard test procedures should be described in detail.

2.3.1.3 Laboratory Reports

Laboratory reports represent another common type of technical document. The writer's main goal is to report the results of an experiment or test done in a controlled setting with clearly defined parameters. Laboratory reports present the data obtained from the experiment.

A laboratory report is a formal document that conveys the theoretical underpinnings of the experiment and the procedures and equipment utilized to complete the work. A laboratory report is written so that the experiment that produced the data can be replicated in full by the reader.

One important consideration is the goal of the report. Will the laboratory report be included in a formal report for a client? Will the report be used in a legal matter? Is the background already known or not? The answers to these questions will determine which sections to include in a laboratory report or whether to use a less formal test report, described in the next section.

2.3.1.3.1 Laboratory Report Draft Outline

1. *Introduction*—As with other reports, the introduction serves as an orientation to the reader, briefly communicating the background and the general context. In formal lab reports, the writer outlines the scope or the context of the main problem, and provides a concise

overview of the issue. The writer also clearly states the problem or goal of the report.

2. *Background/Literature Review*—In this section, the writer thoroughly details the context and may include a very brief history or recent developments in the field on the topic. A literature review summarizes recent literature in the technical field relevant to the topic. This section includes important research discoveries that help offer context to the reader. The literature review or background section should include only the most relevant information.

3. *Procedures*—Unique to a laboratory report is the procedures section. This is one of the most important sections in a laboratory report. In this section, the writer describes the test or experiment performed and any specialized equipment needed or used. This section documents a chronological account of the specific, precise steps taken to perform the experiment or the test. This section may be broken down into subsections for more formal reports or in situations where the procedure or equipment that was utilized were unusual, specialized, or represented new or novel technologies or methods to solve the problem. Writers need to specify exact conditions and not rely on boiler plate or standard language to describe a procedure as this may result skew the results.

4. *Results/Observations*—This section details the findings and results obtained from the experiment. The writer needs to summarize data in a few sentences and then provide a chart showing all the data for each test or procedure undertaken. See the Section 5.7 on presenting visual aids in reports. Both quantitative (numbers) and qualitative (observations) data are presented in this section. When presenting observations or qualitative data (i.e., non-number-based) reports, only objectively observable facts, not impressions, are included in the report. All data should be reported in this section, including nonsignificant data and tests that failed.

5. *Discussion*—Writers often combine the discussion and conclusion sections in shorter laboratory reports. In longer reports, or ones with complex findings, the sections are separated. A good rule of thumb is to separate the discussion and conclusion sections in reports with a standalone literature review. In the discussion section, writers link the results section with the problem or goal of the report, identified in the introduction. The discussion session includes an interpretation of the results for the reader, important findings, and the highlights of the practical applications of the findings. The discussion section also situates the finding of the experiment in the context of the literature review or the background of the problem.

6. *Conclusion*—The conclusion section summarizes the report, high-lights important interpretations from the discussion section, and emphasizes the impact of the findings. The conclusion section also notes possibilities or outliers that may impact the results. Examples include variables that may be present in the field, which are not present in a controlled lab setting. The conclusion section leaves the reader with their final impression of the laboratory report and the interpretation of the experiment or test outcomes.

2.3.1.4 Test Reports

Test reports represent a less formal, scaled-down version of the laboratory report. Test reports are appropriate when reporting the results of a smaller test, when the reader is only interested in specific results, or when reporting one part of an ongoing series of tests, especially internally within a company. The goal of a test report is to report the results of the test with little additional information.

2.3.1.4.1 Test Report Draft Outline

1. *Statement of Purpose*—Test reports begin with a statement of the test objectives or purpose. No background is necessary in a test report. This statement should be between one and three sentences.
2. *Procedure*—This section names the test and any important information about the results. This would include any assumptions made and any conversions or scaling of data. This presentation should be concise and, unlike a laboratory report, it is not necessary to provide enough detail to replicate the experiment in this report.
3. *Results*—Here the writer presents the data and results. Typically, test reports contain data organized into a chart. See Chapter 4.6 for more information on how to visually present data. Since a test report assumes that the reader possesses the skills and abilities to interpret the raw data, the results are presented with minimal narrative. The writer describes the chronological sequence of the actions taken and the results of each action. For example, a test report that identifies compounds present at a site will identify where, when, and how each sample was obtained; then briefly describe the procedures used to test the sample. For example, the writer might note that the sample was mounted on a slide and then examined under specific power of microscope. In this section, the writer presents the results of a test report in their entirety. Charts help present data clearly and precisely.

4. *Conclusion*—In this section, the writer explains the significance of the results, the support for the inferences drawn, and notes variables or potential limitations. The test report needs to balance brevity with enough information to assure that the test was appropriate to the problem and performed correctly.

2.3.2 ENVIRONMENTAL IMPACT ASSESSMENTS/ STATEMENTS

Despite possessing similar sounding names, Environmental Assessments (EAs) and Environmental Impact Statements (EISs), sometimes referred to as an Environmental Impact Assessment, represent two distinct types of reports. An EA explores whether an action by the federal government may result in an impact on the environment. An EIS explores the impact of the action.

2.3.2.1 Environmental Assessments (EA)

EAs should be concise and focused solely on whether an impact will occur because of the proposed action or alternative. After review and acceptance by the agency that commissioned the document, the EA will become a public document.

Not all proposed actions result in an EA. In certain circumstances, a proposed action may receive categorical exclusion from the need for an assessment. Each governmental agency oversees the specifications for a categorical exclusion. If the action does not qualify for a categorical exclusion, there are two possible outcomes from an EA: a finding of no significant impact (FONSI) or significant finding, which will result in an EIS.

2.3.2.1.1 Environmental Assessment Draft Outline

1. *Need*—In this section, the writer outlines why the assessment needs to occur. This includes a description of the environment and the proposed action.
2. *Alternatives*—Here the writer provides a detailed description of all potential alternatives to the proposed action.
3. *Proposed Action Impact*—In this section, the writer discusses the impact of the proposed action on the environment.

4. *Proposed Impact of Alternative*—In this section, the writer documents the impact of the alternatives on the environment.
5. *Consultations*—A complete schedule of consultations for the assessment is present in this section.

For more detailed information: https://epa.gov/nepa/national-environmental-policy-act-review-process

If the EA results in a FONSI, the assessment is complete. If a significant impact is found, the appropriate agency will commission an EIS.

2.3.2.2 Environmental Impact Statements

An EIS documents the likely impact of the proposed action. Agencies also require specific actions and reporting functions for EISs. These requirements are typically more detailed and rigorous for an EIS than for an EA. For planning purposes, it is important to note that government agencies require a public review and comment period for an EIS, which may result in further investigation. The final report incorporates comments raised during this period.

2.3.2.2.1 Environmental Protection Agency Draft Outline for an EIS

1. *Cover sheet*—The name and contact information of the agencies involved, title of the proposed action, location of proposed action, and comment period end date is found on the cover sheet.
2. *Abstract*—The writer summarizes the EIS in a very brief paragraph. The Optional Report Sections later in this chapter contains detailed information on abstracts. The abstract appears on the cover sheet.
3. *Summary*—This section will include a brief description of the proposed action and alternatives, the major findings and recommendations and outstanding or unresolved issues. This section is similar to the executive summary outlined in the optional report section of this chapter.
4. *Table of Contents*—This is a list of the section headings and their starting page numbers. See the Optional Reports section in this chapter for more detailed information.
5. *Purpose and Need Statement*—Similar to the EA, the writer explains the proposed action and purpose of the EIS.

6. *Alternatives*—The writer uses this section to outline potential alternatives to the proposed action.
7. *Impacted Environment*—The location and description of the environment as it currently stands (pre-action) are documented in this section.
8. *Impact of Action*—This section includes the environmental consequences of the proposed action. This includes both direct and indirect impacts and effects of the proposed action. This section also includes the direct and indirect impacts of proposed alternative actions.
9. *List of preparers*—A list of the individuals who prepared the EIS and their credentials.
10. *Recipients*—A list of the recipients of the EIS.
11. *Index*—A listing by topic with page numbers.
12. *Appendices*—Not all EIS will contain Appendices. See the Optional Report Sections later in this chapter for a more detailed discussion of Appendices.

Additional Resources

- EPA's detailed explanation of each section: http://bit.ly/Codeof-Regulations
- Information about the National Environmental Policy Act: http://bit.ly/NationalEnvironmentalPolicyAct
- Specific list by state and by agency: http://bit.ly/NEPAbyState

2.3.3 PROPOSALS

In proposals, engineers present a plan of work for consideration for funding. Solicited proposals invite engineers to respond to a defined need. Government agencies publicly solicit RFPs and provide detailed information about the scope of the work. Engineers also respond to solicited proposals in response to client inquiries. Common external proposals include sales proposals, often known as bids, although professional engineering services are more commonly procured through a qualifications-based process. Other common external or solicited proposals include research or grant proposals. Agencies and clients often require the inclusion of specific sections and information from all bidders to ensure equal comparison and evaluation of the proposal. Matching the language of the proposal to the RFP request to aid the reader in quickly confirming all requested information is present and helps the reader compare similar sections. Writers can use the formatting requirements as a guide to develop the proposal.

Unsolicited proposals both define a need and pitch the solution to a company or agency. To succeed, unsolicited proposals must first clearly identify the need and persuasively argue that the need represents a problem. The impact of the problem in concrete terms must be clearly stated. Then, the proposal lays out the plan of work to solve the problem. Unsolicited proposals often target internal needs within a company.

For all types of proposals, the unique motivating factors of the audiences guide the development of the proposal. For lengthier proposals, front matter, such as table of contents and lists of tables or figures, helps reader navigation of the document.

2.3.3.1 Proposal Draft Outline

1. *Title Page*—The title page includes the name of the project, the authors and their affiliations, the date submitted, and name of organization for whom the proposal was prepared.
2. *Abstract/Summary*—This section orients the reader to the project. Solicitors may use the abstract or executive summary to eliminate proposals outside of the defined area of need. The summary focuses on the problem, the importance of the problem, and the solution.
3. *Introduction*—The writer clearly identifies the need and defines the problem in this section. An introduction explains why the proposal was written. Depending on the RFP specifications, the problem statement may be included in the introduction or may stand alone. For an unsolicited proposal, the introduction section is where the writer clearly outlines the problem, the reason the problem exists, the effects of the problem, and the impact of the effect in quantifiable real-world terms.
4. *Background/Literature Review*—The writer reviews previous attempts to resolve the actual or perceived problem and the relevant theoretical background to the defined problem. In solicited proposals, this section demonstrates the theoretical foundation for the proposal. A tightly focused and brief literature review/background section is the best approach for a solicited proposal. For research or grant proposals, the literature review also demonstrates how this proposal will represent a new or novel approach to the problem.
5. *Project Plan/Proposal*—The section contains the details of the proposed plan of work and describes the exact terms of the work. It includes the objectives, a proposed schedule of work, and a statement of deliverables. In this section, the writer also documents what is not included as objective or a deliverable of the proposal to

avoid potential confusion. Writers often organize this section either chronologically or according to deliverables and include the proposed cost or budget in this section.

6. *Experience/Qualifications*—For external proposals, readers expect a brief statement of qualifications tightly focused on the proposed project. This section briefly outlines prior experience with similar projects and the credentials of the involved staff.

7. *Conclusion*—In this section, writers restate the defined problem and review the main deliverables. The proposal concludes with a summary of the importance of proposed work.

2.3.4 DESIGN REPORTS

Design reports outline the specifications of a to-be-built item to resolve an issue or solve a problem. A design report presents a solution to a problem. These reports serve as a written documentation and a set of instructions to guide the physical manufacture of the product. Design reports may be produced in response to a government agency or an industry RFP. Government agencies will outline the scope of the designs needed and provide details on the format for the design.

Design reports must communicate exactly what is required to bring the design to life. This includes material specifications, assumptions, detailed descriptions of actions and steps required, and the intended functionality of the final product. Design reports are intended to stand alone, without the author's presence, in communicating the proposed design. Design report authors avoid ambiguous, vague, or unclear language as this type of language will affect the success of the project. Reviewing and revising the design document will ensure that explicit, clear, and detailed communication exists. While an external proofreader is recommended for all reports, many writers consider a proofreader mandatory for design reports.

2.3.4.1 Design Report Draft Outline

1. *Background/Problem*—The writer identifies the problem and why the problem needs resolution. This section also clearly states the goals for the design. This section may also review relevant background conditions and contain a brief literature review identifying relevant attempts at solving similar problems. If the design rests upon theoretical assumptions, the writer outlines and foreshadows those theories in this section. This section also documents any client requirements, constraints, and expectations.

2. *Proposed Design*—In this section, the writer outlines the design and the analysis that led to the design, including alternative designs and the rationale for their nonselection. Most importantly, this section includes components of the design, their interdependencies and functionalities, how to build the design, and its uses all described in exacting detail.

   Communicating the design will result in a great deal of detailed writing, which may overwhelm the reader without a logical and well-thought-out organization structure. Grouping major topics together and utilizing section headings orients the reader and prevents confusion. In addition, writers should embed visual aids such as diagrams and visual aids, where possible, to help the reader picture the proposed design. Organizing the sections from general to specific, such as providing a sketch of the completed design and then breaking down into the component parts, is a useful organizational structure. See the section headings side bar in the Forensic Analysis Report section for more information on organizing section headings.

3. *Proposed Cost*—Estimated costs for the design are provided in this section. Government agencies often require this section, also known as the proposed budget section. To justify proposed costs, this section also contains an estimated project time table. The author needs to document cost breakdowns by component parts, including costs for personnel, materials, permits, documentation, and other associated expenditures, and account for any possible cost-saving measures and their impact on the design.

4. *Conclusion*—The writer summarizes the design proposal and accounts for the strengths and weaknesses of the proposed design. The section also contains any limitations and possible solutions, the expected outcome of the design, and suggested testing associated with the implementation of the design. If a prototype of the design and/or any testing has already been completed, the results are outlined here as supporting evidence of the efficiency of the design.

Citation: http://me.umn.edu/education/undergraduate/writing/How-to-write-a-Design-Report.pdf

2.3.5   OPTIONAL REPORT SECTIONS

The previous sections describe common sections and templates for reports. Depending on the type of report, the audience, and the goals

for the report, consideration should be given to including some or all of the following sections to help the reader navigate and understand the report.

2.3.5.1   Executive Summary

Executive summaries appear at the beginning of the report and contain a brief overview of the report, emphasizing the problem statement, recommendations, and conclusions. In an executive summary, results are presented in their final, simplified form, and only if directly relevant to the conclusion. An executive summary may be utilized when reporting to nontechnical decision makers more interested in the conclusions and recommendations than technical details. Executive summaries are most appropriate for longer reports or reports where a great deal of technical analysis is presented. Data charts should not be presented in an executive summary. Even though the executive summary comes first, it should be drafted last.

2.3.5.2   Recommendations

If the recommendations are complex, require extensive narrative to justify the recommendations, or the findings generated many recommendations, a separate recommendations section may be appropriate. This section may be offset from the conclusion to draw more attention to the recommendations. Writing for technical or research journals often requires a separate recommendations section.

2.3.5.3   Appendix/Appendices

Appendices contain information that is too detailed, technical, or extensive for the main report. Each appendix functions as a mini-report created in support to the main body of results. The appendix provides deeper, but not vital, information for understanding the report. For example, in a site analysis where the investigator collected soil samples from multiple locations, a description of each location becomes tedious and exhausting to read. Including a map with the location of the collection sites as an appendix allows readers to access this detailed information if they desire, but allows them to skip the more detailed information when reading the report. Photographs of the site and the soil collection locations represent other viable

potential appendix options. Other examples of appendix options include a glossary of technical or site-specific terms or more full documentation of statistical analyses.

Each appendix is specific to one type of information. Using the previous example of the map and photographs, the map represents one appendix and the photograph represents a separate appendix. Appendices appear as standalone documents at the end of the report.

All appendices are referenced in the text of the main report. No appendix should exist in the document unless referenced in the main body of the report. For example, writers refer to a map of sites as "See Appendix A for detailed locations of soil samples" in the report.

Appendices are titled in order of appearance in the main report using a capital letter followed by the title. For example, a map of the soil collection sites is titled Appendix A: Map of Soil Collection Locations. The next document, a photograph of a soil collection locations, is titled Appendix B: Photograph of Soil Collection Location #4. In the table of contents, the Appendices are ordered by capital letter and list the full title of each appendix.

2.3.5.4   References

If the report includes references and citations, a reference section should be included. See Chapter 5 for more information on how to properly cite sources.

2.3.5.5   Front Matter

Front matter is the information provided in formal reports that help the reader navigate the report. Front matter appears before the body of the report and consists of a title page, the abstract, the table of contents, a list of figures, and a list of tables, as appropriate. Some authors include the executive summary in the front matter.

    Title Page—Lists the name of the report, the author, contact information, and publisher information.

    Table of Contents—Provides a list of section and subsection headings and the page numbers in the order they appear in the report. Include in the table of contents the Appendix(ces) in a list ordered by appearance in the document. Note that page numbers are provided in lower case italics until the Introduction or Problem Statement section

where conventional Arabic numbers are utilized. Only the first page number of the section is shown. See Figure 2.1.

Figure 2.1. Example table of contents with front matter.

Adapted from: USEPA (U.S. Environmental Protection Agency) 2014. An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska. Region 10, Seattle, WA. EPA 910-R-14-001.

Abstract—An abstract is a short, concise, summary of the problem and conclusion contained in the paper. Usually between 150 and 200 words, the abstract is a short paragraph to help the reader decide whether the report is relevant. The abstract is positioned immediately following the title page. Abstracts are included in formal, external reports and in any report for a technical or research journal. Similar to the executive summary, the abstract is drafted at the end of the writing process.

List of Figures—If the report contains more than two illustrations, graphics, drawings, photographs, or maps, a list of figures should be provided following the table of contents. The figures are listed in the order they appear in the report, using the title of the figure, and its page number. See Figure 2.2.

List of Tables—This list includes the full name of each table and the page it appears on in order of appearance in the report. See Figure 2.3.

Figure 2.2. Example list of figures.

Adapted from USEPA (U.S. Environmental Protection Agency). 2014. An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska. Region 10, Seattle, WA. EPA 910-R-14-001.

Figure 2.3. Example list of tables.

Adapted from: URS Corporation. 2008. Source Test Report of the Coke Steam Vent. URS 40942073.

2.3.6 STATEMENTS OF QUALIFICATIONS

In a statement of qualifications, the writer outlines the abilities or work a company is certified and qualified to perform. Statements of qualification usually include three main sections: Overview, Profiles of Services, and Profile of Projects. Firms and businesses often make their statement of qualifications freely available so that potential customers may investigate the firm. The statement of qualification may be as short as 5 pages or exceed 100 pages. A statement of qualifications is a sales document that helps drive business to a firm.

Example Profile of Services

Detailed, accurate, and precise profiles of services aids potential customers and funders in quickly assessing the company's strengths and skills. Strike a balance between detailed and overwhelming by selecting broad categories and concise language to present areas of expertise. For example, a firm that completes environmental testing services may include the following bulleted list in their profile of services:

Environmental Site Services
- Phase 1 Environmental Site Assessment (pre-purchase)
- Phase 2 Environmental Site Assessment
- Phase 3 Environmental Site Assessment
- Baseline Studies
- Remedial Action Plans

Material Testing
- Field Concrete Testing
- Concrete Core Sampling
- Field Masonry Testing

Reporting each service offered creates an accurate and detailed profile of services.

RFPs usually require a statement of qualifications. If providing a statement of qualification for an RFP, writers need to amend the statement of qualifications to fully respond to each point requested. This may include editing the section headings to match the sections identified in the RFP.

2.3.6.1 Statement of Qualifications Draft Outline

1. *Overview*—The writer introduces the firm and includes the mission and vision, contact information and location and any professional affiliations. Some companies provide information about key personnel, important insurance information, key relationships with other firms and other information in this section.
2. *Profile of Services*—In this section, the writer describes the services the firm is qualified to offer. The writer's goal is to create a precise, extensive, detailed, and exhaustive list. Grouping services by major category and providing bulleted lists allows the reader to quickly grasp the available services. See the side bar for an example of a profile of services.

3. *Profile of Projects*—In this section, the writer highlights the scope, breadth, and depth of projects the company previously engaged in or provides a sample of the types of projects the company is qualified to undertake. Sometimes referred to as Project Profiles, Representative Projects, or Past Clients, this section provides an opportunity to describe the projects best suited for the company. Past experience may be presented in many ways, from a table with a list of clients and the area of service provided to full-page profiles of representative projects.

   Representative project profiles are approximately one page, single spaced, and often include a photo or a side bar to highlight the most important information. The project description will identify the name of the client, the scope of the project, a description of the problem statement, highlights of the work undertaken to solve the problem, and the resolution.

2.3.7 BUSINESS COMMUNICATION

Reports make up one set of documents engineers commonly write. Business communications comprise another large set of documents engineers write during their work. Like reports, business communications also convey information and represent official documentation.

2.3.7.1 External Business Letters

Business letters are typically utilized to convey information to an external reader outside of the organization. Business letters represent the most varied types of communication, including general correspondence between two environmental engineering firms or confirmation and receipt of information or parts. Business letters also convey additional information to a customer or seek information from others in the form of an inquiry letter. Engineers also use business letters to respond to a solicitation, accept a customer, respond to a complaint, or refuse to accept work. Business letters are legal, formal documents. Business letters are printed on high-quality paper and mailed to the recipient.

2.3.7.1.1 Business Letter Draft Outline

Business letters are formatted single-spaced documents with left justified text. The top left-hand corner includes the date, the sender's address, and

the recipient's address as separate blocks with a space between each block. The formal salutation addresses the recipient by their title and last name. The introduction, body, and conclusion follow the salutation.

1. *Introduction*—The writer summarizes the purpose and intent of the letter. Recent verbal communication is referenced in the introduction.
2. *Body*—In this section, the writer outlines the main purpose for the letter and states the main points clearly and concisely. As relevant, history, background, justifications for decisions, and other relevant information are included.
3. *Conclusion*—The writer summarizes the main points of the letter and outlines future action, deadlines, and contact information.

End the letter with a closing salutation, such as "Sincerely" followed by a signature immediately underneath. The name of the sender and their credentials is blocked under the signature. If anything is enclosed in the envelope, such as a contract, list the title of the document below your name in smaller print. See Figure 2.4.

2.3.8   OTHER TYPES OF WRITING

Environmental engineers collaborate with many different individuals during projects. Effectively documenting these interactions can play a role in how efficiently engineers work together. Two common types of documents produced are agendas and meeting minutes or recaps. Both are vital to ensuring productivity among a team.

2.3.8.1   Agendas

An agenda lists the topics and outlines the plan for a meeting. Prior to the meeting, the organizer should share the agenda with all members and notify individuals who are expected to present information. Many presenters find it helpful to know the length of time in the meeting allotted to their topic. This practice allows everyone to come to the meeting with appropriate documents prepared to work.

2.3.8.1.1   Agenda Draft Outline

- Name of meeting
- Location

September 1, 2017

John Doe
JD Engineering Company
Box 343235
Boston, MA 02115

Joe Client
Client Company
12345 State Street
Boston, MA 02115
Dear Mr. Client:

In this introduction, I will state that we last spoke on the phone on July 28, 2017. I will also state the main concerns you had and that the purpose of this letter is to address those concerns.
In the body of the letter, I will note that your concerns were unfounded. I will outline the reasons why the concerns were unfounded and I will separate the reasons into separate paragraphs for ease of reading:

Reason #1—my reason and why it is justified
Reason #2—my reason and why it is justified
Reason #3—my reason and why it is justified

In this conclusion statement, I will reiterate that although you were concerned about something, the concern was not justified due to reasons 1, 2, and 3. I will then state that if you would like an in-person presentation of these results, or to schedule a call to discuss these results, to please contact me at 555-111-2222 before October 30.

Sincerely,

INSERT SIGNATURE
John Doe, P.E.

Enclosures: Findings Report

Figure 2.4. Example business letter.

- Time, date, and duration of the meeting
- Topics
- Date of next meeting (if necessary)

2.3.8.2 Meeting Minutes

Meeting minutes, or recaps, serve as the formal written record of the meeting. Meeting minutes record who was present at and absent from the meeting. The minutes summarize the conversation of the topics discussed in the meeting. Meeting minutes document highlights of discussions, recommendations offered, and action items identified. If proposals have been debated, minutes record the main points of the discussion, both for and against a proposal. Expected outcomes may also be recorded. Meeting minutes avoid details and focus on the outcomes and action items generated at the meeting. Typically, meeting minutes are written following the same format as the agenda. Minutes are usually distributed to the participants of the meeting, but may also be distributed more widely once the participants agree the minutes represent the meeting accurately.

2.3.8.3 E-mails

Engineers also communicate through e-mail. E-mails, like other forms of business communication, convey information. It is most appropriate to use e-mail to solicit information or to reply to a solicitation for information. E-mails are used when the information to be conveyed is short and specific in nature. Generally, e-mails should be less than a paragraph or two in length. Writers should consider either revising the note or using a business letter for messages beyond a few paragraphs in length.

While e-mail may speed the delivery of the document, writers should compose an e-mail with care. Despite the appearance of informality and the ease of composing and sending an e-mail, it is important to note that an e-mail represents a formal document in a business setting. An e-mail sent to a colleague may be forwarded onto other individuals, including supervisors and customers. E-mails may also be used in legal proceedings, and unlike in a business letter, may be retrieved from the sender or the receiver. E-mail may be archived, meaning it may be retrieved even after deletion. Writers should keep their e-mails professional, formal, and focused. A good rule of thumb is to write e-mails as if they will be seen by a supervisor or posted on a website.

Effective e-mail is concise and professional in nature. The sender's address is clearly visible and one of the first things the reader will see, so the e-mail address needs to be professional in nature. Readers use the subject line to decide the relevance and importance of the e-mail. Authors should keep the subject line brief and focused on the main point of the

message. The writer should also carefully consider who receives the e-mail and ensure that the message is appropriately targeted.

2.3.8.3.1 E-mail Draft Outline

1. *Salutation*—Although e-mails may feel informal, the writer needs to formally address the receiver. The salutation includes the reader's title and last name.
2. *Body*—In the body of the e-mail, the author formulates the message. The message should be brief, concise, and reader-specific.
   The body of the letter should be composed with the same attention to professionalism as other technical documents. The writer needs to utilize capitalization, punctuation, and proper spelling when composing the body of the e-mail.
3. *Closing*—At the end of the e-mail body, the writer may choose to summarize the main points of the e-mail and state any action items or deadlines.

Subject Line: Information request, Smith Project

Dear Mr. Doe,

I am writing to request additional information about the soil samples related to the Smith Project.
To complete the requested analysis, I will need the depth measurement each sample was collected at. I plan to test sample numbers 3, 5, 6, 8 and 11.

To complete the test by the deadlines, please send me these measurements no later than one week from today.

Sincerely,

Joseph

Joseph Engineer, P.E.
Chief Engineer
Engineers Corporation United

Figure 2.5. Example e-mail.

4. *Closing salutation*—The closing salutation includes a formal closing salutation such as "Sincerely" followed by the writers' first name, which acts as a signature. The writers' full name, their credentials, and their affiliations appear below the signature. Many e-mail programs contain a "signature" feature that allows senders to automate this section of the e-mail. See Figure 2.5.

CHAPTER 3

PROFESSIONAL WRITING

Focus: Understanding how the reader influences the way information is presented.

All authors write to communicate ideas and information, yet not all writing is the same. Writers create short stories, works of fiction, argumentative essays, dissertations, persuasive copy, technical documents, letters, e-mails, and many other types of writing both formal and informal. Each conveys a message crafted and delivered by the writer. However, each method of writing, such as creative writing, academic writing, and personal writing, exists with expected conventions, tones, and styles. For example, technical documents do not contain scripts or informal language. Likewise, a play does not contain section headings. One main driver of the variation between writing methods is audience expectations. These differences in audience expectations influence the nature of the writing; it is readers, not writers, who judge the success of a document, and failing to consider their expectations and needs will render a document ineffective.

Even within each discrete method of writing, the final product may possess distinct traits as specialized formats have evolved over time. For example, in creative writing, at least one primary goal of the author of both a play and a short story is to entertain the audience, in one way or another. The formats of each type of writing, however, cause the writer to produce vastly different final products. Smaller differences exist as well. For example, in academic writing, a persuasive essay will appear different from a dissertation. Even within the dissertation format, each work conveys its academic discipline's approach to the writing style. A dissertation in psychology, for example, will look very different from a dissertation in history. The differences between forms of writing (academic and popular, or formal and informal) can be found in both the form and the content of representative samples. The format differences are perhaps the easiest to notice and follow, as they are immediately apparent from a cursory

inspection of the layout of a document. This can be seen in Chapter 2 of this book, which defines and outlines the most common formats for technical documents.

More difficult to notice and implement effectively is the subtler differences in content, which arise from an author's cultivated understanding of her audience. In an effort to demystify the process of developing an understanding of one's audience and to provide some tools for authors seeking to strengthen their ability to communicate effectively with a chosen audience, this chapter briefly explores the relationship between a piece of writing and its audience, and how the intended audience influences the effectiveness of the writing. A selection of writing methods is introduced to demonstrate the differences between the styles.

3.1 ACADEMIC WRITING

Most engineers are familiar with academic writing from their undergraduate career. As a student, successful academic writing requires anticipating the goals of the faculty member. Faculty members read student papers to evaluate the student writers' grasp of the content to assess their skills. For students responding to an assignment, one goal is to demonstrate content knowledge and expertise. Effective demonstration of content knowledge requires broad knowledge of the subject area and deep knowledge of the specific content. Effective academic writing as a student requires the author to demonstrate their knowledge to their faculty member because the goal of the faculty is to evaluate that knowledge.

Analysis forms the main foundation of all academic writing; effective student academic writing must clearly and exhaustively demonstrate this skill. Academic papers focus on understanding and analyzing previous literature, exposing potential gaps in the literature, and crafting a logical and persuasive guide to the analysis for the reader. The writers' analysis of existing source material creates the line of logic and argumentation present in the paper. Like content knowledge, faculty evaluate the student's ability to perform this analysis.

Student writers also perform other skills for evaluation, and assignments provide an opportunity to demonstrate their English language, research, evaluation, and persuasion skills. Writers demonstrate these skills through the quality of the source material, the ability to incorporate source material, their ability to integrate their ideas with previous literature, and their ability to communicate their arguments. Faculty readers are judgmental in nature, assessing the demonstration of these skills.

Faculty evaluating student work represent a large but specific population of the academic writing audience. The other main audience is comprised of individuals who read scholarly journals. These readers are deeply interested in the subject matter and read to learn more about a topic. Readers seek to learn new facts or theories from these works. As a result, writers take a great deal of time to expand upon arguments and detail multiple incidents to document and build their case. To build the credibility of the argument requires detailed analysis documented with care.

The intended audience for academic writing, whether of student work or scholarly journals, are content and discipline experts. As a result, the writing is formal. The writer seeks to convince the reader of some purpose using analysis and persuasion. In the case of a student writer, the purpose may be the demonstration of ability or content knowledge. For other academic writers, the goal is to convince other experts of the quality and credibility of a theory derived through analysis.

3.2   CREATIVE WRITING

Creative writing entertains the reader and communicates the author's reflections on a variety of subjects. Readers of creative writing expect to find the writers' thoughts and opinions, not hard facts and citations. Creative writing spans a vast quantity of writing product. Readers do not expect to learn processes or academic knowledge through creative writing, but may expect the writing to spark their own internal reflection process. In other words, readers may learn from creative writing, not from a presentation of facts or an analysis of theory, but instead from their own internal reactions to the writing.

Creative writing contains many different formats. Formatting conventions classify different types of creative writing. Creative writing, more than any other writing form, considers the delivery of the writing in the authoring process because in some cases, the audience is not a reader. Poems, plays, narrative prose, short stories, comics, and screenplays are all considered creative writing. Each has different formatting conventions that the author must consider from the beginning.

Creative writing, as a method, intends to reach all individuals. Creative writing, while often adhering to formal formatting conventions, is informal in nature. Since creative writing often reflects lived experiences, the language of creative writing may be vulgar. Readers pick up creative writing works to be entertained, stimulated, provoked, and moved; the writing matches these expectations.

3.3 PROFESSIONAL WRITING

Technical represents a highly specialized form of professional writing. Technical writing forms the foundation of how engineers communicate with each other and with the world. Engineers need to share their ideas, innovations, and designs with others for projects to move forward. The analysis, solutions, and recommendations that engineers generate during investigations into incidents need to be understood to prevent future mishaps. Technical writing takes place in a business environment, for the purposes of professional communication in the workplace.

Professional writing differs from the previously described forms of writing. The goal of professional writing is solely to convey information, often technical in nature. Professional writing is used nearly exclusively in a business environment and exists to facilitate communication between individuals producing work. Where academic writing demonstrates skills and creative writing entertains, professional writing produces—whether that be ideas, recommendations, or other work products. In a business environment, the readers need to understand the document as quickly and clearly as possible.

Professional writing needs to address the perspectives of multiple audiences in the same document because the needs and experience of the intended audience vary widely. Readers may be concerned primarily with budget expenditures or with the feasibility of a proposed solution. Therefore, professional writing needs to be clear and free from ambiguity. While unintended, professional documents are official, formal documents. These documents may be used in legal proceedings.

3.4 CHARACTERISTICS OF PROFESSIONAL WRITING

Authors engaged in professional writing need to remain aware of two key facts about their readers. The first is that the readers may have a diverse, nontechnical background. Authors should be aware that the readers will include specialists and nonspecialists, as well as unintended readers who are forwarded the document. The second key fact is professional writing exists solely to enable work and work production. In this setting, ambiguous communication results in lost time and money and may contribute to personal or property injury.

Because of these key facts, professional writing evidences the following characteristics:

- *Clarity*—Clarity in writing refers to whether the writer logically sequenced the structure of the document, the paragraphs, and the sentences to enhance reader comprehension. The draft outlines presented in Chapter 2 will help the writer achieve clarity within the larger structure of the document. Presenting broad concepts first, followed by more detailed information in each section, also facilitates clarity. See the Section Headings Box on page 11 for more information on moving from broad to narrow information in sections. Clarity also results from keeping each paragraph tightly focused on the topic and from removing extraneous information. See Section 6.1 for more information about the revisions process.
- *Precision*—Selecting words that are explicitly accurate is writing with precision. Because of the nature of technical documents, words must have the same meaning to every reader. The writer's choice of words in technical writing should be undertaken with an eye toward precision. In the same way that engineers check their calculations for accuracy and simplicity, authors should select plain, clear, words that cannot be misinterpreted.
- *Conciseness*—Conciseness and precision work together to make the document clear and effective. Conciseness refers to eliminating redundant details, paragraphs, and words. A concise document also contains only paragraphs and sections that fully connect to the main point of the document. Each point is clearly and fully communicated in as few words as possible. Short sentences do not guarantee a concise document. Revising for conciseness means detecting and removing clutter in the writing. See Section 6.2.3 for information about features in word to facilitate concise writing.
- *Tone*—The tone of professional writing is formal, serious, detailed, and focused. The goal is clear communication to facilitate work; while colleagues may also be friends, communication should be professional. The writer's emotions, feelings, and humor are inappropriate in professional writing. The best tone to strike in professional writing is matter of fact, but not egotistical. Writers should communicate confidence through their analysis and skill, without arrogance. Writers can strike a positive, professional tone by respecting the reader as an intelligent nonspecialist. Section 2.1.2 contains more information on the tone of technical documents.
- *Adaptability*—In professional writing, more so than any other writing method described earlier in this chapter, the writer needs to consider the needs of the reader before beginning. In academic writing and creative writing, reader expectations are both relatively stable

and uniform. A faculty member evaluates student papers, or a poet seeks to convey the depth of a human experience, both of which are anticipated by both the author and the reader. In professional writing, however, an engineer reads to determine the feasibility of the recommendations, a manufacturer reads to determine specifications for the proposed design, a financial manager reads to perform a cost–benefit analysis on the project. In professional writing, one document must meet all of these expectations.

Professional writing differs from academic, creative, and personal writing in several important ways. The expectations of the readers drive many of these differences. Writers of technical documents should keep in mind the reader's expectations for their documents. A checklist for conducting reader analysis can be found in Section 2.1.1. This checklist can help writers target their writing even more effectively. Understanding and writing to meet the reader's goals can make the document more effective. Readers of professional documents are not hoping to be emotionally moved by the document; instead they want the information as quickly as possible. Likewise, the readers do not evaluate the author's research skills as they would in an academic document.

Technical writing is a learned skill, one that improves with practice. Close attention to the process of writing and being cognizant of the characteristics described in this book will help strengthen this vital skill. Writers who stay focused on clearly, completely, and concisely conveying information in professional writing will be effective. The effort in honing the skill of professional writing will pay off. An engineer can impact the world only as well as they can communicate their ideas.

FUNDAMENTALS OF PROFESSIONAL WRITING

Grammar has a bad reputation of being boring, tedious, and traditional, but, really, it is standardized grammar and spelling that allows people to efficiently communicate ideas with professionalism and nuance. This section covers all the basics, which, once mastered, can be used to manipulate and wield written communication effectively. It is worth mastering these grammatical principles: a grammatically incorrect sentence will confuse the reader, while a misplaced apostrophe or semicolon can make a writer look careless or ignorant. Using correct grammar will help ensure that the meaning is clear, and will communicate that the author is a detail-oriented professional.

This chapter begins with a review of the form and function of the primary units of grammatical writing (the sentence and the paragraph) and the use of punctuation marks to subtly affect the audience experience. With those fundamentals covered, the use of impersonal third-person voice in professional writing is discussed: how and when to use it, and why. The chapter concludes with a review of how to most effectively incorporate visual aids into professional writing.

4.1 SENTENCE STRUCTURE

Focus: What constitutes a "sentence" and why complete sentences are important in professional writing?

4.1.1 WHAT IS A SENTENCE?

A sentence, at its core, is a group of words that express a complete thought. Typically, this requires a *subject* (the topic of the sentence) and a

predicate (what is being said about the subject). All complete sentences, no matter how long or how short, can be broken down into a *subject* and its *predicate*. Incomplete sentences, which lack either a subject or a predicate, are almost impossible to decipher and are guaranteed to undermine the reader's confidence in the writing. For that reason, in this section the most effective methods of "chunking" sentences are reviewed: that is, ways of looking at a sentence of any length and complexity and correctly identifying its subject and predicate. A few tricks and shortcuts are also shared that will help a writer parse more complex sentences. Once these "chunking" skills have been honed a bit, different kinds of subjects and the variety of components that can form the predicate are briefly discussed.

To begin, the following sentence from the first paragraph of an article about environmental engineers who are developing a new, low-cost way to capture carbon is examined.[1]

Finding an efficient absorbent has long been a challenge for most absorption and desorption processes.

In this example, "Finding an efficient absorbent" is the *subject*: the thing, in this case a goal, that the sentence as a whole is about. The *predicate* is the goal described by the subject "has long been a challenge for most absorption and desorption processes."

Finding an efficient absorbent has long been a challenge for most absorption and desorption processes.

As can be seen, the *predicate* provides context and meaning for the *subject*. Without its predicate, the subject "finding an efficient absorbent" raises a lot more questions than answers. With the predicate, a reader has a lot more information and the sentence is complete and meaningful. Since the sentence in question is from the very beginning of the article, the predicate helps readers to understand the focus and scope of the discussion.

The reader can understand from this introductory sentence:

- that he or she should know something about absorption and desorption processes, or that they will learn something about them;
- that this article will be addressing, and perhaps solving, a specific challenge related to absorption and desorption;
- that the authors of this article believe that the solution to the challenge lies in *finding an efficient absorbent*.

For a relatively short and simple sentence, it is communicating a lot of meaning to the reader.

Here is the next sentence in that article:

A successful CO_2 absorbent must have fast reaction kinetics (the rate of chemical processes), be low in cost, and be able to regenerate with a low barrier to complete the whole CO_2 capture-release cycle.

Here a *subject* ("A successful CO_2 absorbent") is matched with a multipart *predicate*, which describes three requirements for success AND clarifies the meaning of "successful" in this particular context.

The absorbent must:

- have fast reaction kinetics (the rate of chemical processes),
- be low in cost, and
- be able to regenerate with a low energy barrier.

In order to successfully:

- complete the whole CO_2 capture-release cycle.

Once again, it is seen that the *predicate* provides clarity and specificity for the *subject*.

The "chunking" of one more complex sentence into its *subject* and *predicate* is examined before looking in more depth at the different kinds of building blocks that can be used to make *subjects* and *predicates*. Here is a last example from a different article, demonstrating a more complex predicate:

Algae production consumes more energy, has higher greenhouse gas emissions and uses more water than other biofuel sources, such as switchgrass, canola and corn.[2]

Here, "algae production" is the *subject*, and it has a three-part *predicate*: "consumes more energy" [than other biofuel sources]; "has higher greenhouse gas emissions" [than other biofuel sources]; and "uses more water" [than other biofuel sources]. The words in the square brackets are understood to apply to each of the three parts of the predicate, which is why they only appear once in the original sentence.

For more examples, and additional practice breaking a sentence into its constituent parts, please refer to the Additional Resources sidebar. The remainder of this section looks more closely at subjects and predicates, and provides guidelines for wielding them effectively in professional writing.

Additional Resources

- Review examples from the BBC here: http://bit.ly/sentenceConstruction
- Watch videos and learn more about sentence diagramming here: http://bit.ly/GrammarRev
- Read more about the elements of sentence construction here: http://bit.ly/SentenceElements

4.1.2   DEEP DIVE INTO SUBJECTS

4.1.2.1   Types of Subject

There are many different kinds of subjects, as outlined in the following Table 4.1.

Table 4.1. Subject types

Subject type	Example	Suggested use or strength
Noun phrase	*The black cat* lay curled in the sun.	The noun phrase is most useful when adding modifiers (such as <u>black,</u> here) to increase precision.
Pronoun	*He* refused to leave.	When the subject has been clearly named in an earlier sentence and repetition of the full subject is unnecessary or feels unnatural.
Gerund	*The periodic vibrating* caused fissures in the wall.	Allows the consequences of an action to be highlighted.
Infinitive	*To play* was his greatest desire.	Allows an action to be highlighted.
That-clause	*That she had piloted the first large passenger airplane* was much remarked upon.	Allows a complete sentence to be given another secondary context.

Free relative clause	*Whatever they said* was lost on the children.	Creates a dynamic subject (i.e., "whatever they said" can refer to any number of utterances).
Direct quote	"*You're late*" is rarely heard in the modern office.	Allows a complete phrase or sentence to be given additional context.
Implied	Do your homework!	Used for instructions and commands.
Expletive	*It* is quite windy.	An expletive subject does not add anything to the meaning, but performs a necessary syntactic role.
Cataphoric *it*	*It* is well known that strong vibrations can cause fissures in cement.	When the first incidence of the subject (it) refers to a more precise phrase that occurs later in the sentence.

4.1.2.2   Identifying the Subject

As can be seen from Table 4.1, subjects come in many different forms. However, there are three reliable criteria for identifying subjects: Identifying agreement between the subject and the verb of a sentence; noting the position of the subject (often immediately preceding the verb); and paying attention to the semantic role—the subject will typically be performing the action expressed by the verb. See Table 4.2 for examples.

Table 4.2. Identifying subjects and simple predicates

Method	Example (<u>subject</u>, *verb*)	Notes
Subject/ Verb agreement	<u>The wall</u> *lacks* sufficient supports.	In this case, the singular subject agrees with the singular form of the verb.
Position in sentence	<u>The findings</u> *suggest* that the proposed project will exacerbate local erosion.	The subject is often located directly in front of the verb.
Semantic role	<u>The site manager</u> *provided* detailed drawings.	If the predicate includes an action verb, the subject will be what is performing the action.

It can be seen that each of the example sentences "passes" all three of the methods for identifying the subject of the sentence. A quick review of the example sentences from the subject-type table (Table 4.1) and application of those methods of subject identification to the sentences here will demonstrate that convergence.

4.1.2.3 Constructing an Effective Subject

Now that some of the variety of subjects in common use has been explored, what can be brought back to professional writing? If clarity is the primary goal in professional writing, there are two important considerations: Specificity of subject clauses and the use of pronouns.

4.1.2.3.1 Specificity

In professional reports, specificity is primarily necessary for clearly articulating a problem. Like a fiction writer, the writer wants the reader to be able to picture the scene in their head. However, some details are more important than others. Use of modifiers should be limited to the subject of the paper or report, and usually do not need to be applied to peripheral or incidental subjects. For instance, if writing a report about a site visit, it is probably unnecessary (and even distracting) to describe the appearance of individuals, but readers will likely want as much detail about the site itself as the writer can supply. Typically, two modifiers per subject is a comfortable amount of specificity, but this is flexible. A review of Table 4.3 will provide a sense of how much detail is useful, and when it becomes distracting. Without any additional context, what different kinds of assumptions can be made about the subjects in the first, second, and third columns? If the writer is drawn to the additional details of the third column, consideration should be given to whether there might be ways of providing the same level of detail without sacrificing clarity and readability.

Table 4.3. Modifiers

No modifiers	1–2 Modifiers	3+ Modifiers
The bio-fuels	The algae-based bio-fuels	The lab-grown, heavily processed, algae-based bio-fuels
The site	The rural site	The deserted, forested, rural site
The flora	The local indigenous flora	The colorful, vibrant, thriving, local indigenous flora

While the optimal level of specificity is fairly clear-cut, the choice of details to include should be closely aligned with the purpose in composing the document, and the needs or expectations of the primary audience. Careful consideration should be given to which details will best support the author's argument and encourage the readers to come to the author's desired conclusion, or best present the relevant information. Any extraneous details can, and should, be omitted.

4.1.2.3.2 Ground Rules for Pronouns

Pronouns are useful for avoiding repetition, especially of a complex subject, but overuse of pronouns can undermine the clarity of professional writing. If the readers have to backtrack to remind themselves of the subject, or if there is a pronoun that could refer to multiple subjects, then the author is not communicating clearly, effectively, or efficiently. A good rule of thumb to avoid overuse of pronouns is to maintain a ratio of 2:1, or two pronouns for every fully expressed subject. Consider the following passage:

> *The site manager* granted our crew access to the location between 3 and 5pm; *he* provided detailed records and agreed to be interviewed at a later date. Should we be unable to schedule an in-person interview in the next three days, *he* offered to take questions by e-mail and to respond with written comments as needed.

Since the pronoun "he" could not possibly refer to the other subject present ("we"), there is unlikely to be any confusion. However, a writer may feel that the second "he" should be replaced with the full subject, "the site manager." Both options are completely acceptable. However, if the passage was extended and yet *another* "he" was used in place of "the site manager," the reader might at that point have to refresh their memory and confirm that the writer is still referring to the site manager. To avoid interrupting the reader's experience like this, it is prudent to repeat the full subject at this point.

4.1.3 DEEP DIVE INTO PREDICATES

"Predicate" is a slightly thornier category to unpack than "subject," as it typically encompasses the greater part of the sentence. No matter how big or small, though, the predicate can be understood as providing the idea about the subject. Usually, this is action-oriented: the predicate will tell

the reader what the subject is doing, what it is, or what it is like. While predicates can be *simple* (including only the verb phrase) or *complete* (including the verb phrase and all other words that provide information about the verb phrase), the focus is on *complete predicates* here. Simple predicates are merely the complete predicate with all extra information, such as adjectives and adverbs, stripped out.

4.1.3.1 Verb Clauses

The most common kind of predicate is a verb clause. As verb clauses are so common, they are also typically the most readily accessible grammatical construction for a broad or diverse audience. This is not to say that only these kinds of constructions should be used: the choice of grammatical construction is often dictated by the content that needs to be communicated, and it is not always possible to shoehorn an idea into a standard verb clause construction. However, it can be observed that the vast majority of the writing encountered or created in a professional environment employs the grammatical constructions laid out in Table 4.4.

Table 4.4. Verb phrase predicates

Predicate type	Example
Verb Only	The birds <u>sing</u>.
Verb + Direct Object	The project manager <u>writes the report</u>.
Verb + Indirect Object + Direct Object	The client <u>gave us a tour of the grounds</u>.
Verb + Prepositional Object	The client <u>listened to our presentation</u>.
Verb + Object + Predicative Noun	The courts <u>granted her asylum</u>.
Verb + Object + Adjunct	Our team <u>met the contractors at the site</u>.
Verb + Predicative Prepositional Phrase	The supervisor <u>is at the site</u>.

4.1.3.2 Direct and Indirect Objects

In Table 4.4, it can be seen that several predicate types include an *object*. Objects are either *direct* or *indirect*: the direct object is the person or thing being acted on, the noun (or pronoun) receiving the action, while

the indirect object answers the question "to whom or for whom is the action being done?" In the examples below, direct objects are highlighted in green and indirect objects are in yellow.

The project manager presented her report to the team.

The project manager sent the CEO her report.

In these sentences, the direct object answers the questions "what is presented?" and "what is sent?" In both cases, the answer is "her report." The indirect objects, in yellow, answer the question "to whom was the report [presented, or sent]?" The indirect object in the first sentence is part of a prepositional phrase ("to the team"), which usually supersedes the indirect object designation. However, the important thing to bear in mind is that both answer the question "to whom was the report [presented, or sent]?"

Why this grammatical distinction between direct and indirect objects is important in a manual for professional writing should be considered. If the intent is to communicate clearly, it is necessary to understand what information a reader expects. Were the indirect objects to be left out when writing the sentences above, presenting the reader with either "The project manager [presented/sent] her report," they would likely feel as though they were not being given all the information. This is because both verbs in these examples are *transitive verbs*, which require an indirect object. Most verbs are transitive, so rather than providing a list, a review is provided here of ways to identify them.

Once the verb is identified, the question becomes: is [verb] done to someone or something? For instance: One *reads* something; One *writes* something; One *tours* something; One *learns/remembers/tries/climbs/catches/tells* something. These are, therefore, transitive verbs and require a direct object: the "something" being read, toured, learned, or written. However, one may also *fall/laugh/disappear*. These verbs and others like them do not require an object and are called *intransitive* verbs because they contain the entire concept of the action. The person taking the action is also the recipient of that action. The difference is that with transitive verbs, the doer does the action to someone or something else; with intransitive verbs, the doer is also the recipient of the action.

With the fundamentals of sentence construction (and deconstruction!) covered, the next section takes a closer look at the first thing that can be built with them: paragraphs. What are they, and how can they be deployed and manipulated to increase the clarity and effectiveness of professional writing?

4.2 PARAGRAPHS

Focus: What constitutes a paragraph and how can paragraph structure and sequence effect the clarity of professional writing?

4.2.1 WHAT IS A PARAGRAPH?

Paragraphs are a way of collecting sentences that allows the author to organize ideas and show the progression or development of an idea. This means that each paragraph should be able to stand alone, although it does not need to. In technical writing, as in other forms of professional writing, it is wise to keep paragraphs short and concise. While short paragraphs pull the audience along and keep them focused, longer paragraphs are more likely to make a reader feel tired and start to skim the report or e-mail.

A strong paragraph in any kind of professional writing shares the following characteristics: it has a sense of *unity* and *coherence*, it begins with a *topic sentence*, and that topic sentence is *adequately developed* over the course of the next few sentences. Depending on the subject material and the amount of space available, a paragraph may present one idea with some supporting evidence, or it may contain several ideas that relate to the overall topic of the paragraph. Both models are fine, as long as the author is able to maintain clarity: as soon as ideas start to become jumbled, it is time to consider breaking them into different paragraphs and addressing each separately.

Unity and *coherence* in a paragraph are achieved when it has a single clear focus. For instance, a report on the effectiveness of a particular regulation of air pollution may consist of one paragraph on each of the following: (1) The major source(s) of air pollution the regulation is meant to limit; (2) data from environmental surveys, which can show whether the air pollution has gotten better, stayed the same, or gotten worse; (3) a hypothesis explaining these environmental data trends; (4) suggestions for testing the hypothesis. In this rough outline, it can be seen that each main idea is related to the one before it: this is *coherence*. The reader is also able to point at a clear main idea or topic for each paragraph: that is *unity*.

The topic sentence overlaps with ideas of unity and coherence because, even though there are no real rules for what a topic sentence should look like or where it has to go in the paragraph, the quickest way to check that a paragraph has one is to try to summarize the paragraph in one sentence. If that can be done, then the reader will likely be able to do so as well, and a clear and coherent paragraph will have been constructed.

Adequate development of the idea laid out in the paragraph can be accomplished in several different ways; the choice will be informed by the kind of idea being developed. For instance, if the author is preparing a report on algae use in water treatment plants, he or she might define important terms in one paragraph, provide data from field tests in another paragraph, compare and contrast the results of different tests in the next paragraph, and discuss the anticipated effects or consequences of algae use in water treatment plants in another paragraph. By the end of the report, the reader will feel like they have a strong understanding of the pros and cons of introducing algae into the water treatment process, and should be able to discuss the ramifications in a meaningful way.

The best way to determine whether the "development" of the idea is "adequate" is to have clearly laid out the scope and purpose of whatever is being written before starting to write. It is best if this scope and purpose can be phrased in such a way that it can confidently be seen whether it has been achieved. Some common ways of thinking about scope and purpose in technical writing are to first clearly identify the audience (i.e., are they experts or laypeople? Do they need to be convinced of something? Are they likely to agree with the ideas being presented already, or will it be necessary to work hard to get them to agree?), and then identify what action or change the writing is intended to effect (i.e., do you want the readers to be able to implement a new strategy, or perhaps understand the complications of a particular situation so that they are better equipped to discuss the pros and cons of different approaches?).

Once the purpose and scope have been clarified, it will be possible to identify all the different kinds of information that need to be included in order to successfully achieve the desired result. For more on how to define purpose and scope, and on how to determine the most effective way of communicating them, please see the chapter on outlines and drafting. The remainder of this section looks at introductory, body, and conclusion paragraphs in a little more depth.

4.2.2 PARAGRAPH TYPES

While the principles described previously apply to all paragraphs broadly speaking, there are certain kinds of paragraphs, such as introductory paragraphs or concluding paragraphs, which have additional responsibilities. In order to achieve unity and coherence throughout a piece of writing, each paragraph needs to work together to support and expand the ideas introduced earlier and prime the reader for ideas discussed later in the work.

4.2.2.1   The Introductory Paragraph

This is where the purpose and scope should be clearly laid out for the audience. Based on the introductory paragraph alone, the reader should be able to answer the following questions:

1. What is the author's goal in writing this?
2. What kind of evidence is the author going to draw on to support their position?
3. What is outside the scope of this paper?
4. What kind of response does the author likely anticipate from me?

If a letter or presentation is being written, the audience should also be able to answer the following after reading the introduction:

1. Who is the author?
2. What is my relationship to the author?

If the audience has been given this information in the introduction, then the author can feel confident that the reader has been given everything they need to be able to appropriately and effectively contextualize the rest of the letter, report, presentation, or article. The author will have done their job as a responsible and professional author in the workplace. For more information on tailoring the approach to an audience, please see Section 2.1.

4.2.2.2   Supporting Paragraphs

The supporting paragraphs should be laid out in a way that best supports the scope and purpose. In some cases, such as technical reports, the introduction will include a brief outline of the argument development, in which case the supporting paragraphs should be laid out to mirror that development. Especially in technical writing, once the audience has been told what to expect, it is important that the author provide exactly what was promised, in exactly the order described. This will help build audience trust, which is crucial if the author wishes to be persuasive. This consistency also contributes to the clarity and cohesion of the writing.

Each supporting paragraph should draw on the idea discussed in the paragraph before it, and introduce the idea discussed in the paragraph that follows it. This will ensure that the unity and coherence of each paragraph is extrapolated to the paper as a whole. Please see Section 4.2.2.4,

"Building Bridges Between Paragraphs," for a more in-depth discussion of effective use of transitions and signposts.

4.2.2.3 Concluding Paragraph

The concluding paragraph is the opportunity for the author to end on a strong note. Depending on the kind of writing being done, this could be:

- A reminder of the requested action and some suggestions for next steps (i.e., in a formal letter or in a progress report);
- A review of the problem addressed, and perhaps a proposed solution (i.e., in an article for either a scholarly or expert audience); or perhaps
- A summary of the argument and a final appeal to win audience support (i.e., for a position paper or an article for a general audience).

No matter what kind of paper is being written, it is important to remember that the conclusion is more than a summary: the audience has just read the paper, the letter, or the article, and presumably they have learned something. The conclusion should recognize that, and highlight it where possible.

4.2.2.4 Building Bridges Between Paragraphs: Effective Use of Transitions and Signposts

Clear transitions are the easiest and most important way to both clarify an argument for the author, and to ensure that the readers will be able to follow the presentation of the author's thought process. "Bridges" are sentences, usually one at the end of the preceding paragraph and another at the beginning of the subsequent paragraph, which explicitly tie the ideas in the two paragraphs together. When the work as a whole is considered, it should be possible to notice that the bridges not only link adjacent paragraphs, but that they also continuously build upon or refer to the larger argument or purpose of the paper.

Sometimes the connection between the two ideas is reasonably straightforward; it is easy to build bridges between each point, development, or new piece of information. In these cases, the bridges practically build themselves! In larger, or more complicated and nuanced projects, it may be necessary to think more carefully about how to tie the pieces into a coherent whole. Bridges are crucial opportunities for the author to clarify

the relationship between ideas, and should be taken advantage of fully. To this end, there are four types of "bridges" that are most useful; these are outlined in Table 4.5.

Table 4.5. Types of transitions

Type	Strength	Examples
Sequential	Good for use in a narrative, in describing a premise-conclusion type of relationship, or a derivative relationship in which one idea depends on, or builds on, another.	*Thus, Therefore, Then; It follows that…, This indicates that…, This implies that…; From this we can see that…, What this means is that…*
Comparative	For use when ideas share some kind of property; especially useful when the similarity is not immediately obvious.	*Similarly; Just as…, In the same vein…*
Contrastive	Useful in presenting different sides of an argument, different perspectives, or alternate findings.	*But, Though, However, Nevertheless, Nonetheless; Then again; This ignores, it is not…but rather; The difference between…and…is that*
Synoptic	For use after an idea or set of ideas has been established, to summarize the most important points before presenting the final findings or desired take-away.	*Essentially, Basically, Ultimately; In short; The main point is*

One effective way to judge the efficacy of the bridges in writing is to try to use them to summarize or outline the argument. If they are very strong, the excerpted bridges will combine to form a cohesive summary of the development of the ideas presented in the report. If something feels loose or unclear, it is a good indication that the author or the presentation may not be as firmly grounded in that particular aspect of the argument, and it may be worth considering that relationship or connection further.

Having explored the more macro elements of strong professional writing in the form of sentences and paragraphs and the ways in which their successful deployment can strengthen and clarify the arguments, the more

persnickety elements of grammatical writing can be addressed. Beginning with the important principle of agreement and continuing into guidelines for the effective use of punctuation, the following two sections require a shift in perspective toward the micro level of written communication; but continue to draw on the foundational concept that effective written communication requires clearly expressing the relationships between every element in the work, and that every element presents an opportunity to clarify and add nuance to an argument—or to confuse, and perhaps even unintentionally mislead, a reader.

4.3   AGREEMENT

Focus: Understanding the principles of agreement

4.3.1   WHAT "AGREEMENT" IS AND WHY IT IS IMPORTANT

Word agreement is one of the best ways to ensure that the meaning of a sentence is clear and easy to understand. Word agreement refers to the necessary consistency of form between, for instance, subjects and verbs, subjects and pronouns, and adverbs and verbs. The most familiar kind of agreement is "subject-verb" agreement: for instance, the phrase "they rides" creates a bit of dissonance in the reader because the subject, "they," is plural while the verb "rides" is singular.

Agreement is most likely to become an issue when writing longer sentences with multiple subjects, or sentences that include lists with multiple parts. For instance, the following sentence contains several subject/ verb pairs, each of which must be in agreement or the reader may become confused about the relationship between them.

The new process allows scientists to follow the lifecycle of the organism, but skeptics contend that any new insights gained into the nature of the organism in the controlled lab environment [may not be true in the wild].

Pair 1: process, allows [both singular]

Pair 2: scientists, to follow [both plural]

Pair 3: skeptics, contend [singular]

Pair 4: insights…environment, may not be true [subject and modal verb from the dependent clause]

As demonstrated in the previous sentence, subject/verb agreement is crucial to facilitating comprehension. If it were not clear which verb was associated with which subject, it would be very difficult to correctly parse the meaning of the sentence.

There are four aspects of agreement: Person, Case, Gender, and Number. Table 4.6 outlines these kinds of agreement and provides examples of correct and incorrect usage.

Table 4.6. Agreement

Kind of agreement	What to look for	Correct example	Incorrect example
Number	Singular or plural	The dog jumps	The dogs jumps
Case	*Subjective* (I, you, he/she/it, we, they, who, whoever); *Objective* (me, you, him, her, it, us, them, whom, whomever); *Possessive* (my, mine; your, yours; his; her, hers; its; our, ours; their, theirs; whose)	I ate his sandwich; Peter kidnapped me; To whom does this belong?	I ate he sandwich; Peter kidnapped I; To who does this belong?
Person	First person, second person, or third person	I am; You see; They claim	I are; You sees; They claims
Gender	Male, female, or neuter	Zoe got a ticket after she ran a red light	Zoe got a ticket after it ran a red light

Mistakes in agreement can be minor, such as "She came with I," which is still understandable despite causing some cognitive dissonance on the part of readers. More serious mistakes in agreement can make it impossible for a reader to clearly understand the meaning of a sentence, such as when person, gender, and case conspire to create a sentence that could be understood in multiple ways. In the chapter on proofreading, we recommend reading a piece of writing backward, sentence by sentence. This practice helps authors catch agreement issues, which introduce ambiguity or multiple interpretations.

Additional Resources
For more practice with the different kinds of agreement: http://bit.ly/agreementGrammar

4.4   GENERAL PUNCTUATION GUIDELINES

Focus: To review the different uses of the most prevalent punctuation marks and how their effective deployment can improve the clarity and readability of professional writing.

4.4.1   GENERAL PUNCTUATION RULES

Punctuation is an important tool for clarifying meaning within sentences by codifying relationships between the ideas expressed in words, phrases, and sentences. Misplaced commas or extraneous semicolons can undermine the clarity of writing as much as a misspelled or misused word would. Deployed effectively, however, these punctuation marks can act as guides for the reader, signaling transitions between ideas, as well as relationships within and between complex and compound sentences. The rules for deploying punctuation marks are rarely taught in this light, however, so this section revisits each of the major punctuation marks and their use with an emphasis on effective deployment for clarity and precision. In this section, commas, semicolons, and colons are discussed. In the following section, the use of apostrophes and the possessive are examined.

4.4.1.1   The Comma

Taking the most holistic view of the comma, it would be thought of as a way to separate and enclose specific phrases and clauses—a bit like a low stone wall that in no way impedes an ability to see or move beyond, but does effectively delineate the boundaries of a field. The comma has many uses, the most important of which are: to separate introductory or contextualizing phrases from the main clause of a sentence, to group separate items in a list, to clarify groupings of nouns and adjectives, and, when used with a coordinating conjunction, to separate main clauses within a sentence.

4.4.1.1.1 Use of Commas to Delineate Introductory or Modifying Elements

Commas should be used to separate a clause or phrase that introduces or modifies the sentence. For instance, the following sentence from the *Science Daily* article about capturing carbon uses commas to delineate a clause that modifies (in this case, contextualizes) the subject of the sentence:

> The discovery, a milestone in clarifying the scientific underpinnings of moisture-swing chemical reactions, is critical to understanding how to scrub carbon dioxide from Earth's atmosphere.

It can be seen that the clause is not necessary; without it, the sentence would still be grammatical. However, by including the clause, the author is ensuring that the audience is on the same page as the author in terms of understanding the importance of the discovery in achieving the goal laid out in the rest of the sentence: learning how to "scrub carbon dioxide from Earth's atmosphere."

The same principle is at work for introductory clauses. The following example comes from the executive summary of the *Science Daily* article about algae-based biofuel:

> With many companies investing heavily in algae-based biofuels, researchers have found there are significant environmental hurdles to overcome before fuel production ramps up.

The introductory clause delineated by a comma, like the modifying one in the previous example, is *dependent*, meaning that it cannot stand on its own. Alone, it would be ungrammatical. However, these dependent clauses add a great deal of meaning to a sentence; in the examples provided here, they provide important contextualizing or clarifying information that guides the reader to a shared understanding of the information being presented.

What would happen if the commas were missing from those sentences? Here is the first sentence without the commas delineating the modifying clause:

> The discovery a milestone in clarifying the scientific underpinnings of moisture-swing chemical reactions is critical to understanding how to scrub carbon dioxide from Earth's atmosphere.

The meaning of the sentence is more or less the same, but it is harder to read and there appears to be a word or two missing after the word "discovery." It may have been necessary to slow down, or read the sentence twice to ensure that the meaning was correctly parsed. Without those commas, it is more difficult to identify the subject, and the sentence seems jumbled and unclear. With the commas, the reader can clearly see that the sentence is made up of the subject, a clarifying phrase describing the subject, and then the predicate telling the reader what the subject is up to.

Here is the second example, without its helpful comma:

With many companies investing heavily in algae-based biofuels researchers have found there are significant environmental hurdles to overcome before fuel production ramps up.

Once again, the main difference here is that reading this sentence, the reader might feel rushed, almost breathless. Since there are other grammatical clues (such as the initial "with," which signals that what follows is a prepositional clause) the meaning is not as confused as it is in the first example; however, the lack of a comma means that the reader does not get a clear signal about where the main sentence starts, forcing them to read through the whole thing in one hurried breath. It may also leave the reader wondering whether "algae-based biofuels" is an adjective describing the researchers. In both cases, the addition of a comma (or two) serves to delineate extra information from the main sentence, thereby clarifying both for the reader.

4.4.1.1.2   Use of Commas in a List, or with Parallel Words and Phrases

If a series or list is composed of simple, one- or two-word options, commas may be used to distinguish between them. The list should include three or more items to require a comma in the first place. In the following example, commas delineate the boundaries between three parallel phrases that comprise a list:

The site visit included *an interview with the site manager, a tour of the afflicted area, and a question-and-answer session with concerned local citizens.*

The commas deployed here are ensuring that readers do not have to put additional effort into understanding how the items in a list are

delineated. The author may think that the phrasing is sufficiently clear, but those commas nevertheless serve to emphasize the organization and pacing of the sentence for the reader.

If the sentence was comprised of only two of the three parallel phrases, the first comma would be replaced by the word "and," as demonstrated here:

> The site visit included *an interview with the site manager and a tour of the afflicted area.*

As shown here, in a list of two items, no comma is necessary to emphasize or clarify the delineation between them: a simple *and* is enough.

4.4.1.1.3   Use of Commas to Group Nouns and Adjectives

One of the more complicated rules for comma use is determining when one is needed to group modifying adjectives with the noun they modify. The decision hinges on whether the adjectives in question are equal (i.e., of equal importance in modifying the noun), or unequal (i.e., one is more central to the identity of the noun than the other). There are two simple methods of determining whether adjectives are equal, and thus when a comma is needed; each is illustrated here.

- *Changing the Order of the Adjectives:* if the resulting sentence makes sense regardless of the adjective order, then they are "equal" and do not require a comma.
- *Equal*: The pH level of the *muddy stagnant* [or *stagnant muddy*] water was perfect for tadpoles.
- *Unequal*: Our team visited the *remote, arborous* [~~arborous remote~~] site twice a month for two years.
- *Inserting "And" Between the Adjectives:* if the sentence still flows after adding an "and" between the adjectives, they are "equal" and do not require a comma.
- *Equal*: The pH level of the *stagnant* and *muddy* water was perfect for tadpoles.
- *Unequal*: Our team visited the *remote* [~~and~~] *arborous* site twice a month for two years.

The bottom line when it comes to effective deployment of commas is that they should meaningfully group words or phrases, and provide some

guidance as to the pacing of a sentence. They are not always necessary, but when used effectively they can greatly improve the clarity and flow of professional writing.

4.4.1.2 The Semicolon

The semicolon, to continue the analogy, is a well-maintained stone wall perhaps two or three feet high. Unlike the low stone wall of the comma, the semicolon creates a boundary between clauses that cannot be so easily breached—but nevertheless suggests that the clauses on either side derive meaning from each other. The semicolon can be used to either: join related main clauses; delineate between coordinate clauses that are joined by a transitional word or phrase; or, as demonstrated in this sentence, separate items in a list that already includes commas. Each of these is examined in depth in the following section.

4.4.1.2.1 Use of Semicolons to Join Related Main Clauses

Semicolons can be used to join two otherwise complete sentences that are very closely related. But why use a semicolon instead of a full stop? The use of a semicolon signals to the reader that these two sentences are working together to express the idea the author would like to convey. Rather than presenting two discrete points of information, the content of the second main clause builds on, or otherwise complements, the content of the first main clause.

The following examples illustrate how the two main clauses can relate to each other. When reviewing these examples, consideration should be given to how that relationship is affected by the use of either a full stop or a semicolon.

Our team visited the local reservoir. There we collected soil and water samples, and noted the local flora and fauna present.

Our team visited the local reservoir; there we collected soil and water samples, and noted the local flora and fauna present.

While both options are grammatical, the use of a semicolon here does two things. First, it creates a more fluid reading experience for the audience; rather than coming to a complete stop for a full beat, as we do when confronted with a full stop or period, the reader merely pauses.

Second, it more closely binds the two sentences together, further ensuring that the reader understands that both sentences share the same subject—there is no confusion when "our team" becomes "we." Ultimately, the choice of whether to use a full stop or a semicolon here rests entirely with the author; there is no wrong choice, per se, it merely depends on how the author would like to express the relationship between the clauses, and which feels more natural to the author when read aloud. For additional insight, this paragraph should be reread, noting when semicolons were used and when a full stop was used, instead. How the use of these two punctuation marks affects the readability and clarity of the paragraph should also be noted.

The same principle applies for the use of semicolons with transitional words or phrases, such as however, therefore, and accordingly. Normally, these would signal the start of a new sentence; however, if an author wants a smoother transition between the two sentences in question, a semicolon may be used, rather than a full stop. See the following example.

> Environmental degradation in this region is usually the result of monoculture; in this case, however, we were able to identify the primary cause as a dramatic change in weather patterns over the last five years.

4.4.1.2.2   Use of Semicolons to Separate Items in a Series

When a sequence or list is comprised of longer phrases, which may already make use of commas, the items in the list need to be separated by semicolons. In this way, readers are ensured a clear distinction between each part of the sequence or item in the list.

For example, consider the following:

> There are three primary suspects in the case: Mr. Jones, the neighbor; Ms. Daniel, the recently-terminated housekeeper; and, of course, the victim's spouse.

If one were to replace the semicolons with commas, the sentence would still be understandable, but readers would expend more energy in ascertaining comprehension. As discussed earlier, an author's goal in professional writing is to ensure that readers do as little extra labor as possible, so that they can focus on the author's message and not its delivery system.

4.4.1.3 The Colon

The colon, like the semicolon, is more of an obstacle than the comma: it is a stone wall that can be easily seen over, but represents a more solid barrier to movement. This sentence, and the one just read, are examples of one of the more distinctive uses for a colon: to separate an explanation or illustration from the initial idea. It is an excellent way to make a claim and then immediately provide examples, evidence, or other information about the original claim. The information that *precedes* a colon must be a complete sentence in its own right, but the information that comes *after* a colon can be almost anything: a list, a noun or verb clause, or a predicate. The only thing they must have in common is their relationship to the main sentence: anything after a colon must be explaining or expanding on something from the main sentence. Please reread this paragraph and pay special attention to what information is presented in front of the colon, and what comes after. Each example is examined in detail as follows.

1. "The colon, like the semicolon, is more of an obstacle than the comma: it is a stone wall that can easily be seen over, but represents a more solid barrier to movement."
   - Before: main idea; After: explanation to further clarify main idea.
2. "This sentence, and the one you just read, are examples of one of the more distinctive uses for a colon: to separate an explanation or illustration from the initial idea."
   - Before: main idea; After: illustration in support of main idea.
3. "The information that *precedes* a colon must be a complete sentence in its own right, but the information that comes *after* a colon can be almost anything: a list, a noun or verb clause, or a predicate."
   - Before: main idea; After: specific examples of main idea.
4. "The only thing they must have in common is their relationship to the main sentence: anything after a colon must be explaining or expanding on something from the main sentence."
   - Before: main idea; After: explicit rephrasing of main idea.

4.4.2 CORRECT USE OF APOSTROPHES

One very common mistake in writing is the improper use of an apostrophe. Apostrophes have two uses: to denote possession, as in "Smith's study,"

and to take the place of an omitted letter in contractions such as "don't." Note that contractions are not typically used in professional writing unless they are included in a direct quote from another source. Another common mistake with the use of apostrophes is their use to form the plural; please note that there is not a single English word that forms the plural with an apostrophe.

Looking at possession first, the following are examples of correct apostrophe use for singular nouns:

1. Johnson's team
2. Danielle's idea
3. Ben's birthday

It is noted that in each of these examples, the reader will understand that only the *possessor* is singular by the location of the apostrophe *before* the "s." The thing being possessed can be singular or plural—it has no impact on the location of the apostrophe. There is only one exception to the "apostrophe-s" construction of a singular plural, and that is when the possessor is a name or word ending in "s." When this is the case, the word should be said out loud to decide whether a second "s" can be heard. For instance: "Jones' theory" or "Jones's theory?" In this case, the latter flows better. "Socrates' dialogue," though, would be an example of a singular possessive that follows the plural possessive construction of "s-apostrophe."

Contractions, it should be noted, are often considered inappropriate for professional writing. While this can vary from company to company, it is important to always remember that individuals from a number of different institutions may be receiving any given report, and it is not a bad idea to write for the most conservative members of an audience.

When an apostrophe is used in a contraction, such as *don't* and *won't*, it is taking the place of the missing letter. In the two examples, this letter is the "o" in "not," such that "do not" becomes "don't" and "will not" becomes "won't." Another common contraction that can be confused with the possessive is words such as "he's" to mean "he is." When using this contraction with a common noun or name, it is important to make sure that readers will have no trouble determining from context whether the apostrophe is indicating a possessive or a contraction. The most commonly confused contraction and possessive is *it's* versus *its*. The first one, *it's*, is a contraction for "it is," a pronoun and a verb. The second, *its*, is a possessive of the same order as *hers*, *his,* or *their*.

4.5   THE USE OF IMPERSONAL, THIRD-PERSON WRITING IN PROFESSIONAL DOCUMENTS

Focus: Understanding the relative strengths of first- and third-person writing in professional scenarios, and how and why to avoid the passive voice.

4.5.1   WHAT IS THIRD-PERSON WRITING?

Third-person writing is traditionally used in academic and professional writing because it emphasizes the objectivity of the information being presented and is felt to hold more authority than either the first- or second-person voices. In contrast, first-person writing uses the pronouns "I" (singular) and "we" (plural), and signals subjectivity rather than objectivity. In some situations, such as presenting opinions or suggestions, use of first-person writing is encouraged; however, data should almost always be presented in the third-person. While third-person writing often does not make direct use of the third-person pronouns presented in the chart here, they can be used as a litmus test: if the subject of the sentence can be replaced by one of the pronouns below, then it is using the third-person voice.

Third-person pronouns, by case:

	Singular	**Plural**
Subjective	He, She, It, They	They
Objective	Him, Her, It, Them	Them
Possessive	His, Hers, Its, Their	Their

It is noted that while "they/them/their" is traditionally plural, in the last few years it has been increasingly adopted as a gender-neutral singular pronoun in both formal and informal writing. Using "they/them/their" as a singular pronoun in the third person allows a writer to avoid the awkward "he or she" phrasing, and the potentially discriminatory practice of using "he" to refer to all readers. It may be noted that the singular "they" has been used at many junctures of this book.

Here are two examples of the third-person voice in scientific writing:

- The researchers found that surface runoff can increase significantly, from 28 percent of baseline in 2035 to 78 percent by 2100, due to reduction in forested area and increased evaporation.[3]

- According to the analysis, led by the Yale Center for Business and the Environment (CBEY), renewable thermals have significant market potential in the state if supported by appropriate public policy and financing tools.[4]

It can be seen from these examples that use of the third person allows the author to put some distance between themselves and the content being presented. Sometimes this is helpful (e.g., when the facts presented are not up for debate, when describing parameters outside the control of the writer, or when discussing the work of others), and other times it may seem like the author is using the third person to avoid taking responsibility or to obfuscate responsible parties. This concept is discussed further in the section on use of the passive voice.

4.5.2   WHAT IS THE PASSIVE VOICE?

The passive voice refers to a grammatical construction, which makes the object of the action into the subject of the sentence, thereby obscuring the person or thing that is performing the action on the object. Its use obscures the "true," active subject of the sentence by either omitting it entirely or by placing it at the end of the sentence, generally in accordance with the following template: [noun] [verb phrase] by [noun].

Sometimes a writer will want to use the passive voice to highlight a secondary subject, but should use it sparingly: a preponderance of sentences in the passive voice will exhaust the reader and generally make it more difficult to communicate clearly and effectively.

Here are some examples of the passive voice, followed by a revised sentence in the active voice. Note how the sentences place emphasis and focus or redirect the reader's attention.

A study has been conducted in order to determine suitable benchmarks for scalability.

This is a reasonable use of the passive voice: the object being elevated to a subject ("A study") is likely of particular interest to the audience. However, use of the passive voice here means that the reader does not know *who* is conducting the study. Depending on the context, this information could be just as important as the fact that the study has been conducted. Many readers may even feel that it is *more* important to know who is conducting the study, because that information can be used by engaged

readers to make judgments about the validity of the study, or the potential biases of any findings reported. Consider the following revision:

> The EPA has conducted a study in order to determine suitable benchmarks for scalability.

The change, while simple, makes the sentence more straightforward and clear. It also increases the authority of the author, and the likelihood that readers will feel the author is trustworthy. Please note that a professional report would be expected to include a footnote to the original study referred to in the text. For information on the practice of in-text citations, please see the chapter titled "References, Citations, and Works Cited Formatting and Use."

4.6   USE OF TABLES, GRAPHS, CHARTS, PHOTOGRAPHS, AND OTHER VISUAL AIDS

Focus: How to incorporate them into professional writing, how to refer to them in the text, how to use them to complement written explanations.

Visual aids assist the reader in understanding detailed information. Visual aids, unlike an appendix, facilitate understanding the main point of the text and help the reader process large amounts of information in text. Visual aids clarify the text.

Different types of visual aids exist in technical documents including tables, charts, photographs, maps, illustrations, figures, and flow charts. Each of these different types of aids serves a distinct purpose. Tables present data organized into rows and columns. Charts and graphs present data using diagrams such as pie charts or bar graphs. These are most often used to present data. Photographs document a physical item. Illustrations or schematics can represent a proposed prototype or a detailed section of a larger part. Maps document physical locations and flow charts document processes. All of these visual aids convey information quickly and efficiently.

No hard rules exist for adding visual aids to text. While revising drafts, writers need to identify areas of the text where visual aids may enhance the speed at which the reader understands the text. Large amounts of data represent good candidates for tables. Proposed designs also benefit from illustrations or drawings that can demonstrate details difficult to convey in text. Processes that involve branching, or are beyond three steps, also

benefit from a visual aid such as a flow chart. Again, the goal of technical writing is conciseness, and if a visual aid will present a concept or data better than text, writers should use the visual aid.

It is important to note that writers should only employ visual aids where necessary and not to spice up a technical document. Each visual aid needs a defined purpose or reason for use and needs to be anchored in a specific location in the text. Again, it is important to note that visual aids complement the text, not the other way around. Back-to-back tables or diagrams without context challenge, rather than facilitate, understanding. Tables and visuals should be grounded in the text and writers should refer the reader to the visual aid in the text.

All visual aids in technical documents must include a label and a title. There are two labels for visual aids in a technical document: Tables and Figures. Tables refer only to the presentation of data organized in rows and columns. All other types of visual aids are labeled figures. The caption, which identifies the visual aid, is formulated by indicating the label, the section number, and the number of the table or table followed by a period. A title that briefly explains the visual aid follows on the same line. For tables, the caption is immediately above the table. See Table 4.7.

Table 4.7. Table of visual aids

Name	Use	Label
Table	Large amounts of data organized by row and column	Table
Chart	Data organized using visual elements, such as a pie chart or bar graph	Figure
Illustration	Drawings, diagrams, schematics	Figure
Photograph	Picture	Figure
Map	Illustration or picture of a physical landscape	Figure

For figures, the caption is immediately below the figure. See Figure 4.1.
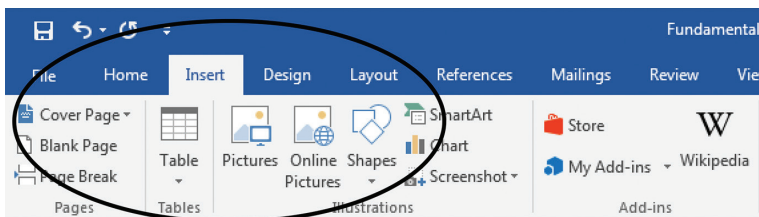
Figure 4.1. Insert tab.

Tables, graphs, and charts can be created in Microsoft Word by using the options available on the "Insert" tab. Photos, illustrations, flow charts, and drawings can be scanned or directly uploaded and inserted into the document also using the Insert tab. The visual aid should follow the in-text reference of the aid.

Visual aids can significantly strengthen a technical document when used well.

NOTES

[1] https://sciencedaily.com/releases/2016/06/160622192653.htm

[2] "Engineers find significant environmental impacts with algae-based bio-fuel" https://sciencedaily.com/releases/2010/01/100121135856.htm

[3] https://sciencedaily.com/releases/2017/03/170328132206.htm

[4] https://sciencedaily.com/releases/2017/03/170324083039.htm

REFERENCES, CITATIONS, AND WORKS CITED

Focus: When and how to appropriately cite and reference materials.

In the broadest terms, use of citations in a technical paper places the author in a larger conversation; it demonstrates to the readers that the author is familiar with the work that has been done on the topic and how it relates to the question, problem, or subject-matter being addressed. When references are incorporated effectively, connections may sometimes be seen between different studies that had not been considered before—in such cases, the inclusion of references is a great service to the author, as well as to the reader.

From a more practical perspective, including references in professional work can also be a way to avoid having to paraphrase all the research or information that is tangentially relevant to the work: references can be used to point the audience toward this other research without overburdening the report. This use of references is especially helpful when writing for a general audience and it cannot be assumed that the reader will have an expert's knowledge of the subject. By incorporating references in this way, a service is provided to the readers: they are provided with the information necessary to continue their own investigation of the subject at hand, according to their particular interests or concerns.

Of course, citations are not always needed—those situations are addressed shortly—but on the whole, a technical document that does not reference information from other studies, ideas that were tested in other published cases, or hypotheses that were suggested by the results of other people's tests, is not likely to make a strong and persuasive case.

5.1 WHEN IS A CITATION REQUIRED OR OTHERWISE APPROPRIATE?

A citation is absolutely required whenever an author is referring to work that the author's writing builds upon, draws from, or uses as evidence to strengthen their argument. For instance, if writing a report about environmental degradation at a specific site after the installation of, say, a large-scale fish farm, references should be included to reports on similar sites that identified when researching the project, even if a quote or paraphrase from that report is not used. This could look something like the following:

> A study published by Xxxx and Yyyy (YEAR) shows that similar sites along the Mississippi River suffered loss of diversity in the years following installation of large-scale fish farms.

Perhaps the same company or team published multiple studies on the same subject. In that case, the example would look something like this:

> Studies published by Xxxx and Yyyy (YEAR, YEAR, YEAR) show that similar sites along the Mississippi River suffered loss of diversity in the years following installation of large-scale fish farms.

Or, if the studies were published by different groups, like this:

> Studies published by Xxxx (YEAR) and Yyyy (YEAR) show that similar sites along the Mississippi River suffered loss of diversity in the years following installation of large-scale fish farms.

Note should be taken of the *signaling language* used to ensure that readers understand the context in which the author is providing these citations. In all of these examples, the author is merely providing the necessary information for readers to track down these reports; the author is not necessarily quoting from these reports or even sharing the particulars of their findings (i.e., the evidence they collected).

If that kind of detailed information is desired, the author would have to either use a direct quote, or paraphrase the relevant information. In these cases, whenever possible, it is important to add the necessary information to point readers directly to the quote. Usually this is a page number, a page

number and figure number, or, if paraphrasing several pages, a page range, and it would look like this:

> Studies published by Xxxx (YEAR) and Yyyy (YEAR) show that similar sites along the Mississippi River suffered loss of diversity in the years following installation of large-scale fish farms. Xxxx's study, which covered three sites along the Mississippi, one up-river and two down-river from the fish farm, found that the environmental degradation down-river significantly affected the diversity of the site (YEAR, STARTING PAGE-ENDING PAGE).

If the author or authors of the referenced work are not referred to in the body of the writing, it is necessary to include their last name, or the name of the institution if it is a dataset published by an institution rather than an individual, in the citation. For instance, a report published by the EPA in 2015 would be cited as follows, with the "pp" indicating a place-holder for a page number if the author needs to include one: (EPA 2015).

A citation is *appropriate*, but not necessarily required, when an author would like to point the audience toward other research that the author is not directly building on, arguing against, or otherwise directly in conversation with. In this situation, as a generous author, there are a few choices: a "recommended reading" list could be included either at the end of the section or at the end of the report (but it must clearly separate from the works cited page, which should only include works that you referenced directly); or the citations could be incorporated into the text by including some information about why the works might be interesting, but are not directly relevant to the topic at hand. For instance:

> The study by Xxxx and Yyyy (YEAR) may provide insight into the speed with which environmental degradation can occur, although the sites discussed are of a sufficiently different nature as to not supply a direct comparison.

Traditionally, citations are *not* required for information that is considered "common knowledge," but determining what can be considered "common knowledge" is complicated and varies according to the audience. The audience for professional writing can be very diverse, making it difficult to establish a clear common ground; for this reason, professional writing typically provides citations for even something that the author may consider "common knowledge."

5.2 WHAT IS THE CORRECT FORM OF CITATION TO USE?

There are many citation styles in use, and which is relevant is determined by the field in which the author writing or by the conventions established by a firm or department. For this manual, the APA (American Psychological Association) citation style is considered, as it is one of the most commonly used and the principles are often transferrable. However, each citation style has extensive resources that authors are encouraged to explore, as need be.

5.3 WHAT IS THE DIFFERENCE BETWEEN A BIBLIOGRAPHY AND A WORKS CITED PAGE, AND HOW DO I CREATE ONE?

Until now, this section has focused on *in-text* citations. In-text citations, however, are only the first step. They are markers that point readers to a full citation at the end of a report or paper. The section of a professional report or other piece of writing in which full citations are found is called alternatively a *bibliography* or *works cited*; the name is determined by the citation style used. Papers written in the APA style, for instance, have a bibliography. The citations in a bibliography must be presented in alphabetical order by the author's last name. When citing multiple works by the same author, the citations should be presented in chronological order.

Here is what a citation in APA style looks like. In this case, a journal article in print is being cited:

Gleditsch, N. P., Pinker, S., Thayer, B. A., Levy, J. S., & Thompson, W. R. (2013). The forum: The decline of war. *International Studies Review*, *15*(3), 396-419.

The components can be examined more carefully:

Gleditsch, N. P., Pinker, S., Thayer, B. A., Levy, J. S., & Thompson, W. R. (2013). The forum: The decline of war. International Studies Review, 15(3), 396-419.

First author's last name, First initial., Middle initial., Second author, etc. (Year published). Article title. Journal title, Volume(Issue), first page-last page.

This is all the information necessary to ensure that readers are able to locate the exact same piece of information to which the author is referring. The information necessary will vary by the kind of source; for instance, information found online will require the website as well as the date accessed, because websites can be updated and edited and the exact date accessed will ensure that the reader can find the correct version of the website through a service such as the Internet Archive. However, because citation styles are updated every so often, authors should be sure to check the most recent guidelines to ensure accuracy and compliance. Each citation style has an accompanying manual that can be easily located online or through a library.

There are several programs that help researchers manage their sources by allowing them to develop and maintain a database of the articles, datasets, studies, and other information sources they need. Zotero is one of the easiest to use, and is free; researchers interested in exploring this kind of program can go to zotero.org to set up a free account.

One can also create a bibliography in Word. The next few pages walk the reader through the process, which begins with adding sources as in-text citations in the body of the text, but ultimately allows an author to generate bibliographies directly in Word.

The first step is to add a source to the document as the document is being written. The following is from the Microsoft Office support site,[1] and applies to Word 2016, Word 2013, Word 2010, and Word 2007:

5.4 ADD A NEW CITATION AND SOURCE TO A DOCUMENT

1. On the **References** tab, in the **Citations & Bibliography** group, click the arrow next to **Style**.

---
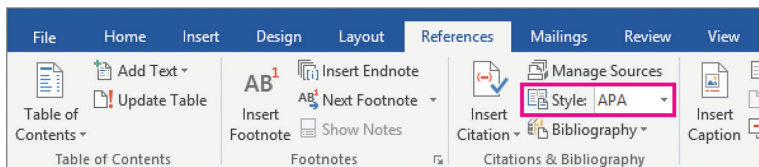
[1] "Add a citation and create a bibliography." https://support.office.com/en-us/article/Add-a-citation-and-create-a-bibliography-17686589-4824-4940-9C69-342C289FA2A5 (accessed September 2, 2017).

2. Click the style that you want to use for the citation and source. For example, social sciences documents usually use the MLA or APA styles for citations and sources.

3. Click at the end of the sentence or phrase that you want to cite.

4. On the **References** tab, in the **Citations & Bibliography** group, click **Insert Citation**.
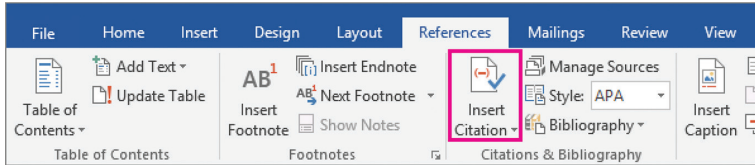
5. Do one of the following:
   - To add the source information, click **Add New Source**, then begin to fill in the source information by clicking the arrow next to **Type of source**. For example, your source might be a book, a report, or a website.
   - To add a placeholder, so that you can create a citation and fill in the source information later, click **Add New Placeholder**. A question mark appears next to placeholder sources in Source Manager.

6. Fill in the bibliography information for the source.

Once the report has been written, adding sources according to the instructions just given, Microsoft Word can use the information provided to generate a bibliography. Once again, the following is from the Microsoft Office support site.

5.5   CREATE A BIBLIOGRAPHY

Now that one or more citations and sources have been inserted into the document, it is possible to can create a bibliography.

1. Click where you want to insert a bibliography, usually at the end of the document.

2. On the **References** tab, in the **Citations & Bibliography** group, click **Bibliography**.
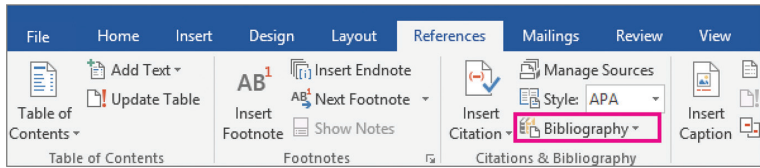
3. Click a predesigned bibliography format to insert the bibliography into the document.

For more, including instructions on how to add additional citations from previously used source, and how to search for and manage sources, please see http://bit.ly/MicrosoftWordBib.

CHAPTER 6

PROOFREADING

Focus: How to ensure your work is professionally presented.

Engineers proofread their schematics, double check diagrams, and confirm data before presenting results. Engineers should apply the same quality of attention to writing technical documents. Technical documentation needs to be precise and accurate; virtually no one can achieve perfection on the first try. It takes time to select the correct word, to ensure that a phrase conveys the intended meaning, and to create a narrative that flows well. In writing, descriptions and explanations that may initially appear clear will appear unclear in subsequent readings.

More importantly, technical documents are the formal representation of an engineer's work and professionalism. If an engineer's written communication about their work does not appear professional, it reflects poorly on the conclusions and recommendations drawn in the report. The technical document produced during a project is often the only opportunity an engineer has to present themselves and their work. Typos, spelling errors, and other careless mistakes in the final work product reflect poorly, not only on the author's writing ability, but also on their professionalism and, potentially, even their abilities as an engineer. Writing communicates more than just the words on paper; it also communicates the level of attention and care the engineer has put into finding the solution. The importance of proofreading cannot be overstated.

6.1   DRAFTS AND REVISIONS

Writers embark upon a multistage process to develop technical documents. The two main tasks in the writing process are drafting and revising. In the drafting process, the goal is to simply write all of the content. It may take

several drafts to ensure that all questions are answered and all required information is present in the document. During this phase, many writers find it helpful to simply write without worrying about style and grammar. In preparation for the revision stage, many authors purposefully write in greater detail than they anticipate needing.

During the revision stage, writers should begin the process of editing the document for clarity and conciseness. Each paragraph should have a clearly identified topic or main point and each word or phrase should support that main point. During this process, writers often significantly reduce the document length by removing extraneous details, selecting more targeted words and phrases, and re-writing entire sections for simplicity. In addition, during revisions, writers often move content from section to section, add headings to facilitate reader understanding and navigation of the document, and note where charts or graphics would aid reader comprehension. The revision process is fluid and dynamic. It is also time-consuming: a writer should account for several days of revisions.

During the drafting and revision processes, there are three methods to proofreading the document. The first involves customizing and utilizing the features of Microsoft Word to automatically engage in a proofreading process. The second method is a content review, which is best employed during the revision process. The third is the final review that the writer should engage in following the revision process, but prior to publishing the document.

6.2 PROOFREADING FEATURES IN MICROSOFT WORD

Most writing is done using Microsoft Word, with which most engineers are probably familiar from their undergraduate days. This section covers the features most helpful to technical writing in Microsoft Word. All features described are for Microsoft Office 2016. Many features are similar in Microsoft Word 2013, but some differences do exist. These features help authors write more efficiently as they automate the correction of typographical errors (typos), misspellings, incorrect punctuation, and grammatical errors. Customization and set-up of specific proofreading features in Microsoft Word generally takes less than three minutes.

By default, Microsoft Word will automatically detect spelling and potential grammar issues without running special or extra checks. Microsoft Word indicates these types of issues with different colored lines underneath the error.

6.2.1 SPELLING ERRORS/RED WAVY LINES

When a word is misspelled, a red wavy line will appear underneath it. This will happen automatically and will occur as soon as the space after the word is entered.

For example: The dog jumps over the fenece.

The red line indicates that the word "fenece" is misspelled. Moving the cursor over the red line and right clicking will result in a list of words. In addition, synonyms will also pop up. See Figure 6.1.
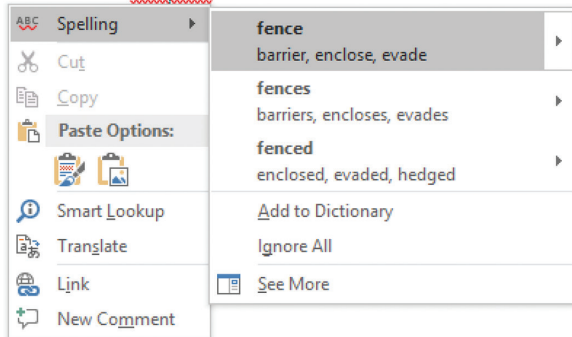
Figure 6.1. Spelling corrections.

Selecting the highlighted gray word will result in that word replacing the incorrect word in the text. Microsoft Word is not a perfect system and does not always suggest an accurate correction. Clicking on the top choice without checking the meaning will lead to word choice errors. While the software can automate a great deal of the spell check with some accuracy, nothing substitutes for a close reading of the final draft.

6.2.2 CUSTOMIZATIONS

When the author selects the arrow immediately to the right of the suggested replacement, additional options appear. See Figure 6.2.

The option to "Add to AutoCorrect" appears in this menu. This customization allows the writer to automate correction of certain common misspellings. For example, if the writer consistently and habitually misspells the word "fence" as "fenec," then selecting the Add to AutoCorrect option will automatically correct the misspelling. This is a powerful tool for authors to speed up known, consistent errors in their writing.
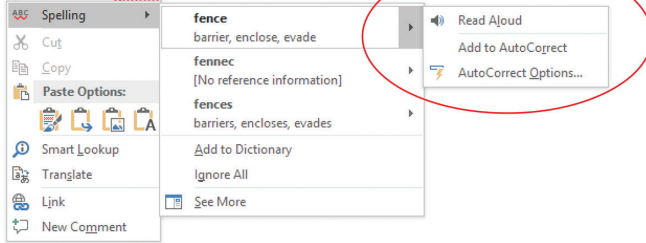
Figure 6.2. Autocorrect.

Writers may also find that the AutoCorrect feature inaccurately changes words. In addition to AutoCorrect, writers may also customize the dictionary using the Add to Dictionary option. Different from AutoCorrect, this option allows writers to add words to the dictionary so that they do not appear as misspelled in the text. This option is useful for technical terms, industry jargon, or location-specific words. This customization ensures that the word will not be flagged as misspelled.

6.2.3   GRAMMAR ERRORS/BLUE LINES

When grammar errors, or potential grammar errors, exist in the sentence, two blue lines will appear under the word.

For example: The dogs jumps over the fence.

There are multiple ways to correct potential grammar errors. The blue line will suggest one potential method to correct the error. Right clicking on the word underlined in blue will bring up a menu that indicates the grammar issue, as well as a possible or suggested solution. See Figure 6.3.
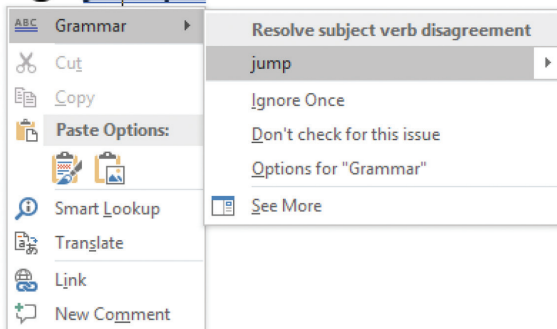
Figure 6.3. Grammar error.

In this case, the issue is subject verb agreement. Microsoft Word assumes the subject is correct and prompts the author to correct the verb. With blue lines, it is particularly important to read through the sentence again before correcting the error to retain the desired meaning. Different fixes may change the meaning of the sentence.

For example, the original error: The dogs <u>jumps</u> over the fence.

Suggested correction: The dogs jump over the fence.

In this case, Microsoft Word prompts the writer to change the verb from jumps to jump to agree with a plural subject. The sentence is now grammatically correct. The meaning of the sentence is that multiple dogs are jumping over one fence.

However, an alternative solution exists: The dog jumps over the fence.

This suggestion also solves the grammatical error, although not in the way suggested by Microsoft Word. The subject becomes singular and the verb stays the same. The meaning of the sentence is changed from multiple dogs jumping over a fence to a one dog jumping over a fence. Both sentences are grammatically correct, but only one sentence conveys the writer's intended meaning.

This example clearly demonstrates the importance of author attention to the proofreading process. Microsoft Word is simply a program that detects errors and rule violations. The system does not perfectly infer the writer's intended meaning and can only deduce the context to a limited degree. It is the responsibility of the author to preserve the meaning and intent of the sentence.

One important note: The blue lines will not appear until after the sentence is completed with the use of punctuation. Unlike potential spelling errors, which are underlined in red line immediately after the completion of the word, there is a delay before the blue squiggle appears. In addition, the author also can choose to "ignore once" or "ignore all" instances of a grammar error. Writers can use this option to override the suggested grammar fix. This will remove the correction while work continues on the document.

6.2.4   CONCISENESS/DOTTED RED LINES

In Microsoft Word 2016, dotted red lines appear under typed words to represent a subset of the grammar check and indicate an opportunity to revise for clarity and conciseness. See Figure 6.4.

The dog was large in size and jumped over the fence.

Figure 6.4. Concise wording.

Right-clicking on the dotted line will reveal a menu with suggestions for more concise language. Similar to the spelling and grammar features, the selected option will replace the in-text writing.

This feature is less robust than the spelling or traditional grammar tools. This tool is most effective at detecting common phrases that may be condensed for clarity, but the writer should not rely on this tool for effective revision. When undergoing the revision process, the author should seek opportunities to revise words and phrases independent of the tool in Microsoft Word.

6.3   CONTENT REVIEW

The content review takes place during the revision process. The content review includes both a global review of the document and line-by-line editing. The goal of this process is to shape and finish the draft into a polished, well organized, and concise technical document. This process may take several days or even weeks, depending on the length of the document and the extent of the editing process.

The goal during the revising process is to ensure that the writing in the document is precise, accurate, and targeted. Writers need to question how each section fits and should be able to answer why each section exists in the document. If the content of the sentence, paragraph, or section does not directly support the main points of the document, then the content does not belong in the document. Writers should not fear discarding or adding information during this process. It is quite common to find that a topic barely mentioned in the initial drafts needs more robust explanation. Likewise, writers also find that a topic that was detailed extensively in the drafting phase only requires a few sentences in the final document.

Writers typically develop their own preferences regarding revision cycles. Some writers prefer to look at one section at a time, making sure that each section is sound. Some authors work from the beginning, ensuring that the overall flow of the paragraphs and sections is logical. Developing an approach to the revision process takes time; writers should experiment with different approaches.

6.3.1   TECHNIQUES FOR CONTENT REVIEW

The following techniques may assist writers in reviewing document content during the revision process.

Read Out Loud—One of the best techniques for a writer engaging in the revision process is to read the draft aloud. People are excellent at unconsciously filling in gaps and correcting typos when reading, especially when reading their own work. Reading out loud forces the mind to account for each word and allows the writer to hear the language. Just as the mind is excellent at filling in gaps while reading, it is likewise excellent at detecting abnormalities in speech. This technique is particularly powerful for writers who are not confident in their abilities. Writers can hear rough transitions and incorrect grammar more easily when the document is read out loud.

Put it Down—Writers should build time into their revision process to take a break from the document. Walking away from the document for at least 24 hours helps the mind reset. Returning to the document after 24 or 48 hours will make gaps in the logic of a document clearer and easier to address. For long documents, writers may find it beneficial to revise in sections, putting each section away for periods of time while working on others.

Question the Document—This technique involves referencing the reader analysis created at the beginning of the writing process. See Section 2.1 for a reader analysis checklist. Using this technique, writers interrogate each paragraph and section from the perspective of the reader to anticipate questions. Writers can question whether each sentence, paragraph, and line is important from the reader's point of view.

Map to Recommendations—If the document contains a recommendations section, the writer should be able to tie every paragraph and section to the recommendations in some manner. For example, the introduction lays out the problem, which is what the recommendations set out to correct. Following this approach assists the writer in keeping the document tightly focused.

Conclusion/Recommendation Support—This technique applies to the recommendations or conclusions sections. Using this technique, the writer critically appraises each recommendation and its supporting arguments, then maps the supporting arguments back to evidence previously presented in the document. This technique ensures that no new or unsubstantiated information or opinions underpin the recommendations.

Rechecking Ignored Grammar—Toward the end of the revision process, the writer has combed through the document multiple times, adding, deleting, and revising content. Both at this point and at the end of the final revision, writers should re-check for ignored spelling and grammar concerns. As modifications to the document take place, writers

need to strive for consistency, which can be difficult to maintain. Other potential issues are stylistic. For example, Microsoft Word may prompt the writer to use a contraction where possible. If the writer has previously ignored spelling or grammar suggestions, a forced re-check will include words previously ignored.

   The procedure for re-checking a document is to first select "File" from the main menu, then "Options," which is the last item in the left menu. Once the "Options" menu item is selected, a new menu will appear. On this menu, the writer should select "Proofing." The proofing option is the third item down on the left gray menu. Once proofing has been selected the writer should select re-check document. See Figure 6.5.
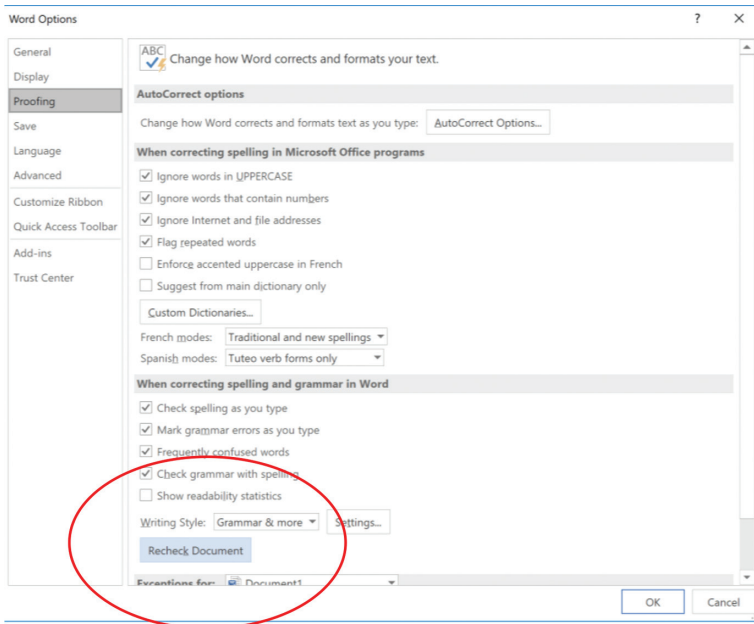
Figure 6.5. Re-checking ignored spelling and grammar.

   Reduce Word Count—Some writers set a target word count, often 10 percent fewer than where the document stands following a round of initial revisions. This challenge, while abstract and arbitrary, forces the writer to reduce redundant and unnecessary words and phrases. When the goal is to reduce the word count by 10 percent, the writer needs to use as few carefully selected and targeted words as possible to convey the meaning.

6.4 LINE EDITING

During line editing, the writer goes line by line seeking and fixing errors. Writers develop different workflows through the revision process. Many writers prefer to focus on global edits first, and then line edit; some prefer to begin with line editing. For most writers, the line editing process is the last step before completing a final review just before publication. It can be helpful during the line editing process to work backward, either from the last section or from the last sentence in a paragraph. Working backward forces the mind to pay careful attention to each sentence. No automation or substitute exists for a careful examination the document line by line.

Following line editing, many writers enlist a colleague or friend who is not connected with the project to read the document. Writers may find nonengineers most helpful for this task. Professional writing must communicate complex technical details to nontechnical people. The individuals reading the document may not have any technical experience at all, but may exert tremendous influence on the project. Enlisting a nonengineer to read the technical document and point out unclear language during the revision stage ensures that all readers will understand the document.

6.5 FINAL REVIEW

The final review is the last step a writer takes before printing or submitting a document. The goal of this process is to prepare the document for publication or dissemination. If the drafting and revising processes have gone well, this final step should require very little effort. Writers completing this step often use a checklist, such as the one provided as follows, to verify that the document is complete.

Final Review Checklist

- All items requested in the RFP, customer request or the initial project documentation are present in clearly identifiable section headings.
- All requested sections are clearly documented in a Table of Contents.
- Page numbers from the Table of Contents, List of Figures, and List of Tables match actual page numbers in the document.
- Table, figure, and appendix labels are accurate. See Section 4.7 for information on labeling.
- Text references (i.e., See Table 4.7) to table, figure, and appendix labels are accurate.

- Section numbers, figure numbers, and table numbers, are sequential and continuous.
- Font and font size are consistent.
- Punctuation, especially in lists, is consistent.
- Section heading font and font size are consistent with each other.
- Line spacing is consistent.
- References are present where appropriate and are properly formatted. See Chapter 5 for a detailed explanation of how to set up a bibliography and how to prepare footnotes in Microsoft Word.
- Margins are normal size and no figures, illustrations, or tables are split between two pages. This step is especially important when printing documents.

About the Authors

Joan Giblin began tutoring English over 15 years ago when she was awarded a Teaching Assistantship at Kansai Gaidai University in Hirakata, Japan. She continued tutoring as an English teacher in Tokyo, Japan. Joan has been tutoring engineering students at the undergraduate level in writing for nearly a decade. In addition, Joan tutors both undergraduate and graduate level students. Joan also has taught undergraduate courses for over 12 years.

Joan currently oversees academic support at Wentworth Institute of Technology, including the writing assistance programs. In this role, she has expanded programs to support engineering students in their academic pursuits. Joan emphasizes the importance of clear concise writing to help students and professionals achieve their career goals.

Emily Coolidge Toker started editing for professionals and academics in the sciences, social sciences, and humanities while doing a Master's degree in Cultural Studies at Sabanci University, Istanbul, Turkey. She has taught graduate and undergraduate-level courses for sociologists, art historians, engineers, mathematicians, and scientists, and edited publications for academic, professional, and nonexpert audiences in each of these fields. The field of engineering has a special place in her heart, as both her father and her brother are structural engineers.

Emily has a Master's of Library and Information Science from Simmons College, where she specialized in intellectual property, information literacy, and needs assessment. She has been a graduate writing tutor at the Wentworth Center for Academic Achievement since 2014, where she created an introduction to technical writing for incoming students in the College of Engineering.

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Technical Writing for Environmental Engineers

Joan Giblin • Emily Coolidge Toker

There are many kinds of writing required in the workplace, and a degree of mastery is necessary for effective and efficient communication between colleagues, clients, and managers. This book is meant to serve as a guide and tool for engineers navigating formal and informal writing in the workplace. Topics include the most common types of technical documents, the fundamentals of professional writing, the use of references and citations, and how and why engineers and other professionals should always proofread their work.

Joan Giblin began tutoring English over 15 years ago when she was awarded a teaching assistantship at Kansai Gaidai University in Hirakata, Japan. She continued tutoring as an English teacher in Tokyo, Japan. Joan has been tutoring engineering students at the undergraduate level in writing for nearly a decade. In addition, Joan tutors both undergraduate and graduate level students. Joan also has taught undergraduate courses for over 12 years. Joan currently oversees academic support at Wentworth Institute of Technology, including the writing assistance programs. In this role, she has expanded programs to support engineering students in their academic pursuits.

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