ChE-119

Technical writing: Its importance & how to do it well

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What is "technical writing"?

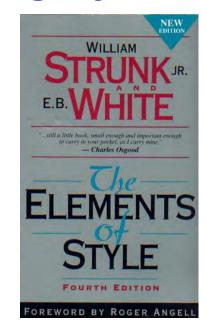
Technical writing: the clear, concise, & unambiguous presentation and analysis of scientific or engineering results

- Distinct from literary, journalistic, or personal communication styles and contents
- Differences in their respective purposes and intended audiences
- In technical writing, every statement should be based on evidence and not on unsupported opinion.

Elements of effective writing style

Strunk & White: The Elements of Style

Online: http://www.bartleby.com/141/



Elementary principles of writing

- The paragraph is the unit of composition: one paragraph per topic
- Begin each paragraph with a topic sentence
- End the paragraph with summary sentence consistent with beginning
- Put statements in positive form
- Keep related thoughts and words together
- Keep verb tenses consistent

1. Know your audience

- Make the technical depth of your writing compatible with the background of the readers you intend to reach.
 - Are you writing for engineers? managers? technicians? lay people?
 - Identify your objective and main message(s)
- Never start writing until you have decided to whom you are writing.
- This establishes the scope and depth of what you will write.

2. Use a clear style

- A technical paper should not have the same chatty tone as a personal letter.
- Key to technical writing:
 - Keep it simple and explicit
 - Write to communicate not to impress
- Avoid verbose, flowery, overly formal styles, which will obscure the main messages

3. Be concise

- Technical professionals are busy people.
- Make your writing less time-consuming for them to read by telling the whole story in the fewest words possible

How do you make your writing more concise?

Avoid redundancies: needless wordiness in which adjectives or adverbs repeat an idea.

- a new innovation (if it's an innovation, it's already new)
- very unique (unique means there is only one!)

Elements of effective writing style

Strunk & White: The Elements of Style

"Omit needless words. Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a machine should have no unnecessary parts."

- definitely proved
- orange in color
- viable alternative
- worst-case maximum possible error
- because of the fact that

Examples of poor usage

3. Be concise: examples

Redundant & wordy:

- advance plan
- actual experience
- two cubic feet in volume
- cylindrical in shape



- during the course of
- in the form of
- in many cases
- in the event of
- exhibits the ability to
- in order to

Rewrite as:

- plan
- experience
- two cubic feet
- cylindrical
- during
- as
- often
- if
- can
- to

3. Be concise: examples

Redundant & wordy:

- terminate
- utilize
- incombustible
- substantiate
- optimum

Rewrite as:

- end
- use
- fireproof
- prove
- best

• Avoid intensive adverbs: *very, really, truly, actually* Readers pay no attention to these overused words.

4. Be consistent

- Inconsistencies in technical writing will confuse your reader
- Result: readers will think your work & reasoning are as sloppy and disorganized as your writing
- Strive for consistency:
 - numbers, units of measure, symbols, equations
 - hyphens, punctuation, capitalization
 - grammar, technical terms, abbreviations

5. Avoid jargon

- Every domain of science and engineering has its own special language.
- Technical jargon is a helpful shorthand when communicating with professionals in your field.
- Must be clearly defined, so readers without special background will not become confused.
- For example: "yield"
 - Chemical Engineering: how much product a reaction makes
 - Car driver: slow down at an intersection
 - Mechanical Engineering: when a material is fatigued or has failed

6. Be specific, precise, and explicit

- Technical readers are interested in detailed quantitative information: facts, figures, conclusions, & recommendations.
- Avoid imprecise or subjective terms, such as good, bad, fast, slow, tall, or easy
- Rather say explicitly what makes something good, bad, easy, or describe explicitly how fast or slow something is.
- a tall spray dryer
- plant
- process unit
- unfavorable weather
- structural degradation
- high performance

- 40-ft tall spray dryer
- oil refinery
- distillation column
- rain
- leaky roof
- 90% efficiency

7. Use figures effectively

For example:

images, photos, maps, schematic diagrams graphs, tables, flowsheets

- "A picture is worth a 1000 words"
- Diagrams, graphs, and other visuals can reinforce your text.
- Pictures can often describe things which are hard to convey only through words.
- Most people remember ~10% of what they read, but ~30% of what they see.

8. Use the "active" voice

"Active" voice → action is expressed directly
 "John performed the experiment."

Versus "passive" voice:

"The experiment was performed by John."

"Active voice" is more direct and concise.

<u>Passive</u> Active

Control of the bearing oil supply is provided by the shutoff valves.

Shutoff valves control the bearing oil supply.

Leaking of the seals is prevented by using o-rings.

O-rings keep the seals from leaking.

Fuel-cost savings were realized through the installation of thermal insulation.

The installation of thermal insulation cut fuel costs.

9. Organize your messages & approach

- Introduction or Abstract (executive summary):
 - "big picture"
 - significance of results + important conclusions of the work
 - must be short, succinct, to the point
 - write version to start.....re-write after paper is complete
- Body: "supporting details"
- Conclusions: "wrap-up"

Said another way...

- Tell them what you are going to tell them
- · Then, tell them
- Then, tell them what you just told them

10. Other general rules

- write out numbers (seven vs. 7) when less than 10
- units (metric)
- affect (influences, a verb) vs. effect (a result, a noun)
- insure (to get insurance) vs. ensure (to be confident)
- NO colloquialisms, slang, or contractions (y' all, gonna, ain' t, isn' t, etc.)
- SPELL CHECK! (There is NO excuse!)

11. References (bibliography)

- Direct quotations from other authors must be cited.
 NO EXCEPTIONS!
- All substantial information taken from another source should be cited:
 - give credit to prior work & ideas
 - relieve responsibility for accuracy
 - points the reader to more information
 - provides a date for ideas
- Web citations are <u>not</u> allowed
 - impermanent and not peer-reviewed
 - find the original sources or documents
- Use the MLA format from library: http://www.library.ucsb.edu/help/citeformat.pdf



MLA BASIC CITATION FORMATS

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If you retrieved your journal article from an online source, you should cite it following rules found in section 5.9.4 of the MLA Handbook for Writers of Research Papers. (See citation and call number at the bottom of this page.)

12. Other pointers

- No sentence fragments
- Use commas
- Figures
 - All figures must be numbered AND have captions
 - MUST be referenced in the text discussion
 - If you take it from somewhere...you MUST cite it!
- Consider breaking your paper into sections with appropriate headings
 - Introduction, specific topics, conclusions/summary
- Proofread + spell check → We have no sympathy

13. Steps to better technical writing

W.S. Pfeiffer – Pocket guide to technical writing

- 1. Write a brief purpose statement
- 2. Determine the technical level of your intended readers
- 3. Collect & document information carefully
- 4. Write an outline
- 5. Write your first draft quickly
- 6. Revise in stages

14. Examples: Abstracts

from Nature

Amplitude spectroscopy of a solid-state artificial atom

David M. Berns^{1,2}, Mark S. Rudner¹, Sergio O. Valenzuela³†, Karl K. Berggren⁴†, William D. Oliver^{2,4}, Leonid S. Levitov¹ & Terry P. Orlando^{2,5}

The energy-level structure of a quantum system, which has a fundamental role in its behaviour, can be observed as discrete lines and features in absorption and emission spectra. Conventionally, spectra are measured using frequency spectroscopy, whereby the frequency of a harmonic electromagnetic driving field is tuned into resonance with a particular separation between energy levels. Although this technique has been successfully employed in a variety of physical systems, including natural and artificial atoms and molecules, its application is not universally straightforward and becomes extremely challenging for frequencies in the range of tens to hundreds of gigahertz. Here we introduce a complementary approach, amplitude spectroscopy, whereby a harmonic driving field sweeps an artificial atom through the avoided crossings between energy levels at a fixed frequency. Spectroscopic information is obtained from the amplitude dependence of the system's response, thereby overcoming many of the limitations of a broadband-frequency-based approach. The resulting 'spectroscopy diamonds', the regions in parameter space where transitions between specific pairs of levels can occur, exhibit interference patterns and population inversion that serve to distinguish the atom's spectrum. Amplitude spectroscopy provides a means of manipulating and characterizing systems over an extremely broad bandwidth, using only a single driving frequency that may be orders of magnitude smaller than the energy scales being probed.

14. Examples: Abstracts

Applied Physics Letters

adjectives

Photonic crystals with SiO₂-Ag "post-cap" nanostructure coatings for surface enhanced Raman spectroscopy Avoid massive compound

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We demonstrate that the resonant near fields of a large-area replica molded photonic crystal (PC) slab can efficiently couple light from a laser to SiO₂-Ag "post-cap" nanostructures deposited on the PC surface by a glancing angle evaporation technique for achieving high surface enhanced Raman spectroscopy (SERS) enhancement factor. To examine the feasibility of the PC-SERS substrate, the simulated electric field around individual Ag particles and the measured Raman spectrum of trans-1,2-bis(4pyridyl)ethane on the PC-SERS substrate were compared with those from an ordinary glass substrate coated with the same SiO₂-Ag nanostructures. © 2008 American Institute of Physics. [DOI: 10.1063/1.2998695]

Avoid use of personal pronouns

Trite: does not communicate anything.
Better to state what is learned or compared explicitly

14. Examples: Abstracts

Journal of The American Chemical Society

One-Dimensional Optoelectronic Nanostructures Derived from the Aqueous Self-Assembly of π -Conjugated Oligopeptides

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Abstract:

The aqueous self-assembly of oligopeptide-flanked π -conjugated molecules into discrete one-dimensional nanostructures is described. Unique to these molecules is the fact that the π -conjugated unit has been directly embedded within the peptide backbone by way of a synthetic amino acid with π -functionality that is compatible with standard Fmoc-based peptide synthesis. The peptide-based molecular design enforces intimate π - π communication within the aggregate after charge-screening and self-assembly, making these nanostructures attractive for optical or electronic applications in biological environments. The synthesis and assembly are reported along with spectroscopic and morphological characterization of the new nanomaterials.

15. Examples: 5-paragraph essays

Step 1:

- Choose an interesting topic
- with an appropriate scope and level
- with a clear overall message to be conveyed
- that can be subdivided into 3 subordinate points that support that main message

Step 2: Organize the essay

Introduction Paragraph

5-paragraph essays

- Introduces the motivation, topic, and scope of the essay
- "Thesis" Statement: One sentence, usually at the end of the first paragraph, that concisely states the main message of the essay.

Body Paragraph #1

Detail #1 Data, analysis and discussion
Detail #2 that support the "thesis" statement

Detail #3

Body Paragraph #2

Detail #1
Detail #2
Additional data, analysis and discussion that support the "thesis" statement
Detail #3

Body Paragraph #3

Detail #1
Detail #2
Detail #3

Additional data, analysis and discussion that support the "thesis" statement

Conclusion paragraph

Wrap up essay & leave reader with main message(s) and most interesting points

Introduction Paragraph

5-paragraph essays

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Body Paragraph #1

Detail #1 Data, analysis and discussion that support the "thesis" statement

Detail #3

Now you can begin writing!

Body Paragraph #2

Detail #1
Detail #2

Additional data, analysis and discussion that support the "thesis" statement

Detail #3

Body Paragraph #3

Detail #1
Additional data, analysis and discussion

Detail #2 that support the "thesis" statement

Detail #3

Conclusion paragraph

Wrap up essay & leave reader with main message(s) and most interesting points

Write the essay!

- Think small; build the full essay gradually.
- Divide your essay into sections and develop each piece separately and incrementally.

The Introductory Paragraph

- The opening paragraph sets the tone; start general and finish with a specific "thesis" sentence (the main message that you will then support in subsequent paragraphs)
- It introduces the topic and how you will develop it (the "thesis"). If you do a good job in the opening, you will motivate interest in your reader.
- Write in the active voice as much as possible; it is more powerful than the passive voice.
- Unless you are writing a personal narrative, do not use the pronoun "I" and generally avoid use of other personal pronouns (e.g., "we", "our").
- Vary sentence structure; avoid the same dull pattern of always starting with the subject of the sentence.
- Brainstorm to find the best supporting ideas
- The best supporting ideas are the ones about which you have some knowledge. If you do not know about them, you cannot do a good job writing about them. Don't weaken the essay with ineffective arguments.
- Practice writing introductory paragraphs on various topics
- Even if you do not use them, they can be compared with the type of writing you are doing now. It is rewarding to see a pattern of progress.

Write the essay!

Supporting Paragraphs

- Write a transition to establish the sub-topic; each paragraph has to flow, one to the next.
- Write the topic sentence; the transition can be included in the topic sentence.
- Supporting ideas, examples, details must be specific to the sub-topic
- Avoid the tendency to put in too many details; the emphasis you established in the Introduction will help you keep focused on the appropriate details, examples, and discussion points.
- Vary sentence structure: Avoid beginning sentences the same way (subject + verb + direct object)
- Avoid pronouns and lists

The Ending or Summary Paragraph

- Summarize main thesis message, supporting points, and offer conclusions.
- You cannot assume that the reader sees your point unless you explicitly tell them.
- Summarize your argument with some degree of authority/confidence
- This paragraph should leave your reader with no doubt as to your position or conclusion of logic.
- Be assertive (but not exaggerated as this is the last thought that you are leaving with the reader.
- Finish with a sentence or sentences that relates the message and conclusions more broadly and generally to areas where they may be important

Write the essay!

Editing and revising your essay

- Proofread!! Check your spelling and grammar; subjects and verb tenses must agree, and verb tenses should be consistent
- Examine your whole essay for logic; the thoughts should develop clearly and flow smoothly
- Avoid gaps in logic or too much detail.
- Review individual sentences; vary their lengths and structures
- Use active verbs to be more descriptive
- Avoid passive constructions with the verb "to be"
- Use transitional words and phrases
- Avoid sentences beginning with pronouns and constructions such as "There are....," Example: "There is a need to proofread all works" becomes "Proofreading is a must."
- Be concise and be precise