A guide to writing technical reports

M. P. Hayes
Department of Electrical and Computer Engineering
University of Canterbury

Version 4.3

Abstract

This report provides a guide to writing technical reports. It is targeted at undergraduate engineering students. It provides a recommended structure for reports and makes suggestions on presentation and writing.

Contents

1 Introduction

Writing your first technical reports is not easy. The goal of a technical report is to express findings in a clear and unambiguous manner.

This report is targeted at undergraduate engineering students to help them write a technical report. It is structured as follows. Section 2 presents a suggested structure for a report. It describes the key sections found in a report and provides recommendations. This is followed by suggestions for writing style, grammar, and spelling in Section 3. Presentation suggestions are provided in Section 4 and conclusions are drawn in Section 5. Finally, lists of gaucheries and weasel words are in Appendix A and Appendix B.

2 Structure

Here is a typical top-level structure of a report:

Title
Abstract
Table of contents
1 Introduction
2 Background
3 Method
4 Results
5 Discussion
6 Conclusion
7 Acknowledgements (if required)
8 References
A Appendix A
B Appendix B

The title, abstract, introduction, conclusion, and references are not optional. Some reports have no appendices; this example has two. One might be for schematics and the other for software listings.

S-1 All sections starting from the introduction should be numbered.

S-2 Sections of the report should be referenced by number. For example, Section 3 discusses the writing style that should be used for a report. Do not refer to the section above or below since they sometimes move around.

S-3 Do not use too many levels of subsections. Some styles suggest only two levels; three is okay.

2.1 Abstract

The abstract is sometimes called an executive summary. It usually comes before the table of contents.

The abstract for a short report contains no more than three or four paragraphs. Its purpose is to allow the reader to quickly determine if it is worth reading the rest of the report.

A-1 The abstract is not numbered.

A-2 The abstract should summarise what is in the report, in particular, it should specify the key findings. For example, this report presents suggestions for how to write a report, ...

2.2 Introduction

This section introduces the purpose of the report and what it to be found in it. There is some minor repetition with the abstract but the introduction should be more detailed.

I-1 A report must have an introduction.

I-2 The introduction is the first numbered section.

I-3 You should describe the top-level concepts before diving into the minutæ. A simplified system diagram is useful here.

I-4 The end of the introduction should contain a *roadmap* to inform your reader how you have organised your material. The table of contents assists a reader who has an idea what they are looking for, say someone who has already read the report.

For example, ... Guidelines for the writing style to be used for a technical report are given in Section 3. This is followed by ...

2.3 Conclusion

C-1 All reports should have a conclusion. No exceptions. This is what your boss will read first.

2.4 References

R-1 All reports should have a references section. No, a bibliography does not count! When you make a statement you need to be able to back it up. If the reader thinks you have made a mistake or would like to know more details, they can look up the source. The references should be numbered[1] and give full details.

R-2 A reference section is not just a collection of URLs. These are transitory compared to books, papers, and patents. If you use a URL add the date when the web page was last updated.

R-3 All references must be cited in the report.

R-4 Use the specified reference style. The APA style is preferable for theses and long reports where there are a large number of references. For short reports, the IEEE transactions style is common.

2.5 Appendices

X-1 Software listings belong in an appendix. Code fragments are okay for the main report body to illustrate a point.

X-2 Detailed tables of experimental results belong in an appendix. The main body of the report should only show the general results.

[1] Personally, I prefer the APA style as commonly used for theses where the author's name and year is used instead of a number.

X-3 Schematics listings belong in an appendix. The body of the report should use block diagrams or simple circuits.

3 Writing

There are many writing styles. A technical report should be written to be concise and unambiguous. If the reader thinks that your grammar and spelling is sloppy, they will assume that your arguments are sloppy.

This section considers the writing tense in Section 3.1, followed by suggestions for sentences in Section 3.2, paragraphs in Section 3.3, punctuation in Section 3.4, and spelling in Section 3.5. It concludes with suggestions for usage of however and related words in Section 3.6. For more suggestions, refer to the excellent little book called the "Elements of Style" (Strunk and White, 1979).

3.1 Tense

W-1 A report should be primarily written in the present tense except when describing the results of experiments. In this case, use the past tense.

W-2 There is rarely a need for the future tense. Rather than saying that referencing *will* be considered in Section 2.4, say that referencing *is* considered in Section 2.4.

W-3 Ideally reports should be written in the third person although it is acceptable in some parts to use the first person, especially in an introduction.

W-4 Only use the first person plural if there are multiple authors[2].

W-5 The passive voice should be avoided except when describing experimental procedure.

3.2 Sentences

The key to a technical report is its brevity and lack of ambiguity. You are not expected to win the reader over by your rhetoric and fancy sentence composition.

W-6 Most students write sentences that are too long[3]. Long sentences are hard for the reader to parse and can introduce ambiguity.

W-7 There should be only one idea per sentence.

W-8 Do not join independent clauses with a comma. Start a new sentence.

W-9 When a sentence is first written it usually contains redundant words since this is how we speak. A competent writer will remove the redundant words. The rule is "*if you can remove a word from a sentence without changing its meaning, then it is not needed*". For example, "an instant in time" is simply an "instant". An "actual fact" should be replaced with "fact". See Appendix A.

W-10 Remove weasel words, see Appendix B.

[2]James Clerk Maxwell sometimes added his dog as an author so he could use we in a paper instead of I.
[3]I used to.

3.3 Paragraphs

W-11 Keep paragraphs short.

W-12 It is unusual to have a single sentence paragraph in a technical report[4].

W-13 Do not start a paragraph with "However,", "Furthermore,", "Moreover,", "Hence,", etc.

3.4 Punctuation

The correct use of commas can lead to heated debate. Commas are used for many things: primarily to add a pause, add a parenthetical phrase or clause, and to delimit a list.

Delimiting a list is one the most contentious uses of a comma. I like the serial comma[5], aka the Oxford or Harvard comma. With the serial comma you would write "beer, wine, and spirits" instead of "beer, wine and spirits". Sentences without the serial comma are more prone to ambiguity.

W-14 Whichever comma style you use, the key is to be consistent. This way the reader has more confidence that you know what you are doing.

W-15 Novice writers link sentences together with a comma. Instead, it is best to start a new sentence. If you know what you are doing, there are times where you can use a semicolon.

W-16 Don't use contractions in a technical report! For example, haven't should be have not.

W-17 The apostrophe indicates possession, i.e., belonging to someone or something. It is not just used to indicate that an s follows at the end of the word! This is a common mistake especially when referring to an object by an initialism or acronym. For example, consider a UAV (Unmanned aerial vehicle). The plural of UAV is UAVs, so we would say "Michael had two UAVs." but not "Michael had two UAV's." since this violates the use of an apostrophe to indicate possession. However, we would say "The UAV's propellor was broken." since the propellor belongs to the UAV.

W-18 When an initialism or acronym is first used it should be defined. For example, the Fast Fourier Transform (FFT) is an efficient algorithm for computing a Discrete Fourier Transform (DFT).

W-19 Commas usually follow the abbreviations i.e. and e.g. in the same way you would if you said "that is" or "for example".

3.5 Spelling

W-20 The key is to be consistent and to use the spelling for the person who commissioned the report. So for an assignment, that means New Zealand English.

W-21 Correct spelling in a report is not optional. Incorrect spelling implies that the author is stupid, indolent, or both.

[4]They are common in newspapers.

[5]See `https://en.wikipedia.org/wiki/Serial_comma`.

3.6 However, furthermore, hence, thus

Words such as however, furthermore, hence, thus, nevertheless, etc. are useful for presenting two sides of an argument. However, it is bad form to randomly throw them into a sentence. The best place is at the start of a sentence, immediately followed by a comma[6], however, they can be used as linking words in the middle of a sentence.

However you write, be careful with however since it has two meanings! In this example, however is not followed by a comma.

4 Presentation

This section considers the presentation of the report. It considers recommendations for the main text in Section 4.1, floats (such as figures, tables, and listings) in Section 4.2, equation formatting in Section 4.3, and unit formatting in Section 4.4.

4.1 Text

P-1 Use at least a size 11 font for the main text to make it easy to read.

P-2 Do not make the margins too narrow. A wide line is hard to scan by the human eye. A rule of thumb is that there should not be more than 75 characters per line[7].

P-3 Avoid headings without text between them. Instead add some introductory text to explain what the reader will find in the sub-sections.

P-4 With computer typesetting underlining is frowned upon. Why? I suppose it does not look good and became unfashionable with the demise of the typewriter. Look at any book. Instead, use emphasis with **bold** or *italic* fonts.

P-5 It is a good idea to have program identifiers in a fixed size font when referred to in the report, for example, `serial_tx_byte`.

P-6 Avoid widowed headings. These are headings at the bottom of the page with no following text.

P-7 Avoid random capitalisations. Be consistent.

4.2 Figures, tables, listings

F-1 While magazines often have text around figures, this is considered poor style for a report. Yes, you can cram in more content but does this make the report better?

F-2 It is important that fonts in figures are not too small. Be careful, when scaling an image since this will alter the size of any text. If you need to reduce the size of an image, generate the text in a larger font.

[6]Some people vociferously argue for a semicolon.

[7]This is why journals and newspapers use multiple columns.

System diagram to do

Figure 1: System diagram of the foobar device showing the grand frobnicator connected to the little thingamajig at the top. The super grandiloquencer is omitted for clarity.

F-3 It is best to avoid bitmapped images (GIF, BMP, JPEG, etc.) that contain text since aliasing makes the words hard to read. If this is unavoidable, you will need a high resolution of at least 300 dots per inch. In comparison, images displayed on web pages have a typical resolution of only 75 dots per inch.

F-4 All figures and tables must have captions. The caption should be meaningful and describe the figure/table. For example, see Figure 1.

F-5 The caption should end with a full stop. This way you can add other sentences and remain consistent with your punctuation.

F-6 All figures/tables need to be referenced from the text. For example, Figure 1 shows the system diagram.

F-7 All figures and tables must be referred to by an identifier. Do not say, "see the figure below". Instead, say "see Figure 1".

F-8 It is common to refer to figures (tables) with the word Figure (Table) capitalised so that it stands out in the text. This helps the reader to find where the figure (table) is described in the text.

F-9 Software listings should use a fixed size font so that columns line up.

4.3 Mathematics

M-1 Equations are best separated from the surrounding text. This makes the equations easier to read and allows them to be numbered.

M-2 To improve the flow of the prose, it is desirable that equations are punctuated as part of a sentence. For example, the voltage drop, V, across a resistor due to a current, I, flowing through it is given by Ohm's law,

$$V = RI, \tag{1}$$

where R is the resistance of the resistor.

M-3 All variables in an equation must be defined when first used. The dependent variables are most often defined after the equation.

M-4 Equations that are referred to should be numbered. It does not hurt to number all equations.

M-5 When referring to an equation it is desirable to mention it by name as well as by its number. For example, the voltage drop can be found using Ohm's law (1).

M-6 Is is common to refer to an equation by its number in parentheses, for example, (1) instead of Equation 1.

M-7 Do not use the * symbol for multiplication in an equation; use $\times$ or implied multiplication. For example, $a \times b$ or ab.

M-8 Operators and words should be typeset in an upright Roman font, not italics. For example, cos not cos, dx not dx.

M-9 Words in superscripts and subscripts should be typeset in an upright Roman font, not italics. For example, V_{rms}, I_{max}.

4.4 Units

U-1 Technical reports should use SI units. A unit named after a person is written in lower case unless it is abbreviated in which case the first letter is capitalised. For example, 5 joules or 5 J.

U-2 Prefixes are never capitalised—m means milli but M means mega; an error of nine orders of magnitude. Thus 4 MHz, not 4 mhz, 4 Mhz, etc.

U-3 The SI standard says units should be separated by a small space from the value, for example, 1 GHz instead of 1GHz. In LaTeX this can be achieved with `1\,GHz`. Note, you need an unbreakable space since you do not want the number and unit on separate lines.

U-4 Units are typeset in an upright Roman font but not italics. For example, 42 watts not 42 $watts$ and 42 W not 42 W.

5 Conclusion

This report provides suggestions for the structure, writing, and presentation of a technical report. It is not a representative example of most technical reports; the recommendations are better summarised in an appendix. Nevertheless, hopefully it will help you write an excellent technical report.

6 References

Howard, P. (1983). *Weasel words*. Corgi Books.

Strunk, W. and White, E. B. (1979). *The elements of style*. Boston: Allyn & Bacon.

A Gaucheries

Richard Bates, a former professor of the ECE Department at UC, insisted that his students expunge all gaucheries from their writing. He especially hated redundant words and tautologies. For example, you were likely to be struck by a thunderbolt if you said an instant of time.

Here are some gaucheries to expunge from your writing with some replacements:

a variety of different → a variety of
actual fact → fact
adept at → adept in
approximation of → approximation to
at the conclusion of → after
at the present time → today, at present
at this point in time → now
can be found → is found
compensate for → compensate
compensating for → compensating
connect up → connect
correct for → correct
correcting for → correcting
detailed → discussed
doubt but → doubt
due to the fact that → because
during the course of → during
during the time that → while
frequently → often
help but → help
in the course of → during
in order to → to
in the vicinity of → about
in the neighbourhood of → near
in this day and age → today
instant of time → instant
in the event that → if
irregardless → regardless
join together → join
known as → called
most unique → unique
new and innovative → innovative
not got any → no
offshore to → offshore
prior to → before
quite →
the reason why → because
to begin with → to begin
used → used, applied, employed, invoked, utilised (used is the most overused word in English)

very →
very unique → unique
whether or not → whether

B Weasel words

Weasel words[8] should be avoided in a technical report since they obscure clarity. They are phrases or words that "sound good" but do not actually convey any information. For example, the word "actually" in the preceding sentence does not add information to the sentence.

There main categories of weasel words are:

1. Vague expressions: some people, experts, it is well known, many, somewhat, in most respects, various, fairly, several, extremely, exceedingly, quite, remarkably, few, mostly, largely, huge, tiny, are a number, excellent, significantly, substantially, clearly, vast, relatively, completely, very[9].

2. Use of the passive voice to avoid specifying an authority: it is said.

3. Adverbs that weaken: often, probably, possibly, truly, actually, basically, interestingly, surprisingly.

C Other resources

- Grammarly is a free online English grammar and spelling checker. See `/www.grammarly.com`.

[8] `https://en.wikipedia.org/wiki/Weasel_word`. See also Howard (1983), an interesting book on weasel words.

[9] Samuel Clemens (aka Mark Twain) said that you should replace all uses of very with damn; this way if you do not delete them then your editor will.