HOW TO WRITE A TECHNICAL REPORT

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ABSTRACT

Mechanics of writing a technical report is explained in a pseudo report format. The purpose of this pseudo report is to explain the contents of a typical engineering report. It can also be used as a template for an actual engineering report. With some adaptation, the format can be extended to other type of technical writings as well.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF SYMBOLS

r radius of a circle

V volume of a sphere

π pi

ACKNOWLEDGEMENTS

INTRODUCTION

Contrary to current layman thinking that engineering works only involve working with machineries, many tasks perform by an engineer involve writing. Written communication, in fact, is an integral part of engineering tasks. The ability to write a technical report in a clear and concise manner is a mark of a good engineer. An engineer must be able to translate the formulae, numbers, and other engineering abstractions into an understandable written form.

There are uncountable variations in engineering report format. Each group, institution, company may have its own "standard" format to follow. This report is being offered as an example of the kind of information and progression order that should be present in a sound technical report. There are certain elements common in most engineering writings. These elements can be seen in any typical engineering report. A technical report must inform readers of the reasons, means, results, and conclusions of the subject matter being reported. The mechanics and format of writing a report may vary but the content is always similar.

EXPERIMENTAL DETAILS

Many engineering writing is centered on reporting of experimental works. In such a case, there should be an "Experimental Details" section in the report. The information to be included in the experimental details section is:

1   Equipment used in the experiment. List the equipment name and model number, e.g., Instron universal testing machine Model 4300.

2   Testing conditions. List environmental condition if it is applicable. Use and refer to figures to explain test set-ups. Figure 1 shows the test set up of nothing
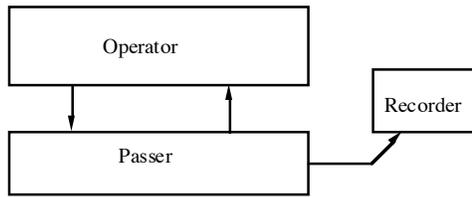
Figure 1   Schematic of experiment set up to do nothing.

3   Testing parameters. Table 1 shows the test parameters used in the experiment on nothing.

4   If the test parameters are to be changed as a part of the experiment, list the different parameters in a table format.

RESULTS AND DISCUSSIONS

Since this report is not a real report, there is no result to report. Table 2 list the "no result" that would have been in an actual report. Figure 2 shows the plot of Quantity 1 versus Quantity 2. Graphs and figures should be used as necessary. Results can be reported separately before they are discussed or they can be reported as they are being discussed. Choose whichever way that is more suitable to the nature of the data being reported.

SECTION DESCRIPTIONS

The following is a section-by-section description of the parts in a technical report. As mentioned previously, not all of the parts may be needed in a given report.

Table 1   Test matrix for experiment on nothing.

Trial	Parameter 1	Parameter 2	Parameter 3
1	1	20	1.2
2	1	15	2.2
3	2	20	2.2
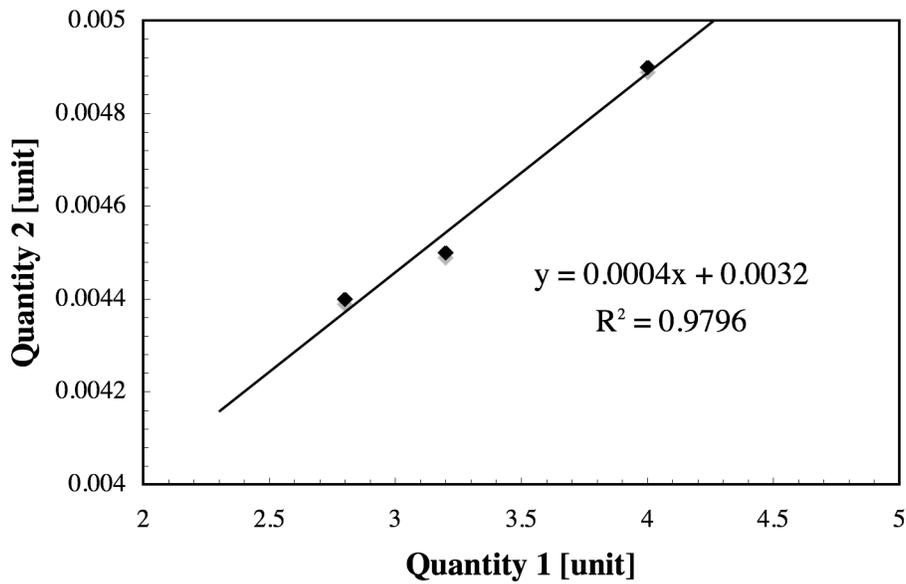
Figure 2   Quantity 1 versus Quantity 2

Letter of transmittal

A letter of transmittal is an optional part of a report. It is a matter of courtesy to include one if the report is being submitted for an official purpose. A letter of transmittal is addressed to the person the report is intent to reach. It should include the name of the author, affiliation, title of the report and purpose for its submittal. If included, a letter of transmittal will be on a separated sheet of paper not bounded to the actual report.

Abstract

An abstract of a technical report briefly summarizes the report. It should describe motivations, methods, results, and conclusions. Be concise in the abstract. Think of an abstract as

Table 2   Some numbers from the result of the experiment on nothing

Trial #	Quantity 1 [unit]	Quantity 2 [unit]
1	4.0	4.9×10^{-2}
2	3.2	4.5×10^{-2}
3	2.8	4.4×10^{-2}

3

a one-paragraph summary of the report. Ideally, an abstract is one paragraph long. Have a words limit, e.g., maximum 500 words, in mind when writing an abstract.

Table of Contents

As the name implies, Table of Contents is the list of what is in the report. Major sections of the report must be listed with page numbers. Second and third level headings may also be listed as appropriated. Think of revising the structure of the report if fourth level heading is important enough to be listed in the Table of Contents.

"Index and Tables…" feature in a word processor is the quickest way to automatically build the Table of Contents in a report.

List of Figures and Tables

This section contains two related but separate lists. List of Figures contains the listing of all the figures (drawings and graphs) that appear in the report. They are listed in consecutive order that they appear in the report with figure captions and page number. List of Tables is similar to the List of Figures but for all the tables that appear in the report.

List of Symbols

This list is optional. It can be used if the report contains a lot of formulae and symbols. The readers often appreciate a list explaining the sympols used in the report.

Acknowledgements

The author(s) must acknowledge every person or agency involved in funding, guiding, advising, and working on the project that are not part of the authoring team. Failure to acknowledge someone contributing to the project is a serious breach of etiquette and may be construed as plagiarism, a very serious offense. Traditionally, editor, proofreader, and fact

checkers are not included among those acknowledged.

Introduction

The beginning of the introduction should quickly explain the importance of the experiment being reported. Simply say that something is important is not adequate. The author must make a case for it.

If there is no separate "Technical Background" section in the report, this section is where the necessary concepts that were applied in order to obtain the results are explained. An assumption must be made regarding the technical level of the readers. Assume that the readers already possess technical ability to understand the material then present the technical information accordingly. Do not attempt to write an introductory text on the subject. Nor should the writer assume that the readers are experts in the subject.

Experimental Details

This is the section where details of the experiments or research conducted are discussed. The descriptions maybe in paragraph form, list form, or a combination of both. Think of experimental details section as a recipe in a cookbook. The description must contain enough details to enable someone else to duplicate the experiment. Engineering and scientific experiment must be repeatable and verifyable.

Results and Discussions

Had this been an actual report, the results should be reported in table or graph format. Report only the final results. Raw data and intermediate results that are not central to the topic of the report can be placed in the Appendix if needed.

The Results and Discussion section should be the most substantial part of the report. This is where the results of the experiment are reported and discussed. Any significance in the work

reported here must be made clear by detailed discussions. Consider this section to be the "meat" of the report while other sections constitute the rest of the "ingredients".

<u>Conclusions and Recommendations</u>

Conclude what was discussed in the Results and Discussion section. Do not conclude anything that had not been discussed. Think of the conclusion as a short restatement of important points being presented in the report.

Once conclusions are made, make some recommendations as to the utilities of those conclusions. Explain how useful the methodology and the results are. Mention restrictions or limits pertaining to the use of the results. For example, "The results reported here only apply to the second full-moon night a month (blue corn moon) and not any other night." Suggest what the next step in the study should be to overcome the limitation or advance the study further.

Both conclusions and recommendations may be in the form of descriptive paragraphs or running lists. Whichever the format is chosen, apply it consistently for both the conclusions and the recommendations.

<u>References</u>

Giving proper credit to originator of an idea is very important. Any idea, formula, etc., not originating from the author must be cited. It is unlikely that a report is so original that it is not built upon any previously discovered knowledge. A reference section is a required component in any technical report. Failure to reference prior works may be interpreted as claiming those works to be your own. Plagiarism is one of the most serious offences for engineering and scientific professions. A sanction from your colleagues for this offence is enough to end one's professional career.

References must be attached to specific formulae, pages, or passages in the report. They

are numbered consecutively according to the order that they appear in the report. Use superscript numbering or square bracket to denote a reference. Part of the source material being referenced must also be specific. It must refer to specific formula, page, passage, or idea in the source material being cited.

Any work, formulae, or discussion that is a common knowledge in the field does not need to be referenced. For example, it is a common knowledge for engineers that $F = ma$. There is no need to reference Newton for this. This rule applies to common formulae that can be derived or are well known by people in the field also.

See References section for the format of references from books, essays, journals, World Wide Web, and personal communications.[1,2,3,4,5] A particular technical journal may have its own format for the authors to follow. The information to be included in the references, however, is always of the same nature as what is presented.

<u>Appendices</u>

In is imperative that the way you determine the result from the raw data be made clear. Others should be able to duplicate the experiment according the instruction provided in the "Experimental Details" section and reduce the data according to the "Sample Calculations" in the Appendix to obtain results similar to what is reported. Other supporting information that is not central to the main points to be made in the report is placed in separate appendices as needed.

Consider carefully the necessity of including the raw data in your report. Include one set of the raw data for example calculation is adequate for most purpose. Listing pages and pages of numbers that nobody can decipher is excessive and likely not count as a good credit to the author. Photocopied text and references are also inappropriate since doing so may be a copyright violation. Retracing drawings from other sources is not acceptable for the same reason. Direct

copy of materials from other sources must be accompanied by explicit permission from the copyright holders of those materials.

MISCELLANEOUS DESCRIPTIONS

There are many other points that should be considered in writing a technical report that apply to the whole report. The points presented here are, by no means, exhaustive nor authoritative. They are merely suggestions.

Major or first level headings should start on a new page unless two or more headings can fit on a single page. Think of a heading as a start of a new chapter in a book. A new chapter always starts on a new page. That being said, this pseudo-report does not follow the stated guideline too rigidly.

12 points, serif typeface such as Times is standard for report writing. Keep color usage to a minimum if at all. Black text and black or gray-scale figures are adequate for most technical reports. Do not use san serif font such as Arial or fancy font such as *Script* in writing the body of a technical report. Serif fonts are best for long text in a book format. San serif fonts are designed for headlines or presentation composing of short phrases or lists. Try to avoid all capital letters in the body of the report. It is an equivalent to "shouting" in writing.

Contractions are not used in formal writing. For example, use "It cannot be said that …" instead of "It can't be said that …" Similar line of reasoning applies to the use of abbreviation. Consider using it sparingly. Fully type of "versus" instead of "vs." does not require extraordinary effort with the use of a computer yet will keep the writing easily readable. Use "Figure" instead of "Fig." and "Table" instead of "Tab." will spare the reader of having to translate the abbreviations while reading. If abbreviations were used, use them consistently through out the report. For example, do not switch among "versus", "vs." and "vs". Note that an abbreviation is

followed by a period, e.g., "vs." not "vs".

Many engineers and scientists use acronyms in their writing without giving it a second thought. If the target audience were definitely people in the exact field, acronyms would present no difficulties. As a matter of courtesy though, consider writing out the full name with acronym in parenthesis the first time that name appears in the report. Then use the acronym in any subsequent occurrences. For example, "My corporate counsel wants to talk to you about your intellectual property (IP) violation." Following this convention will prevent any confusion that may arise when one acronym having more than one possible meanings, e.g., "intellectual property (IP)" versus "internet protocol (IP)."

1-inch on all sides is standard for margins in a loose-leaf report. Use 1.25 to 1.5 inch left margin for a bounded report. If the report is to be graded, type on one side of the page only and use double space for line spacing. This leaves room for instructor's comments.

A formal report is written in third person. For example, "An experiment on something was conducted…" instead of "We did this experiment on…" Avoid overly complicated or doubly passive sentences. Many modern authors of technical reports forgo third person narrative altogether.

Equations and formulae are numbered consecutively in the order that they appear in the report. Equation is centered on the page with equation number on the side followed by the explanation of the symbols used in the equation. Think of the equation and the explanation as one sentence. For example,

$$V = 4/3\ \pi r^3 \hspace{4cm} [1]$$

where, V = volume of a sphere
r = radius of a sphere.

Note a period marking the end of a sentence after the second "sphere" but not the first one.

A particular figure, table, equation, or heading is treated as proper noun and is referred to as such in the report. When a figure is being referred to, consider that it is being called upon by its name. For example, "As can be seen in Figure 5…" not "As can be seen in figure 5…"

Tables and figures are listed separately in the table of contents. Each group is numbered consecutively in order appearance in the report. In any case, a table or a figure must come after the text that refers to it. Tables are always at the bottom of the page but figures may appear any where on the page with or without text on that same page. For a short report or a journal article, it is acceptable to put the tables and figures at the end of the report.

All tables and figures must include captions. A caption is a description explaining the table or the figure. A caption must be self-explanatory. For example, "Table 4 Test parameters for dust balls collection experiment" is acceptable but "Table 4 Test parameters" is not.

Engineering report normally uses only horizontal lines to denote sections in a table. The use of vertical lines is avoided since they may be misinterpreted as engineering markings.

Figures may include schematic diagrams, pictures, or graphs. The main type of graphs used in reporting engineering test results is scatter plot. A scatter plot treats both x and y data as values. A similar looking graph type, a line plot, is not normally used to report scientific data. In line plot, the x data are treated as names or categories not values.

Data presented as a graph are plotted without lines connecting the data points. A line connecting two data points on a graph implies that intermediate values can be read directly off the line. Use curve-fitting line to show a trend in the data instead of connecting points. When using a curve fit, the fitting equation and the R^2 (indication of how good the fit is) must be included. A curve fit line without the information underlining the curve fit does not have any scientific meaning.

The breakdown of a report into sections helps organize the information into logical sections. There is no "standard" convention dictating the number of sections in a report. The sections used in this report follow a more common breakdown of a technical writing reporting results of an engineering experiment. Appropriate adjustment should be made for other type of reports. Regardless of the number of sections, the logical flow of the information in the report will be similar.

CONCLUSIONS AND RECOMMENDATIONS

Report writing takes more planning than simply sitting down in front of the computer and start typing. Information in the report must be divided into appropriate sections. This "pseudo report" serves only as a guideline to writing a technical report. The format and the number of sections are not rigidly set. Adjustment to the report should be made depending on the nature of the report. It is up to the writer to analyze and adapt the format to suit the situation.

REFERENCES

1   Ferry, J.D., *Name of the Book*, Publisher, New York, 1980, pp 131-140.
2   Mandell, J.F., *Some Really Really Long Essay that is Part of a Volume*, Title of the Volume, Smithee, A (ed.), Publisher, New York, 1999, p 140.
3   Barnes, N.M, Noble, B.J, and Jones, S, *Name of the Article*, Journal of Something Made of Wood. 1980, Volume #, Section #, pp 131-140.
4   Someone, R, *Name of the Article or Web Page*, www.thisbetterbearealwebpage.com/thispage/thisdoc.html, 1966.
5   Kao, B.V., Professor of Everything, Planet Earth, personal communication, 2002.

APENDICES

APPENDIX A SAMPLE CALCULATIONS

Mathematically 1+1=2,

However, similar addition in base 2 produces:

1+1=10

APPENDIX B ALTERNATIVE METHOD FOR CONDUCTION TESTS

The method used to obtain the results in this report is one of many methods available. It is the one chosen because of the availability of the equipment. Other methods may be used equally as well. Some of these methods are:

Method 1
Something.

Method 2

Something else.