Engineering Reports: An Introduction to Style and Organization

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Abstract

This article is an introduction to organization and writing of engineering reports. It presents one approach to construction of an engineering report. It introduces and expands on the parts of an engineering report: executive summary, introduction, procedure, results, conclusions, and summary. Also presented are suggestions for writing an engineering report.

1. Introduction

As an engineer, you will write many kinds of documents: letters, proposals, reports, memoranda, and others. Every company or organization has a concept, and often a format, for each type of document. The format of a engineering report may be formalized (written) or may be informal (use preceding reports as examples). One example of a style guide is presented by Hansen (1991). An important style guide is the *Authors' Guide to Journals and Practice Periodicals* of the American Society of Civil Engineers (`http://www.asce.org/authors/index.html`).

The purpose of this article is to introduce the idea of a style (or format) for engineering reports. It also represents the style you are to use for this course.

2. Organization of the Engineering Report

An engineering report is organized into a series of chapters or sections intended to provide all information needed by a reader to understand conclusions of your project

work. Because your target audience has a broad range of technical understanding, your report must meet different needs and provide information of use to readers with varied technical backgrounds (or no technical background at all). For instance, other engineers may read your report for procedures and conclusions derived through your study; these are technical users. However, the public (a non-technical audience) may also read your report for information. If you rely too heavily on technical jargon, you will fail to reach some part of your target audience. Therefore, a prime consideration is: *Who is the target audience.* The best writers reach all groups.

2.1. Parts of an Engineering Report

The components of an engineering report are:

Title Page The *title page* contains the title of your report, the name of your organization, sometimes your name (and your co-authors'), and the date.

Table of Contents, List of Figures, List of Tables These items are used in longer documents to guide the reader to specific parts of your report. They are not necessary for short documents (such as this article), but are required for engineering reports.

Executive Summary The *executive summary* is a synopsis of your report. It is the first place readers (especially non-technical types) turn for information before detailed reading of the report. Also, others who are interested but are unable to evaluate your technical methods will often read the *executive summary* and *conclusions* to extract the information they need. The operative rule for the executive summary is: *Present no new information in the executive summary*, but feel free to incorporate anything already presented that you think is important.

Introduction The *introduction* of your report should establish the history and background of the project, that is, why it was done. It is vital to state clearly the reasons for the project and the objectives of the report.

Procedure The *procedure* documents the procedures used in your analysis and data base used in your project. Also, be sure to document the sources of procedures and data used in your study. Use this section to describe what you did and what data you used.

Results The *results* section of your report is where you describe what you learned during the investigation. Use this section to interpret your results. If you have few results, then it is sometimes permissible to combine the procedure and results section.

Table 1: Results of HEC-1 simulations.

Test	Q_p (cfs)	t_p (hr)	P_e (in)
5-year precipitation			
Test 1: Horton	735	1.1	1.74
Test 1: Smith	727	1.1	1.74
Test 1: ULR[1]	742	1.1	1.72
Test 3: Horton	634	1.0	1.20
Test 3: Smith	628	1.0	1.16
Test 3: ULR[1]	694	1.0	1.37
Test 16: Horton	380	1.0	0.69
Test 16: Smith	383	1.0	0.69
Test 16: ULR[1]	421	1.2	0.78

Conclusions The *conclusions* section is where you close the loop of the report. Restate your objectives and show how your analysis achieved the objectives. If you have recommendations, this is where they belong.

References The *references* section is where you list reference materials you cite in other sections of your report. Some organizations allow you to list reference materials not cited in your report; others do not allow references beyond those directly cited. I prefer that you include only those references cited in the report. Note that several bibliographic forms are acceptable.

2.2. Variations

Documents, like human beings, often refuse to conform to general rules. So, you can expect some documents to fail to fit the general guidelines presented above. When this happens, modify the standard form to fit your document. Usually, you will have an editor or editorial assistant to help you with reports. This person can give you advice and show you how to improve your writing.

2.3. Figures and Tables

Your readers will expect you to support your analysis and conclusions with facts. If you have a considerable amount of data, it is often convenient to organize these data into a table. Tables are excellent entities for presenting data, and are often used in appendices to document all data collected or used in a project.

For example, consider Table 1. Table 1 is an example of data presented in tabular form. In it are presented part of the results I developed during a recent research project. The objective was to show how use of different infiltration equations (calibrated using the same data set) has little impact on flood hydrographs. By examining Table 1, clearly little impact is seen in peak discharge (Q_p) for each test data set. Differences in Q_p is less than 10 percent. Furthermore, time to peak, t_p, differs by only one computational period, which is the resolution of the model used to compute the runoff hydrographs. Finally, the runoff volume is also within 10 percent for all tests. Therefore, little difference in predicted flood hydrographs occurs by using different infiltration equations, provided each equation fits test data.

Unfortunately, most human beings are unable to discern relations between variables by studying a table. If you are trying to present cause-and-effect relations, then use a figure. That is, use figures (graphs) to support your interpretation of results. Notice in Table 1 that the data could not easily be presented in graphical form.

For instance, consider the response of a watershed to a storm event (a hydrograph). The measured time series includes both precipitation and runoff. If you want to compare hydrographs, a table could be used. However, hydrograph ordinates could be compared more easily in a graph. An example of such a graph is shown on Figure 1. The comparison of time to peak discharge, as well as the general shape of the hydrographs, is easier using the figure than would be if these data were given in a table.

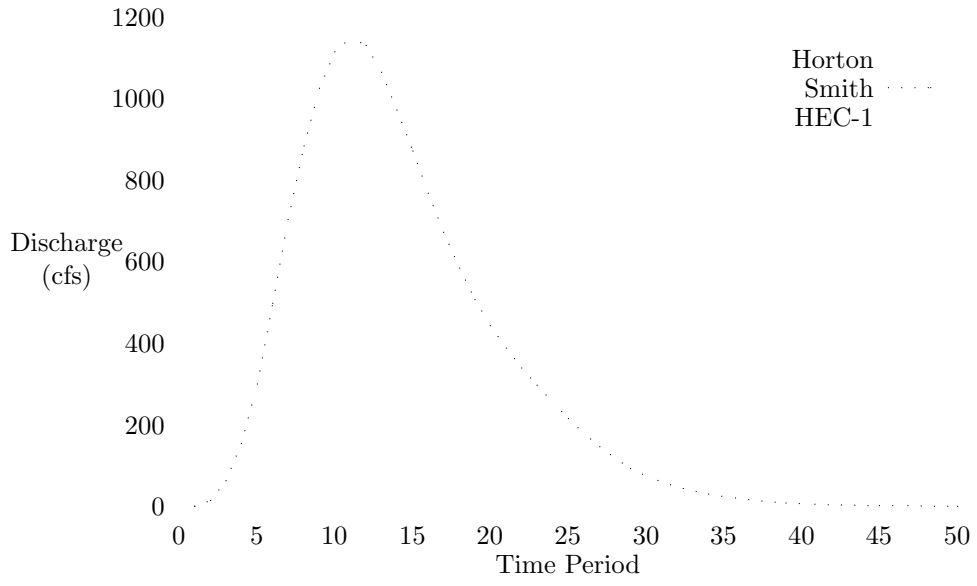

Figure 1: Hydrographs from 100-year storm event.

Be clever in your choice of figures. Often, many figures are drawn during the analysis phase of a project. Not all of these figures are required for the report. For instance, in the previous example, if you were more interested in the relation between precipitation and runoff, a plot of precipitation versus runoff (this is called a scatter plot) would make a stronger presentation than the time-series plot used as an example. If you wanted to present a relation derived to predict runoff from precipitation, then this graph would be better.

One note of caution is required: If you include a table or figure in your report, *be sure to refer to it in the text and direct the reader's attention to those details that the table or figure reveals.* That is, do not simply include a figure or table and leave the reader to his or her own devices to figure out why the figure or table is there; use each figure and table to reinforce your presentation. For more information, Edward Tufte (1983, 1990) wrote two excellent references on producing graphic material. Those books should be available in the library and are well worth reviewing. (They also have some beautiful charts and graphs!)

3. Writing An Engineering Report

Besides the report structure given above, you should spend some time thinking about the process you follow to produce a report. The time it takes to organize your results (and thoughts) is well spent and will help you produce a better report with less effort. I also suggest you obtain and read a copy of *The Elements of Style* by Strunk, Jr. and White (1979).

3.1. Before Completing the Study

Plan ahead for the report. Make notes of procedures you use (a journal or lab notebook is recommended for a lengthy investigation) and be sure to cite sources of these procedures. Keep your computations organized and be sure to date all computations and research. If you keep false paths or erroneous computations (which are sometimes of value), be sure to mark them as incorrect or superseded.

Begin an outline of your report. Use the computer to generate your outline. (You can use either a word processor or a outline processor for this task.) Much of the report can be written before the investigation is complete. This serves two purposes: you organize your thoughts early and record procedures used in your technical investigation.

3.2. After Completing the Study

Take time to review your technical work. Ensure your procedures were appropriate (one last time) and that all of your computations are correct. This is a good time to assemble

results into tables and figures you will use in your report. It is also a good time to begin thinking more about what you want to present.

3.3. Outline

Just do it. Remember that your focus is on organization at the highest levels of your report and on a complete and logical presentation of your technical work, results, and conclusions.

Although writing a good outline is difficult, if you keep good notes during the computational part of your study, you will probably have much of your outline done. Use the report format given above for the headlines. Fill in lower level headlines with the section and paragraph topics you want to present. Finally, fill in sentence level detail (not necessarily in complete sentences) so you have an idea of how your report will fit together. At this point, you should report to your supervisor (instructor or adviser in this case) and review the outline. You can expect to expend significant effort in organizing your thoughts for your outline.

Set your outline aside. I recommend you put the outline in your notebook for at least one night and sleep on it. Review it later and you will find several ways to improve the organization of your report. Remember, reorganization at this point in the reporting process is relatively easy. (It will not be as easy after you write the rough or final draft.)

3.4. Rough Draft

Use your outline to prepare a rough draft. Your focus is now on the clear and logical presentation of concepts, procedures, and results. This process requires work for good presentation.

Begin by transferring information directly from your outline to your word processor and completing incomplete sentences. This is the time to work your figures and tables into the report. Reorganization of sections and paragraphs is appropriate.

If you did not write a good outline, then writing your rough draft will be much more difficult. Not only will you have to consider how to present your thoughts (and deal with the mechanics of writing them clearly), but you will have to organize your presentation as well.

Set your rough draft aside. Again, I recommend you put aside your rough draft for at least one night and sleep on it. A fresh look after a good night's sleep (or a few days rest) is invaluable.

3.5. Final Draft

Review your rough draft for organizational problems, grammatical and spelling errors, and clarity. Your focus is now on polishing the report into a finished product.

Correct deficiencies in your rough draft. When you are satisfied with your report, find a friend or colleague to read the report for you. Ask them to mark errors of grammar and diction. Ask them to mark passages they find difficult to understand and ask them to note any organizational problems they find.

Review their comments and correct the problems discovered by your reviewer. At this point your report should be ready to turn in (or for publication).

Whenever you have someone review your writing, you will learn something. Those items a reviewer notes as problems aren't always as important as the simple fact that a section of your report is questioned. That is, when a part of your writing is questioned, look very carefully at that section. You will often find that the problem isn't just with your writing, but that your logic or presentation is faulty and can be improved substantially.

Most organizations formalize their review process; that is, they require a specific process to be followed for an author to publish a report. My previous employer (the U.S. Geological Survey) has an extensive review process. Reports are reviewed informally at the author's site, then subjected to a rigorous colleague and technical office review system to ensure that publications are technically correct and accurate.

References

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