

# Dissertations and Theses: An Introduction to Style and Organization

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## **Abstract**

This article is an introduction to organization and writing of the thesis or dissertation. The article introduces and expands on the parts of a thesis: The front matter, the body, and the end matter. In the article, the Texas Tech University (TTU) official formatting requirements are discussed, but reference is directed to the actual TTU documents. It is suggested that acquisition of the official TTU documents is an integral part of the writing of a thesis or dissertation. This article presents one approach (Thompson's) to construction of a thesis or dissertation. Also presented are suggestions for writing a thesis.

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## 1. Introduction

As a graduate student, you are likely to find yourself working on a research project for one of your professors. If you are reading this, then that is almost certainly the case. Your research work is likely to culminate with production of a thesis or dissertation that will be part of your requirements for graduation. The thesis is a technical document intended to describe a significant research project. The term *thesis* is a general term. A master's candidate will produce a thesis. A doctoral candidate also produces a thesis, but the doctoral thesis is often referred to as a *dissertation*.<sup>1</sup>

Every organization has a concept, and often a formal format, for each type of document produced by the employees of that organization. For theses produced for Texas Tech University, the formal format for the document is presented on the Graduate School website.<sup>2</sup> These documents provide the format you should follow as you prepare your thesis. The effort invested in reviewing the preparation and formatting guidelines will pay off when the document is reviewed by the graduate school representative charged with quality control.<sup>3</sup>

In addition, access to additional style guides is useful. 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.<sup>4</sup> Finally, the University of Chicago Press Staff (2003), is an important reference document for writing of any kind.

The purpose of this article is to introduce the idea of a style (or format) for theses and dissertations.<sup>5</sup>

## 2. Thesis Organization

A thesis is organized into a series of chapters and sections intended to provide all information needed by a reader to understand the conclusions of your research work. Because your target audience has a broad range of technical understanding, your thesis 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 thesis for procedures and conclusions derived through your study; these are technical users. However, the public (a non-technical audience) may also read your thesis 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.

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<sup>1</sup>Doctoral students are *special*.

<sup>2</sup>See <http://www.depts.ttu.edu/gradschool/thd.php> and <http://www.depts.ttu.edu/gradschool/THDManual.htm>.

<sup>3</sup>Many years ago, when I worked as an independent contractor preparing figures for publication, I saw many students go through the process of writing their thesis only to have it returned to them by the graduate school representative for formatting and stylistic errors that could have been avoided by a simple reading of the instructions. Do not make this mistake and suffer the frustration of having an unnecessary redo of your work.

<sup>4</sup>See <http://www.asce.org/authors>.

<sup>5</sup>The most up-to-date version of this document can be found at <http://shelob.ce.ttu.edu/daves/class-stuff/thesis.pdf>. My web site is generally well-maintained.

## 2.1. Parts of a Thesis

A thesis, like many documents, comprises three parts: The *front matter*, the *body*, and the *end matter*. The front matter contains materials necessary to navigate the document. The *title page*, *foreword*, *table of contents*, *list of figures*, and *list of tables* are contained in the front matter. The body of the thesis contains the *chapter material*, a sequence of chapters that describe the importance of the work, what was done, and what was learned. The end matter is where the *references* and subordinate material is placed.<sup>6</sup> What follows is a more complete outline, including what I think the chapter layout should look like.

**Front Matter:** The *front matter* of a thesis is organizational and the intent is to direct the reader to the important parts of the document. The parts of the front matter are:

**Title Page:** The *title page* is specified by the university. In the case of Texas Tech, the graduate school produces the title page on request by the student.

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

**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 thesis. They are not necessary for short documents (such as this article), but are required for theses.

**Body:** The *body* of the thesis is where all the *good stuff* goes. That is, the body of the thesis contains a series of chapters in which are described the work and the outcome of the research:

**Introduction:** What follows the front matter is a series of thesis chapters in which a story is developed. The story starts out with an *introduction* where you should establish the history and background for the project, that is, why it was done. It is vital to state clearly the reasons for the project and the objectives of the thesis. In many cases, the thesis review committee will ask questions pertaining to the objectives stated in the *introduction*. It is imperative that the objectives be clearly stated in the introduction, and then again in the conclusions.

**Literature Review:** The *literature review* chapter is the place to summarize the results of others who worked on the problem or on a similar problem. It is important to uncover all important literature and summarize the work and results before establishing your procedure. The previous literature sets the stage for the important work you are about to describe.

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<sup>6</sup>According to the Texas Tech University graduate school, the components of a thesis are as presented in this article. Other universities will have other specifications, but the process is the same and the content and organization will be quite similar to what Texas Tech uses.

**Procedure:** The *procedure* chapter documents the methods and materials<sup>7</sup> used in your analysis and the database 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* chapter of your thesis is where you describe what you learned during the research. Use this chapter to interpret your results. If you have few results, then it is sometimes permissible to combine the procedure and results section. Be sure to consult your thesis advisor if you are tempted to consolidate the *results* and *procedure* chapters.

**Conclusions:** The last chapter in a thesis is the *conclusions*. In the conclusions close the story. Restate your objectives and summarize how your analysis, that is your procedure and results, achieved the objectives. If you have recommendations (and you surely will!), this is where they belong.

**End Matter:** In the *end matter*, the final materials needed to complete the thesis are presented. This is where the references are placed and any appendices that are needed to supplement the work presented in the body of the thesis:

**References:** The *references* section (not a chapter) is where you list reference materials cited in other sections of your thesis.<sup>8</sup> For a thesis, list only those references cited in the document, but be sure you list **all** your citations in the references.

**Appendices:** Sometimes a place is needed for materials of record when placing them in the body of the thesis would interrupt the flow of the story. In such cases, use one or more appendices to present these materials. Remember, your thesis advisor will insist that everything necessary to duplicate your results be present in the thesis. That means parameters and procedures necessary for replicating your computations need to be somewhere. If the body is not a good place for a large amount of material, then an appendix is the place to put those results.

The preceding concludes an overview of the organization of a thesis or dissertation. Other materials are often used to support assertions made in the text. These materials most often assume the form of figures and tables. Figures and tables are covered in the next section of this article.

## 2.2. Figures and Tables

Figures and tables are referred to as *floats* by printers. They are material used to illustrate results. 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.

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<sup>7</sup>Some thesis advisors use the term *methods and materials* in place of *procedure*. Whatever you use, be sure it is the term your thesis advisor wants used.

<sup>8</sup>Be sure to follow the guidelines for formatting citations. Most style guides are specific in this regard and the Texas Tech University thesis guidelines are no exception.

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: Uniform loss-rate	742	1.1	1.72
Test 3: Horton	634	1.0	1.20
Test 3: Smith	628	1.0	1.16
Test 3: Uniform loss-rate	694	1.0	1.37
Test 16: Horton	380	1.0	0.69
Test 16: Smith	383	1.0	0.69
Test 16: Uniform loss-rate	421	1.2	0.78

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 an ancient 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  $Q_p$  are 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 the test data.<sup>9</sup>

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 and charts) to support interpretation of results. Notice in Table 1 the data could not easily be presented in graphical form.

For instance, consider the relation between watershed drainage area and the time to peak discharge of the unit hydrograph. If you want to compare the timing parameter of a set of watersheds, a table could be used. However, the relation between time-to-peak and watershed drainage area is better presented in a graph. An example of such a graph is shown on Figure 1. These results could be presented in a table, but a figure is much better for the reader.

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 thesis. 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-

<sup>9</sup>Notice I used text to describe what I wanted the reader to extract from Table 1. This is important and your thesis readers will look for this text.

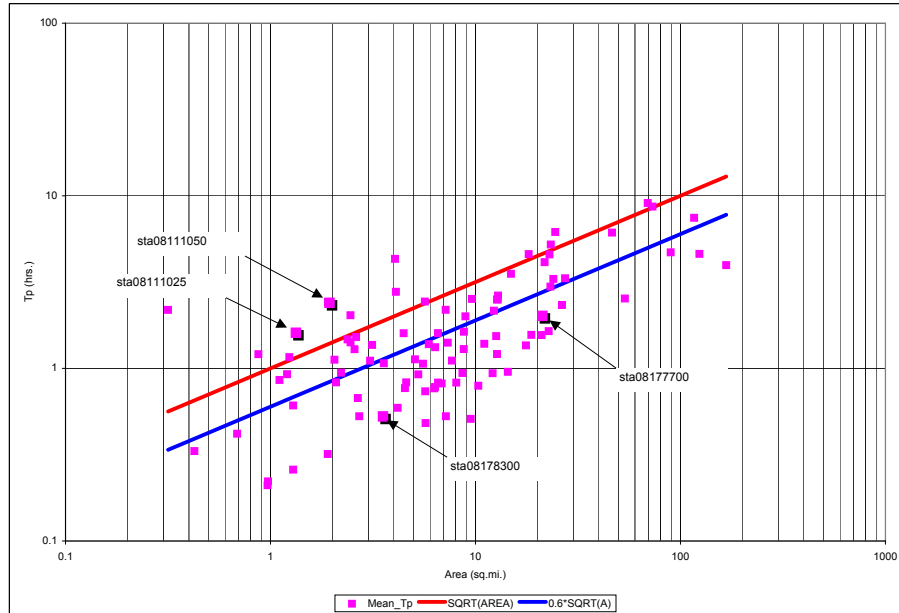


Figure 1: The relation of time-to-peak and watershed drainage area.

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 thesis, *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, Tufte (1983, 1990) wrote two excellent references on producing graphic material. Those books should be available in the library and are well worth reviewing. (Tufte's books also have some beautiful charts and graphs!)

### 3. Writing the Thesis

Besides the thesis structure given above, you should spend some time thinking about the process you follow to produce a thesis. The time it takes to organize your results (and thoughts) is well spent and will help you produce a better thesis with less effort. I also suggest you obtain and read

a copy of *The Elements of Style*,<sup>10</sup> Strunk and White (1979).

The thesis process looks something like this:

1. Selection of research topic
2. Development of the work plan
3. Literature review
4. Assembly of the database
5. Analysis of data (execution of the research)
6. Synthesis of results
7. Reporting (the writing phase)

These topics could provide the material for a book, and maybe a book is needed. But this brief article is not a book and the remainder of this section will address the thesis-writing process.

### **3.1. Before Completing the Research**

Plan ahead for the thesis. Make notes of procedures you use (a journal or lab notebook is highly recommended for any 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 thesis. Use the computer to generate your outline. Much of the thesis can be written before the investigation is complete. The pre-writing of portions of the thesis serves two purposes: you organize your thoughts early and record procedures used in your technical investigation.

### **3.2. After Completing the Research**

Take time to review your technical work. Ensure your procedures were appropriate (one last time) and that all your computations are correct. This is a good time to assemble results into tables and figures you will use in your thesis. It is also a good time to begin thinking more about what you want to present. Furthermore, significant interaction with your thesis advisor is recommended. He or she can provide a lot of guidance on direction and quality control for your work.

### **3.3. Outline**

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

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<sup>10</sup>Maybe you should read it twice, or even three times!



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 thesis format presented in *Parts of a Thesis* 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 thesis will fit together. At this point, you should report to your thesis advisor 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 the outline later and you will find several ways to improve the organization of your thesis. 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 your writing by transferring information directly from your outline to your word processor and completing incomplete sentences. This is the time to work your floats into the thesis. 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.

You will probably not want to give your rough draft to your thesis advisor. The rough draft is for you. It is a foundation to stand on as you revise the rough draft and produce your first final draft.

One of my students asked "Where should I begin the writing process?" I suggest that the literature review can be written early in the project. You must review the journal literature as part of your initial work. So, go ahead and write up your observations and summaries of preceding work. Then, after generating an outline for the remainder of your thesis, I suggest writing the procedures chapter followed by the results chapter. The two chapters are inextricably related and reinforce one another. I would follow these two with the conclusions and recommendations and then clean up the remainder.

### **3.5. Final Draft**

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

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

Review their comments and correct the problems discovered by your reviewer. At this point your thesis should be ready to turn in to your first reader (thesis advisor) for review.

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 thesis 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.

At this point your thesis is ready for your thesis advisor. You should produce the best document you can before handing it over to your thesis advisor. If you do, the editing process with the thesis advisor should go relatively quickly and relatively smoothly.

Review is not just part of the university process. Most organizations formalize their review process; that is, they require a specific process to be followed for an author to publish a report.<sup>11</sup> The thesis review procedure is just another facet of the learning experience. The process should help you to become a better writer. Writing is one of the most important things an engineer does.

### 3.6. Iteration

It is likely that one or two iterations (perhaps more) between you and your first reader will be required before your first reader is satisfied with the thesis.<sup>12</sup> I've been part of the university for over ten years as a faculty member and about fifteen years before that as a student. The iteration of thesis review is a fact-of-life, so accept it.

However, if you do a good job of generating a clean final draft, then the process can be relatively smooth. It's well worth the investment of personal resources and makes the thesis advisor's job much easier when he or she receives a clean document for review. The process is significantly shortened with a clean document and the thesis will be passed off to the second (and others if necessary) readers more quickly.

### 3.7. Cleaning Up

Once the final draft phase of the thesis writing and review process is completed, then it's time to compile the table of contents, list of figures, and list of tables.<sup>13</sup> I am not familiar enough with

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<sup>11</sup>My previous employer (the U. S. Geological Survey-USGS) uses 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. I learned a lot from my thesis advisor. I learned more through the USGS review process.

<sup>12</sup>Sometimes this process is referred to as *exhaustion of the first reader*.

<sup>13</sup>An index is not usually part of a thesis.

Microsoft Word to know how it can be used to do these things. My favorite tool is  $\LaTeX$ , which keeps track of chapters, sections, subsections (and the lot), tables, and figures for me. Creation of the appropriate tables for reference to these items is as simple as including a single mark-up command, `\tableofcontents`, `\listoffigures`, or `\listoftables`. I like those capabilities—in fact, I like them a lot.

Another component of the clean-up process is page numbering. There are specific requirements for page numbers in a thesis too.<sup>14</sup>

## 4. Tools

If I were writing a thesis today, I would use  $\LaTeX$  Lamport (1994) and  $\BibTeX$  for the effort.<sup>15</sup> Implementations of these tools are available for just about every operating system and are relatively easy to install and make operational.

### 4.1. $\LaTeX$ and Friends

$\LaTeX$  and  $\BibTeX$ , as text-preparation tools, are superior to what is usually used, which is Microsoft Word, and can produce much nicer output. In addition, the management of citations, table of contents, and other components is mostly automated. While the tools have some learning curve (what tools don't?), the output produced by them is superior to what can be done with Word and other word-processors. In addition, most software associated with  $\LaTeX$  is open-source and free for the downloading.<sup>16</sup>

### 4.2. Graphics

A number of software packages are available for generating graphics for technical documents. I prefer output in either PDF<sup>17</sup> or TIFF<sup>18</sup> formats. These formats are easy to include in  $\LaTeX$  documents (TIFF graphics work well for Word documents too). On the Windows platform, I use a software called `DPlot`.<sup>19</sup>

For many purposes, the R software language<sup>20</sup> can be used. R can produce serious statistical graphics

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<sup>14</sup>These requirements are well-documented in the TTU thesis-preparation instructions.

<sup>15</sup>I use  $\LaTeX$  and  $\BibTeX$  for as much of my writing as I can.

<sup>16</sup>That does not mean the tools are easy to use. I have several books I refer to regularly when preparing text using  $\LaTeX$  and appurtenant tools. These references are necessary to accomplish work.

<sup>17</sup>The Portable Document Format (PDF) is a form of PostScript suitable for electronic dissemination of documents. It is natively supported on the Apple OS X operating system and Adobe reader clients (<http://www.adobe.com>) are available for most computer platforms. In addition, Adobe Acrobat has some powerful tools for manipulating PDF documents. This includes editing the documents with comments and corrections.

<sup>18</sup>The Tagged Image File Format is also relatively portable and patent-free.

<sup>19</sup>The official web site for `DPlot` is <http://www.dplot.com>. The software is inexpensive and well-supported.

<sup>20</sup>The R-project is an open-source software project developed to produce a sophisticated statistical analysis and

as well as ease computation of most statistical analyses. R is also available on many computation platforms.

On the Macintosh platform, I've been using Kaleidagraph<sup>21</sup> for most of my work. Like DPlot, Kaleigraph is a commercial program for producing graphics on the Mac.

## 5. Thompson's Quirks

It's true that I have a few idiosyncrasies about writing. I'll write more later after I have a chance to think about it...

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modeling environment. The official web site is <http://www.r-project.org>.

<sup>21</sup>The web site for Synergy, the make of Kaleidagraph, is <http://www.synergy.com>.