

13 Thesis

This chapter covers:

- The purpose of a thesis
 - Difficulties of writing a thesis
 - Writing up as a process to be managed
 - To write up as you go along or at the end?
 - Stages of the final write-up
 - Structure of a thesis
 - Elements likely to be needed
 - Other possible useful sections for a thesis
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Note: Much of the material in Chapter 6, *A Journal Paper*, is also relevant to the writing of a thesis.

Purpose of a Thesis

To show to a very small number of expert assessors (probably fewer than five) your competence in pursuing and writing up a body of independent research.

Implications of this:

- Your writing should be aimed at a level appropriate to experts.
- The main material of your work will be – or may have already been – written up as conference or journal papers. The papers will represent a concentration of the work in the thesis.
- The thesis therefore needs to describe all of the work you have done, without being a blow-by-blow account of every piece of data you collected.

Difficulties of Writing a Thesis

1. The sheer size of a thesis

One essential difference between a thesis and any other piece of graduate writing is that of size. Because of this, a thesis is for many people a worrisome event at the end of the experimental work. Very few graduates enjoy writing up their work more than actually doing it; to many, writing up can be a stressful process. It can also take very much longer than expected.

For these reasons, **leave more time to write up than you would expect it to take, especially for a Ph.D.**

2. File handling

Because of the ultimate size of the document, it is worthwhile consulting an IT specialist for information about file handling, importing graphics and so on.

3. The need for backups

This can't be stressed enough.

In every institution, there will be stories about disasters occurring from files not being backed up. In spite of this, it is still remarkable how casual people can be about adequate backup. Ideally, keep backups at different locations (e.g. work and home) and update them regularly – at least once per week.

An effective way of scaring yourself into backing up fully and frequently is to make a mental list of all the ways you could lose your files:

- Burglary of your home or institution
- Theft of your car
- Viruses
- Collapse of the hard drive
- USB failure or loss
- Power supply failures
- Errors by other people using the same computer and so on.

How to Write it: Writing Up as a Process to Be Managed

To write up as you go along or at the end?

Supervisors often try to encourage students to write up while doing the experimental work. Is this a good thing to do?

Advantages of writing up as you go along:

1. You are writing something up while it is still fresh in your mind. This shouldn't be underestimated. It is very easy to forget after a year or so the details of a procedure that was once second nature to you.
2. It lessens the burden of a massive piece of writing at the end.

Advantages of leaving it until the end:

1. It is often difficult enough to keep up the momentum of the experimental work, without having to deal with writing as well.
2. If you hate writing, it allows you to put it off.
3. Students have commented that it is a waste of effort if you don't know what you're talking about at that particular time. This is an instance of gaps in your knowledge, not of muddled thought; understanding of a topic and its implications usually increases with time.

4. **Keeping records.** If you do leave it until the end – as many do – it is essential that you keep exceptionally comprehensive records of your work in progress. It is horrifying what you think you'll never forget, and then do so.

Conference or journal papers

If you have already written up papers from your work, you'll find that this will help to tighten ideas about how to process your thesis.

Stages of the final write-up

1. **Keep in mind what you've done, how you've done it and what's new about your research.**

2. **Work out a basic structure for your thesis.**

There will be several ways in which your work can be structured. You need to work out the optimal way to present *your* material. It may be quite different from that of other people in your work group. Given the mass of information that you are likely to have by the end of your experimental period, deciding on an appropriate structure can be a problem. Many people find that while they can't work it out, they can describe it adequately to a friend; this person could take notes for you or use a voice recorder. See *Structure of a Thesis*, this chapter, page 147.

Using the *Outline mode* and *Master Document mode* of Microsoft Word®

It is worth becoming familiar with the *Outline* mode of Microsoft Word®. This mode will help in the initial organisation, revising and editing of your document. See **The Outline Mode of Microsoft Word®: Organising a Document**, Chapter 1: *Structuring a Document: Using the Headings Skeleton*, page 11.

You can also use the *Outline* mode in conjunction with the *Master Document* mode. A master document is a 'container' for a set of separate files (or subdocuments). You can use a master document to set up and manage a multipart document, such as a thesis with several chapters. For example, you can view, reorganise, format, proof, print and automatically create a *Table of Contents* for multiple documents treated as a whole.

3. **Draw up a preliminary outline of headings and subheadings.**

It will look like a *Table of Contents* without the page numbers. See *Table of Contents*, Chapter 2: *The Core Chapter*, page 23.

Work out your system of headings and subheadings. But keep it flexible; it's very much an iterative process, and you'll need to keep changing it as your ideas evolve. The worst way to work with an outline is to try to shoehorn your ideas and results into an initial rigid structure.

Your initial *Table of Contents* may not bear much resemblance to your final one. You can only do it as far as you can see. The final *Table of Contents* and the finalised structure may take its final form only very late in the write-up.

4. **Write the easiest parts first.**

This is usually anything to do with experimental procedures (see **Materials and Methods**, Chapter 6: *A Journal Paper*, page 93, and Chapter 2: *The Core Chapter*, page 36).

If you are dealing with complex mathematical solutions, you may find that writing the material for your Appendices, where lots of derivations may be needed, can help in clarifying your thoughts.

5. Other late stage tasks.

Graduates say that most of their time is spent working out how to analyse and present their data optimally. Some of the tasks involved are:

- a. Thinking about what the data means.
- b. Considering how it relates to the published literature.
- c. Deciding how to discuss it accurately and succinctly.
(You'll probably find that you can't think about these three things for more than a few hours at a time.)
- d. Reading the current literature.
- e. Analysing the data and presentation:
 - Everything in a science or engineering thesis hinges on how you analyse and present your data.
 - If you have large spreadsheet files, it may take days on each file before you can finally work out how to present the data optimally.
 - After you know what your data are saying, the linking text should readily follow.
- f. Spending a great deal of time on the final formatting.
- g. Rewriting, losing the file(s) and so on.

6. Writing the literature review.

The literature review needs to be written as one of the final stages of the process because your understanding of the interconnections within the literature and of your work will increase with time. It also needs to incorporate the relevant literature that appears immediately before submission of your thesis.

For these reasons, the initial literature review that you may have written at the beginning of your research will be inadequate for your thesis. See Chapter 4: *A Literature Review*, page 63.

7. For referencing: Tables can be an effective way of presenting large amounts of material.

Tables can be very useful in the following, e.g.

- A section called **Review of Methods**, particularly for mathematical work. The references can be effectively tabulated, so that the various mathematical methods of solution are displayed alongside their author(s).
- The **Literature Review** or **State of Knowledge**. As an addition to the text, it may be worth considering using a tabulated presentation to summarise the content of each of the relevant papers.

Date	Author(s)	Title	Comments	Reference Number
Listed chronologically			Your comments on the content of the paper.	If the numbering system of referencing is being used (see page 171), the unique number is used in the text and the <i>List of References</i> .

Various headings in the list of the cited papers could be used. For example, the general review books and papers could be listed first, followed by other sections appropriate to the topic, with papers listed chronologically in each section.

8. Revising and proofreading the thesis.

For the guidelines for revising and proofreading, which are both essential processes to ensure a professional document, see Chapter 17: *Revising*, page 169.

9. Formatting for appearance.

Your institution will have specific regulations on aspects of formatting.

If your thesis topic is one where there are a number of related previous theses, then you have a good range for getting ideas of formatting, style, requirements and so on. But be cautious if there are only one or two: you won't know whether they are good models. Errors tend to be propagated in this way.

Specialist textbooks are good models for structure, headers and footers, formatting and so on, particularly if you are printing your thesis two-sided.

Allow much more time than you would imagine for the final formatting processes and adjusting of the illustrations. The amount of time needed takes most people by surprise.

Structure of a Thesis

Also read Chapter 1: *Structuring a Document*, page 3, for the following information:

1. The basic skeleton of section headings (page 3)
2. Choosing section headings: building an extended skeleton (page 5)
3. The *Outline* mode of Microsoft Word®: organising a document (page 11)
4. The importance of overview information: building a navigational pathway through your document (page 12)
5. Deliberate repetition of information in a document (page 14)

Elements Likely to Be Needed in a Thesis

The elements that a thesis should probably contain are those of the standard skeleton and several from the extended skeleton.

See the following:

- **The Basic Skeleton of Section Headings and Building an Extended Skeleton**, Chapter 1: *Structuring a Document*, page 3.
- **Other Possible Useful Sections for a Thesis**, this chapter, page 150.

Element	Purpose in a Thesis	Cross-Reference to Relevant Part of This Book
Title	To adequately describe the contents of your document in the fewest possible words.	See Title , Chapter 2: <i>The Core Chapter</i> , page 19
Main Abstract or Summary	To give the reader an overview of all of the key information in the thesis: objective, methods, results, conclusions, contributions to originality.	Chapter 3: <i>Abstract/Summary/Executive Summary</i> , page 53
Acknowledgements	To thank your supervisors and the other people who have given you help in your research and in the preparation of your thesis.	See Acknowledgements , Chapter 2: <i>The Core Chapter</i> , page 23
Table of Contents	Gives the overall structure of the thesis. Lists the sections, chapters, headings and (<i>possibly</i>) subheadings, together with their corresponding page numbers.	See Table of Contents , Chapter 2: <i>The Core Chapter</i> , page 23
List of Illustrations List of Figures List of Tables	To give a listing – separate from the <i>Table of Contents</i> – of the numbers, titles and corresponding page numbers of all your figures and tables.	See List of Illustrations , Chapter 2: <i>The Core Chapter</i> , page 26
Glossary of Terms and Abbreviations or List of Symbols	To define the symbols, terms and abbreviations (including acronyms) that you use in the main text of the thesis.	See Glossary of Terms and Abbreviations , Chapter 2: <i>The Core Chapter</i> , page 27
Objectives	To give the main aims of the research.	
Introduction (<i>or</i> the introductory material under various headings)	<ul style="list-style-type: none"> • To clearly state the purpose of the study. • To allow readers to understand the background to the study, without needing to consult the literature themselves. • To describe the historical development of the topic. • To provide a context for the later discussion of the results. 	See Introduction , Chapter 2: <i>The Core Chapter</i> , page 28 And Other possible useful sections , this chapter, page 150

Element	Purpose in a Thesis	Cross-Reference to Relevant Part of This Book
Literature Review (if the literature is not surveyed in the <i>Introduction</i>)	<ul style="list-style-type: none"> • To show that you have a good understanding of the historical development and current state of your topic. • To indicate the authors who have worked or are working in this area, and to describe their chief contributions. • To indicate correlations, contradictions and gaps in the knowledge, and to outline the approach you will take with respect to them. 	See Chapter 4: <i>A Literature Review</i> , page 63
<i>Other Sections Appropriate to the Topic</i>		
Chapter Summaries	To give an informative (<i>not</i> descriptive) overview of the material in each chapter. For definitions of informative and descriptive, see Chapter 3, <i>An Abstract, a Summary, an Executive Summary</i> , page 53, and Chapter 6, <i>A Journal Paper</i> , page 88	See below, page 151
Overall Conclusions Chapter Conclusions	To give an overview of the conclusions drawn from (1) the whole work or (2) each chapter.	See Conclusions , Chapter 2: <i>The Core Chapter</i> , page 39
Recommendations (<i>if appropriate</i>)	To propose a series of recommendations for action.	See <i>Recommendations</i> , Chapter 2: <i>The Core Chapter</i> , page 40
Recommendations for Further Research (<i>if appropriate</i>)	To propose directions for further development of your work.	See <i>Suggestions for Future Work</i> , Chapter 2: <i>The Core Chapter</i> , page 41
List of References	A list of the works that you have cited in the text. Strict conventions govern this process.	See Chapter 15: <i>Referencing</i> , page 169
Appendices	For complex material that would interrupt the flow of the thesis if it were to be inserted into the main body, e.g. raw data, derivations, detailed illustrations of equipment, coding, specifications, product descriptions, charts and so on.	See <i>Appendices</i> , Chapter 2: <i>The Core Chapter</i> , page 42

Other possible useful sections for a thesis

(Note: All of the sections below can also be used as subsections of the *Introduction*.)

1. Statement of the General Problem

A statement of the problem that the thesis work is designed to address
or alternatively:

Objectives or **Aim of the Study** (see **Objectives**, Chapter 2: *The Core Chapter*, page 30).

2. State of Knowledge

A summary of the present state of knowledge in the area. Another name for a *Literature Review*, perhaps more appropriate to a major work such as a thesis. See Chapter 4: *A Literature Review*, page 63

3. Contribution Summary

A summary of the areas of advancement or originality contained in the study.

4. Scope of the Study

The areas that were and were not studied; the limitations of the study.

5. Thesis Structure

A brief description of the various sections of the thesis and what they contain. This is likely to need descriptive statements rather than informative ones. See **Descriptive/Informative**, Chapter 3: *An Abstract, a Summary, an Executive Summary*, page 55

Example

Note the phrases used are those of descriptive rather than informative statements (*discusses, is stated, is described, deals with, gives a review of, chronologically surveys* and so on).

Thesis Structure

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Chapter 3 discusses the integral boundary-layer methods used to calculate the viscous component of the study. The boundary-layer equations and other associated definitions are stated. The implementation of Thwaites' (1949) laminar integral boundary-layer method is described and validated against an experimental velocity distribution...

Chapter 4 deals with the interaction between the inviscid and viscous flow components. It gives an extensive review of available interaction schemes, the methods used to match the two flows and chronologically surveys over 30 viscous-inviscid interaction studies.

Chapter 5... etc.

6. A **Model Algorithm** as a map of the whole thesis.
7. **Each chapter should have the following:**
 - a. **A chapter *Summary***
 - This gives an overview of the material in the chapter. See Chapter 3: *An Abstract, a Summary, an Executive Summary*, page 53
 - **Placed at the beginning or the end of the chapter?**

The optimal position for the assessors is for the summaries to be placed at the beginning of the chapter because this helps them to assess the rest of the information (see **The Importance of Overview Information**, Chapter 1: *Structuring a Document*).

Summaries have traditionally been placed at the end of chapters, but this is not the best position for the readers' understanding of the chapter.
 - ***Suggestion:*** also copy all of the chapter summaries to make a chapter of their own. This can provide a useful overview that is more detailed than the main *Summary*.
 - b. **A set of *Conclusions***

If appropriate to the material, a set of *Conclusions* at the end of a chapter reinforces the material in the assessors' minds and should form part of the intellectual pathway into the material in the next chapter.
 - c. **At the very end of each chapter, probably immediately after the *Conclusions*, outline what the next chapter covers.**

The assessors' understanding of the current chapter is helped by the knowledge of how this chapter will lead into the next one.

Checklists for the Sections of a Thesis

Use the various checklists for the relevant elements in the following:

Chapter 2: *The Core Chapter*

Chapter 6: *A Journal Paper*