Report Writing Notes

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Preface

This is only a draft document; there is still a lot of work to do on it. For now, it will provide some useful info for you. Remember that this is an unofficial document, so if you're asked to do something a different way then just accept it, and don't try to use this to argue about marks. It is written in a casual and easy to read manner. In addition to this, note that the Learning Centre at UNSW[1] provides a wealth of information which may be useful.

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1. Document headings

1.1. Abstract

For a 10 to 20 page document, use a '*three sentence abstract*' that aims to follow the most succinct formula: Essentially the first sentence is like an introduction, it answers the question 'What is the problem?' The second sentence is a summary of the experimental method and theory, answering 'What was done about it?' Finally, the last sentence is like a miniature conclusion, answering 'What happened?', or sometimes, 'what is going to happen?' There may be an extra sentence or so added here depending on the nature of the work, and the sentences usually comprise multiple clauses. Some basic rules for abstracts are: the shorter the better; three to four sentences are optimum for most student reports; do not use bullet points or lists; if you have some very relevant quantitative result, such as "25% improvement…" try to include it; and lastly, write it in the past tense, it is a summary of work you *have done*, not work you are yet to do.

1.2. Introduction

There seems to be a large amount of confusion as to the purpose of the introduction and how it should be written. All too often do students write introductions that look like abstracts, and abstracts that look like conclusions. In general, the introduction is the only opportunity to write with more casual language, and this should be exploited in order to get the readers attention and focus. Fundamentally, the purpose of the introduction is to *introduce* the topic area – a concept that seems to be lost on most. The key work here is *context*; the reader must be able to connect this work to the real world and to succinctly lead the reader to the purpose of the work being documented. In doing so, the introduction should trend towards expression of the objectives of the work being done (try not to list your aims).

Do not write the introduction in the future tense. The work *has been completed*. Start by outlining the general area, and then develop the problems that have lead to the current work.

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[1] http://www.lc.unsw.edu.au/olib.html

One paragraph is usually sufficient for this (around five sentences), considering the reports are usually only ten pages.

1.3. Equipment and experimental method

The documentation of experimental equipment and method often highlights the misunderstanding that students have of the actual purpose of an engineering report. To get full marks for a report-like assignment you do not have to be a mind-reader. Ask yourself the question: '*is the inclusion of this important?*'. If the answer is 'yes', then it must exist in either the body of the report, the appendices, or be accessible via the references. Similarly, you must be careful to avoid the inclusion of irrelevant or trivial information, and present your work in the most concise manner that is practicable.

1.4. Results

Again, the approach to inclusion of results is quite logical. If you have a large number of data points for some particular experiment, then it is more efficient to present it as a graph. If the graph clearly presents those results, then the inclusion of the raw data is probably not necessary at all. If there is some particular reason why that raw data is of importance to the reader (and this may be because there are marks for it), then place it in an appendix and refer to it in the body text. Think of your report as being like a novel: the inclusion of results in the body text is only necessary if it is important to the storyline.

Results are not to be confused with the method you used to solve the problem. Your efforts themself do not count as results, purely the outcome of your effort. Particular note should be taken with regard to submission of code. Your method in this case is the construction of the code in such a manner so as to solve the problem. In most cases, pseudocode is sufficient; exceptions include the use of particularly complex data structures or finite state machines. In this case diagrammatic representations are preferred. Flowcharts are highly recommended for finite state machines. Code itself should thus never be placed in the body of the report, purely in the appendices and only then by request of the assessor.

The result of a coding project is thus the result of tests run using the implemented code. If the code generates output, which is usually the case, then the relevant sections should be recorded and comprehensively annotated. Valid results should be presented succinctly with explanation deferred to the discussion section. Implementations which do not work should state so briefly and leave explanation to the discussion section. Including both quantitative – a relative or general description of the data – and qualitative – a numerical analysis such as % error or amount of overshoot – results which demonstrates a reasonable level of insight into the analysis.

1.5. Discussion

This is where the real analyses of results preside. The discussion gives the writer an opportunity to write in a less structured manner (hence the name: discussion). Here you want to, generally, discuss significant errors and the reliability of results, and also begin to draw conclusions from what has been observed and presented in the results. This is where your analytical skills and technical insight are put to the test. Surprisingly, this is usually the best written of all the sections as there seems to be little misunderstanding as to the purpose of the technical discussion.

1.6. Conclusions

The conclusion is written concurrently with the introduction, and is not the last thing to be written (that is usually the abstract). The conclusion should be approximately the same size as

the introduction, and can usually be written in one paragraph (for standard reports). The conclusion should never introduce new points or arguments: this is the job of the discussion. A good conclusion can be seen to agree with all the objectives that were set out in the introduction. Remember that in experimentation a good result is not necessarily a successful result, rather it is one with which some conclusive result can be drawn. A result that is erroneous to the point that it cannot be used is therefore a bad result. Try not to list things or use bullet points here, these styles are for the body. This conclusion is summarised to produce the last one or two sentences of the abstract.

1.7. References

Many students make it all the way to their thesis write up without having used a single reference properly, if at all. Referencing is your friend. In formal works, referencing becomes a very important aspect of the presentation of information. It allows the writer to state information as fact, and justify it in context with little disruption to the flow of the document. Of course, it also provides the facility of being able to present more complex ideas in a more practical and concise manner. Students should get used to good referencing as early as possible and try to exploit the benefits of it in their report writing. The Learning Centre at UNSW[2] provides a wealth of information regarding referencing.

1.8. Appendices

The appendices are not a dumping ground. Please remember this. The purpose of appendices is to be able to move information from the body of the report, which would otherwise disrupt the flow of the document, to somewhere where it is still readily accessible should the need arise. You must also remember to refer to, somewhere in the text, everything that is in the appendices. If you present a graph of a long series of data points, then the original data need not be included in an appendix should they serve no other significant purpose. Use your discretion in mind of brevity.

2. Document generation

Document generation today is expected to be done via word processor, offering significant benefits to all parties involved. There are essentially only two choices when it comes to generation of engineering reports, these are as follows:

2.1. LaTeX

Most undergraduates have never heard of this as it is becoming less popular due to the significant advances in Microsoft's alternatives. *LaTeX* (pronounced *Lay-tech*) is used widely by academics, and chances are that your subject notes were created using it. Essentially the entire program is written in plain text (similar to using *Notepad*) with different commands used to define different parts of the text. It can take a while to learn but is the easiest way of producing high quality documents. However, if you have Word 2003 or later, there is nothing that you can't do that *LaTeX* can. For the average undergrad, the absent features won't be missed.

In general, no young undergraduates ever use *LaTeX*, primarily due to the fact that they just haven't heard of it. For this reason, only MS Word is really dealt with in this report.

[2] http://www.lc.unsw.edu.au/olib.html

2.2. MS Word

Microsoft's leading word processor is considered to be a WYSIWYG program (What You See Is What You Get), but really this is only because most people use it as a real-time compiler (print layout). Generally, users of *LaTeX* despise MS Word, and justifiably so, but this is usually due to them only having experience with older versions of Word and/or not really knowing how to use programs such as MS Word. XP can do everything *LaTeX* can do: sometimes it's faster, sometimes it's slower. In summary, MS Word is frustrating, and *LaTeX* is mind-numbing: take your pick! Each has benefits over the other and ultimately it comes down to what people have more experience in using.

2.3. Writing methodology

There are various possible approaches to producing your document. Assuming the use of MS Word, the first is the 'Notepad approach'. Basically this is the same approach as writing your document with *LaTeX*, where you commence writing plain, unformatted text in 'Normal' view, without concerning yourself with any format. This method avoids distraction and helps with writing continuity. A second approach is to build a document structure initially using headings and subheadings, inserting figures and graphs, and then 'filling in' the text. Whilst probably more time consuming, many people prefer this method because it helps consolidate in your mind the topic and structure of your writing.

2.4. Printing

Reports should always be printed single-sided on plain white paper (A4). Colour often aids a report if photographs are included, but don't sacrifice print quality for colour (a good B/W laser printer is far better than a colour Dot-matrix). Graphs should rarely rely on colour; however, if a document is being printed in colour then it can be utilised effectively. Though be warned not to use colour as a novelty; for example, having names or headings in some alternative colour may seem like it looks good, but it is quite unprofessional.

2.5. Presentation

Presentation is important as it is the first impression of your work. Always use 80 gsm white paper with a single staple in the top left corner. Avoid buckled and mutilated staples – in the ground floor copy room there is an electric stapler that can usually deal with larger documents, and if it's bigger yet, and you ask nicely, behind the counter is an even more powerful version. Avoid the temptation to use manila folders, plastic sleeves, presentation folders, or basically anything outside of a single staple. If you don't have access to a good stapler, then a clip of some sort is okay.

2.6. Cover Page

The School of Mechanical and Manufacturing engineering has standard specifications for title pages for written assignments given in the course outline. Typically, however, electronic submissions do not need a cover page.

3. Typesetting

Tragically, most students will not even know what this word means. A general definition states: 'Typesetting involves the presentation of textual material in an aesthetic form on paper or some other media'. For the interest of engineering students, this refers to fonts, headings,

formatting, page layout, headers and footers, and so much more that most people just aren't familiar with. It can get quite complex; but for engineers, these are life skills for professionalism. For markers of such reports, it is clear that the approach taken by students is more or less random.

3.1. Font

Some people like 'Arial', some people like '`Courier New`', and some people tend to choose 'random fonts' that look nice. The golden rule here is *don't choose*, just use 'Times New Roman', all the time, for everything from title to references (the appendix is beyond this). Engineers like TNR. It is sometimes suggested that Arial should be used for headings and TNR for body, but ultimately, don't! If you look at any engineering journal or papers, you will invariably find that the fonts are entirely TNR, Roman, or one of the TEX computer modern fonts: all of these are very similar, the most accessible of which is TNR (they are all also Serif and True Type fonts).

3.2. Heading tools

All headings throughout a document should be defined separately in some way to the body text of the document. If you have no idea what this means by the end of third year, you should start learning straight away. In *LATEX*, this is done by holding the headings in brackets and using preceding commands. In Word, this is done by selecting the text, or even just having the cursor in the particular paragraph (remember that a paragraph is anything starting on a new line), and then selecting what style this should be (in XP, there is a style menu that opens up to the right, in 2000 it exists in the formatting toolbar). Heading selection allows hierarchal document structure, automatic and easy-to-change formatting, automatic Table of Contents generation, and hyperlinks if documents are turned into PDFs.

3.3. Formatting

How do you decide what font size to use where? There are titles and different levels of headings, headers and footers and so on. There are bold, italics, underline, and all the combinations thereof. Do you put blank lines after headings or paragraphs, or indents at the start of new paragraphs? Well there are a few basic guidelines that can make this a lot simpler. You'll find most of these to be standard among journals, papers, and professional documents.

These are some ground rules:

- From abstract to the end of references, use nothing but 12 pt. Times New Roman for content, and 10 pt. TNR for organisational text (headers, footers, captions, foot notes, references). Do not use any font other than TNR in figures. If copying figures from Matlab, ensure the 'Plot Tools' capability is used to ensure the font is correct.
- Single spacing is sufficient for documents where the typesetting is done correctly and little comment is expected from the markers. Unfortunately, double spacing is required for thesis, which looks ridiculous, and 1.5 spacing is sometimes requested. 1.5 spacing looks better on poorly formatted documents; however between 1.15 and 1.5 spacing is usually appropriate for documents for which feedback on the text is expected.
- Use **bold 12 pt.** for first level headings, and *italic 12 pt.* for second level. You shouldn't need more than two levels of headings for anything short of a thesis.
- First level headings are preceded by a dotted number, and a space (without any tabs).
- Second level headings are preceded by two dotted numbers and a space (without any tabs).

- Paragraphs and headings of different styles should be followed by 12 pts of spacing (not a blank line).
- Body text paragraphs should start with an indent (not a manual tab), usually ¼ inch or 6.3mm. Don't separate paragraphs with blank lines.
- Body text should be justified (hugging left and right margins) and the use of hyphenation will eliminate ugly spacing from default settings (Tools> Language> Hyphenation… >Automatically hyphenate document in Word 2003; Page Layout>Hyphenation>Automatic in Word 2007) as shown on the previous line.
- Units of measurement should have a space between them and the number (percentage symbol, %, is not a unit of measurement, and is exempt from this rule).
- Use hard spaces (Control-Shift-space) where terms should not be broken between lines. This includes units of measurement and their corresponding number.
- Please be mindful that the number of significant figures is indicative of the accuracy of that number. In general, values should not be presented with more than three or four significant figures.
- Be wary of units such as MPa being changed into Mpa: it is wrong.
- Underline should seldom be used: it is a relic of the necessity of typewriters in being unable to produce alternative characters. The same applies to double spaces following full-stops: another relic of the typewriter. The need in that case was eliminated by the introduction of scalable fonts. Underline is used for web addresses.
- Avoid combination ***bold italics***: it looks bad. Similarly be wary of using ALL CAPS. It is far too striking and gives the impression that something is being SHOUTED! It is sometimes okay for headings.

3.4. Page layout

Page layout primarily concerns the paper size and page borders. For thesis submission, 4 cm on the left, 3 cm top, and 2 cm bottom and right. This allows for a margin where the document is bound to the left; however, standard assignments are only stapled so always use equal left and right margins. Remember, also, to only print on one side of the page. A sensible page border is one inch all round. Also, make sure when you are printing that you change the paper size from US Letter to A4; this is often the default and it's a common mistake, it will affect the borders of your document (in fact, it should be one of the first things you do).

3.5. Page numbers, headers and footers

Minimal use of headers and footers is the rule. People often like to put their life story in the header, please don't. Name, title, and date at most: all on one line. Use 10 pt. font, sometimes italics is appropriate, never put the page number in italics. For the page number, a single numeral in the top right corner is best. There is no need to write 'Page 1' or 'p. 1' or 'Page 1 of 13'. Open up any books you own and see how many you can find that write anything more than just a numeral.

In larger documents, it is also common to use capital Roman numerals for everything beyond the conclusion, and sometimes lower-case Roman numerals for everything before the introduction. This is generally only necessary for something the size of a thesis.

4. Inserts

4.1. Figures

Figures should be inserted with horizontal centring, and if possible, at the upper or lower margin. However, formatting this way is quite advanced; it requires 'locking' of the figure's position. In general, figures should be inserted and sized such that they take as little space as is possible (such that the image is still sufficiently clear). Text wrapping is rarely used. Remember that for such a short document, standard sequential numbering is most appropriate (e.g. Figure 1, Figure 2). Also remember that you can insert nice looking flow charts and basic diagrams by using the drawing tools in Word. Captions for figures (remember a graph is a figure, a table is not) lie below, and are centred. If the caption exceeds one line then it should be left justified with a hanging indent following the figure numbering. These captions should be in 10 pt. and not bold. Remember that if you right click a figure and select 'Caption…' then the text will be locked to the figure (i.e. it the caption won't appear on a different page to the figure). This applies to tables as well. Also remember that you can insert a 'cross reference' (Insert> Reference> Cross-reference…> Figure in Word 2003; Reference>Cross-Reference in Word 2007) for referring to figures and tables, that will auto update the numbering and act as a hyperlink to the figures in PDFs.

4.2. Graphs

The quality standard of Excel graphs produced by undergraduates is in need of improvement. Tufte [1] stated that "excellence in statistical graphics consists of complex ideas communicated with clarity, precision, and efficiency." And in striving to achieve this, the graphical work presents "*…the greatest number of ideas in the shortest time with the least ink in the smallest space.*" Fig. 1 presents an example of how not to present graphical data.

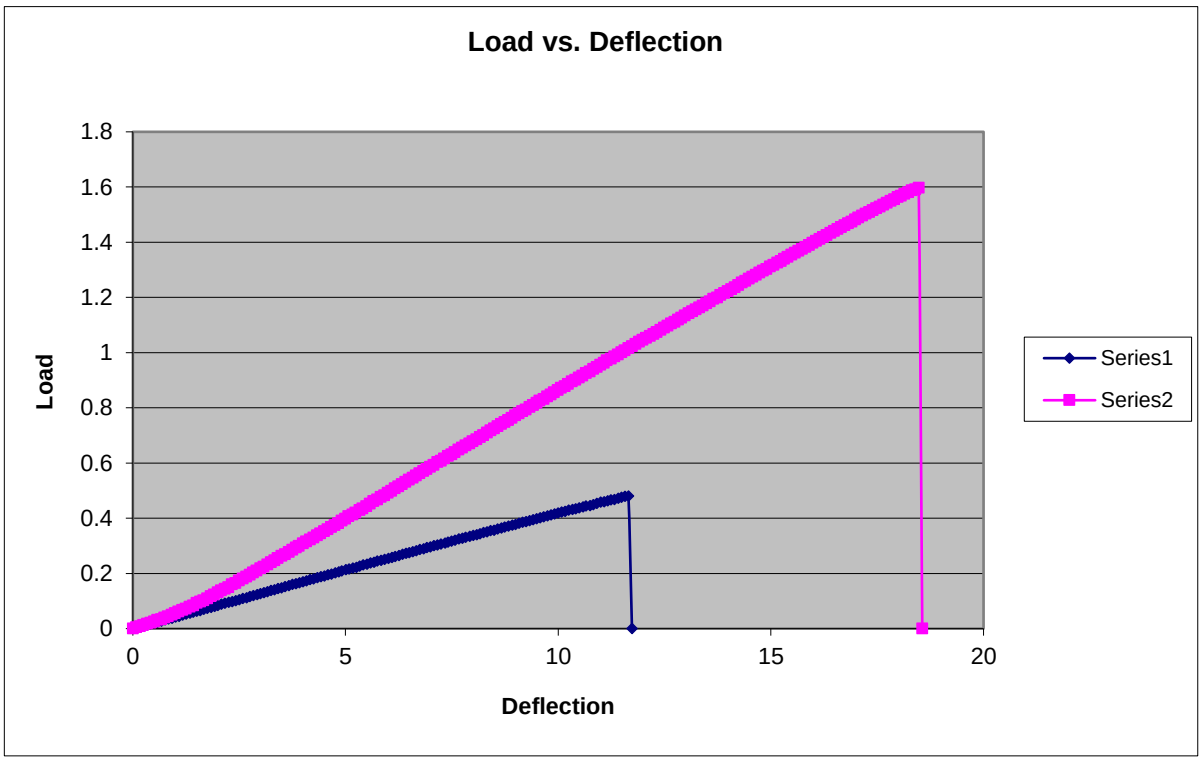

Fig. 1 Graph produced using default Excel settings.

This is, of course, produced using MS Excel 2003, and in this case the default settings are left untouched. If you're an undergraduate student, chances are this looks very familiar. In stark contrast, Fig. 2 shows the same graph, also in MS Excel, with various appearance settings changed and some other small additions. You should be able to figure out how to do this yourself. Please take note of *every* detail that has been changed. A horizontal to vertical axis ratio of 2/3 or 3/2 should be used if there is no other factor to be considered.

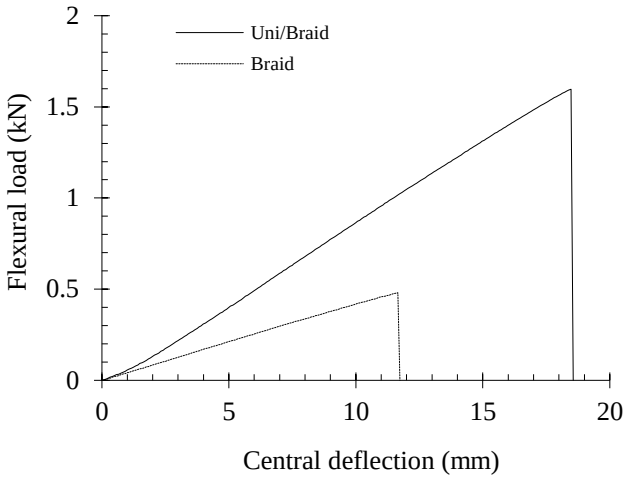

Fig. 2 The same graph, also produced using Excel 2003, with appropriate appearance.

4.3. Tables

Tables follow most of the same ground rules as graphs. It is standard practice to only show horizontal lines (Table 1). Tables included in the body text should be clear and relevant such that the reader will take note of most of the values included. Similarly, if a table appears in the body it must be referred to, and there is no need to restate any of the values in the text. The captions are above rather than below, and the text is always left justified.

Table 1. Note the table content is 10 pt. Times.

Variable	Result 1	Result 2	Result 3	Result 4	
	(Units)	(Units)	(Units)	(Units)	Change
Item 1	1.234	1.234	1.234	3.456	1.2%
Item 3	2.345	2.345	2.345	4.567	2.3%
Item 2	3.456	3.456	3.456	5.678	3.4%

4.4. Formulae

The default program for inserting equations in MS Word is Microsoft Equation. To use this function select Insert> Object…> Microsoft Equation 3.0 in Word 2003 or Insert>Equation in Word 2007. While this program is quite good for creating general equations, the program MathType (which Equation is built from) is far better. Eq. (1) below is an example of classic equation layout. This is the default insertion (including numbering) for MathType. Note the equation is centred (similar to figures) and a bracketed simple number appears to the right hand margin of the page. You can do this with tabs if you don't have MathType[3], but it is a hack

[3] www.dessci.com/en/products/mathtype/.

approach; there is a free demo online. Otherwise, move the cursor slowly along the line until it changes image to a few lines that are right justified; then click. This is a good feature to know regardless.

$$y(\theta) = \frac{1}{2\pi}\int_0^{2\pi}\sqrt{\frac{1}{\sin\theta}}d\theta \tag{1}$$

Where $\tilde{\sigma}$ is the stress vector, $\mathbf{D}$ is the stiffness matrix, and $\tilde{\varepsilon}$ is the strain vector. The paragraph following the equation (as demonstrated) usually describes the notation if it is not already summarised at the beginning of the document or described previously. Note also the reference made to the above equation is easily inserted using the features of MathType and will hence auto-update itself should an equation be inserted before it. In modern versions of Word, there is a built in equation editor that is now quite good. Some academics do not like the mathematical font Cambria. Here is an example:

$$y(\theta) = \frac{1}{2\pi}\int_0^{2\pi}\sqrt{\frac{1}{\sin\theta}}\,d\theta$$

You can compare this to the MathType object in Equation (1). Also notice how I just referred to an equation with a number that is also a hyperlink. Mathtype has a built-in tool for adding these links. For anything shorter than a thesis, equations should be numbered (1), (2), (3) etc, don't let ridiculous defaults like (1.1.2) sneak in. Same goes for figure and table numbering.

5. Language

5.1. Spelling

The only really important thing you must know about spelling is what version to use: Australian English is essentially identical to international English, with a few added colloquialisms. In fact, the only country whose spelling differs from international English is America. The basic rules are: use –ise –ised –isation (as in 'optimise' not 'optimize'); use –our –oured (as in 'colour', 'favour', 'vapour', 'labour'); and use 'modelling' rather than 'modeling'. Change the language settings of the document to use 'English (Australia)'and this will update the spell checker as well.

5.2. Technical language

Live by the following three rules:

1. Everything must be relevant. 'It took two people to lift the weight onto the chair' is not relevant, just like 'we turned the knob to increase the water pressure' isn't either;
2. Be comprehensive. You must consider everything of importance: i.e., every piece of critical equipment, or every important aspect of the results; and,
3. Be concise. Good technical language and experience will allow you to be succinct and articulate when you express important ideas. This can be quite difficult, remembering that you must also be comprehensive.

5.3. Punctuation

Using punctuation correctly can be quite difficult. Most people do not know the correct usage for commas, hyphens, en-dashes, em-dashes, colons, and semi colons. UNSW and Sydney Uni have websites dedicated to this and it is definitely worth a look. Try www.lc.unsw.edu.au/olib.html. They also provide some helpful links.

5.4. Style

The style manual by Eisenburg [2] is a good reference. The official Australian government style manual [3] is available in the UNSW Library (Level 9 (S 686.2252/3 AE)). A good general rule to remember is that the flow of your document from start to finish is of most importance in terms of style. At the beginning of each section the first sentence should be an introduction to the whole of what is to follow.

5.5. Proof reading

Proofread your whole document, start to finish, at least twice. If you want to produce an excellent document, then proof read it as many times as it takes such that you can read from start to finish without making a single change. Proof reading is a skill, and the more you do it the better you will get at it. Many people find they can only properly proofread a printed copy of a document.

References

[1] E. R. Tufte and P. R. Graves-Morris, *The visual display of quantitative information*, vol. 2. Cheshire, CT: Graphics press, 1983.

[2] A. N. Eisenberg, *Guide to Technical Editing*. Oxford Univ. Press, 1992.

[3] Australian Government Publishing Service and J. Pitson, *Style Manual for Authors, Editors and Printers of Australian Government Publications*. Canberra: Australian Government Publishing Service, 1979.