Table of Contents[1]

[1] Note: this is not an index. An index appears at the back of a report, and contains relevant words and concepts, and a list of the pages on which the corresponding ideas are discussed. I've only ever seen one project report with an index. This is a table of contents. Don't get them mixed up.

1 Introduction

Technical report writing is an important skill, and will stand you in good stead in your future career. It's much more precise than many other forms of writing. A project report is not quite the same as a technical report[2], however it should show the same level of care and attention to detail.

This document was written to provide a few pointers about what I look for in a project report, and some tips for writing these documents using Microsoft Word. It is written in the form it recommends, and contains examples of both good and bad styles. It is intended for undergraduate project students, and post-graduate students in their first year. It assumes a reasonable familiarity with Microsoft Word (although not at the level of an expert user), and a reasonable grasp of English grammar.

This introduction chapter introduces this document, and contains some advice about writing reports for me to review.

(You've now read the first couple of paragraphs of the introduction, and you should have a good idea of what's in the rest of the document, whether you have the necessary background to be able to understand it and might find it useful, and what's in the rest of this introduction chapter. All reports should start like that.)

1.1 Background to the Report

I've been supervising undergraduate projects for a few years now, and I find myself constantly giving the same talks to different students. This is getting a bit tedious, and I find I often forget to mention something to one student, and a report then gets handed in at the end which isn't as good as it could be. So I decided to put down my thoughts (or at least those of them that I remember as I write this) and distribute this document. Other thoughts will no doubt occur to me later, and this document will be updated as I remember them.

Please note that there is no accepted standard for project reports. Different supervisors will have different opinions and preferences about style; in some cases this document merely describes my preferences and opinions. Any student reading this document would be well advised to talk to his or her other supervisor as well, and attempt to write a document to satisfy us both.

Distributing this report written in Word has two additional benefits: it allows me to give examples of what I regard as good (and occasionally bad) styles, and it gives me the chance to distribute a sample style gallery that might be of some use. (If you don't know what a style gallery is, look it up under Microsoft Word help.)

[2] At least, I don't think it's quite the same thing. This is one of those points on which there is no agreement here, some people may tell you that a project report is a technical report.

1.2 Writing Reports for Me

This is important, I want everyone to read this, so I'll put it here. Strictly speaking you could argue that this section should be placed in the body of the report since it is not an introduction to anything that is discussed in more detail later, but since it's short I can get away with it.

I am happy to read draft copies of a report before submission. However, I am not happy to read slightly different versions of the same chapter over and over again, and I won't have time to read anything if I am presented with a large document only a few days before the deadline.

I have come up with a few rules for how this can best work for both of us:

1) Run all chapters through a spelling and grammar checker before they get to me, and take note of the advice provided. This is particularly important if English is not your first language. If the grammar and spelling are so poor that I have difficulty in understanding what you are trying to say, then be prepared to have the document returned. I'm afraid I don't have the time, experience or qualifications to teach English as a foreign language. (There are a lot of on-line grammar tutorials on the Internet, which you may benefit from, and other help is available in the University – contact the University's Centre for English Language Teaching http://www.york.ac.uk/celt/ for more advice.)

2) Send me individual chapters one at a time, as soon as they are complete (or as soon as you want some comments on them). This minimises the amount of reading I have to do at the end of the projects, and I hope will encourage you to write as you go along, always a good idea.

Sadly, despite my best advice, every year some students leave their writing up to the last few weeks, then present me with a large document to review at the last minute. They are then disappointed when I don't have time to do this.

Recently, I've been given more project students to supervise, so I have had to be strict with the following rule: I will look at one chapter (or about 15 pages, whichever is shorter) every two weeks for each project student I have. If you give me a document with more than one chapter to review, and don't tell me which chapter to look at, I will only review the first chapter. At busy times, I will operate a queue system.

I'm sorry about this, but I really don't have time to do anything more; and this rule will enable me to be fairer with the amount of help I can offer to different students.

3) If you are sending me a chapter for the second time, then please clearly mark where the changes have been made, so I don't have to read through the whole thing again. (Try turning on 'Track Changes' in Word, or do a comparison of the current version with the last version I looked at then mark the new sections, perhaps using colour.)

4) If English is not your native language, it is almost certain that there will remain a lot of grammatical and usage points which the computer's grammar checker will not pick up. Experience has suggested that the best thing is to leave these until the end, and then for a native English speaker to go through the document once, to correct the grammar. It is better if this person has not been involved with the project, so they don't get too bored.

1.3 Structure of this Document

The remainder of this document is arranged as follows: chapter two introduces some of the basic concepts of writing a project report, of common mistakes, and techniques to ensure that your report looks good. Chapter three is specific for users of Microsoft Word (the word-processing package being used to write this report), and is concerned with more detailed information about how best to write project reports using this program. Chapter four provides a brief introduction to some issues if you choose to use LaTeX instead of Word. Finally, chapter five provides a few conclusions, a checklist, and makes some recommendations for how this report could be improved in the future.

(A section like this, describing what is in the remaining sections of the report, should always be included in the introduction section of a report. Often, it's the last thing in the introduction.)

2 The Basics of Project Report Writing

This chapter introduces some basic techniques and considerations about writing project reports: when to write; the structure of the project report; what sections should be included; what order they should be placed in; and what kind of information I am looking for when I read a project report.

There are a lot of good introductions to report writing out there already (see for example, the information at http://www.amp.york.ac.uk/internal/ugrad/gen/tskills/t_skills.htm), and I won't try and repeat all that information here. I will assume the reader is familiar with this material already (if you're not, do look up and read these pages). Instead, I will concentrate on the particular nature of the project report, the idiosyncrasies of Microsoft Word, and highlight what I have found to be the most common problems.

2.1 Before You Start

The two most important things to do at the start: make a plan about how and when the report will be written, and find out who your target audience is.

As far as the target audience is concerned, in the case of an undergraduate project report, you should be writing for any of your fellow students who are doing completely different projects. This means you can assume any knowledge covered in the core courses, but not in any of the option modules. In the case of a first-year post-graduate report you are writing for someone with the core knowledge of an electronic engineer, but no knowledge about your particular subject area.

There is an exception to this rule, which occurs when the academic supervisor who has been assigned to you knows nothing about your subject area, not even what is taught in the core courses (in my case, this happens when the project is done in JAVA, as I don't speak the language). It's always a good idea to check with your academic supervisors (or whoever else might be reading the report) what they know. In the case of a project written in JAVA, I would appreciate an appendix on "introduction to JAVA and OOP". (An appendix is an ideal place for information that only some of the readers of the document will require.)

The previous paragraph has a mistake in it. OOP is an acronym, and as such, it should be defined the first time it is used. (Having a glossary at the beginning does not eliminate this requirement.) So it should have read "introduction to JAVA and object-oriented programming (OOP)".

2.1.1 Planning and Top-down versus Bottom-up

In terms of how to write the report, just as with computer programs, reports can either be written top-down (start with a list of chapter headings, then add the sub-headings, then write each section individually); or bottom-up (just start writing, and then fit a structure around what you've come up). And just like with computer programs, the best results usually come from a combination of the two approaches. Top-down ensures that you don't leave any important sections out; bottom-up allows you to write freely, without thinking about what you should be saying, and a more fluent and readable style can emerge.

And please do write in fluent, easy-to-read styles. This isn't a technical report going to your boss, this is a document that will be read by an academic over a weekend, when he's probably got about seven others to read as well, and a dry 'academic' style can be tedious to a point beyond the ability of the brain to tolerate. (This is one of my personal preferences: other academics may prefer a more formal, dryer style. I see no reason why technical documents should not be a joy to read; and I wish many more of them were.)

In terms of planning, as soon as you have an idea of what the project document is likely to contain, I would recommend writing a top-down structure and setting a timescale for when each section will be completed. Any plan you come up is almost certain to change as the project progresses; but it's better to have a plan and change it than not to have a plan at all.

Then, up to the last three or four weeks, I'd recommend working in a bottom-up style, just writing about whatever interesting things have been going on at the time, and your current thoughts. As the project nears completion, these bits of writing can be fitted into the top-down structure, and any gaps identified. It's an iterative process (the top-level plan often changes when you find there's very little to say about something), but I would strongly recommend managing the process, rather than just hoping things will fit together at the end.

2.1.2 When to Write

You have been writing as you go along, I trust, even if it's just keeping a detailed lab-book? This is one of the most important things. Leaving all the writing up to the end never results in a good report. This reflects one of the key differences between project reports and technical reports: a technical report is concerned with what has been done and what the results were; a project report is more concerned with how you did it. Remember, we are trying to give you a mark for all the work you did throughout the project (including the problems, bugs and dead ends), on the basis of a single document handed it at the end. In fact, we're almost more interested in the problems and bugs than in the final result.

Leave all the writing to the end, and you will forget about some of the more frustrating bugs you found, irritating problems you had, and all the things you tried before you finally found a solution. Yet these attempts, ideas and frustrations are exactly what we want to read about. There are lots of marks available for having inventive ideas and problem solving, but we need evidence to award these marks: please let us give them to you.

This is also one of the benefits of sending weekly emails with current progress, issues and concerns. They can be used as a memory-jogger if the relevant sections of the report are not being written up as you go along. Another benefit is that they provide a diary of events that can be used to plot progress against the project plan.

2.2 Structure: What to Include

A project report should include a front page, an executive summary or abstract, a table of contents, possibly a glossary, an introduction, a literature survey or market survey, some sections describing the work done, a conclusions and further work section, acknowledgements, bibliography, references, and appendices. There's no need for version control or a revisions page: a project report will only have one revision (another difference

between project reports and technical reports). A few more thoughts on each of these sections follow:

2.2.1 The Front Page

Probably isn't part of this document, and can be prepared in a separate file if necessary (certainly that helps keep headers and footers off it). You're often given specific instructions about what should be on this page and where. Stick to them.

2.2.2 Executive Summary or Abstract

One or other of these should follow. An executive summary is never any longer than one page, and often rather less. It is a one-page summary of the report, including the key results. It is written for managers who only have time to read one page: bear this in mind when you are writing it. An abstract is a description of what is in the rest of the document, without necessarily containing any of the key results. It's about 100 words long, usually one paragraph, and acts as an advert for the rest of the report. After reading the abstract, a potential reader should know whether he wants to read the rest of the document or not.

Both executive summaries and abstracts get separated from the main report, so they must be capable of standing alone. That means no references and no cross-references in either.

In most examples of an undergraduate or first-year postgraduate project report, I would suggest that an executive summary is more appropriate. Abstracts are more appropriate for technical papers, from where they are collected in abstracting journals and made searchable on the web; this isn't going to happen here.

2.2.3 Table of Contents

Always include one of these (Word can generate them automatically[3], provided you use heading styles for your chapter and section headings), but make sure it's not too long. For a project report, much more than a page isn't sensible, it would take too long to find what the user wants to find. Not every sub-sub-sub-heading has to be here: use some discretion. Bear in mind that this is a table in name only: it doesn't need a caption, and it shouldn't have a border; that makes it look very odd.

Word can also automatically provide tables of figures and tables of tables as well (and tables of formulas, but that's going too far). Include them if you like, I don't mind. I don't find them particularly useful myself, but they do add a couple of pages to the report if it seems a bit on the thin side.

[3] For Word versions before 2007, see 'Format → Bullets and Numbering → Outline Numbered', and 'Insert → Index and Tables → Table of Contents'. Or look up Microsoft Word Help on 'Table of Contents'. This really does save a lot of time.

If you're using Word 2007, choose a suitable scheme from the Multilevel list button in the Paragraph pane in the Home window. I'd suggest the one that starts "**1** Heading 1". You can edit the Heading styles by right-clicking on the styles in the Home window, and selecting "Modify...".

Individual chapters can have mini-tables of contents themselves; and this can be quite useful if the chapter has a lot of sub-sub-sub-headings that have not been included in the main table of contents. This is a bit awkward to do in Microsoft Word (it's very easy in LaTeX), so if you're planning to do this, proceed with care.

2.2.4 Glossary

I like these, I find them very useful. Not just for the acronyms, but any terms that you are using to represent a particular technical concept (for example a "method" in OOP) can be included here. However, note that this doesn't mean you don't have to define acronyms when you first use them.

2.2.5 Preface

Some reports – notably PhD, MPhil and MSc thesis, have a preface at this point. The purpose of the preface is to place the report in context of the degree, and to allow a statement that all the work that has not been attributed to others is your own. Have a look at some other theses to get examples of the requirements for this: it depends on which degree you are doing.

2.2.6 Introduction

The introduction has two functions: to introduce the project (why you're doing it, what part of your degree it takes (if you haven't already said that in the preface), and what the aims were), and to introduce the report (what is coming in the following sections). After reading this, the readers should know what the project is about, why you are doing it, whether they have the necessary background to read the rest of the report, and know how to find whatever they want in the rest of the report.

As one famous American orator once said, when asked how he planned his talks: "first I tell 'em what I'm going to tell 'em, then I tell 'em, then I tell 'em what I told 'em". While I wouldn't entirely agree with that advice for presentations, it's not a bad structure for a technical report. The introduction is the chance to tell the reader what you're going to tell him.

Probably the most common fault with introductions is that they go into too much detail, too fast, assume knowledge that the reader doesn't have, and don't put the report in context. A useful vision image is that of a cone: the first paragraph of the introduction should be very broad, giving the so that everyone can understand how the subject of the report relates to something they are already familiar with. Then the following paragraphs should narrow the focus, explaining what part of the previous paragraph the report is concerned with, and explaining why it is an interesting part of the wider problem. The last paragraph can then introduce the specific subject that the rest of the report will consider.

2.2.7 Literature Survey or Market Survey

This should be the next section in: a literature survey for theoretical projects or a market survey for projects that ask you to build something for production. It's evidence that you have looked at what others have done in the field. As the saying goes "a couple of weeks in

the lab can save almost an hour in the library". If you haven't looked up what others have done before, you are almost certainly not working efficiently.

2.2.8 Sections Describing the Work

I'll try in this section to give some advice about how to describe work done; this is often one of the hardest sections of the report to structure in an easily readable way. *[Hypothesis/Purpose]*

For a project report, I've found these are best written chronologically, almost like a diary of how you got to wherever you did; this is the easiest way to impose a structure on the document. Of critical importance are the reasons why you made any decisions you did (if you don't write these in the report, you are sure to be asked about them in the viva). *[Previous experience.]*

If the project has different strands (e.g. if software and hardware were developed essentially independently), then these can be separated in different sections; otherwise I'd suggest writing them in terms of the phases of the project: planning, implementing and testing, perhaps; or whatever else seems appropriate. Each section, and each subsection of a report can be divided along similar lines; this section of this report included. Of course not all of the sections mentioned here will be relevant to every part of your report, but you might like to think about them, or use them as a structure. When reporting on an actual experiment, I would expect to see all of them, though. *[Experiment design.]*

For each section, it is often useful to consider exactly what you are trying to say. A lot of the time you can use the structure:

1. Hypothesis/Purpose. First, state what you are trying to find out, or trying to do, as clearly as possible.

2. Previous experience. Describe relevant information from the literature review, advice gained, and any other relevant facts.

3. Experiment design. State how you designed the experiment, simulations, including what results would be considered to confirm the hypothesis, and what results would be expected to reject it (with supporting maths if appropriate).

4. Experiment execution. What happened when you tried to run the experiment, what went wrong, what unexpected things happened (if any).

5. Experiment results. Was the hypothesis confirmed or rejected?

6. Conclusions. Including what you would have done better.

[Experiment execution.]

I've tried to divide this section of this report along the lines it describes. It's not a perfect fit, since I am not describing an experiment here. Nonetheless, I hope you can see how this section is structured. It's useful to consider the structure of every document, and every section of a document, along these lines. It really does help the reader if there is a logical

flow of ideas, rather than a whole series of facts and observations in no real order (or at least not in an order that is clearly stated at the beginning).

Of course, there are a lot of parallels between the hypothesis/purpose to a section, and the introduction to the whole report; and between the previous experience and the literature review sections. Good reports are like fractals: no matter on what scale look you should be able to find the same structures. *[Conclusions.]*

2.2.9 Management

Unlike projects in industry, we don't really 'manage' these projects, we don't have time. We just supervise them. You'll have to manage yourself, in the sense of setting milestones, budgets and monitoring progress. In your report, it would be good to include a management section, including a breakdown of what you spend most of your time doing, how you planned your time, whether your original time-plan was followed, and if not, why not.

2.2.10 Conclusions and Further Work

This is always one of the most interesting chapters to read (anyone short of time will tend to read the introduction and this chapter first). A couple of rules about conclusions: they should always follow logically from the rest of the work, and they must never reference any material not included elsewhere. There should be no new information contained in this chapter, it is just a summary of what has been stated before, and what can be logically deduced from it.

If there are a lot of ideas for further work, this could be separate chapter, coming just before the conclusions.

2.2.11 Acknowledgements

It's always nice to thank people that have helped you[4].

2.2.12 Bibliography

A bibliography is a list of sources that you've found useful for background information, but haven't directly quoted, or taken any specific piece of information from. Alternatively, they might be sources that the reader can look for to get further information. They appear after the main text. Project reports may or may not have bibliographies, but they always have references.

2.2.13 References

A reference is a source from which you have taken a specific piece of information. Unless your work is completely original (highly unlikely), you will have references. The golden rule about references is that they should contain enough information for the reader to easily find the original sources without using a search engine. For a technical paper this means name of author(s), title of paper, journal or magazine title, date of publication, volume number and

[4] The author of a useful guide on writing reports, perhaps?

page references; for a book this means name of author(s), title of book, edition, date of publication and publisher. For a web-site, just the URL and the date you accessed it might be all you have, although most web-pages have titles, and if you know the name of the author then include that as well.

All academic publishers have their own set of (very strict) guidelines about the format of references. Unfortunately, they do not agree: the IEEE style is not the same as the IET style, and the Kluwer style differs again. The important thing is to be consistent. You could do worse than adopt the IEEE style[5] [2][6]. This includes such details as the titles of books of papers, conference proceedings or journals should be in italics, and the authors initials and surname should precede the title, which is placed in quotation marks. Book titles should be followed by the edition number, publishers and publication year; journal titles by the volume, page numbers and date[7].

Web-pages are usually not good references for two reasons: firstly many web-pages are not peer-reviewed and have not been edited for accuracy, so the information is not reliable; and secondly web-pages can change at any time, and anyone looking at your reference might not see the same thing that you saw. At the very least, the reference should have information about when you viewed the page.

Wikipedia is (sometimes) an exception: articles are read (and corrected) by many people, so that much of the information about technical subjects is often quite good (although there are some exceptions). There are two golden rules for using Wikipedia as a reference source: always read the "discussion" pages so you are aware of any controversy and can check whether anyone else has reviewed the article; and reference the actual version of the web-page you are reading (Wikipedia helpfully keeps a historical record of all previous versions of articles). This is easy to do: just click on the "Toolbox" link on the left-margin menu, select the "Cite this page" menu item, then choose whichever version fits into the referencing style you have chosen (Chicago is a good one for engineering articles).

At this point, I should add that I don't encourage people to use Wikipedia (or any other encyclopaedia) as a reference source, since it is not the original source of any information: anything in Wikipedia has been taken from other publications available elsewhere, and there may have been an error in the process.

It's much better to go to the original sources of the information (the 'primary sources') and read and reference them. However, Wikipedia is often a good place to start, and there are often a good set of references at the end of the articles.

[5] There's a useful guide to the IEEE style available from the K-ROY pages: http://www.york.ac.uk/k-roy/

[6] Note that the citation (the [2]) is part of the sentence that it refers to and comes before the full-stop. A lot of people seem to put it after the full-stop, so that it's part of the next sentence like this.[2] Please don't do this, it's wrong.

[7] Word 2007 has a set of different citation and bibliography styles built-in. Sadly, the standard engineering citation styles are not amongst the default styles provided, but you can add the IEEE style in relatively easily. For more details, see section 3.8.2.

Some examples of references in an acceptable and consistent style follow (there are lots more in the K-ROY booklet, available from http://www.york.ac.uk/k-roy/referencing/index.htm).

[1] G. Murray, et al., "LaTeX class file for IEEE publications," http://www.ctan.org/tex-archive/macros/latex/contrib/IEEEtran/IEEEtran.cls, (accessed on September 17th 2004).

[2] B. Crow, I. Widjaja, J. Kim, P. Sakai, "IEEE 802.11 Wireless Local Area Networks", *IEEE Communications Magazine*, Vol. 35, no. 9, September 1997.

[3] Wikipedia contributors, "Reference," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Reference&oldid=50359148 (accessed June 17, 2006).

[4] J.G. Proakis, "Digital Communications", 4th edition, McGraw-Hill, September 2004.

(The last example is a reference to an entire book, not to an article within a book.)

2.2.14 Appendices

Anything that isn't essential for reading the report, but the reader might find useful. I can think of a few possibilities for suitable contents in project reports: software code listings; introductions to subjects that some readers will need, but others won't (for example OOP[8]); a full set of circuit diagrams, if they have been drawn in a suitable computer-aided design (CAD) package, could usefully be included here; or perhaps a lot of raw test-result in list or graphical form which are discussed in more detail in the text. Again, the rule is that they should not be essential to the text: the reader should be able to read the entire document without feeling they are missing anything.

Appendices do not share the same numbering scheme as chapters. The first appendix is usually appendix A, then appendix B, etc; whereas chapters are more conventionally numbered.

2.3 Structure: Sections and Sub-sections

You'll note from reading section 2 that you've got a very clear idea of what is going to be in the remainder of this section (in all the sub-sections below section 2). This should be true of all levels in the hierarchy. For example, this section, on report structure, gives examples, both good and bad, of the use of hierarchy.

2.3.1 Close-Harmony Singing in the Balkans

This shouldn't be here. Nowhere, in either section 2 or section 2.3 (i.e. the preceding sections higher up the hierarchy) is any indication that there might be information in the following sub-sections on close-harmony singing in the Balkans. Don't do this.

[8] I don't need to explain what OOP stands for here, as I've already done that earlier in the report.

2.3.2 How Not to Write about Close-Harmony Singing in Vietnam

2.3.2.1 South Vietnam

Note there was no text under the previous heading 2.3.2 How Not to Write about Close-Harmony Singing in Vietnam: one heading immediately followed another. Try to avoid this: it looks better if there is always at least a sentence, so the readers can check if they are interested in reading the rest of section 2.3.2, and if not, move on to the next section. However, just putting "this section of the report introduces close-harmony singing in Vietnam" adds no information to the title, so don't just write that. Introduce the rest of the section, for example: "the techniques of close-harmony singing in Vietnam vary widely across the country, with significant differences being observed between the southern and northern regions".

2.3.2.2 North Vietnam

Oddly enough, I know absolutely nothing about close-harmony singing in North Vietnam. However, you might like to note that this heading does not appear in the table of contents. I have restricted the number of levels of detail in the table of contents, so that items of interest can be quickly found. Use some discretion here: but I would think that for a project or MSc report, a table of contents much longer than a page or two is not going to be helpful.

2.3.3 Sub-sections, Sub-sub-sections and Sub-sub-sub-sections

It can be tempting to put in a lot of hierarchical layers in a report, too many levels can interrupt the flow of the reader. As a guideline: every section with its own heading should be capable of standing alone. You should be able to take it out of the report, and give it to someone who asked about the subject of that heading, and they should be able to read it and understand it without looking at the rest of the document.

In particular, it should be possible for the reader to take a break at the end of any section with its own header, come back later, and not have to spend time re-reading the previous section to remind themselves of the context.

A heading can also be appropriate when someone might be looking for information about that one specific subject discussed in the report in this case the heading can aid the navigation of the document. This is, however, rarely the case in a project report when most readers will be reading the whole document anyway.

2.3.3.1 The Current Rules About Sub-Headings

I should also point out that the current specification for project reports says “there should be a maximum of three levels of chapter/heading”. This is another of those rules that I personally don’t agree with, and I use four levels of headings quite often in my own writing. However the rule is there, so I would advise you to consult your supervisors to see what their opinion on the matter is before you start using four levels of headings. If you can avoid four levels without sacrificing clarity of structure (perhaps by breaking up a long chapter or second-level heading into two chapters or headings), then it might be safer to do so.

2.3.3.1.1 A Bad Example of Too Much Hierarchy.

However, I would agree that a fifth level of hierarchy is almost certain to be inappropriate.

2.3.4 Report Length

Often the project guidelines will specify some number of pages. Do not write 150 page reports for an undergraduate project (unless you print them out triple-spaced for some reason). No-one will have time to read them. Bear in mind the academics often get around four days to read eight project reports: we just don't have time to wade through vast tomes. Make them as long as they need to be, but no longer. If you're having trouble filling 40 pages (3rd year or taught MSc), 70 pages (4th year), or 100 pages (MSc by Research or MPhil/DPhil Transfer Report) the chances are you either haven't done enough work, have left the writing up to the end and have forgotten all the details, or you're not including some important information that I'd like to read about.

2.4 What I Look For in a Project Report

In this section of the report, I'll describe what it is that gets credit in a project report. Always bear in mind that no matter how wonderful the gadget is that you've built, or how user-friendly the software; the majority of your marks will be given for the project report. If you have some brilliant idea, or solve some irritating bug in a creative way, you won't get much credit for this unless you write it down in the report. If in doubt - write it down and include it (as an appendix if nowhere else seems appropriate).

2.4.1 Project Report Marking

At the University of York, we mark projects according to a number of criteria: format and presentation, grammar, originality, ability to work with others, ability to work alone, problem solving, dedication and the ability to plan, amongst them. To get marks, we need to see evidence for each of these things in the report. That means the format, presentation and grammar have to be good, and that's quite straightforward to achieve; but it's less obvious how to provide evidence of "ability to work alone", or "originality".

These things have to be done indirectly: the last thing I want to read is a table listing all the ideas you had during the course of the project, neatly summarised. The best way I know to do this is to write the main sections of the report in almost a diary form: for example, "the program didn't compile, so it was suggested that the web be searched to see if someone else had come across the same problem. After some time spent searching for help; a page of known compile bugs was found [1][9], which suggested the use of the linker's -qc option, and this then worked". Now I know whose idea it was to try this option, who thought of looking on the web, and who did the actual web-searching, and I can mark accordingly.

(Personally, I don't mind the use of the first person in writing reports, and the IEEE appear to agree with me [2], but I know a lot of my colleagues differ with me on this issue. I suggest you check with your supervisors before starting to write. The safe option is to use the passive

[9] This is a reference to the URL of the web-page of the bugs, so the reader can look up your sources if necessary.

tense wherever possible, although that can make it difficult to identify who did what, a particular problem in group projects. Some people use the “royal we”, but I’d discourage this, except of course if you happen to be the crowned head of a country. Reading sentences like “we inserted the disk into the machine” when all the fingers involved in the movement clearly belonged to one person is just a little too silly. I can tolerate formality, but not at the cost of accuracy.)

The ability to plan is perhaps best demonstrated in a separate chapter of the report. One thing that often separates 2.1 projects from 1st projects is the ability of the student to step outside the day-to-day linear task of just doing the project, and consider the project management aspects, and wider contexts as well. Why is the project being done? Who is going to be interested in it? What resources were available for the project? Were they sufficient? Could you have achieved more with more money? What was the original time-plan for the project, and was it followed? If not, why not, and how would you do things differently next time? Is it cost-effective? Has the project been worthwhile to you personally? What have you learned from it? Has it changed your impression of what it means to be an electronic engineer / researcher?

One other golden rule while I remember it: it must be obvious what you did, and what ideas you had yourself and didn't find on a web-page or from other reference. (This is another difference between a project report and a technical report: in a technical report no-one would care whose idea it was, or who did what.)

Another golden rule while I’m at it, true for both project reports and technical reports: you should always include enough detail about any experiments performed that another researcher could come along and repeat your results.

2.5 Resources on the Web

There are a lot of good introductions to technical report writing on the web; but bear in mind that most of them are concerned with technical reports, not project reports (and the two are slightly different). It's well worth reading a few of these to get an idea of the subject and issues of technical writing.

For example, http://owl.english.purdue.edu/ has a lot of resources available. Any list I put here will be out of date by the time you read this, so I suggest doing a web-search for technical writing information, and having a browse.

2.6 Speeling and Grammatically Errors

These really irritate me. Perhaps I am a bit too pedantic in this area, but I regard them as a sign of carelessness, and insufficient attention to detail. An engineer who is careless with details isn't much use to anyone: just overlooking a single point in a new design can render the whole product useless. Spelling checkers are getting quite good at sorting out most of the common spelling mistakes, but be careful about "there", "their" and "they're", "of" and "off", etc. Getting someone else to proof-read your work is a useful technique to sort these out. Another trick is to read your report out loud: that engages a different part of the brain in interpreting the words, and you can spot errors that you'd overlooked.

Grammatical errors and malapropisms are harder to spot. Some of the most common are listed below.

- 'it's' (with an apostrophe) is short for 'it is' or ‘it has’. 'its' (without an apostrophe) means 'pertaining to it'. It's important to get this right; otherwise a document loses its credibility.

- "dependent" is an adjective, it means something that relies on something else; "dependant" is a noun, referring to your children or aged relatives.

- The “weather” report tells you “whether” to expect rain or not.

- Hyphens separate parts of compound words (e.g. brick-red), and there is no space between the words and the hyphen. If you put space around a hyphen (e.g. brick - red), it becomes a dash. Dashes have a similar use to colons: they separate related phrases in the same sentence. Do not confuse the two.

- "effect" and "affect". Both can be nouns and adjectives (so even grammar checkers have trouble with these words), but unless you're a political journalist you are unlikely to use effect as a verb; and unless you're a psychologist, you're unlikely to use affect as a noun. I'm hoping to affect your report writing skills, and have an effect on your final mark.

- “principal” is usually an adjective (although can also be a noun, especially in the US), referring to something highest in rank or importance; “principle” is a noun referring to a law. “The principle of superposition was demonstrated by the principal engineer.”

- “Discrete” means composed of individual separate parts (a discrete waveform); “discreet” means modest, or unobtrusive. A “discreet waveform” is then one that doesn’t draw attention to itself: a rather charming, if useless, concept.

- “Compliment” means something nice someone said about you. “Complement” means something that makes something complete. I gave a compliment to the complement of students on my course.

- Every sentence must a verb in it.

- Try not and start sentences with "so", "and", "but", "therefore", "moreover" or "however". These words are used to link two concepts or ideas; and putting both concepts in the same sentence (often with a semi-colon) helps establish this link.

- (If an entire sentence is enclosed within brackets, the full stop comes within the brackets.) Otherwise, if a sentence starts before the open bracket, the full stop comes after the closing bracket (like this).

- Semi-colons. There are many times when they are useful: separating items in lists; separating items in a sentence that have their own internal commas; joining two sentences with very closely related contents.

- Colons mean "OK reader, here it comes", and must follow what, up to the colon, has been a complete sentence. You need many things to write a successful project report: style; something interesting to say; and these notes.

- It's acceptable to occasionally split an infinitive when the alternative would be cumbersome.

- kHz, please, not KHz or khz[10]; similarly for MHz. (It's always entertaining to read about processors running at 20 mHz, but it doesn't get many marks.) You might have to convince Word not to automatically 'correct' these for you; this can be done in the Tools/Auto-correct window.

- I like the convention that there is a space between the number and the units "3.4 kHz", not "3.4kHz", but this is a matter of taste. The important thing is to be consistent. The problem is when you get to the end of a line at the wrong point in the sentence, and get 3 kHz, with the 3 on one line and the kHz on the next, which looks inelegant. There's an easy way round this: don't use a normal space between the 3 and the kHz, use a Ctrl-Shift-Space. Word won't break a line on a Ctrl-Shift-Space. (The same is true for Ctrl-Shift-hyphens, Word won't split a line on those, even though they otherwise look exactly like a normal hyphen.)

- Fewer people, less noise. If you can count them, use "fewer". If you can't, use "less". Whoever wrote the notice "eight items or less" sometimes found at supermarket checkouts is clearly illiterate.

- License is a verb, licence is a noun. The magistrate granted a licence, licensing the licensee.

2.7 Circuit Diagrams

See Horowitz and Hill's "The Art of Electronics" for a good introduction on how to draw circuit diagrams. Golden rules: make them legible; minimise the number of long wires going all over the place (use ground symbols and internal tags if needed); use bus symbols; and include either reference designators (e.g. R23 for a resistor) and a bill of materials which tells me what value, tolerance and power rating R23 is, or put all this information on the circuit diagram itself. If your circuit is too big to fit on one diagram and still be legible (usually the case), then put it on two or more diagrams. Often circuits can be conveniently split up into sub-sections, for example power supply and decoupling (don't forget decoupling), user interface (knobs, switches and displays) and processor.

2.8 Numbers

There's a rule of thumb that says spell out the number in letters (e.g. three, not 3) if you can do so without using a hyphen, otherwise use numbers (e.g. 21, not twenty-one). It's just a guideline, and I can think of several exceptions; but it does seem to make sentences flow better.

[10] Although note that Kbaud is OK. 1 Kbaud means 1024 symbols per second, 1 kbaud means 1000 symbols per second. Unfortunately, 1Mbaud can mean either 1048576 or 10^6 symbols per second. If you want to be absolutely clear that you mean 1048576 baud, then you could use mebibaud. This is the IEC standard, although not many people seem to use it.

2.9 Plagiarism

This could well be the most important section in this document. Get this wrong just once, and you could lose 10% of the project mark instantly for cheating. Plagiarism is becoming an increasingly important subject as more and more cases of people copying sections from books, notes and web-pages into their reports are being discovered.

The rules are simple. You can include any material you like from anywhere (up to the maximum amount permitted by copyright law – about a page or so, I think) provided it is correctly attributed and referenced. If you didn't write a sentence, then it should be enclosed in quotes, and referenced. If you didn't derive an equation yourself, it should be referenced to the place you took it from. If you didn't draw a diagram, then it should be referenced (usually at the end of the caption). See the examples below. Do this for every figure and every quotation that you take from the web.

Failure to do this will result in heavy penalties, and could, in theory, result in you being thrown out of the University for cheating.

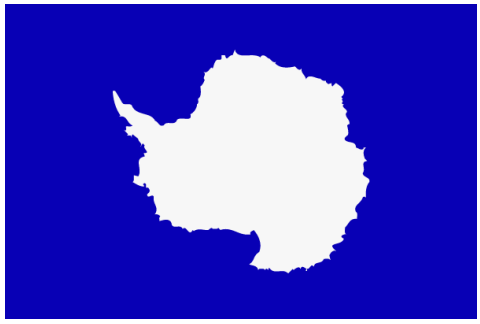

Figure 1 – The Flag of Antarctica (taken from http://sunsite.tus.ac.jp/multimedia/pics/flags/antartica.gif)

or:

Figure 2 – The Flag of Antarctica (taken from [3])

2.9.1 Plagiarism in Indiana

I found a useful example from America, which I've taken from the web-pages of the university of Indiana, and reproduce here in its entirety [4].

"Here's the ORIGINAL text, from page 1 of *Lizzie Borden: A Case Book of Family and Crime in the 1890s* by Joyce Williams et al.:

The rise of industry, the growth of cities, and the expansion of the population were the three great developments of late nineteenth century American history. As new, larger, steam-powered factories became a feature of the American landscape in the East, they transformed farm hands into industrial laborers, and provided jobs for a rising tide of immigrants. With industry came urbanization the growth of large cities (like Fall River, Massachusetts, where the Bordens lived) which became the centers of production as well as of commerce and trade.

Here's an UNACCEPTABLE paraphrase that is **plagiarism:**

```
The increase of industry, the growth of cities, and the explosion of the
population were three large factors of nineteenth century America.  As
steam-driven companies became more visible in the eastern part of the
country, they changed farm hands into factory workers and provided jobs for
the large wave of immigrants. With industry came the growth of large cities
like Fall River where the Bordens lived which turned into centers of
commerce and trade as well as production.
```

What makes this passage plagiarism? The preceding passage is considered plagiarism for two reasons:

- the writer has only changed around a few words and phrases, or changed the order of the original's sentences.
- the writer has failed to cite a source for any of the ideas or facts.

If you do either or both of these things, you are plagiarizing.

NOTE: This paragraph is also problematic because it changes the sense of several sentences (for example, "steam-driven companies" in sentence two misses the original's emphasis on factories).

Here's an ACCEPTABLE paraphrase:

```
Fall River, where the Borden family lived, was typical of northeastern
industrial cities of the nineteenth century.  Steam-powered production had
shifted labor from agriculture to manufacturing, and as immigrants arrived
in the US, they found work in these new factories.  As a result,
populations grew, and large urban areas arose.  Fall River was one of these
manufacturing and commercial centers (Williams 1).
```

Why is this passage acceptable?

This is acceptable paraphrasing because the writer:

- accurately relays the information in the original uses her own words.
- lets her reader know the source of her information.

Here's an example of quotation and paraphrase used together, which is also ACCEPTABLE:

```
Fall River, where the Borden family lived, was typical of northeastern
industrial cities of the nineteenth century. As steam-powered production
shifted labor from agriculture to manufacturing, the demand for workers
"transformed farm hands into industrial laborers," and created jobs for
immigrants. In turn, growing populations increased the size of urban areas.
Fall River was one of these hubs "which became the centers of production as
well as of commerce and trade" (Williams 1).
```

Why is this passage acceptable?

This is acceptable paraphrasing because the writer:

- records the information in the original passage accurately.
- gives credit for the ideas in this passage.

- indicated which part is taken directly from her source by putting the passage in quotation marks and citing the page number.

Note that if the writer had used these phrases or sentences in her own paper without putting quotation marks around them, she would be PLAGIARIZING. Using another person's phrases or sentences without putting quotation marks around them is considered plagiarism EVEN IF THE WRITER CITES IN HER OWN TEXT THE SOURCE OF THE PHRASES OR SENTENCES SHE HAS QUOTED."

Not only is that a very useful description of plagiarism, but it's fine to include here, because I've said, right at the start, that I've taken the whole thing from the web, I've put the whole thing in inverted commas so the reader knows exactly where the quote ends and my own words start again, and I've referenced it. If I had failed to do any of these things, I could be heavily penalised.

3 Microsoft Word

In this chapter, I'll try and give some hints here about the best ways I've found so far of including and formatting figures, equations, tables, references and other things requiring special formatting in Microsoft Word. I'm sure that there will be tricks I don't know about, so if you know of a better way of doing anything described here, or of a good way around any of the features[11] of Microsoft Word that I've highlighted, then please let me know.

It will probably take at least a day, after you've finished all the writing, to get Word to format the document correctly, sort out the cross-references and the table of contents. Do plan for this time.

3.1 Equations

Equations should always be numbered. The way I do this is by defining an "equation" style (see the style sheet in this document for an example), which puts the equation number at the right-hand side, as most textbooks do, for example:

$$b = \frac{q^3}{\sqrt{\sum_n b^n}} \qquad [3.1]$$

where *b* is referred to in italics in the text, as it appears in the equation itself. The Microsoft equation editor is capable of doing most things, and can also put equations like $b = \sqrt{a/r}$ in a paragraph; but don't put complex equations in paragraphs since you can't refer to them by their reference number, and it upsets the spacing in the paragraph (notice the rather ugly gap between the first and second lines in this paragraph).

It's not exactly obvious how to do this: a new type of caption has to be defined which is just an open square-bracket; the closing square bracket is then added manually, with a space to keep the expression symmetrical. After inserting the caption, the whole line can be re-formatted in a suitable "equation" style with tabs set to get the spacings correct.

Another way to do this is to put a one-row two-column table in the document, put the equation in the left-hand box, and the number in the right-hand box.

(Alternatively, if your budget allows, get hold of a copy of MathType: an extension to Microsoft Word that does all this and much more automatically for you.)

Cross-referencing equations done in this way can be unreliable. If you encounter difficulties, it might have to be done by hand (unless Microsoft get themselves sorted out in a future version of Word).

Equations are best done in the Microsoft equation editor, which should come as part of Word (though you might have to enable it). If there isn't a little $\sqrt{\alpha}$ button on the toolbar, try Insert

[11] 'Features' in the sense of 'documented bugs'.

Object, then choose Microsoft Equation from the list. One pitfall: all too frequently I see equations like this:

$$Microsoft\ editor = a\sin ine \qquad [\ 3.2\ ]$$

when what I really wanted was:

$$Microsoft\ editor = asinine \qquad [\ 3.3\ ]$$

The problem is that Microsoft, in an effort to be helpful, recognises "sin" as a function (sine), and puts it in non-italic font. This is very annoying, but there's an easy fix: in the equation editor you can select the offending text, and choose "Style – Variable" from the menu. Please do this, it looks dreadful otherwise.

3.2 Figures

I usually prepare figures in PowerPoint, and then paste them into Word using Paste/Special/Paste As Picture (Enhanced Metafile). I don't know exactly what this means, but it seems to have the highest success rate of any method I've tried so far. I then choose "in line with text" from the layout tab of the format picture dialogue window, and centre the picture in the page. That way it stays put: the alternative of using Word's "intelligent" figure-positioning features can drive one mad when it keeps insisting on moving a picture somewhere you don't want it.

You can draw directly in Microsoft Word, but I've found this feature to be rather bug-ridden: the PowerPoint drawing tools seem to be more reliable (which is odd, since they should be identical). Pasting it as an Enhanced Metafile will attach the figure to the nearest paragraph (signified with an anchor sign when the figure is selected). You're then responsible for leaving enough space around the figure so that it fits, by adding blank lines (you can paste as an ordinary Picture in which case Word will leave the space for you, however I've had problems with some pictures trying this method).

All figures should be numbered and labelled (select the figure and use Insert->Caption/Label->Figure in Word 2000 or References->Insert Caption in Word 2007), with the label below the figure in question. The label should not be on the next page: some paragraphs may have to be moved around to ensure this, usually after the report is complete.

References to figures can be done using the Insert/Cross-reference facility in Word (and this is a good idea, since then the numbers stay in the correct order when you add or delete other figures) but just inserting a cross-reference to a figure ends up with something like 'Figure 3.1'. If you're writing an IEEE paper, they will require the reference to be of the form 'Fig 3.1' which Word can't do. The only good solution I've found so far is to turn off Word's helpful automatic features and do it by hand.

Figure 3.1 - An Exciting Green Rectangle

3.3 Graphs

The best way of doing these rather depends on what package is being used to create the graphs in the first place. If MATLAB, then I tend to paste them into Powerpoint first, convert them to a Microsoft Office Drawing, then group them together, and treat them as a figure. This allows Powerpoint to change the spacings, font-sizes, and line-widths in the graph, which is not easy in MATLAB. If a dotted line is drawn in MATLAB, then "tracing" over it with a Powerpoint curve, then deleting the original MATLAB line and re-formatting the curve to whatever colour and width is required can drastically reduce the size of the figure, and make the resultant document more reliable (Word has a habit of doing strange things when it runs out of memory).

3.4 Flowcharts

Maybe it's just the options I've got configured, but Powerpoint seems much better at doing these than Word. For one thing, it's got the "Connectors" option under the "Autoshapes" menu, which makes wiring up flowcharts easy. Use connectors, and when you pick up and move the shapes, the wires joining them up automatically move too! It's great.

3.5 Tables

Very similar to figures. The "Draw Table" item under the Table menu heading is quite good at formatting them, allowing various different-sized boxes to be drawn in. One point to be careful about:check after you've finished writing the report that no table appears across a page boundary, and that the caption and the table (or figure, for that matter) are on the same page.

<table>
<tr><td rowspan="3">African Carnivores</td><td colspan="2">Dogs</td><td>Cats</td></tr>
<tr><td>Hunting Dogs</td><td rowspan="2">Hyenas (not really dogs or cats)</td><td>Lions</td></tr>
<tr><td>Jackals (definitely dogs)</td><td>Leopards</td></tr>
</table>

Table 3.1 - Carnivore Table with Odd-Shaped Boxes

They should be captioned, with the same style as used for figure captions, and can then be collected and cross-referenced in the same way. Notice that the text in the boxes is done in the *Normal No Space* style, which does not automatically put a blank line under each paragraph - this makes the table look more compact.

3.6 Styles and Numbering

This document mostly uses styles called *Normal* (used for default paragraphs), *Caption* (for captions), *Headings 1 through 9* (for paragraph heading), *Normal No Space* (sometimes useful for arranging text in tables or special formatting), and *Program* (used for program code examples). There are a few others (used for footnotes, headers, and footers, as well). Try to limit the number of different styles you use, and above all, be consistent.

Section numbering is very important to get right, and Word can help you with this. If you get hold of a copy of this report in Word format, and try to edit the number of this section from 3.6, you'll find you can't. Word has numbered it for me – in fact I've set Word up so that when I introduce a new Section or Subsection header, it automatically numbers it, and re-numbers anything else to keep the whole numbering system consistent.

You can set this up using the Format->Bullets and Numbering->Outline Numbered menus (or just copy this document and use it as a template). Do use this – it makes life a lot easier, and makes generating the Table of Contents at the start of the report easy.

3.7 Program Code

Excepts from program code always seems to look better in a non-proportionally spaced font, for example using the style *Program* in this document, which uses Courier New:

```
for (loop = 0; loop < 999; loop++)
  {
  printf ("This is a really, really, useful program.  Not.\n");
  }
```

Code Fragment 3.1 - An Example of a For-Next Loop

This makes them stand out from the text, which is useful when the language looks more like English than the 'C' code example above. Software projects which contain a lot of code examples might consider introducing a new type of caption, the code fragment (as shown above), so that code-fragments and examples can be cross-referenced: for example the code fragment above becoming Code Fragment 3.1; although note that Word has 'helpfully' put the 'C' and the 'F' in upper case, so you might have to do these by hand anyway if you want the reference to be code fragment 3.1).

3.8 References and Citations

This best way to add these has changed dramatically between Word 2000 and Word 2007.

3.8.1 Word 2000 Referencing and Citations

The best way to handle these is with endnotes (Insert/Footnote/Endnote)[12]. That way they get added in to the end of the document, and automatically numbered. You'll have to add your

[12] Word 2007 has a citations feature, but by default it can't put the citations in square brackets, which is rather annoying. Correcting this requires hacking around in the Word configuration files – only for experts.

own square brackets around them though, Word doesn't do this for you [5]. I like the convention that there should be a space before the reference, i.e. as shown above, and not like this[5], but this is a personal preference: again the important thing is to be consistent. (Of course, it looks silly if you leave a space and that puts the reference on the next line, but that's easy to fix: just use a ctrl-shift space instead of a normal space.)

Be careful if you have anything in your document after the references. If you've moved the references back to before the appendices, and then add a new reference, it can get separated. It's probably easiest to leave the references right at the back of the document until you've finished writing the positively last version, then cut and paste them back to just after the conclusions, and before the appendices (and then update the table of contents).

3.8.2 Word 2007 Referencing and Citations

In Word 2007, there is an automatic "Citations and Bibliography" tool (under the Referencing Menu). It's very useful, and gives a professional-looking and consistent references section. The only problem is that it can't do engineering-style references by default (none of the default styles is suitable for engineering documents).

Fortunately, there's a simple way round this. Go to: http://bibword.codeplex.com/Wikipage and download and install BibWord, this will add several reference styles to Word, including the IEEE style.

After this, filling in the forms for each reference as you enter them is a good habit to get into, and the rest of the process is all handled by Word. This feature is a major reason to upgrade to Word 2007. (One point: remember to tick the "Corporate Author" box for anything taken from sites like Wikipedia, otherwise you might find the author or Wikipedia articles listed as "W. Contributors".)

3.9 Footnotes

I rather like them, provided they are used sparingly and correctly[13]. Microsoft Word is quite good at adding them.

[13] They can be used to add interesting asides or comments that would otherwise distract from the main thrust of the sentence. Rule of thumb: it must never be essential to the understanding of the document to read the footnote; otherwise the footnote should be in the main text.

4 LaTeX

Of course, if you decide not to use Microsoft Word, and use LaTeX[14] instead, then all the bugs/irritations in the previous section will be irrelevant for you. Instead, you'll be faced with a whole new set of irritations (but you're very unlikely to find any bugs). LaTeX works well, but it can take a while to find out how to get it to do what you want. For a BEng project I wouldn't recommend it for new users: it would take too long to learn for what is a comparatively short report.

For MEng and MSc thesis, it is well worth considering, particularly if you are working on a unix platform. For numbering, sorting out cross-references, handling references, formatting complex equations and positioning graphs and figures in sensible places in the text, it is streets ahead of Microsoft Word. The big disadvantage is that it's not WYSIWYG, so it takes very careful proof-reading, and may take several iterations to get a formula to look how you want.

There are several very good introductions to LaTeX available on the web. The best place to start may well be "The (Not So) Short Introduction to LaTeX2e, available from: http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf, though a search of the web will no doubt reveal some other good introductions.

4.1 Some Things to Watch Out For if You Choose LaTeX

Firstly, LaTeX documents are prepared in text editors. Some have spelling checkers, some don't. If you use one that doesn't, it's not a bad idea to run the .txt documents through Word at some point. (One good text editor for the PC that does include a spelling checker is TextPad, and a free evaluation version is available from http://www.textpad.com.) Otherwise the document will need very careful proof-reading.

The chances of finding a text-editor with a good built-in grammar checker are not high – in fact, I don't know of one (please let me know if you find one). This is another good reason to run the source text documents through Word before compiling them. You might not always agree with Word's opinions on grammar, but it can pick up a lot of genuine errors that simple spelling checkers can miss. Again, the only alternative is very careful proof-reading, and it's better to get someone else to do this if possible, someone who does not know the document well already, and won't read what they expect to be there, rather than what is there.

Word automatically works out whether you want a ' or a ' character from context, similarly, it sorts out the difference between " and ". LaTeX doesn't – you have to tell it whether you want a start quotes symbol by using the `` (two ASCII code 96 characters) or an end-quotes symbol using '' (two ASCII code 39 characters).

Watch out for '\' and '%' signs in the text as well. '\' is a LaTeX escape character: if you want a '\' to appear in your report, you'll need to write '\\'. '%' is a LaTeX comment: the

[14] Which, by the way, is pronounced "lah-tech". The character at the end of the word is a capital Greek chi, not an upper-case X.

rest of the input line will be ignored. This can result in some interesting sentences: for example,

```
``During the final stages, consumer testing indicated that out
of the two hundred people who returned their questionnaires,
99.5% of users were very satisfied.  The only dissenter
thought the whole thing was a waste of time.''
```

Produces:

```
"During the final stages, consumer testing indicated that out
of the two hundred people who returned their questionnaires,
99.5 thought the whole thing was a waste of time."
```

(The problem input line should look like:

```
99.5/% of users were very satisfied.  The only dissenter
```

to avoid this problem.)

4.2 BibTeX

I've read a couple of LaTeX reports recently that suffered from the same problem: references were not numbered sequentially. I can only assume this is because the authors did not know about bibTeX. BibTeX is an add-on for LaTeX that sorts out all the references for you. It takes a bit of getting used to the format of a .bib file (the file in which bibTeX stores all the information about references), but it's not hard, and many scientific search engines on the web (for example citeseer http://citeseer.ist.psu.edu) will provide the bibTeX entry for you. For example, one such article is of the following format:

```
@misc{ kari-interference,
  author = "Jari Ylioinas Kari",
  title = "Interference Suppression in MIMO HSDPA Communication",
  url = "citeseer.ist.psu.edu/656615.html" }
```

All you need to do is collect these into a .bib file (in any order), and then include a statement such as:

```
…previous work in this field \cite{kari-interference} shows that …
```

whenever you want to reference a document in your thesis. Then, in your top level LaTeX file, include the line:

```
\bibliography{mybib}
```

(where mybib.bib is the name of your .bib file) in your LaTeX input file where you want the reference section to be. After running LaTeX enough times to get the cross-references sorted out, just run bibTeX then LaTeX again, and you're done. There are lots of guides on the web to using bibTeX – I would highly recommend it for managing references.

5 Common Mistakes

Despite my best attempts, a lot of students still make the same mistakes. I've gathered up the most common ones here. You could use it as a checklist. Please make sure that you haven't made any of these before sending me chapters to read.

1. **Not using Heading Styles for the chapter and section headings**

   It makes life a lot easier, really it does. Suddenly your document has a set of consistent styles: all headings are the same size, in the same font, and the table of contents can be created automatically.

2. **Not using Multilevel lists to do automatic numbering of chapters**

   It's a little harder to find these in Word 2007 than it was in Word 2000. (In Word 2007 select "Multilevel List" from the Paragraph pane in the Home window, and choose a suitable style from the library. I'd recommend the one that starts "**1** Heading 1".

   (Or, just take the Word version of this document and delete all the text. Then start writing again using the styles in the document. They have outline numbering built-in.)

   If you don't do this, you'll have a terrible time trying to generate the table of contents. If you do, you can generate a great-looking table of contents in a few seconds.

3. **Not using Microsoft Word's 'Insert Caption' feature to title figures**

   Again, people seem to use Word as a typewriter. It really would be worth learning more about what Word can do before starting to write your report. Use the automatic "Insert Caption" feature, and all figures are automatically numbered (and re-numbered when you add or delete a figure).

4. **Not referencing figures in the text**

   I often come across figures just floating around, with nothing in the text referring to them at all. It's usually obvious what they are, but this is another 'Golden Rule': all figures must be referred to in the text.

5. **Inconsistent styles of heading**

   Most often a problem with overseas students who are not used to the difference between 'lower case' 'UPPER CASE' and 'Title Case'. All chapter and section headings and figure captions should be in title case, for example: "Wonderful Things About Tiggers".

6. **Putting citations after the full stop**

   For example, adding a citation like this. [3]

Why do so many people do this? Where does it come from? You can't have copied the idea from anywhere, no-one publishes papers or books like this. If a citation applies to something in a sentence, the citation must be in the same sentence. And that means before the full stop.

7. Putting two section headings together with no text in-between

See section 2.3.2.1 for more details. (That's a cross-reference by the way – I just pointed a cross-reference at the section titled "South Vietnam", Word knows where it is. If I move things around later, Word will update this number for me.)

8. Not putting in enough references

A very frequent problem. I read things like "research has shown that $a = 2.7$ is a good value to use". What research? Where did this come from?

Or perhaps I might read "MIMO systems can help improve capacity". How do you know? Where I can go and read more about how? No-one is born knowing this.

Another 'Golden Rule': if you take any information from anywhere, it needs a reference to the source.

9. Not starting new chapters on new pages

It's easy to do. Just use a "Ctrl-Enter" to add a page-break. It makes the report look more professional.

10. Not defining all the quantities in an equation

This happens a lot. I often read things like "the capacity of the link is then:

$$C = W \log_2 \left(\det \left(\mathbf{I} - \frac{\lambda_i}{\sigma^2} \mathbf{H} \right) \right) \qquad [5.1]$$

where **H** is the channel matrix."

Fine, but what is W? What is λ? What is σ? If you write an equation you have to clearly state what all the terms in the equation represent. Otherwise it's useless.

11. Writing something in the report you don't understand

I can see how tempting this might be to do. If you just can't get you head around a derivation or a proof, you just copy it from a textbook into your report. However, this is very dangerous. We'll probably ask you about it in the viva, and if you can't explain something in your report, it really doesn't look good. It's much better just to quote the result and add a reference to where the derivation comes from. Writing anything is a claim that you understand it (unless you put it in quotes, so it's obviously not your own words).

6 Conclusions and Further Work

This report was written for undergraduate and first-year postgraduate students to help answer the perennial questions of what a project report should contain, how they are marked and how suitable reports can be generated in Microsoft Word.[15]

All feedback is very welcome - let me know what you found useful, and what you found not-so-useful, and what additional information you would have liked to be included in future versions. Inevitably, I haven't thought of all the issues and common problems in report writing, but I will maintain this document and include any issues I spot during the marking of the next set of project reports.

I estimate it took about three days, in all, to write this. It should save me about six or seven hours in talking to different students each year, and hopefully the same time again in making comments on initial versions of reports. It'll also do a better job of communicating what I am expecting in a project report, and I'm less likely to miss things out. So after two years, I should be ahead in both quality and time. Or at least that's the plan. Do tell me what you think.

[15] That's the "tell 'em what you told 'em" bit.

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