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| Image result for engineers miscommunication  Writing Guide  For Engineering students | Abstract  As an engineer, it is vital that you can communicate your ideas. It is likely that writing in an engineering context is vastly different to everything you have previously been taught. This document is designed to both teach you good writing practices and become a reference guide for later use.  Dylan Cuskelly;james.bradley@newcastle.edu.au  ENGG1500 |

## Nomenclature

|  |  |
| --- | --- |
| TL;DR | Too Long; Didn’t Read |
| ≠ | Does not equal |
| T | Temperature (K) |
| t | Time (s) |
| Cp | Specific heat (J/(kg•K)) |
| k | Thermal conductivity (W/(m•K)) |
| W | Watts |
| J | Joules |
|  |  |

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# Communicating as an engineer

This document is deigned assist novice engineers to write in an appropriate technical format. It is written primarily with a first-year school leaver in mind; however, the skills and techniques are transferable to PhD quality writing. The document is to inform the novice writer in the rules and common practices of technical writing, as well as provide a quick reference resource for writers to consult when concerned about a particular issue. It also serves as a checklist to help with proof reading, which is perhaps the most difficult task for someone who already struggles at writing.

As an engineer communicating is essential, however it is not an area where engineers tend to excel, especially in their formative years. The good thing about technical writing is that it is a learned skill. Being a good technical writer is not a matter of natural talent, it is a matter of hard work.

Why you need to be a good writer:

* You will use it all the time, both at university and in your career.
* You may know the answer to life, the universe, and everything, but that is useless to the rest of us if you cannot communicate it.
* You will be judged on it. Clear writing is an indication of clear thinking.
* Employers want you to know it. Communication skills are key to almost all jobs.
* Report writing is often the only way communication occurs between engineering firms and clients.
* You need it to get marks. Not just in report writing classes.

Communicating, for us at least, is the process in which one person takes some knowledge which is in their head and places it in the head of the recipient.

1. The first step in this process is encoding of the knowledge. This can take many forms, the most common being writing or speaking (or sometimes interpretive dance).
2. The recipient, through a process such as reading or listening, then decodes this information and the transfer of knowledge takes place.

Unfortunately, corruption of the message can occur along the way, and when this happens, the recipient does not gain the intended message. Corruption can occur as the message is encoded (poorly written), and when it is decoded (not read carefully enough) and sometimes in transit (pages lost).

Examples of corruption in encoding/decoding

* Poorly written:
* Unclear flow of thoughts
* Spelling and grammatical mistakes
* Language:
* Native tongue
* Technical language /jargon
* Acronyms
* Assumed knowledge:
* Too high and the reader can’t keep up
* Too low and they will become bored
* Appropriate length:
* Engineers tend to be overly brief on a subject they understand well
* And long winded on subjects they understand poorly (TL;DR)

## Feedback

One of the major complexities of writing is that it is entirely a *one-way* communication. There is no way for the writer to know if the message is received as intended. This is a major concern with methods where one person is communicating with many recipients (lectures, reports, speeches etc.). This can be challenging for new writers as the vast majority of communication that we do happens in a feedback loop. In a conversation (either spoken or written), the recipient can communicate back to the originator and so any miscommunications or corruption can be rectified. This feedback is often not possible with engineering communication and so it is essential that the information is portrayed as clearly as possible.

Many things contribute to the decoding of the information that are not strictly written text. Presentation is key!

Students often find writing difficult for two reasons; firstly, they are used to being the recipient and they often find it hard to become the deliverer. Secondly, their experience has generally been in communicating to an audience who knows more than they do (teacher) and so find it hard to fully explain themselves to someone who knows less than they do.

## Technical writing

There are a few overarching key aspects of technical writing.

**Technical writing serves to convey information to the reader**. This is your overall goal and everything else is secondary. It may sound simple but when things begin to become complex and you begin to feel lost (which happens to everyone at some stage) always ask yourself: “Am I making the person reading this smarter?”

**You are writing for the reader**. At all times you should be attempting to put yourself in the shoes of the reader, make digesting your work as easy and informative as possible. This means it is important to take some time to understand who your reader is, what they might already know, what level of language is appropriate and what they will be looking at getting out of your work, all before you begin writing. When a 5 yr old asks you why the sky is blue, launching into an explanation of Rayleigh scattering may not be appropriate.

**If the reader does not grasp the meaning behind your work, that’s your fault!**

“If you can’t explain it simply you don’t understand it well enough.”

A. Einstein.

**Rules are there to help.** There are rules and common practices followed by technical writers which serve to *help* all writers to work within a consistent format. Using the appropriate format, although it may seem arbitrary to you, will help your reader to understand your work and makes your work appear professional. I would never expect you to memorise all the rules of the English language but I do expect you to google them as required.

**There is no set strategy for how to write**. What works for you may not work for your colleagues. Each person who speaks to you about writing will have their own personal biases. You may notice quickly that I may have some very different opinions to your English teacher and your future lectures/employers may have different ideas again. This document intends to show you a number of different strategies to help you, though ultimately practice is what will allow you to develop a strategy that works for you.

# Technical writing methods

**Things to keep in mind at all times**

*Have a plan*. Know what you want to say before you begin writing.

*Technical writing is* ***not*** *like writing an essay*! At all. Providing 3 examples and some emotive language does not make a report!

*You are an expert* on the topic which you are writing about (or you will be) and the reader is attempting to learn from you. The better you understand the topic the easier it will be to write about it.

*Less is more*. Longer ≠ better in technical writing. In general, you need to write as concisely as possible. A reader would much rather read 8 high quality pages than 30 rubbish ones. Using big words, long sentences and many pages can make your work lack direction, confusing the reader and corrupting your message. Every piece of superfluous information you put in your report raises the chances of the target becoming confused and losing the key message.

*Writing is a learned skill*. Anyone can learn to write to an acceptable level with enough hard work. Make no mistake, for many of you, it will be hard work and you may never become a natural but being a bad writer is simply laziness.

## The writing process

No one ever sits down and writes a high quality engineering report from start to finish in one go, and it is often not advisable to try. The process generally has a number of steps and many iterations between each step Figure 1.

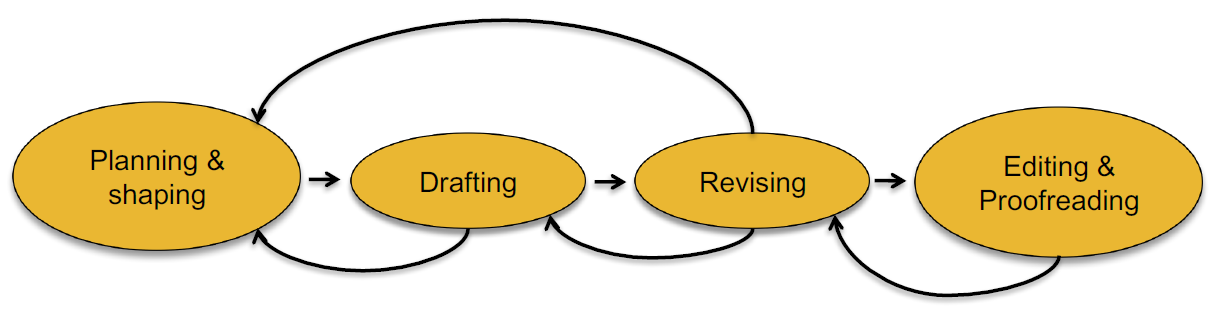


Figure 1 - The writing process.

Useful stages to follow are;

**Planning**: gather ideas, think about the purpose of writing

**Shaping**: consider ways of organising the material

**Drafting**: write in sentences and paragraphs

**Revising**: evaluate the draft organisation (add, cut, move)

**Editing:** check for grammar, spelling and punctuation

**Proof reading**: check final copy (ask someone else if you can).

Your first draft does not have to be perfect or even good (and for many of you it won’t be), it simply means you will need to have more drafting/revision iterations. Many young writers struggle when doing their first draft as it is not very good and they quickly become demoralised. Do not fear, it is easier (and often faster) to improve a piece of rough writing then to write brilliantly onto a blank piece of paper. Remember it is about hard work, not natural talent! A 3-page journal paper may have 15 revisions before acceptance, a thesis closer to 50. Your assignments and reports should go through all the steps in Figure 1 at least once.

## How to start

Once of the most difficult parts of writing is knowing where to start, staring at a blank word document knowing you need to create a 150 page report is a daunting task. Remember start with planning, not writing!

**Determine your objective: Why are you writing this document?**

* An English teacher told you to for your HSC exam.
* You need to explain a complex problem to a peer form another discipline.
* You have finished a large project in industry and are reporting back to your client.
* To present your experimental findings to the scientific community.

By answering this question, you should clearly establish:

**Purpose**: are you trying to; *persuade* a marker you know something? *Teach* someone something you know and they do not? *Report* on your progress to your boss

**Audience**: Who are they? What is their background? What do they actually need to know?

**Requirements**: Time allocated, level of quality. An exam answer (10 min and messy) is very different to a scientific article (months to write and perfect).

Alice: ‘Would you tell me, please, which way I ought to go from here?’

The Cat: ‘That depends a good deal on where you want to get to’

Alice: ‘I don't much care where’

The Cat: ‘Then it doesn't much matter which way you go’

Alice: ‘....so long as I get somewhere’

The Cat: ‘Oh, you're sure to do that, if only you walk long enough’

Alice in Wonderland, Lewis Carrol.

The next thing you will need to do before you begin writing a document is to put all of your ideas together and determine exactly what you need to write about. This should include all background (introductory) information you will need to include; but also should allow you to see what can be left out without your report loosing meaning. This might seem trivial when you only have a few ideas that have a logical order or where order is irrelevant, but when you need to prepare a complex document, the way in which you present ideas will become essential. There are a number of different ways that you can undergo this process.

## Target audience example

Depending on your target audience you need to tailor your technical explanation. Consider the following statement in a report using computational fluid dynamics (CFD) to analyse a sailing boat.

“CFD was used to optimise the new hull shape showing a 5% gain in hull speed for the current sail plan. It is recommended from these results that the company takes on the new design in the current hull line-up as a replacement to our previous X model.”

Likely responses:

**Marketing**: “Awesome, we are going to sell more of these!”

**Engineer**: “Which CFD software did you use and how have you proven the gain in hull speed? What else do we need to improve to cope with the extra speed? Have you thought this through??”

**Engineer specialising in CFD**: “5% seems unlikely! What flow conditions did you use, what were your boundary conditions? Which solver did you use? What was your y+? How big was your inflation layer? How did you build you mesh? Etc,etc,etc.

So, Marketing gives you 100%. The Engineer gives you 50% and the Fluid specialist fails you miserably.

Conversely;

CFD was used to optimise the new hull shape. The program use was ANSYS Fluent using the inbuilt SST solver and a domain 3 times fore and 8 times aft the hull. A variety of wave periods and amplitudes were tested, between 10 and 20 s and 0 to 1 m respectively. Mesh independence was shown for a tetrahedral mesh with a body size of 20 mm and first layer inflation of 1 mm.

Now the responses change

**Marketing**: What? English please…

**Engineer**: That’s great but I still need to know what else I need to change to cope with the extra speed?

**Engineering specialist in CFD**: Awesome, nice job. Maybe we could extend this to a FSI or investigate the possibly of cavitation to further reduce form drag!

# Strategies for writing

## Freewriting

Once you need to start putting words on paper, there are a few strategies to get started. Personally, I like freewriting. This involves simply starting and writing whatever comes to mind about the subject without worrying much about the quality (organisation, grammar etc). Dot points are often useful here as you are trying to move as quickly as possible. Often what you write in this section are notes for yourself about what you plan to write later, and thus they do not have to make sense to anyone else. This method will quickly produce a *very* rough, often long, draft. This draft will then need to be improved upon *drastically*. This method will require a larger number of drafts and often the first draft is completely scrapped as you realise the document needs to be rearranged and largely (completely) will need to be rewritten. However, it puts ideas down on paper which if often the hardest part, then you can organize them and rewrite. (I used freewriting to prepare this document).

## Clustering

Clustering is one method for graphically relating your ideas Figure 2. This can be done effectively both with pan and paper or computer packages. It involve taking the main topic first then putting down and ideas you have related to that topic. You then draw in any connections between the ideas or the topics. Using this method you will spend more time planning how you will arrange your ideas before you start. Although you will not start writing immediately, you should be able to produce a much better first, and so save yourself time in the long run.

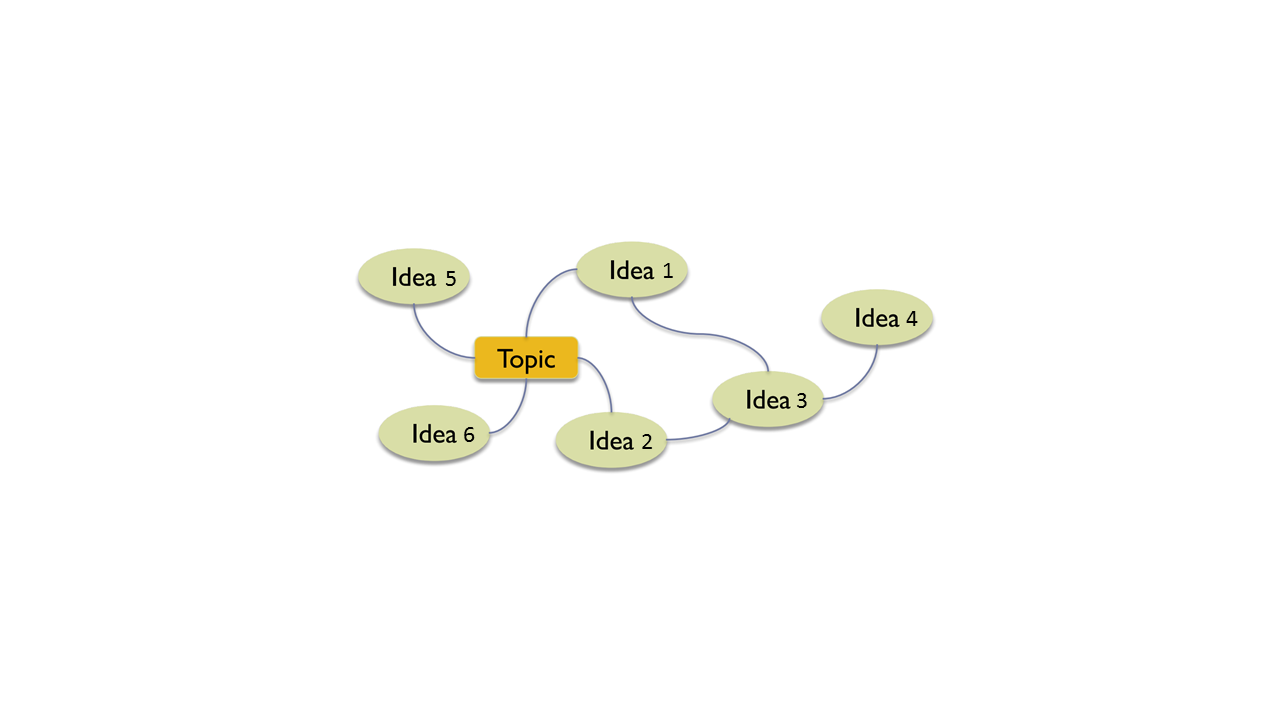


Figure 2 – Clustering.

In this way you can get all of your ideas down and see how they relate to each other. This should give you an idea of both what is and isn’t important and an indication of the order some things will need to be written in. For example, idea’s 1 & 2 may need to be introduced before 3 and then 4. Ideas can also be generated in a more traditional brainstorming session, which works in a similar way to clustering, without the graphical connections between ideas. These ideas generally become chapters or sections of your report. Each of these ideas can then can then be further broken down potentially with their own cluster diagrams and eventually will become topics for your paragraphs, while the larger ideas may become sections or subsections of your report.

## Headings first

A different method of planning is to make a multilevel list. Starting with the intended chapter or section headings first. Then under each heading write any sub headings you will need to explain that idea. Under each subheading put in the key dot points of the content which will fill these sections. Continuing adding sub levels until you have a dot point representative of each paragraph you intend to write. The final dot points become the topic of each paragraph. Simply fill in all the paragraphs. At each level of heading you should look through the list and check if you are happy with the order and rearrange at the list/ dot point level, before you start writing paragraphs. You will often realise when discussing results that key points of your introduction are missing and using this method you can easily go back and add key information.

## Writing

Next, you want to begin turning your ideas/ subheading/dot points into paragraphs. It is important that each paragraph has a clear point which should be summed up in a topic sentence, and supporting/ descriptive information surrounding it. This is useful to the reader as it lets them know that when they start a new paragraph they are moving onto the next point.

The length of both your paragraphs and sentences is important. Longer sentences and paragraphs make it easier for the writer to explain a complex idea, however they make more work for the reader, which can lead to confusion, whereas shorter sentences have far more impact but can read like a recipe with poor flow if used to often. The same arguments can be applied to paragraphs. Note the use of different length sentences in this paragraph. Short sentences have more meaning. Long sentences are better for explaining.

Breaking your document up into small sections makes approaching the writing process far easier. If you set aside some time to work on your report (1 hr, 1 day, or one week) you can identify which section you will tackle (this paragraph, page 7 or Chapter 2). This is one of the most useful suggestions I can make to a novice writer.

## Incubation

Taking a break from your document is often required, even between the planning and writing stages. It can be very useful to put down your work and come back to it after a period of time. This time can range from minutes to months and will depend on your timeframe. It is very easy to become buried when writing and spend too much time focusing on things that are not of any real significance, and then running out of time and rushing critical components. Taking a break will often help you to see clearly what you are trying to do. It will also help you to view your previous work from the perspective of a potential reader far easier. I left this document for about 4 weeks in between the first and second drafts, then another 4 weeks with the co-author.

## Revising

Depending on the quality of your drafting you may want to do your initial revising on the computer, however it is often advisable to print your draft and read a paper copy. People tend to notice different things when reading on a computer vs a paper copy. You can immediately affect change on your computer, however bigger picture issues such as layout or the order of paragraphs are often only picked up in a printed version.

Revising involves 4 main activities:

**Add**: As the author, you understand the topic you are trying to communicate completely and so often skip over important aspects in the writing process. Generally after an incubation period you will realise you need to go back and fill in words, sentences, paragraphs and even sections as required.

**Cut**: Regularly information is placed in which distracts more than it helps the reader and these tangents should be cut to avoid confusion. If something does not have to be there, it should not be there. First drafts are often written in a long-winded way, and can be cut down significantly. This can apply to cutting entire everything from words through sentences/paragraphs/pages/sections or even entire chapters. Rewriting and improving one section might mean another section has become redundant and can be removed. This will be required for your later submissions in ENGG1500 as you need to fit more and more information into tighter page limits. It is also very common when stitching together sections written by different people, as information is often repeated.

The formatting section provides advice on reducing wordiness.

**Move**: Hopefully through good **Planning** most of your ideas should be in a logical order, however somethings will invariably need to be moved. Freewriting tends to need more of this. If you move a sentence or paragraph you will need to read/rewrite the surrounding text so that a nice flow is maintained. Moving ideas into the most logical order is a great way to remove unneeded words from your document.

**Rewrite**: As you work through the revision process you may decide that it is better to simply rewrite a section rather than try to fix it up. This is perfectly fine and strongly encouraged. This generally produces a better result while often being faster and easier than trying to fix a messy piece of writing.

Don’t be afraid to spend many iterations drafting and revising. There is no point doing ‘fine details’ (editing and proofreading) if you are going to have to come back and completely rewrite a section. It can be very hard for a new writer to ‘scrap and start again’ but often this saves more time than trying to ‘polish a …’

‘Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts. This requires not that the writer makes all sentences short or avoid detail, but that every word tell.’

William Strunk, Jr, The Elements of Style.

## Editing

This section of the report is designed to be kept by the reader in used as a reference when editing future documents.

Now you are into the details of your report. You shouldn’t be adding a lot of new information here but improving on what you already have written. In this section you should ask yourself:

* Are your sentences grammatically correct?
* Are your sentences short?
* Have you used concrete language and omitted needless words?
* Is your punctuation correct?
* Have you used an appropriate reference citation style?

This is where you need to pay attention to ensure your work comes across as high quality. Unfortunately, it is a rather laborious and unrewarding activity. As you are not adding more words here (often you will end up with less words after your editing step) it can often feel as though you are not making progress. However, the readers first impression of you is often formed by the little things, and having a nicely put together document will greatly help with the reader’s impression of your work.

## Proof reading

This is your final check. I would strongly encourage you to print a copy of your document and read it in a different place to where you wrote it. I often write at home and read at work. You are looking for any small details as well as formatting and layout issues. It is always best if you can get someone else to read your document for you. Swapping with a classmate is generally the easiest way of doing this, however it is better if you can find someone similar to your target audience. This document was passes back and forth between the two authors multiple times and handed to a third party for proof reading.

If you follow all of these steps, you should always be able to produce a high quality document. However, reading these steps I know many of you will not feel willing to follow all of them especially when you start an assignment the night before it’s due. Although it is possible to fill the required amount of pages for an assignment in a few hours of frantic writing you will never be able to produce a result to be proud of. If you do want to improve, you now have a strategy that you can use for anything from a 10 page report all the way up to a PhD thesis or professional engineering report.

Not all of these steps have to take a long time. Remember ‘why are you writing this document?’ If it is just a txt to a friend or a 1% assignment maybe you don’t need to spend much time in each stage but you might still want to follow the logic used.

A handy little trick is to copy your text in google translate (or other) and have it read back to you. Our ears and our eyes are wired differently and grammatical errors will become obvious. Another important piece of advice is to leave the work overnight before proof reading. If the writing is still fresh in your mind you will miss small mistakes as your brain knows what is mean to be there and fills in the blanks. The longer you leave it the better this tends to work.

# Sections

Below is a list of sections typically found in an engineering report and a brief description of each. This is not a definitive list and will change as is appropriate or requested. There are a great many resources available which will detail what belongs in each of these sections and a lot of debate about exactly what should go where. Not all sections are required in every report you write and each audience may expect different things from you. One important thing to remember is that you do not have to write your sections in order, abstracts for example are almost always written last and it can be easier to write an introduction if you have already written a results sections. It is also important to remember that your report will generally not be read in order. When doing a literature review (research) generally the abstract is read, then the results then the method. The figures are generally the most interesting part and it is only if I am interested that I will read the work start to finish (maybe 1 in 20 or 1 in 50 papers).

**Abstract:**

A brief description of the work in the report. This tells an expert in the field the answer to the question you originally set out to answer. After reading your abstract nothing in your report should come as a surprise to the reader.

**Executive summary**:

Similar to an abstract however the target audience is not an expert in the field but an experience person without specific knowledge. This often is some form of ‘boss’ or client who might not actually be an engineer but hopefully knows something about the area. Here you need to convey the essence of your report using the appropriate language so that a time poor manager can get the information they need.

**Introduction:**

This section brings the reader into your realm. By the end of the introduction, the reader should know what to expect from your work.

**Theory:**

An outline of the underlying theory of you work as well as any new theory you derive. It is extremely important to remember your target audience in this section

**Literature review:**

A review of previous work in the same field of study or work that is applicable. This review ensures that you do not, unless required, redo previous work. It may also help the reader understand why your work is important.

**Method:**

How, exactly, did you conduct your work? This is important so that others can repeat or verify your results. This section is often very short, despite the fact that it is where most of the time is spent.

**Results:**

What were the outcomes? Again, care needs to be taken to ensure the appropriate level of detail is included. Results should be summarised in a way that makes them clear to read. ‘Raw data’ can be included in the appendixes as required.

**Discussion:**

This section is critical. It is here that you explain your observations and thoughts. You must always justify why you think things happen.

**Conclusion + recommendations:**

What does your work mean in the context you have defined?

**References:**

Here you reference the work of others

**Appendixes:**

Often there is information that may be useful, though doesn’t fit in the report. This information made available as an appendix to readers if they wish to look through it. Appendix can have a variety of information;

* drawings or plans
* raw data
* images
* scripts or code
* mathematical proofs
* journal or diary entries
* many others.

# Formatting

The above sections give advice on how to structure a document but little on how to actually turn ideas in your head into words. There are an enormous amount of rules and conventions that that are used to help you be clearly understood. In this sections rules and conventions will be stated and their origins explained as well as they are known. Numerous tips, advice and examples will also be supplied.

Formatting details are often arbitrary but sometimes critically important. They depend entirely on your audience. One example from an industry partner who was working for a client: submitted 2 copies of a final report after carrying out a 10 month job (approximately 400 pages). The report was not accepted as it was presented in a 4 ring binder whereas the client used 2 ring binders. Just one example of where an arbitrary sounding detail became an issue.

Having a correctly formatted document is very important as, a bit like a job interview, first impressions carry a lot of weight. Also, a correctly formatted document is far easier to read. Here is your chance to be creative. A little bit. Sometimes.

## Formatting Rules

In some cases, for example some journal publications, the formatting is dictated to you and there are no options to stand out other than to present exceptional work (the point of journals!).

When you work for a company they will likely have a ‘Style guide’ that tells you how to format all documents. This ensures that there is a consistent look to all company outputs. This can be a very important part of branding!

At other times, for example reports at University, it is entirely up to you how the document is to be formatted. This should not be open slather to use every font and colour available in your word processor. Instead, a chance to think about the most appropriate way to aid in conveying your message to your target audience. There is that point again!

Always avoid using multiple carriage returns and tabs to format and align your document. This creates a great deal of work to get everything looking cohesive. Instead use the Styles built into word, or, if using LaTeX you’ll be forced into some kind of styling.

Take this document as an example; all of the styles have been setup so that the formatting in each section is the same. If a change to formatting is required, you only need to update the style and the entire document will update to reflect the change. This is much easier than redoing carriage returns and tabs throughout the document and keeps everything looking consistent. Documents with inconsistencies don’t look or read well.

Resist the urge to use the ‘canned’ formatting. You’ll note in this document there are a number of styles that have been created. For a truly professional looking document, this is the only option. When you think that there are marks associated with how every written assignment at University ‘looks’ it becomes clear that it is worth the practice.

## Group work

When writing a document in groups, as will happen for the rest of your life, always have a formatting session once the document is put together or start with a style guide. It is obvious when groups don’t do this and it looks terrible. It is always recommended that you print a copy of your assignment and at least flick through it before submission. Formatting issues are often hard to spot on a screen but incredibly obvious in a printed version.

It is also very important to ensure the compiled document reads as one single body and not 4 distinct parts. This will almost always require sections to be rewritten. Information is invariably repeated and subsequently needs to be cut. This can be quite difficult for groups, as one person’s hard work will be deleted; however, it is required for a concise document.

Similarly to information being repeated, some is invariably missed, which always followed by the expression ‘Oh, I thought you were doing that’. Again working well together comes down to having everyone on the same page (so to speak) and having the time to edit your report properly.

## How to use bullet points

Interestingly this is something that is not often taught and many, many people do it incorrectly. The use of pointed lists came from our friends in the legal community who used to be even more notorious for writing ineligibly.

Imagine the following sentence:

At the termination of the contract, the undersigned relieves his rights to his tractor, farm shed, 150 head of cattle, Holden ute, big screen TV, watch, all shirts.

Lists like this can be very lengthy and difficult follow, so were changed:

At the termination of the contract, the undersigned relieves his rights to his;

* tractor
* farm shed
* 150 head of cattle
* Holden ute
* big screen TV
* watch
* all his shirts.

You’ll notice that the commas on each row are implied, the leading letters are not capitalised and the list is finished with a full stop, exactly as they were in the original. Here a semi colon is used.

Some times a list is formed with complete sentences, so when writing one of these lists:

* A colon is used at the end of the preceding sentence.
* Each line is started with a capital letter.
* Each line is finished with a full stop.
* There are some more complicated types in this document for your reference.

You will be surprised, now that you know how these are meant to be formatted, how often you see them done incorrectly.

Numbers are used instead of bullets when either a definite sequence is required or there is a definite number of articles.

## Language

It is very important that you select the correct language style of your target audience. Sometimes these changes will be subtle other times stark.

‘Yeah bra, my exhaust is fully sick!’

‘My new exhaust headers have improved the thermal efficiency of my engine.’

When writing technical information, to ensure you convey your message clearly, there are some good guidelines to stick too.

**Qualitative vs quantitative language**: In technical writing, we want to use numbers wherever possible. A measurements is not ‘pretty good’ it is ‘within an acceptable error margin of 5%’. The first was qualitative, the second quantitative. However, when you are discussing concepts that cannot be assigned a numerical value qualitative writing is your only option.

**Acronyms**: while acronyms are very common in engineering they are often both overused and poorly explained. It is essential that an acronym, however simple, is written out in its entirety the first time it is used. For example three letter acronyms (TLA’s) are very common in engineering, it should also be noted that you do not capitalise the words even through the acronym is capitalised. You should also remember that, although it saves you time, a reader may have to translate an acronym in there head each time it is used, thus making considerably more work for the reader. Remembering that your goal is to make digesting your report as easy as possible for the reader the overuse of acronyms is to be avoided.

**Jargon**: Like acronyms, technical terms are common in engineering to sum up a complex phenomenon in a single word or phrase. Like acronyms an experienced reader will benefit by the shorter writing style but a different reader might find it hard to process. If you read the CFD analysis in the Target audience example section you may come across ‘jargon’ such as ANSYS fluent, y+, Mesh independence, tetrahedral mesh or inflation layer. To an experienced reader this is by far the simplest way to convey this information; however, to the novice this passage is meaningless. What is deemed a technical term and what deemed jargon is a based on the audience.

## Writing style

Everyone has a slightly different writing style. This is OK. You will need to develop your writing style to be appropriate in a technical setting. As mentioned previously for many of you, this will be hard work.

## Write in active voice

So, why does Word keep underlying things in blue and telling me that I am writing in a passive voice and how do I fix it?

Many documents we read are written in a passive voice. Therefore, many of us inadvertently have learnt to write this way, known as social learning. There are a couple of way to look at this and it can be tricky until you understand.

Look at the last sentence of the previous section:

When writing technical information, to ensure you convey your message clearly, there are some good guidelines to stick too.

I started with:

When writing technical information, to ensure your message is conveyed clearly, there are some good guidelines to stick too.

They both have the same meaning; however, the first one sounds more definite.

The subject of this sentence is ‘your message’. In the second sentence, the subject is being acted on (conveyed). This is passive. In the first, the message is dominant. This is active.

Active voice more closely resembles spoken language; hopefully ideal spoken language. When we speak, we generally use the active voice without thinking. Our writing should become that automatic.

You would never say:

Passive: My car (subject) was driven (action) to work by me.

Or,

Passive: Breakfast (subject) was eaten (action) by me this morning.

Instead, you would say:

Active: I (subject) drove (action) my car (object) to work.

And,

Active: I (subject) ate (action) breakfast (object) this morning.

Do not think that every sentence you write cannot be written in a passive voice, it should be the exception rather than the rule. Depending on the style of document the use of passive or active voice can become difficult. It will suffice to say here that passive voice is not required to be formal and in many cases in incorrect.

## Put statements in positive form

Essentially, you need to talk about what did happen rather than what did not. Remember, something always happens; it just may not be what was expected.

If something did not happen, that should of.

The match did not light.

Vs.

I struck the match on the flint 35 times until it broke. It is likely that either or both the match and the flint were contaminated. Further attempts yielded the same results.

The first sounds like a failure, the second as if you may have discovered something. It is also very important to avoid double negatives at all times. The use of active voice and positive form should take care of this but it is still something you should be conscious of.

## Use definite language

Almost all of what we do is based on fact in engineering. Because of this, we need to communicate in a definite fashion. It is important to be as unambiguous, as this often leads to miscommunication. That does not mean that you cannot make a statement that cannot be proven, however it must always be prefaced with by stating it is an opinion. Examples which best demonstrate definite language are:

Pick **a** box.

Vs.

Pick **the first** box.

Or,

**Any** of these **may** be suitable.

Vs.

**This** one **is** suitable.

## Omit needless words

It is easy to ‘pan out’ sentences with words that are not required. One is more conversational, the other matter of fact. Because we talk all day (or did before Facebook), it is easy to fall into writing this way. Engineering reports are about fact:

There are two ways that exist to do this.

Two ways exist to do this.

Often there is limited space for us to write, there should be. When writing a technical document conversationally it becomes waffly. This document has a strong conversation tone, as this assists is very waffly as it

## Tautologies

Tautologies are a repetition of meaning. Sometimes they are obvious and other times less so. Avoid using them. Here are some examples, see if you can work them out:

* Fatally murdered.
* I went there personally.
* He is always making predictions about the future.
* The hotel room wasn’t great but is was adequate enough.
* The diameter of the circular section was 19 mm.
* The size of the SHS was 19 x 19 mm.
* They hiked to the summit at the top of the mountain.

## Express coordinated ideas in similar form

When writing sentences it is important to keep the form consistent. This is another best shown by example [2]:

The French, the Italians, Spanish and Japanese. (Wrong)

Vs.

The French, the Italians, the Spanish, the Japanese. (Correct)

The French, Italians, Spanish and Japanese. (Correct)

The Rule: An article or preposition applying to all members of a series must be used only before the first term or used between each term.

When used on sentences that are more complicated:

Formerly science was taught by the textbook, while now the laboratory method is employed.

Vs.

Formerly, science was taught by the textbook; now it is taught by the laboratory method.

The second passage here is correct, as it is definite. The first passage sounds undecided.

## Keep summaries to one tense and voice

The first point here is that once you select a way to go, stick with it! Changing from one voice to another or changing tense is for the novelist writing stories. Reports are written, typically, after the fact, so you should be writing in past tense. As you are generally discussing facts, and facts are independent of who they occurred to, the use of personal pronouns is generally strongly discouraged.

|  |  |
| --- | --- |
| 1st person | I, we |
| 2nd person | You, your |
| 3rd person | He, she, it, they |

# Figures

You can often show a lot more information in an image, table or figure more clearly and easily than in a passage of text. It needs to be clear that this is easier for the reader! There can be days or weeks of work in making a ‘good’ figure.

## Figures and images

Figures should be printable in black and white where possible. You cannot control how your end users print a document and if meaning is lost, it’s your fault.

Figure 3 shows a chart formatted in different ways to highlight the importance of formatting. Chart 1 is not well laid out with a poor choice of colours, when printed in black and white is rather meaningless. Chart 2 is easy to read in both colour and black and white.

Figures should always be introduced in the text before they appear wherever possible. This allows you to give some context and meaning to the figure. As your figures should convey a lot of information they will be reasonably hard to digest for the reader. Your surrounding discussion can help with this. Always caption your figures, cations should appear below.

Word documents can save images as full resolution so that they can be changed or copied without losing quality. Word does not do this automatically; the options menu is where it is changed.

Always have a copy of your figure that you can edit. You do not want to be completely remaking a figure for a small but necessary adjustment. Figures, like your writing, can have numerous edits and updates.

|  |  |
| --- | --- |
|  |  |
|  |  |

Figure 3 Chart colour selection examples.

## Tables

Tables can be a very good way of displaying data; it is up to you whether a table or chart best portrays the information you are conveying. Avoid ‘over formatting’ tables as excessive colours and fonts can become dominant. You do need to ensure that the important information is obvious.

Caption tables above rather than below like figures. Introduce tables in text prior to their insertion, the example, Table 1, has been taken from the Units section of this report to illustrate a properly formatted table. It is important to ensure tables are not split over two pages.

Table Some examples of unit formatting

|  |  |
| --- | --- |
| Abbreviation | Unit |
| m | meters |
| A | Amperes (Andre-Marie Ampere) |
| V | Volts (Alessandro Volta) |
| N | Newtons (Sir Isaac Newton) |
| Pa | Pascals (Blaise Pascal) |
| psi | Pounds per square inch |
| g | grams |
| °C | Celsius (Anders Celsius) |

## Tables not Tabs

Always avoid the Tab button as it creates an ever-increasing workload to correctly line things up. Instead, use tables and if required, make the borders colourless. Figure 3 was oriented in this way.

## Equations

There will be many times when you will be required to enter equations into your documents. The Word equation editor has become far more user friendly over time. A neat trick in the 2016 version is the ability to auto (semi) number your equations. Simply type #(number) with no space at the end of your equation. It is important to numer your equations so that you can refer to them. Ensure that you include a table of nomenclature explaining what the terms in your equation are. See the following example of the Heat Diffusion equation (1):

## Numbering pages

You should number the pages of all documents. Number table of contents and or other introductory material with roman numerals. The cover sheet and title pages do not get numbered. The formatting in this document provides an example of correct page numbering.

Insert section breaks into the document at the appropriate places to separate numbering styles. There are many online resources to show how to do this.

## Referencing

There are a number of ways to reference other peoples work. Sometimes you are told which to use, other times you can select. Ensure whichever you choose, that it is consistent. Word has an inbuilt referencing system and there are also excellent add ins such as EndNote to assist with referencing. Ensure you have the same software at home before editing documents, as it can get messy- quickly. It is a good idea to have a redundant backup of your document so that if an add in ruins your whole document then you don’t have to start again from scratch.

In general when deciding what you need to reference think to yourself could I have written this sentence without having read another piece of work? If no then you should reference that piece of work. In general do not quote information in a technical report, rewrite it in your own words. Your work should be an amalgamation of your research where you investigated a great many sources of information, and so should be written to show your understanding.

The library website has some excellent guides to help you learn EndNote:

<http://www.newcastle.edu.au/library/support-for-researchers/research-guides>

## Plagiarism

Plagiarism is covered in detail on the University website; <http://www.newcastle.edu.au/__data/assets/pdf_file/0006/83805/Plagiarism.pdf>

It is up to you to ensure that you do not plagiarise others work, however this does not mean you need to reinvent the wheel. It is therefore important that you know how to correctly acknowledge the work of others. In engineering, we also encourage you to work in teams and support each other, as this is how you will operate in the workforce. You must understand the difference between working through problems together and copying each other’s work.

# Commonly misused words

The English language is a complicated beast. Many words appear interchangeable or have different meanings depending on their use, context and grammar surrounding them. Following are some common terms we come across being used incorrectly. No doubt, there are more.

Although not discussed here, each technical field also has a number of terms with specific meaning, such as stress or strain, which a layperson might use very differently to an engineer. It is important that you are aware of technical terms in your field and only use them in the correct circumstances. For example I would never say I am feeling a bit strained unless I was actually being stretched.

## That and which

How do you know when to use *that* or *which* in a sentence? There is a rule that helps to distinguish the difference. Firstly realise that these are joining words between two facts. If the second fact can be omitted from the sentence without changing the meaning then use **which**, if it is required, then use **that**.

Some examples:

My Holden, which is red, is my first car.

My Holden that is red is my first car.

The first sentence implies that your first car is a Holden and happens to be red. The second implies you have several Holdens but the red one is your first car.

Hopefully you can see the difference here. The second sentence relies on the fact that the car is red to make sense, the first doesn’t.

## Among and between

How do you know when to use among or between? Are you standing between friends or among them? The difference is a subtle but thankfully simple. When naming distinct things you use between (regardless of quantity) and when grouping common items you use among

I stood between Angela, Frank and Teddy.

I stood among my friends.

Or,

How do I choose between a red, yellow, green or white car?

How do I to choose among these colours for a car?

## Farther and further

This one is fairly easy. When talking about a physical distance use **farther**. You can remember this by the fact that it contains ‘far’. If you are talking about a figurative or metaphorical distance, use **further**.

Zoe fired the arrow farther than the previous shot.

Zoe had extended her research further than before.

## In regard(s) to.

There is sometimes confusion as to whether ‘in regards to’ or ‘in regard to’ is correct. The best answer here is to avoid this term all together as it can be replace with a single word e.g. ‘concerns’. By the way, the second is correct, just don’t use it.

## However

There are several ways to use the word however; however, many people do it incorrectly. However, like everything, you can learn!

It is not recommended to use however this often, as this was an example only!

The first sentence was using it as a conjunctive adverb, what? A way to join two sentences to make a compound sentence. Using however indicates that there is some difference between the two clauses.

Steph is the strongest girl I know; however, she just could not budge it.

The other way to use however is at the start of a sentence. In this case, you must follow however with a comma. What comes after the comma must be a complete sentence.

However can be used as an ‘aside’. Here it can interrupt a single sentence, in this case with a comma before and after.

It can, however, be very complicated to use this word correctly!

Lastly, it is used to mean ‘in whatever manner’, ‘by whatever means’ or ‘to whatever extent’.

However we attached the widget, it didn’t work.

Or,

The widget didn’t work however we attached it.

Be careful using however this way as if the reader doesn’t understand the correct way to use the word your meaning could be ambiguous

Compare these sentences:

The bridge fell over however we rebuilt it.

The bridge fell over; however, we rebuilt it.

The two mean entirely different things.

Although you many now understand the different uses of the word however it is often ill advised to use it in multiple ways in a single document. Using the same word in different ways only serves to confuse your reader, even if you are technically correct.

## Units

Without units, most numbers in Engineering are meaningless as well as dangerous. The same is true for using the wrong units. There are some rules on how to display units:

* Always leave a space between the number and unit
* If the unit is named after a person use capital, else do not.

Table Some examples of unit formatting

|  |  |
| --- | --- |
| Abbreviation | Unit |
| m | meters |
| A | Amperes (Andre-Marie Ampere) |
| V | Volts (Alessandro Volta) |
| N | Newtons (Sir Isaac Newton) |
| Pa | Pascals (Blaise Pascal) |
| psi | Pounds per square inch |
| g | grams |
| °C | Celsius (Anders Celsius) |

**Prefixes**: In engineering, we often use prefixes to help make numbers more manageable. Quantities such as Young’s modulus are generally in the order of hundreds of billions of Pascals and it is poor practice to write numbers such as E = 205 000 000 000 Pa as this can very easily lead to confusion. Instead, we use prefixes such as Giga (billion) to simplify the expression, eliminating multiple zeros. i.e. E = 205 GPa. The metric prefixes are found here <https://en.wikipedia.org/wiki/Metric_prefix> . In general, only prefixes which denote a multiple of 1000 are used, and so units such as centimetres are incorrect.

When using prefixes some letters are used to mean both larger and small, the letter ‘m’ for example can refer to both Mega or milli. The rule here is that if the letter is capitalised it means bigger (M =Mega), and if it is lower case it means smaller (m = milli).

# ENGG1500 specific requirements

Some rules for ENGG1500:

1. Staples whenever possible.
2. Binding only if a staple will not fit.
3. No plastic sleaves. Ever!
4. Always use a cover sheet and title page if supplied or requested (your company will have its own cover page and letter head).
5. You can use LaTeX if you want but it does not impress me.

# Appendix 1 - How was this document written

Out of interest, here is a summary of how this document was written.

1. Freewriting of ideas onto page(s), some complete, others in point form in a very rough order.
2. Refinement of some sections and some reordering to form the body of a document.
3. Generation of some of the figures.
4. Passed to a cowriter- with meeting to discuss the expected outcome.
5. Read through with general tidy-up of spelling and obvious grammar problems.
6. More freewriting at end of document with new ideas.
7. Second meeting between writers to discuss.
8. Setup document with styles for ease of editing.
9. Tidy up of document sequence with styles being applied at the same time.
10. Feedback sought as per general direction of document meeting between writers.
11. Generation of remaining figures.
12. First full review removing unwanted sections and refining the remaining.
13. Passed back to 1st writer for review and comment.
14. Mark-ups complete and submitted for final review to proof-reader.
15. Proof-readers changes implemented.
16. Published for your enjoyment.

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