A Short Guide to Effective Engineering Report Writing

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Preface: Although the quality of the report 'format' is not included in the assessment criteria in this subject, it is good practice to get into the habit of constantly improving your report's style. Written communication is a very important part of the design process. In fact, it is so important, effective report writing is one of the prerequisites for certification as a professional engineer required by the Institution of Engineers, Australia (IEAust) when you graduate. During the extent of your undergraduate career, you will be able to develop your writing into a very effective tool.

This guide is only a short guide and by no means exhaustive. For a more in-depth look into the elements of a formal engineering report, it is strongly recommended that students read some of the texts below in order of preference:

- 1. Winckel, A. & Hart, B., 1995, Report writing style guide for engineering students, 4th edn., University of South Australia, Adelaide. (Available from the UNSW Bookshop or Online)
- 2. Finkelstein, L., 2001, Pocket Book of Technical Writing for Engineers and Scientists: McGraw-Hill.
- 3. UNSW School of Mechicanical <u>Presentation of Student Written Assignments</u>

1. Elements of an Engineering Report

A typical engineering report generally comprises of the following components:

	Title Page
Preliminary	Abstract/Executive Summary
	Disclaimer
	Acknowledgments
	Table of Contents
	List of Illustrations/Figures/Tables
	Nomenclature/Symbols
Body of the report	Introduction
	Discussion
	Conclusion
	Recommendations
	References
Supplementary	Appendices

N.B. Different engineering report styles have the components in different orders i.e. Traditional vs. Administrative (ANSI). However the above format is the generally accepted standard.

1.1 Title Page

The title page should be short and contain all the necessary information for the reader. It should include the following;

- Name of the university and school
- Name of the subject
- Title of the report
- Name of the group and group members including ID numbers
- Date of submission

Try to make the title of the report as brief and informative as possible. For example, the two titles below represent the same report.

- 1. Feasibility Study for High Volume Manufacturing
- 2. A Report on the Feasibility of Manufacturing a Component in High Volume

Clearly the former (first) of the two is the better choice in titling as it is shorter, but also contains all the relevant information describing the core of the report.

1.2 Abstract

An Abstract is a shorter, condensed version of the whole body of the report. Usually it is written last and should not contain information that isn't addressed within the body. For short reports less than 10-15 pages, the Abstract should be on the order of half a page to two pages. For extremely short reports, the Abstract is usually omitted. For longer reports, the Abstract is replaced by an Executive Summary which is on the order of several pages.

The Abstract should contain;

- Purpose of the report
- Details on how the topic was approached i.e. design process.
- Results of the report
- Conclusions and recommendations drawn from the results

A short example of an Abstract is given below with indicators of the sections,

Abstract

Purpose

This report details the design of a replacement drive system required for a preexisting roller crusher. The original drive system was subject to failure due to insufficient torque output of the motor. The new drive arrangement would incorporate a suitably rated motor to provide the required power for the roller system. This involves 2 speed reductions via a belt and chain drive setup. Approach

Calculations were carried out on the torque requirement of the system, based on certain functional constraints. The roller system was required to maintain a nominal rotational speed of 260RPM with an absolute lower limit of 250 RPM. A motor was selected to fulfill the torque requirements of the rollers. The chain and belt drives were then designed based on the power transmission requirements via an intermediate shaft.

Results

A suitable three-phase induction motor was selected that has an 18.5kW output which allowed the roller to maintain a speed above 250RPM. The belt and chain drives were designed, and components selected from major suppliers. The belt drive required a duplex V-belt while the chain required triplex 18.05mm pitch chains.

Conclusion and Recommendations The drive system was designed on the functional torque requirements of the roller system. Assumptions were made about the inertias and efficiencies inherent in the system. Further revisions of the drive should include considerations of the existing inertias of the drive components, which may decrease the required power output of the motor, resulting in cost reductions.

1.3 Disclaimer

<u>Including a Disclaimer is optional.</u> In fact, the School of Mechanical Coversheet includes a disclaimer. This section only serves as a reminder when writing a professional report in industry.

A Disclaimer is just a formal declaration of the authenticity of your report. It usually contains a short declaration followed by the signatures of the contributing members.

We, the members of Team ##, declare the following work to be our own, and that any content from other sources has been acknowledged and fully cited.

Signed,

John DOE (z######)

insert signature here

1.4 Acknowledgements

<u>Including Acknowledgements is optional.</u> This can be on the same page as the Disclaimer. It simply has a short paragraph acknowledging significant contributions an external individual has made to your report.

1.5 Table of Contents

- The page title should be Table of Contents
- The page must have the same formatting throughout
- Refrain from underlining the table of contents
- Page numbers should not have a prefix pp or page. Where possible, use leaders (series of dots) to connect the section headers to page numbers
- Use indentation for each level

Table of Contents
1. Literature Review 1
1.1 Operating Environment 2
1.2 Robots in USAR 3
1.2.1 RoboCup4
1.3 Microcontrollers 5
1.4 Signal Transmission
1.5 Summary9

1.6 List of Illustrations

- The page title should be List of Illustrations if the report contains both tables and figures
- If figures or tables only, then use List of Figures or List of Tables respectively

List of Illustrations
Figure 1. Sketch of Concept Design10
Figure 2. Prototype Drawing of Part11
Table 1. Cost per Part6

1.7 Nomenclature

<u>Including Nomenclature is optional.</u> It contains a list of symbols or abbreviations that are used in the report. However, Nomenclature can be omitted by having the symbols explained where they are first used. The symbol's S.I. unit of measurement must also be displayed.

Nomenclature

Surface friction coefficient

Magnetic Flux Density (Tesla)
 Electrical Resistance (Ohms)

1.8 Introduction

The Introduction contains all the background information required for the report. It contains the following;

- Purpose of the report
- Background of the report
- Scope of the material (Boundaries and limits of investigation)
- Procedure undertaken to address the problem

A short example is given below.

	Introduction
Purpose	The purpose of this report is to detail the design of a computer case, suitable for high volume manufacture aimed towards the computing enthusiast market.
Background	The recent boom in computer products has quadrupled in the past few years due to the advances in information technology. Due to the high demand of quality parts, enthusiasts comprise a large part of the market sales for computer parts from brand name suppliers that cater to their needs. The need for cases that house large graphics cards have become increasingly popular.
Scope	We are tasked to design a new computer case that has the ability to house the latest in graphics cards. Considerations are made into aesthetics and ergonomics of the case. There is also an increasing demand for cases that have convenient accessibility to the inside components, as well as good airflow for cooling.
Procedure	The design team gathered information about the preferences from various sources for the design. We gathered information from computer gaming enthusiasts, as well as programmers and IT professionals. An iterative design process was used to converge the concept design into a feasible solution, by incorporating the suggestions gathered.

1.9 Discussion

This is the body of the report. It contains all the information about your strategies employed, procedures and results. It may also include analysis or discussion of the material.

Use appropriate headings; do not use headings like 'Main Body'. For example,

2. Design Process

The first step in the design process was conceptualization. The team collated various concepts and decided on the first prototype by taking notable parts and functions from each concept sketch...

2.1 Conceptualization

A major factor influencing our concepts were...

...

3. Manufacturing

Design changes had to be made to various parts as their feasibility for high volume manufacturing were low due to cost ...

The headings should follow a logical order, so the topics flow. For example, it's not logical to put Design Process after Manufacturing.

1.10 Conclusion

The conclusion should include the report's most significant findings, and also reiterate the report's original purpose. It should <u>not</u> include material that isn't presented within the body of the report. Effectively it should be a quick and concise summary of the main points.

1.11 Recommendations

In many reports, recommendations are not required. In the case they are required, the following format is used;

- Each recommendation is numbered or use bullet points
- The recommendation must be brief

An example is shown below,

Recommendations

- The design of this part fulfills the necessary criteria for operation given that only a handful will be produced.
- 2. Further revisions of the part design should take existing inertias into consideration.
- This part should be further modified to allow it to be green sand cast moulded for high volume production.

1.12 References

A list of references used within the report. The list must be;

- In alphabetical order by the author's surname
- Consistent in referencing style (Harvard)

For example,

References

Budnyas, R.G. & Nisbett, J.K., 2008, Shigley's Mechanical Engineering Design, 8th ed., McGraw-Hill, Sydney.

Feng, N.S., 2009, MMAN2100 Engineering Design 2 Lecture Notes, University of New South Wales, Sydney.

Johnson, R.A., 2000, Probability and Statistics for Engineers, 6th ed., Prentice-Hall, Sydney.

1.13 Appendices

In some reports, an Appendix is not required. The Appendix usually contains,

- Large diagrams or figures unsuitable to place within the body
- Information that is not important enough to place within the body
- Material such as engineering drawings etc.

Each section of the Appendix must be labeled Appendix A, Appendix B, and so on. For Appendix sub-sections, you maybe expand the labels such as Appendix C-1, Appendix C-2 etc.

2. Format of an Engineering Report

2.1 General

- Use A4 paper
- Only use one side of each paper i.e. no duplex printing
- Use binding or clips to compile the report, stapling is discouraged as it can tear and fall apart

2.2 Pagination

- Place page numbers at the centre and bottom of each page. Hyphens i.e. (-8-) are optional
- Consider the title page as page 1
- Roman numerals (i, ii, iii) are used for preliminary pages of the report
- Arabic numerals (1, 2, 3) are used for pages spanning the body of the report
- (Optional) Appendices use A1, B1, C1, C2, C3 etc. where Appendix C has 3 pages

2.3 Referencing

Use a consistent referencing style throughout the report (Harvard referencing).
 Documentation on the Harvard referencing style is available from the UNSW Library.

The format guidelines described here are not absolute, and variations are acceptable.

2.4 Format

2.4.1 Fonts

- Cursive or fancy fonts should not be used in the report
- Fonts should nominally be around the size 12 point
- Fonts should be smaller, around 10, for quotations, figures and tables

2.4.2 Headings

- Headings should have larger font and in bold
- Headings and sub-headings should be numbered using decimal system i.e. 1.1, 2, 2.1, 2.2 etc.
- The numbers after each decimal represent a sub-heading
- Headings can be multi-tiered i.e. 2.1.3.1 but sub heading beyond the third decimal is discouraged

- Each new major section heading must start on a new page ie. 1. Introduction is on one page and 2. Conceptual Design starts on a new page with all its sub-headings.

2.4.3 Justification

- Text should be left or fully justified. Full justification is preferred for reports.

2.4.4 Figures and Tables

- Figures include all illustrative material such as diagrams and sketches etc.
- Figures and tables can be numbered by (heading no).(fig. no.) i.e Figure 2.2
- Figures and tables are usually centred
- They must have a descriptive caption
- They MUST be referred to in the text
- If they are referenced from another source, you must include a citation

For example,

The Sukhoi 47 nicknamed Berkut (Golden Eagle), is one of the few aircraft apart from the Grumman X-29 that employs the supreme maneuverability of forward-swept wings as shown in Figure 1.



Figure 1: A photograph of a Russian Su-47 Berkut Supersonic Jet Fighter (Aircraft InFormation, 2007)

2.4.5 Equations

- Equations are numbered by placing a number in parentheses (#)
- Each equation begins on a new line and is centred
- Each adjacent equation is aligned by their equals signs =

For example,

In finding the solutions to the damped ODE, one employs the general solutions of the form of (1).

$$x_1(t) = A\sin(kx - \omega t) + B\cos(kx - \omega t)$$

$$x_2(t) = Ce^{-i(kx - \omega t)}$$
(1)