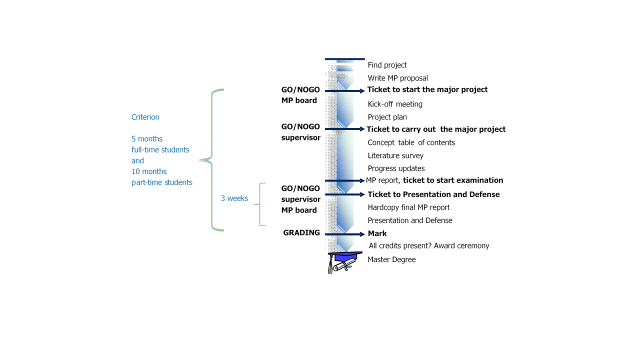
**Major Project**

**Template**

**HOW TO WRITE   
A MAJOR PROJECT REPORT**

****

**Arnhem, June 2018**

**Master Automotive Systems**

**Master Control Systems Engineering**

**Master Engineering Systems**

**PREFACE**

Writing a major project report is a challenging task. This document is intended to help you to structure your report. Consider it an example and feel free to create your own document. Still, we hope it helps you to create your major project report effectively.

As soon as you are ready and you got your feedback from your company coach and your HAN supervisor, please hand in at [finalthesis.tm@han.nl](mailto:finalthesis.tm@han.nl) for evaluation.

From the perspective of the writing process itself, it is effective to write your introduction, especially background, process definition and objectives, as soon as possible. It will help you to focus your work.

Staff Master program

Automotive Systems

Control Systems Engineering

Engineering Systems

Arnhem, September 2018

*No part of this publication may be reproduced and/or made public, whether mechanically or electronically in print, or by photocopy, microfilm, automated system or any other means what so ever, without prior written permission being obtained. To this end, an application can be made to the director of the HAN program.*

*The only exception to this rule applies to students, who are expected to use this document to create their own Major Project report.*

**SUMMARY**

To complete your master programme, of course you want to present an impressive Master Project report. Still, it can appear quite a struggle to accomplish this. To provide a helping hand, this document is provided.

Its objective is twofold. It provides some background and tips how to create a well written Master project report, and this word document itself serves as template are expected to use as a default to create your own report.

When you compose the summary of your report, consider it a separate document, very briefly presenting your complete project. Probably, your summary will be read by many more people than the body of your report. And a well-written summary may make people decide to read your full report. So time spent on your summary is generally well invested.

A simple way of reducing your message to the nitty-gritty of a summary, is to ask a colleague to interview on your major project topic. Record (on your cell phone) the answers you give to “what did you research, why, how did you tackle the research question, what did you find and what are the conclusions and implications?” Next, type out the sentences.

[6] *Report writing for readers with little time*: chapter 6.4 (summary)

**CONTENTS**

[1 Your first chapter 1](#_Toc415394048)

[1.1 Background 1](#_Toc415394049)

[1.2 Problem definition 1](#_Toc415394050)

[1.3 Objectives 1](#_Toc415394051)

[1.4 Approach 2](#_Toc415394052)

[1.5 Literature survey 2](#_Toc415394053)

[1.6 Outline of the major project report 3](#_Toc415394054)

[2 The body of the text 5](#_Toc415394055)

[2.1 Introduction 5](#_Toc415394056)

[2.2 How to write 5](#_Toc415394057)

[2.3 Text 5](#_Toc415394058)

[2.4 Figures 6](#_Toc415394059)

[2.5 Equations 7](#_Toc415394060)

[2.6 Tables 8](#_Toc415394061)

[2.7 Computer listings 8](#_Toc415394062)

[2.8 Appendices 9](#_Toc415394063)

[3 Some considerations on the content.. 10](#_Toc415394064)

[3.1 Validate your models! 10](#_Toc415394065)

[3.2 Discussion needed? 10](#_Toc415394066)

[3.3 Conclusions and recommendations 10](#_Toc415394067)

[3.4 What should the size of my report be? 11](#_Toc415394068)

References

Appendix A Nomenclature

# Your first chapter

## Background

Your first chapter should introduce the subject of your Major Project in a similar fashion as in your major project proposal. As the readers of your report are not aware of the context of your work, you need to present some backgrounds on your project. In what kind of industry is your work relevant? What is the origin of your project?

Common pitfalls:

* Do not use the background to present the company or organization you work for extensively. Your report is a technical report, not an advertorial. Therefore, the companies number of employees, product range and financial results are not of any interest to the readers.
* It is always difficult to decide how much background needs to be added to make clear the problem you investigated. It could help if you imagine you are writing the report for a fellow master student (also working on his or her final science project) that does not know about your specific topic.

[6] Report writing for readers with little time: chapter 3 (From assignment to text)

## Problem definition

Now we know the background, what exactly is the problem you face? Try to pinpoint the problem by giving an accurate definition. This is the most difficult and at the same time most important part in your report. Make sure you take sufficient time to think about this! Here, graphs presenting components, connecting signals and flows might be helpful for your readers. The process definition as discussed in the course ‘Introduction Modeling’ provides a structure. And do not forget to introduce names and units!

## Objectives

The readers now understand the problem. Continue by presenting the objectives that you addressed in your research. Introduce them and present them as a short list. Clear objectives help you to focus your choice of methodology, results analyses and conclusions. Therefore, you should spend some time on accurate objectives, although this section will probably not exceed a third of a page.

Common pitfalls:

Do not mix up objectives with tasks. Tasks are only part of the process to reach your objectives. Objectives present the goals you are aiming for.

## Approach

When you feel your approach needs some explanation, include a section on the subject. Here you can argue why you conducted your research the way you did, what advantages these methods offered you and how you avoided disadvantages in the analyses of the results.

Common pitfalls:

* Do not present a chronological schedule of your work, but do argue why your methods were the best way to find relevant data for your objectives. For your audience only the technical decisions, motivations and results are relevant. The time you spent programming a user interface is irrelevant to the reader.

## Literature survey

You are probably not the first to examine the problem you presented. So it is wise to search for literature (books, journal papers, conference proceedings, internet pages, patents) to solve the problem as effectively as possible. Make sure you ask staff members at HAN Study Centre for help as they really know their way around sources.

Discuss the sources which are useful for your argumentation. It is important to read critically. Try to distinguish why they are useful and where they fail to completely solve your problem. And be happy when you found a source that does provide a full solution: you still need to demonstrate that you can understand and apply the written material.

Reading the literature is useful for another reason: it helps you grasp the correct vocabulary for your major project report work. In fact, reading carefully and defining your words helps you formulate your thoughts more precisely. You would not be the first budding scientist to discover that certain journals use different terms for the same phenomenon than other journals, and that certain researchers have a different definition than others. Describing such different meanings, and defining the meaning in which you use the term, helps your readers understand where you are coming from in your work, And in addition, in the process of critical reading you learn the phrases and word combinations that are used in the field .

There are different ways to refer to sources. In technical reports it is most common to refer by using square brackets and a number [1]. At the end of your report, as a final appendix, include a list with references. Take care that you refer slightly differently to books [1], journal papers [2], conference proceedings [3], internet sources [4] and patents [5]. When referring to a book, you generally only refer to part of the book. You can solve this by referring to section 2.2 of [5], or when you refer to the book only once, by including the page/section/chapter in the reference itself.

If your literature survey is very comprehensive, you can consider a separate chapter on the subject.

Common pitfalls:

* Do not present the literature survey as a kind of list of references that are somehow relevant. Key is to discuss why a reference is relevant to your work.
* When you refer to a book or paper in the text you usually use the authors name or the title. As an example: *“As described in the book Mechatronics [1] ….” , “As pointed out by R. K. Ahluwalia et. al [2] ……”*
* Refer to all ideas and texts that you feel have inspired you: avoid plagiarism when using materials and ideas that others have used before. Plagiarism is a mortal sin in academia as it destroys your academic credibility.

[6] Report writing for readers with little time: chapter 7.4 (literature report)

[6] Report writing for readers with little time: chapter 4 (Dealing with sources of information)

## Outline of the report

Spend some lines on explaining to your readers how you organized your report. It makes your work more accessible. The organization of your report should be a logical consequence of what you mentioned in the objectives and approach.

A technical report is not a book. The readers, probably engineers, should be able to recognize the structure of the report easily, to get to the information needed quickly. Therefore most technical reports have a clear, recognizable, structure (IMRAD)

1. Introduction
2. Methods
3. Results
4. Discussion
5. Conclusions

Note that you are not bound to this structure, but it might provide a good starting point to structure your own report. And do not forget to include your Summary before the Contents and a list of References as first or final appendix.

Try to write your first chapter on objectives and literature already at the start of your Major Project. It will help you to focus and it makes your work more effective. You could also write a blueprint / poster in which you outline at paragraph level what you will write where.

[6] Report writing for readers with little time: chapter 6 (Requirements for each part of the report)

# The body of the text

## Introduction

To help the readers, you might consider to start each chapter with a short introduction of what the readers may find here. In the introduction you explain the purpose of the chapter. An example:

*In this chapter the body of the text is discussed. As has already been mentioned in paragraph 1.6, you are free to use any structure you like for the report. In this chapter have we collected some remarks which will help you to write the body of your text.*

[6] Report writing for readers with little time: chapter 5 (Structuring)

[6] Report writing for readers with little time: chapter 9

(Putting ideas into words)

## How to write

Remember that your audience is interested in the technical content of your work. Therefore, you should define your technical choices, motivate them, enumerate assumptions and present alternatives. You do not need to discuss issues related to the project itself, such as tasks, the time needed for experiments, discussions with the customer on requirements, etc. These are of less interest to your readers than the findings. This also implies you will not write sentences like ‘I did the experiment..’ as it is not relevant to the readers who did the experiment. Only the results of the experiment are relevant, and therefore often the passive voice is used. This technical focus certainly helps to create a to-the-point report.

[6] Report writing for readers with little time: chapter 2 (Writing effectively in professional situations)

[6] Report writing for readers with little time: chapter 12

(Layout)

## Text

Your report will consist of chapters, sections and possibly subsections. Avoid the use of sub subsections as it will become messy and will not help to create transparency for the readers. Start a new chapter on a new page. Leave an empty line between the title of a section and the body text and leave 3 empty lines before starting a new section.

Generally, a letter type of 10 or 11 points and a line distance of 1.1 or 1.2 provides the best readable result.

## Figures

A picture can explain a thousand words. When introducing a figure, call it figure with a succeeding figure number and put a meaningful title below the figure. In text, refer to a figure as figure 3.1. You can number figures per chapter or throughout the report. Leave two empty lines between the body text and the figure and center the figure.

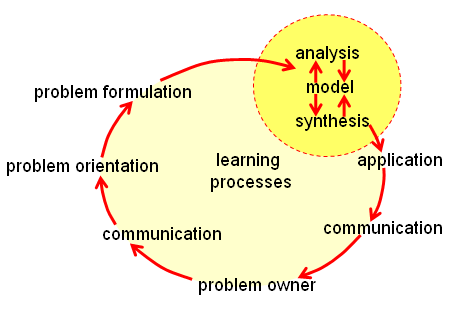


Figure 3.1 The problem cycle

Acceptable software to produce graphs like block diagrams is PowerPoint. As PowerPoint is available on almost every Windows computer, the risk of incompatibility is reduced. Nevertheless, when copying a graph from PowerPoint to Word, there is a hatch. When you simply use ‘copy’ and ‘paste’, Word will interpret your graph as a set of separate objects. As a result, your graph can appear differently in Word and in PowerPoint. To avoid this, choose ‘copy’ in PowerPoint, but ‘past special’ in Word. Then select the option ‘enhanced metafile’. This preserves the scalability of the graph but leaves letter types etc. unchanged.

Naturally, Excel offers options as well. If you want to include graphs from Matlab or Simulink, use the plot function to adjust the plot to your expectations and use the ‘copy figure’ option in the drop down menu to copy the figure to your report. It is advisable to also save the figure as a ‘.fig’ file in Matlab. This allows you to adjust scales, titles, etc. later, when appropriate.

Graphs should be numbered and completely labeled and titled. The title should be brief and descriptive, such as “Motor Speed as a function of Torque.” The independent variable should be shown on the abscissa (horizontal axis) and the dependent variable should be shown on the ordinate (vertical axis). Scales should be labeled with the name, symbol, and units of the quantity involved. Each of the curves on a sheet should be clearly identified, and all of the experimental points shown. Graph scales should be chosen for easy reading but with due regard to the accuracy of observed and computed quantities, so that variations are neither concealed nor exaggerated. For instance, if temperatures can be read only to the nearest degree, the smallest subdivision on the graph paper should be one degree or greater. Major scale divisions should be chosen so that interpolation is easy. The subdivisions should preferably represent 2, 5, 10, 20, 50, 100 etc. Most scales should start from zero; if they do not, a broken axis must be used. Smooth curves should be drawn with no extrapolation beyond the experimental points. Any discontinuities or points of inflection should be examined with suspicion. Methods of plotting that give straight lines are preferred.

Comments:

* Put effort into making your graphs. A clear graph generally explains more than a lot of words. In addition, you can reuse the graphs for your major project presentation!

[6] Report writing for readers with little time: chapter 11 (Illustrations)

## Equations

Before writing your equations, make a list of all parameters and variables including their name and units in alphabetical order. This list, the ‘nomenclature’ will help you to create consistent equations. It is very common to include this nomenclature in your report: as first appendix or just before the list of contents.

Equations are very important in technical reports. Mathematics is the language for technical stuff. So take care of your equations! The readers recognize a clear equation already by its structure and names for parameters and variables. Check your references for the nomenclature used, to make sensible choices for your own nomenclature. As example: *T* generally indicates a temperature and *P* a power.

An equation preferably indents a tab stop and has a unique equation number. Keep a blank line before and after the equation. In text, refer to the equation just by using the equation number in round brackets: ‘According (1) the power is proportional to the temperature difference.’

 (1)

To distinguish between variables and parameters, you can indicate time dependency by adding (t) to the variable. Nevertheless, the difference between parameters and variables is generally clear and thus the time dependency is omitted.

Check your equations on units! It is very effective to observe if you have omitted a parameter.

Common pitfalls:

* Do not use dots ‘.’ nor asterix ‘\*’ to indicate a multiplication. In mathematics, a dot or an asterix has other meanings. Just put parameters and variables in a row as in (1) as the operation will not be ambiguous.
* Do not try to create equations as text. Use an equation editor to create your equations. In Word, go to ‘Insert’ → ‘Equation’. It directly provides some examples you can use as starting point to create your own equation.
* Latex could be used to create complex formulas. You could then Print-Screen this and import it into your Word file.

## Tables

Tables are used when an enumeration is not sufficient to list items. All tables are numbered subsequently and referred to in the text as ‘table 3.1’. Leave two blank lines between the body text and the table.

Table 3.1 Main vehicle parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Description | Value | Units |
| *M* | Vehicle weight | 4600 | kg |
| *A* | Vehicle frontal area | 4.4 | m2 |
| *fr* | Coefficient of rolling resistance | 0.015 | - |
| *cx* | Coefficient of air resistance | 0.7 | - |
| *mj* | Equivalent mass of rotating parts | 200 | kg |
|  |  |  |  |

Common pitfall:

* Decimals in English are separated by a full stop (.)
* Thousands are separated by a comma (1,000)

## Computer listings

It is uncommon to present computer listings or programming graphics like LabVIEW windows in a technical report. Generally it neither supports nor motivates your technical choices. Therefore, consider if you really want to present and discuss listings.

If you feel you have a unique software solution, consider presenting the listing or graph in an appendix. When presenting listings, use a uniform spaced letter type, such as courier:

% --- Plot results

figure

subplot(211)

plot(taxis,y,taxis,ym)

grid

xlabel('Time [s]')

ylabel('Amplitude [V]')

title('Process output and model output')

## Appendices

All information that distracts from the main thread, but which is still relevant, should be included in an appendix. Think of supporting measurements, mathematical excursions or computer listings.

[6] Report writing for readers with little time: chapter 6.10 (Appendices)

# Some considerations on the content..

## Validate your models!

In all major projects, validation is important. Therefore, many reports will discuss experiments and their results. A chapter on these results generally comprises a description of the experimental setup and presents the results without too much interpretation. Especially when the interpretation also needs some discussion and some assumptions , consider a separate chapter on the subject. Note that in some cases there are no measurements available or possible. Then you can consider to verify your work using literature or first principle relations.

Common pitfalls:

* Measurements with unmotivated sample times.
* Graphs too short to cover the dominant time constants.

## Discussion needed?

As discussed in the previous section, when results are obvious and require little discussion, you can omit this chapter. Still, consider that a discussion chapter provides you an opportunity to show your master level. It should comprise the interpretation of the results presented. Do the measurements validate the models? Can you explain the differences? Do the results prove that the objectives are fulfilled? Or have phenomena been observed which were unexpected? And if so, how can we explain them or do they even initiate new ideas? Compared to the other chapters in your report, the discussion section is less ‘fixed’ and more philosophical in nature.

## Conclusions and recommendations

Your conclusions should reflect your objectives. Has the problem been solved? How well has it been solved? What did we learn from this project? Are there issues left? Note that conclusions should not contain new information. All information presented should already have been presented in the previous chapters.

There is no need to include recommendations in a technical report. But especially when there are issues left, and you have a clue on how to deal with those issues, it is relevant to present that in this section. Such a section is an opportunity to demonstrate your master level by discussing matters beyond the scope of your problem. On the other hand, it always underlines the unsolved issues in your work..

[6] Report writing for readers with little time: chapter 6.7 (Conclusions)

## What should the size of my report be?

With respect to the size of your report, there are no fixed rules on the numbers of pages, etc.. But a report of more than 100 pages with a body text of more than 50 pages will raise an eyebrow in the board of examiners. It might suggest that you find it difficult to distinguish between main and side issues. But still, it all depends on the subject.

## Presenting your report orally

If you have received a final and last GO for your final report, you can present your report orally.

The viva voce presentation and defence is your opportunity to demonstrate your abilities at master level in front of your major project committee. The chairman of the major project committee (first examiner) and the second examiner of HAN University of Applied Science are responsible for the final mark and consulting the other major project committee members.

The assessment is carried out based on a protocol and is subsequently signed.

[6] Report writing for readers with little time: chapter 13

(Presenting a report orally)

**REFERENCES**

Five examples of references are included here: a book [1], a journal paper [2], a conference paper [3], an internet source [4], and a patent [5].

1. Cetinkunt S., *Mechatronics*, Wiley, 2007
2. Ahluwalia R.K., Wang X., Rousseau A., Fuel economy of hybrid fuel-cell vehicles, *J. of Power Sources*, vol. 152, pp. 233-244, 2005
3. Gao Z., Rhinehart R.R., Theory vs. Practice: The Challenges From Industry, *proc. American Control Conf.*, Boston, USA, 2004
4. Dieselnet, [www.dieselnet.com](http://www.dieselnet.com), September, 2012
5. Amano Y., Umeno T., Tomura S., Ishikawa T., Kanada N., Yoshida H., *Hybrid vehicle controller*, US patent Pub.No. US2009/0030568, 2009
6. R. Elling, B. Andeweg, J. De Jong, C. Swankhuisen (2012). Report writing for readers with little time, Noordhoff Uitgevers Groningen/Houten

**APPENDIX A Nomenclature**

**Symbols**

*A* Frontal surface area vehicle [m2]

*CD* Double layer capacity [F]

*Id* Current demand [A]

*Paux* Auxiliary power [W]

*n* Number of samples [-]

*ts* Sample times [s]

*v* Vehicle speed [ms-1]

*α* Inclination [RAD]

*ηEM* Efficiency electric motor [-]

*ω* Frequency [RAD/s]

**Acronyms**

ARMA Auto Regressive Moving Average

FIR Final Impulse Response

LPF Low Pass Filter

MPC Model Predictive Control