UNIVERSITY OF BERGEN
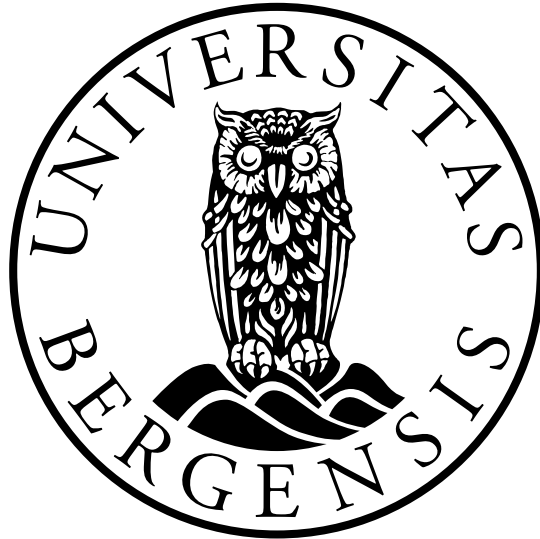

Department of Information Science and Media Studies

MASTERS THESIS

En lang tittel er grei å splitte sånn ca på midten

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Any negative polls are fake news, just like the CNN, ABC, NBC polls in the election. Sorry, people want border security and extreme vetting.

Donald Trump

Abstract

Here you give a summary of your your work and your results. This is like a management summary and should be written in a clear and easy language, without many difficult terms and without abbreviations. Everything you present here must be treated in more detail in the main report. You should not give any references to the report in the summary – just explain what you have done and what you have found out. The Summary and Conclusions should be no more than two pages.

Acknowledgment

I would like to thank the following persons for their great help during . . .

If the project has been carried out in cooperation with an external partner (e.g., a company), you should acknowledge the contribution and give thanks to the involved persons.

You should also acknowledge the contributions made by your supervisor(s).

O.N.

(Your initials)

Contents

List of Figures

List of Tables

List of source codes

List of abbreviations

FTA Fault tree analysis

MTTF Mean time to failure

RAMS Reliability, availability, maintainability, and safety

Chapter 1

Introduction

The first chapter of a well-structured thesis is always an introduction, setting the scene with background, problem description, objectives, limitations, and then looking ahead to summarize what is in the rest of the report. This is the part that readers look at first—*so make sure it hooks them!*

1.1 Background

In this section, you should present the problem that you are going to investigate or analyze; why this problem is of interest; what has, so far, been done to solve the problem, and which parts of the problem that remain.

Below, I have set up some headings (subsection titles) without a number. These are included to help you remember to cover the related issues. The headings should be removed in your final print.

Problem Formulation

You should define your problem in a clear an unambiguous way and explain why this is a problem, why it is of interest—and to whom. It is also important to delimit the problem area.

Related work

You should here present the main books and articles that treat problems that are similar to what you are studying, and give proper references to each of these as they are reported. If you, later in

your thesis, describe the "state of the art" – with a detailed literature survey, you may just give a very brief survey here (approx. a quarter of a page). If this is the only literature survey, you need to go into more details. An objective of the literature survey is to show the reader that you are familiar with the main literature within your field of research – so that you do not "reinvent the wheel."

References to literature can be given in two different ways:

- As an *explicit* reference: It is shown by Lundteigen and Rausand (2008) and partly also by Rausand (2014) that . . . .

- As an *implicit* reference: It is shown (e.g., see Rausand and Høyland, 2004, Chap. 4) that . . . .

In the example above, we have used "author-year" references, which is the preferred format.

Remark: Following agreement with your supervisor, you may also refer by numbers, for example, [1]. To do this, open the file `ramsstyle.sty` and comment out (by %) the command `\usepackage{natbib}` and un-comment the corresponding command `\usepackage[numbers]{natbib}`.[1]

You may include a link to the Internet in the text or in a footnote by using a command like: http://www.ntnu.edu/ross.

When you refer to the scientific literature, you should always write in *present* tense. Example: Rausand and Høyland (2004) show that . . . .

Remark: Hyperlinks are included by the command `\usepackage{hyperref}` in `ramsstyle.sty`. If you feel that the hyperlinks are disturbing when you enter the text, or want to avoid the hyperlinks in printed text, you may either comment out or edit this command in `ramsstyle.sty`.

What Remains to be Done?

After you have defined and delimited your problem – and presented the relevant results found in the literature within this field, you should sum up which parts of the problem that remain to be solved.

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[1]Notice the strange way we have to write the "backslash" in the text. This is because the "backslash" is a command in LaTeX.

1.2 Objectives

The main objectives of this Master's project are

1. This is the first objective

2. This is the second objective

3. This is the third objective

4. More objectives

The objectives shall be written as *fundamental objectives* telling what to do and not *means objectives* telling how to do it.

All objectives shall be stated such that we, after having read the thesis, can see whether or not you have met the objective. "To become familiar with . . . " is therefore not a suitable objective.

1.3 Approach

Here you should describe the (scientific) approach and experiments that you will use or have used to solve the problem and meet your objectives and tasks. Experiments may in this context relate analyses you need to carry out in order to investigate a specific hypothesis, task objective, or similar. You should specify the approach and experiments for each objective and/or task. It is preferred that you supplement your explanation of the approach with an illustration.

If there are any ethical problems related to your approach, these should be highlighted and discussed.

1.4 Contributions

Here you give a list of your main contributions in the project or master work.

1.5 Limitations

In this section you describe the limitations of your study. These may be related to the study object (physical limitations, operational limitations), to the environmental and operational conditions, to the thoroughness of the analysis, and so on.

1.6   Outline

Here, you give an overview of how the remaining part of the report is organized. A proposed structure of the main chapters in the report can be as follows (note that some chapters are not numbered):

- Preface: Contains practical information about what you have done, and where the work has been carried out. Any assumed background of the reader should be specified here.

- Acknowledgments: Here, you show the gratitude to who have been supporting your work, professionally and family as relevant.

- Summary: Contains the management summary, and should be a layman's explanation of what you have done and why it is important. This would be the talk you could give if you in an interview is asked about what you did in your thesis, or if some of your relatives ask the same question. This chapter should therefore include as few domain specific words as possible, so that no detailed background in the topic is required.

- Chapter 1. Introduction: Structure already discussed in this chapter.

- Chapter 2. Theoretical background: Here you identify and give the theoretical background needed in this report, with proper references to each literature reference used. The selection of what to include should be discussed and agreed with the supervisors. Theory may involve concepts, definitions, methods, regulations/key standards, theory to explain specific system behavior, and so on.

- Chapter 3..N-2: The naming of the following chapters relies entirely on the specific topic in question. Proposed structure should be discussed with supervisor.

- Chapter N-1 Results: This chapter should be the last chapter *before* "Conclusions, discussion, and ideas for further work"

- Chapter N. Conclusions, discussion, and ideas for further work.

- Bibliography

- Appendix A etc (as needed): Appendix A may for example be acronyms as shown here.

Remark: Notice that chapter and section headings shall be written in lowercase, but that all main words should start with a capital letter.

The report should be no longer than 60 pages in this format for the master as well as the specialization project, with the possible exception of appendixes (which may take up some space if including e.g. code from programming). This does not mean that the report must be at least 60 pages, and the effort should be directed to be as concise as possible throughout the report.

Chapter 2

Equations, Figures, and Tables

The content of Chapter 2 will vary with the topic of your thesis. This chapter only gives guidance to some technical aspects of LaTeX.

Remark: If you want a shorter chapter or section title to appear in the Table of Contents and in the headings of the chapter, you just include the short title in square brackets before the title of the chapter/section. Example:

`\section[Short Title]{Long Title}`

2.1   Simple Equations

Mathematical symbols and equations can written in the text as λ, $F(t)$, or even $F(t) = \int_0^t \exp(-\lambda x)\, dx$, or as displayed equations

$$F(t) = \int_0^t \exp(-\lambda x)\, dx \tag{2.1}$$

The displayed equations are automatically given equation numbers – here (2.1) since this is the first equation in Chapter 2. Note that you can refer to the equation by referring to the "label" you specified as part of the equation environment.

You can also include equations without numbers:

$$F(t) = \sum_{i=1}^n \binom{n}{i} \sin(i \cdot t)$$

More Advanced Formulas

Long formulas that cannot fit into a single line can be written by using the environment `align` as

$$F(t) = \sum_{i=1}^{n} \sin(t^{n-1}) - \sum_{i=1}^{n} \binom{n}{i} \sin(i \cdot t) \tag{2.2}$$

$$+ \int_{0}^{\infty} n^{-x} e^{-\lambda x^{t}} \, dt \tag{2.3}$$

In some cases, you need to write ordinary letters inside the equations. You should then use the commands

`\textrm  and/or \mathrm`

The first command returns the normal text font and will be scaled automatically, while the second command will be scaled according to the use.

$$\mathrm{MTTF} = \int_{0}^{\infty} R_{\mathrm{avg}}(t) \, dt$$

Please consult the LaTeX documentation for further details about mathematics in LaTeX.

Definitions

If you want to include a definition of a term/concept in the text, I have made the following macro (see in `ramsstyle.sty`):

☞ **Reliability:** The ability of an item to perform a required function under stated environmental and operational conditions and for a stated period of time.

When text is following directly after the definition, it may sometimes be necessary to end the definition text by the command

`\newline`

I have not included this in the definition of the `defin` environment to avoid too much space when there is not a text-block following the definition.

Figure 2.1: This is the logo of UiB (rotated 15 degrees).

2.2 Including Figures

If you use pdfLaTeX (as recommended), all the figures must be in pdf, png, or jpg format. We recommend you to use the pdf format. Please place the figure files in the directory **fig**. Figures are included by the command shown for Figure 2.1. Please notice the "path" to the figure file written by a *forward* slash (/). You should not include the format of the figure file (pdg, png, or jpg) – just write the "name" of the figure.

Each figure should include a unique *label* as shown in the command for Figure 2.1. You can then refer to the figure by the *ref* command. Notice that you can scale the size of the figure by the option `scale=k`. You may also define a specific width or height of the figure by replacing the `scale` options by `width=k` or `height=k`. The factor `k` can here be specified in mm, cm, pc, and many other length measures. You may also give `k` as a fraction of the width of the text or of the height of the text, for example, `width=0.45\textwidth`. If you later change the margins of the text, the figure width will change accordingly. As illustrated in Figure 2.1, you may also rotate the figure – and also do many other things (please check the documentation of the package `graphicx` – it is available on your computer, or you may find it on the Internet).

In LaTeX all figures are floating objects and will normally be placed at the top of a page. This is the standard option in all scientific reports. If you insist on placing the figure exactly where you declare the figure, you may include the command `[h]` (here) immediately after `\begin{figure}`. If you will force the figure to be located either at the top or bottom of the page, you may alternatively use `[t]` or `[b]`. For more options, check the documentation.

Large figures may be included as a *sidewaysfigure* as shown in Figure 2.2:[1]

2.3 Including Tables

LaTeX has a lot of different options to include tables. Only one of them is illustrated here.
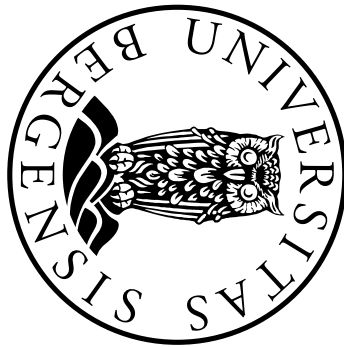
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[1]You can use a similar command for large tables.

Figure 2.2: This is the logo of UiB.

Table 2.1: The degree of newness of technology.

| Experience with the operating condition | Proven | Level of technology maturity | |
		Limited field history or not used by company/user	New or unproven
Previous experience	1	2	3
No experience by company/user	2	3	4
No industry experience	3	4	4

Remark: Notice that figure captions (Figure text) shall be located *below* the figure – and that the caption of tables shall be *above* the table. This is done by placing the `\caption` command beneath the command `\includegraphics` for figures, and above the command `\begin{tabular*}` for tables.

2.4   Copying Figures and Tables

In some cases, it may be relevant to include figures and tables from from other publications in your report. This can be a direct copy or that you retype the table or redraw the figure. In both cases, you should include a reference to the source in the figure or table caption. The caption might then be written as: *Figure/Table xx: The caption text is coming here (Rausand and Høyland, 2004).*

In other cases, you get the idea from a figure or table in a publication, but modify the figure/table to fit your purpose. If the change is significant, your caption should have the following format: *Figure/Table xx: The caption text is coming here (adapted from Rausand and Høyland, 2004).*

2.5   References to Figures and Tables

Remember that all figures and tables shall be referred to and explained/discussed in the text. If a figure/table is not referred to in the text, it shall be deleted from the report.

2.6   A Word About Font-encoding

When you press a button (or a combination of buttons) on your keyboard, this is represented in your computer according to the *font-encoding* that has been set up. A wide range of font-encodings are available and it may be difficult to choose the "best" one. In the template, I have

set up a font-encoding called UTF-8 which is a modern and very comprehensive encoding and is expected to be the standard encoding in the future. Before you start using this template, you should open the Preferences ->Editor dialogue in TeXworks (or TeXShop if you use a Mac) and check that encoding UTF-8 has been specified.

If you use only numbers and letters used in standard English text, it is not very important which encoding you are using, but if you write the Norwegian letters æ, ø, å and accented letters, such as é and ä, you may run into problems if you use different encodings. Please be careful if you cut and paste text from other word-processors or editors into your LaTeX file!

Warning

If you (accidentally) open your file in another editor and this editor is set up with another font-encoding, your non-standard letters will likely come out wrong. If you do this, and detect the error, be sure *not* to save your file in this editor!!

This is not a specific LaTeX problem. You will run into the same problem with all editors and word-processors – and it is of special importance if you use computers with different platforms (Windows, OSX, Linux).

2.7   Plagiarism

Plagiarism is defined as "use, without giving reasonable and appropriate credit to or acknowledging the author or source, of another person's original work, whether such work is made up of code, formulas, ideas, language, research, strategies, writing or other form", and is a very serious issue in all academic work. You should adhere to the following rules:

- Give proper references to all the sources you are using as a basis for your work. The references should be give to the original work and not to newer sources that mention the original sources.

- You may copy paragraphs up to 50 words when you include a proper reference. In doing so, you should place the copied text in inverted commas (i.e., "Copied text follows ... "). Another option is to write the copied text as a quotation, for example:

> Birnbaum's measure of reliability importance of component i at time t is equal to the probability that the system is in such a state at time t that component i is critical for the system.
>
> Rausand and Høyland (2004)

2.8 Code example

If you want to show some code in your thesis Minted is your friend.

```python
import os

os.chdir('test/')
backups = os.listdir().sort()
nrOfBackups = len(backups)
if(nrOfBackups > 10):
    oldestBackup = backups[0]
    os.removedirs(oldestBackup)
print(backups)
print(nrOfBackups)
```

Listing 1: Some code example

Chapter 3

Conclusions, Discussion, and Recommendations for Further Work

In this final chapter you should sum up what you have done and which results you have got. You should also discuss your findings, and give recommendations for further work.

3.1 Summary and Conclusions

Here, you present a brief summary of your work and list the main results you have got. You should give comments to each of the objectives in Chapter 1 and state whether or not you have met the objective. If you have not met the objective, you should explain why (e.g., data not available, too difficult).

This section is similar to the Summary and Conclusions in the beginning of your report, but more detailed—referring to the the various sections in the report.

3.2 Discussion

Here, you may discuss your findings based on your results, their strengths and limitations. Note that this discussion is more high level than discussions made in relation to results you have achieved and presented in the previous chapter. The discussion here should put your work in larger context. You may address if you achieved what you had intended to do, why not (if you did not), if you got results in which you did not expect, why the results are important, why there are limitations in using the results, or if there are opportunities to transfer your results and findings into other domains, and so on.

3.3   Recommendations for Further Work

You should give recommendations to possible extensions to your work. The recommendations should be as specific as possible, preferably with an objective and an indication of a possible approach.

The recommendations may be classified as:

- Short-term

- Medium-term

- Long-term

Bibliography

Lundteigen, M. A. and Rausand, M. (2008). Spurious activation of safety instrumented systems in the oil and gas industry: Basic concepts and formulas. *Reliability Engineering and System Safety*, 93:1208–1217.

Rausand, M. (2014). *Reiability of Safety-Critical Systems: Theory and Applications.* Wiley, Hoboken, NJ.

Rausand, M. and Høyland, A. (2004). *System Reliability Theory: Models, Statistical Methods, and Applications.* Wiley, Hoboken, NJ, 2nd edition.

Appendix A

What to put in appendixes

This is an example of an Appendix. You can write an Appendix in the same way as a chapter, with sections, subsections, and so on. An appendix may include list of code (in case you are programming), more details about results that you have presented in the report (could be a more complete description of results, in case you decided to focus on the most important ones in the main report), supplementary information and descriptions you have found relating to the system you are analysing, such as drawings. You may discuss with your supervisor what are relevant information for appendixes.

A.1   Introduction

A.1.1   More Details