

LEWIS UNIVERSITY

Structural Quality & Software Evolution

A Thesis

By

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Submitted in partial fulfillment of the requirements

for the degree of
Master of Science in Computer Science,
Concentration in Software Engineering

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The undersigned have examined the thesis entitled ‘**Structural Quality & Software Evolution**’ presented by **Alison Major**, a candidate for the degree of **Master of Science in Computer Science (Concentration in Software Engineering)** and hereby certify that it is worthy of acceptance.

TODO: Add lines for signatures here. Justify above paragraph.

Abstract

Some software engineering projects fail to evolve, which makes them obsolete. This topic is interesting and important to developers because the software that fails to evolve will fail to generate user engagement, leading to revenue loss. We review a number of projects and resources to understand the correlation of software structure quality and its impacts on a system's ability to evolve. With this understanding, we explore ways to improve the evolution of a software system through tools and suggestions.

Acknowledgements

TODO: Update this section with my own acknowledgements.

Gratitude is a great virtue, though revenge is profitable

It's customary and good manners to say thank you however, where do you draw the line? In some of the theses that I've read, and I write this after having read thousands, literally, the following and more have been acknowledged: God, one's advisor, one's better half, parents, children, friends, classmates, lab-mates, lab technicians, lab assistants, pets, fav. Prof, neighbors, physicians, exercise trainer(s), wiki, the maintenance guy, landlord, the school hockey team, secretary, department head, driver, dentist, chauffeur, the police, fav. presidential candidate, one's chef, Led Zeppelin, the pastor, one's biggest crush, the cable man, the mani/pedi girl, hair stylist, the best/worst/fav bar tender(s), the janitor, one's obs/gyn, one's mentor, and in a more recent thesis, Michael Phelps (8 gold medals at the 2008 Olympic games in Beijing, China, way to go...)

Keep in mind that one has to use one's own words when writing an acknowledgement. Plagiarism is unauthorized.

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Chapter 1

Introduction

The main goal of your introduction is to identify a problem that is worthy of investigation. It must also provide some idea of your research goals and approach to research. Specific objectives can be introduced in the introduction chapter or they can be saved for later after you've provided additional background on the topic and state of the current research and its gaps. The Introductory chapter often concludes with a summary of the organization of the thesis, including identification of the general content of specific chapters and appendices.

Ideally, chapter one defines the overall importance of the problem areas and provides an introduction into what you did, chapter two is why you did it in the context of what was previously known, three is how you did it, four is what you found and five is what it all means – putting the pieces together, (what's your contribution to the research field).

It should be noted that the objectives of your research define the OUT-COME, i.e. what will be learned. They are not a statement of the approach or tasks that are required to meet these objectives. Some examples of reasonable research objectives:

- Determine the effect of Marangoni convection on mixing of molten glasses
- Predict the extent of mechanical degradation of polymers

These both define the resulting outcome (prediction, effect on. . .) so they are objectives. The related tasks or research approach could be:

- Solve a set of coupled non-linear PDEs. . .
- Perform experiments on. . .

These define the required steps; they do not define the outcome so they are NOT objectives.

Some theses and dissertations can have some chapters written as manuscripts that can be submitted to peer-reviewed scientific research journals. In that scenario, the grad student should be the principal author of the pending articles. The thesis or dissertation that includes manuscripts as chapters are not exempt from writing an introduction, background/ literature review and overall conclusions and recommendations.

This template uses the MS WORD STYLES extensively to help keep your work in the proper format. These paragraphs use the “thesis-body text” style

that is set for Times New Roman, 12 point font with double spaced lines and extra spacing between paragraphs (no need for hard carriage returns). There are also styles for headers, equations, captions and bulleted lists that you can choose to use. See examples throughout this template.

Chapter 2

Background and Literature Review

The background and literature review section needs to provide sufficient fundamental background information about the subject to support your objectives, hypothesis (or research questions) and methods, and review the pertinent literature related to the specific problem / hypothesis you are addressing. In Johnson (1991), some of the questions that he listed that the literature review should be to answer include:

- what are the fundamental science, math, engineering concepts related to your research (scope),
- what part of your research work has ever been investigated before and what has not, (some of this may have been included in the introduction)

- how does your research work relate to that done by others,
- how have others defined/measured/identified the key concepts of your research,
- what data sources have you used or have other researchers used in developing general explanations for observed variations in a behavior or phenomenon in a concept in your thesis etc.

The lit review (20 pages or more) should not be limited to the above questions only. Ingeniousness and creativity is expected of a grad student. Bullets can be single spaced. The above bullets are in the style “thesis-bullets.” When you type bulleted text, highlight the bulleted text and then select “thesis-bullets” from under the format, style menu to automatically change their formatting as above.

2.1 Section header

Given the length of each chapter, it is required to use headers and sub headers (possibly sub-sub headers). These can be numbered or one can just rely on different formats. The section headers in this document are labeled “heading 2” (“heading 1” was used for chapter titles). The heading styles formats should be consistent throughout the document as it helps significantly in creating the automatic table of contents.

2.1.1 Sub Heading

The subheadings here have a different format (“heading 3”) than the section headers.

Sub-Sub Heading

You can even get to another level of headers, defined here as “heading 4.” The table of contents, however, is currently set up to just include three levels of headers.

2.1.2 Equations

Equations can be created in MS WORD equation editor or they can be created with other software. Equations should be numbered. They can be numbered within each chapter (e.g., 2.1, 2.2) or they can be numbered sequentially throughout the entire thesis. Equations should be indented or centered with the equation number to the right. The example below and associated “thesis-eqn” style can be used for all your equations.

Include example of an equation here.

This equation was written with the equation editor. Found through “insert, object, equation editor 3.0. The equation editor can also be found through “tools, customize, commands”, and in categories, look for insert and in the commands section, look for equation editor, drag and drop the icon onto the toolbar. This editor is fine for relatively simple equations, other

options are available for more complex equations.

2.1.3 Tables

Tables should have meaningful information with descriptive headers. You can use the “thesis-table caption” style to define your captions and refer to the table in the text with a “cross reference” (Table 1). MS Word re-numbers table captions automatically when new tables inserted. But you need to right click on any cross references and “update field” if there are changes.

Step #	Instruction
Create table caption	Insert, reference, caption, table
Format the caption	Format, style, “thesis-table-caption”
Create table	Table, insert...
Format the table	The formatting of the table can vary, including use of single space as appropriate. Most journals require that tables are formatted using table style “Table Simple 1” format.
Reference the table from text	With the cursor at the location you want to cite the table: insert, reference, cross reference, table, label and number only.

Table 2.1: Table 1: Steps in creating a table

2.1.4 Figures

Figures and illustrations are a necessary means of communicating technical information. Often times, figures included in the background/lit review section are copied from existing copyrighted information. In all cases, this is technically inappropriate without also receiving permission from the copyright owner. Citing the source of the figure is not sufficient. This rule is enforced for PhD dissertations because they are submitted to ProQuest for electronic access by others. The enforcement of this rule for MS theses is dependent on the specific committee members.

Resolution of figures is often a problem in theses. Resolution should be at least 300 dpi, preferably 600dpi (2.1). You should note that saving images as jpeg files is a sure way to lower the resolution to an unacceptable extent. From experience, a good way is to copy your graphic (for example from PowerPoint or excel) and when pasting it into word, use the “paste special” “as an enhanced metafile” (2.2). This also substantially reduces the resulting file size in comparison with pasting graphs in as excel graphics.

Sub heading (heading 3) The subheadings here have a different format (“heading 3”) than the section headers.

Sub-sub heading (heading 4) You can even get to another level of headers, defined here as “heading 4.” The table of contents, however, is currently set up to just include three levels of headers.

Equations Equations can be created in MS WORD equation editor or they can be created with other software. Equations should be numbered.



Figure 2.1: Figure 1: Example photo with high resolution. Caption created with “insert, reference, caption, figure” and the style changed to “thesis-figure caption.”

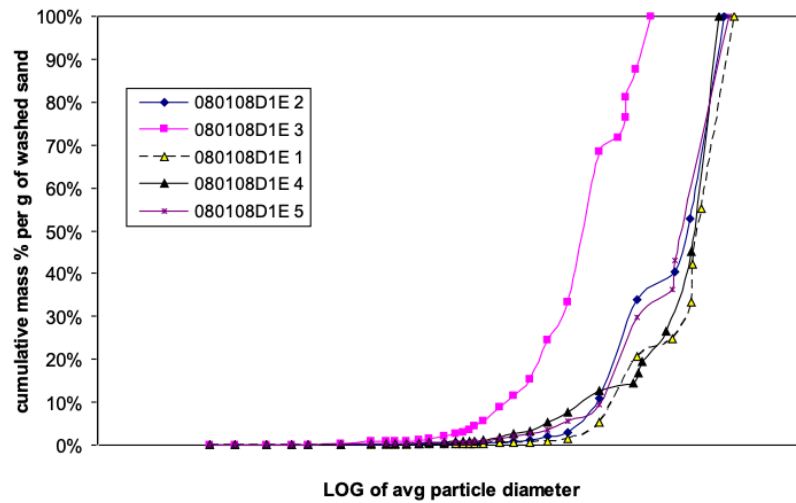


Figure 2.2: “Figure 2: Example of high resolution graphic inserted with “paste special, as enhanced metafile”

They can be numbered within each chapter (e.g., 2.1, 2.2) or they can be numbered sequentially throughout the entire thesis. Equations should be indented or centered with the equation number to the right. The example below and associated “thesis-eqn” style can be used for all your equations. [1] This equation was written with the equation editor. Found through “insert, object, equation editor 3.0. The equation editor can also be found through “tools, customize, commands”, and in categories, look for insert and in the commands section, look for equation editor, drag and drop the icon onto the toolbar. This editor is fine for relatively simple equations, other options are available for more complex equations.

Tables Tables should have meaningful information with descriptive headers. You can use the “thesis-table caption” style to define your captions and refer to the table in the text with a “cross reference” (Table 1). MS Word re-numbers table captions automatically when new tables inserted. But you need to right click on any cross references and “update field” if there are changes. Table 1: Steps in creating a table

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Figure 1: Example photo with high resolution. Caption created with “insert, reference, caption, figure” and the style changed to “thesis-figure caption.”

Figure 2: Example of high resolution graphic inserted with “paste special, as enhanced metafile”

Chapter 3

Methodology

In addition to the detailed methods you need to describe in this section, you need to provide specific objectives and an overview of your approach if they have not already been presented in the introductory chapters. The best place to put those items can vary among theses. Sometimes the background and lit review is really necessary to justify and substantiate the specific objectives and approach and, therefore, it is best to save those details for the beginning of this chapter.

These paragraphs are in “thesis-body text.” Other styles including captions, headers etc. can be used as presented in the previous chapter. Table 2 summarizes all of the styles that can be used with this template.

Style Name	When Used
Heading 1	Chapter Titles
Heading 2	Primary Headers
Heading 3	Sub Headers
Heading 4	Sub-Sub Headers
Thesis-body text	All Paragraphs
Thesis-bullets	Bullets
Thesis Figure Caption	All figure captions.
Thesis Table Caption	All table captions.
Thesis-eqn	Equations
Thesis-reference	Reference list at end of thesis

Table 3.1: Table 2: Styles used in this template

Chapter 4

Results

Results, findings, discussion of results OR manuscripts. It is best to also re-iterate information in your literature review to help substantiate the findings of your research.

This template is best used for directly typing in your content.

Chapter 5

Conclusion

This chapter could also be called “Conclusions and Recommendations” or “Conclusions and Implications.” In general, there should be no new information presented here. It should be a synthesis of information that you’ve already discussed.

References

Includes all references: articles, media facts, books, reports, regulations, internet articles, papers that you referenced from the text. In the text, citations can be (Smith and Jones, 2007) or Smith et al., 2007) (if more than two authors) if you wish to present your references alphabetically. Alternatively, you can include the citations in the text as a number [1] or 1 if you wish to present your references numerically. The MS WORD tools – “insert, reference, footnote, endnote” (or “cross reference” if you refer to the same reference more than once) should be used to help you organize and manage your references.

References can be written in single space with extra space between references as in the format below. There are many different ways to arrange the information and punctuation in a reference listing. The most important thing is to make sure all references are complete and that the format of your references is consistent throughout.

Example, S.Z. (2008). How to cite a complete journal reference. J. Complete Thesis. 1(2): 47-52.

Example, S.Z., Second, W.S. (2007). How to cite a complete conference proceedings paper. In: Proceedings, 2nd International meeting of Masters Students, Paper # XW15 (Potsdam NY, November, 2007).

If you use the “thesis” reference” style you will get the proper line spacing and indent style without further changes. Above are examples to show

complete citation, other formats also acceptable.

Alternative format:

An alternative format for references is to use IEEE format. You can find a reference on IEEE format here: <http://www.ijssst.info/info/IEEE-Citation-StyleGuide.pdf>

You can use either the option provided above in the template or use the IEE format.

We should cite something [1].

Bibliography

- [1] S. Omari and G. Martinez, “Enabling empirical research: A corpus of large-scale python systems,” 2018, [Provided by Dr. Omari].

Appendix A

Type or paste your appendices here. Appendices are a place to organize and include all of the “extra” material that is important to your research work but that is too detailed for the main text. Examples can include: specific analytical methods, computer code, spreadsheets of data, details of statistical analyses, etc. But, these materials do not speak for themselves. There should be a reference to these materials from the main chapters (complete details included in Appendix A) and there should be some text at the beginning of each appendix to briefly explain what the information is and means that is included in that appendix.