

Master's Thesis Expectations – Explosives Engineering Program

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Because of the dramatic increase in master's theses in the department due to the introduction of the explosives engineering master's, the need for serious streamlining to dramatically increase efficiency on behalf of the faculty, and the need to reduce the amount of wasted time and angst experienced by students in re-writes, we have started to put together a manual of expectations for master's theses. This manual will be updated as the need arises and the version will have the last date of addition.

Quality

To provide a quality program acknowledged by both academia and industry we need to ensure both quality education and high quality master's theses. All theses must have excellent work presented in a superior manner in accordance with the reputation and standards of S&T, the department and the program. Whether you have met these standards is decided by the explosives faculty and your committee. Because of this it may take several iterations. The process for acceptance is discussed later in this document.

Purpose of a Master's Degree

1. To show that you have mastered your subject area
2. To prove you have the ability to perform and to present excellent research work

Your committee will assess whether or not you know your area and will also look at how you:

- a) Designed your experiments
- b) Worked on your data
- c) Formed your conclusions
- d) Presented the above in your thesis and defense

Purpose of a PhD

For those that are considering going further academically, the purpose of a PhD is to:

1. Demonstrate your ability to perform substantial philosophical thought in a subject area (a step up from master's work).
2. Increase your understanding of the physical processes and the mechanics of how things work at a fundamental level in your thesis area.

Differences between a MS and a PhD

1. A master's shows your ability to perform research, whereas the PhD concentrates on your ability to philosophize in addition to the requirements of a Master's
2. A PhD is not 2 or 3 Masters slapped back to back.

Picking a Committee

For a master's you are required to have a minimum of 3 persons on your committee. This means you may have 4 if you think that this will be advantageous. The main advisor for your thesis should be a professor in the individual program (for example, explosives engineering). It is your job to find a suitable advisor who will willingly take the task on. You should pick someone who you are compatible with. You need a minimum of two other committee members. These can be from anywhere and at least 2 of these should have a masters or higher degree. If you wish to bring someone in, for example, from industry that has only a BS then that person should be the 4th committee member. Suitable committee members include suitably qualified S&T faculty, faculty from other universities, industry, government and retired and adjunct faculty.

In the explosives program we currently have 2 faculty, Dr. Worsey and Dr. Baird. That means your 3rd committee member will be out of program. It is not necessary that that 3rd committee member be from the Mining Department and if your thesis spans another field of expertise such as civil or geophysics you are encouraged to select someone that is well versed in that field from an appropriate program. Your committee must cover all areas of expertise necessary for a proper evaluation of your work.

Master's Thesis Process of Approval

The advisor is the main contact for the student as far as writing the thesis. For the sake of streamlining the process, and the efficient use of faculty time, the student will work with his advisor until the advisor is happy for the document to be passed to the committee for further review. This may take several iterations to mold the thesis into an acceptable document. At the same time, the student must be aware of and keep track of the University's due dates for the various notifications and actions leading to award of the degree; do not rely on the advisor to do this, as it is the student's responsibility. The student is also responsible for obtaining the correct format for the work from the appropriate University authorities. Giving a thesis to the full committee before it is in proper shape usually results from the student's inattention to the University's requirements for submissions, and will reflect poorly on the student and the advisor. During the thesis work, the committee is there to assist in the validation of the student's logic and to help guide the student.. The graduate seminar is an excellent way to get your committee members in the same room to engage them in the process. At key stages, a student can volunteer to present at the seminar and invite his committee members. Most faculty members would rather sit through a 30-minute seminar, early in the process, than read 100-pages of a poorly developed thesis later on.

At the advisor's option, the student may submit work in a piecemeal fashion, section by section, but not all advisors will allow this. Some prefer to see a draft of the entire work so as to insure there are no gaps in organization or logic. The student must be sure to check with his advisor on this matter.

The appropriate process is bulleted below. The student:

- Performs the major portion of the research, literature search, and writing of the thesis under the advice of the advisor and committee
- Submits the thesis to the advisor.
- Work with the advisor on organization, logic, flow, etc.; this will likely require several iterations, so factor the requisite time into the thesis work flow plan
- Provide the work to the committee upon approval of the advisor
- Works with the committee to ensure any difficulties are satisfactorily addressed
- Schedules the defense
- Makes changes required by the committee due to issues raised during the defense.

After the student submits the thesis with changes made as requested by the committee, the advisor checks it to make sure changes have been accomplished. The advisor will then notify the committee that the thesis is completed. The student will obtain signatures on the University paperwork (there is no longer a requirement that the thesis be signed by the committee members), and then print the requisite copies and submit the work to the Library for binding. The actual binding cost is fairly inexpensive. The following should be given a fully bound copy: university, department, advisor, each committee member, and student. It is recommended that additional copies also be made to give to parents and for the student to have for future distribution to employers, etc. The copies should be in full color if color is used, and the copies must be good quality reproductions. With the advent of cheap quality printers, multiple originals are preferred over photocopies. Reduced size bound copies can also be made; they are useful to give out to other people rather than lending out your original bound copy. The Library will expect that you also present an electronic version to them as we are rapidly moving towards an all electronic information sharing system for interlibrary loans.

Guidelines for Size and Distribution of Information

Length: –

- Main body typically 60 to 99 numbered pages (excluding list of contents, title page etc.), but it should be as long as necessary to accomplish the work, but no longer than necessary. Extraneous filler material will be rejected.
- Appendix Unlimited
- DVD one disk

Main Body

Description needs to be understandable to someone else doing a MS. If a technical person with a PhD has difficulty understanding any part of the main body of the thesis then you have a serious problem. The thesis should be thorough, but excessively descriptive items should be summarized and the detailed description given in the appendixes. Examples of items that are appropriate in the main body are example data, processed data, charts and graphs.

Appendix

Items that are appropriate for appendices include: detailed technical descriptions, specifications, and complex in-depth theory and math. Raw and semi processed data may also be included.

DVD

A DVD should be affixed in the rear of the printed thesis containing:

- a) Electronic copy of thesis
- b) Defense PowerPoint presentation
- c) Raw and processed data files
- d) Explanation of what is on disk and how to use it.

Writing a Thesis:

Use Polya's strategy (at the end of this document). This is a systematic method to approach any number of problems and assigned work items. It is a logical progression of steps, which leads to both success and quality and avoids common pitfalls.

Here are some guidelines on how certain parts of a thesis should be tackled:

Abstract

This is what a person reads first to determine whether the thesis is pertinent. It should say everything in a condensed form, in a maximum of one page, and should contain the following:

- a) Brief description of problem
- b) What you wanted to accomplish
- c) What you did
- d) Your major conclusion(s)

Your Abstract will be electronically published and available to search engines. You should therefore choose about 10 key words that should be included in the Abstract. Every time your thesis is cited by another researcher in a publication it is counted by search engines. These citations and referrals are important if you want to become a researcher or join a faculty.

Writing great Abstracts is a skill you will have to develop, but heeding the contents list above will put you on the right path. Some writers delay writing the Abstract until after completing the remainder of the work, as they find it easier to create the condensed version of the thesis after the thesis actually exists.

Thesis Writing Structure

A well-composed and written work has a fractal-type structure. According to the Merriam-Webster dictionary (<http://www.merriam-webster.com/dictionary/fractal>, accessed 9/16/2010), a fractal is “any of various extremely irregular curves or shapes for which any suitably chosen part is similar in shape to a given larger or smaller part when magnified or reduced to the same size;” in other words, it exhibits self-similarity. In the same fashion, as one reads a well-written thesis, he will see a brief description of the work first, then introductory material, then the body of the work, then a summary, and then conclusions and recommendations that would lead to further research. The next level of substructure of the thesis, a section or whatever it may be, will exhibit the same pattern – an introductory paragraph, body paragraphs, brief summarization (if necessary) and a paragraph that introduces and leads the reader to the next section. The next lower level, the paragraph, performs similar functions. It has an introductory sentence, body sentences, and then a sentence which introduces and leads to the next paragraph.

This type of organized writing has a logical flow, fits nicely into Polya’s Strategy, and it carries the reader from start to finish, without any bumps or stops that will distract or frustrate him.

Additional Items

Research Objective(s). A well-formulated research objective(s) is a huge step in communicating your work. Researchers often communicate what they set out to do instead of what they actually accomplished which diverged/changed and ended up something different. By providing a clear set of objectives, you are better able to discuss the problem (problem statement), your methodology (which should clearly accomplish your objectives), and your conclusions. For instance, if the research objective was to, “test the hypothesis that method A is superior to method B”, then your problem statement should tell us why it is important that we know which method is superior. Your methodology should tell us what criteria you are going to use to select the superior method and how you go about measuring/estimating that parameter. Your conclusion should tell us which method is superior.

Reproducibility. This refers to the ability of a test, experiment, or procedure to be replicated by other researchers. This is a key aspect of the scientific method and is a key part of review. This demands that: (1) You adequately document the methods, processes, and assumptions you use in your research during the research activities (keeping a research journal might be helpful); (2) Your thesis provides a good description of your work that can facilitate replication by others. Due to the use of computer software, some students do not pay attention to the assumptions they are making (every software has inherent assumptions) when they produce graphs and results from the software. For instance, when you produce a contour map from discrete measurements, the software has to interpolate using some interpolation method. If you do not communicate this interpolation method, the results may not be reproducible – different interpolation methods will result in (sometimes, significantly) different contour maps. Take the time to understand the assumptions the computer is making for you, so you can communicate them in your thesis.

Polya's Strategy

Polya's Strategy is a systematic method to approach any number of problems and assigned work items. It can be applied to virtually any problem or task at hand, but it is ideal for writing a thesis or research paper. It is a logical progression of steps which leads to both success and quality and avoids common pitfalls. Dr. Worsley covers this strategy in Mining 003, Introduction to Mining. Polya's Strategy has 5 steps:

Define

- Identify the problem

Think about it

- What are the attributes of the problem
- Identify the area of knowledge involved
- Collect information

Plan

- Flowchart a solution
- Think of alternative plans
- Translate the plan into actions

Carry out plan

- Solve the problem

Look back

- Verify that the problem solved was the one originally defined
- Check reasonableness, logic, and math
- Check criteria and constraint
- Study related problems
- Identify applications
- Identify order of magnitude numbers
- Develop successive approximation strategies
- Study the problem solving skills learned
- Communicate results (*this will be your defense!*)

In the plan the thesis should be flowcharted and a skeleton developed. Decide first on the titles of the chapters. This is how the thesis will be logically broken up. Then individually chart all of the sections in each chapter. Then take each section and chart all of the subsections. Once the full skeleton is developed then go back and budget the size of each section and subsection. For example, say in a subsection on the explosives used, figure how many paragraphs, how much of a page will be verbiage and how many figures will be displayed and how much space they will occupy on the pages, .what you want in the figures or photographs and what you want the title to be.

Once you have everything budgeted then you can work on it one little piece at a time. It is simple to write a paragraph or two on anything you have done. This allows you to concentrate on one individual aspect of the thesis at a time without the stress and confusion of dealing with the whole thing. This will also be how you handle teams in industry while working through projects.