

Guide to MS Project or Thesis Work with Dr. B

Greg M. Bernstein, *Senior Member, IEEE*

Abstract—This document serves as your guide to working with Dr. B on your Masters project or thesis at SJSU. It describes the basic steps involved in research and development and the *rules of the road* for working with Dr. B as your adviser. Writing for engineering publications is described at a high level and specific tools and techniques given. Failure to follow any of the requirements or guidelines in this document will result in the immediate termination of the adviser/advisee relationship.

Index Terms—Research and Development process, Adviser/advisee relationship, technical writing, writing tools, academic dishonesty, project pitfalls.

I. INTRODUCTION

At one of the universities where I am currently an adviser there are three routes to finishing a master's of science (MS) degree in electrical engineering these include: (a) MS project, (b) MS Thesis, (c) comprehensive exam. This note covers: the research and development (R&D) process for either an MS project or thesis (I'll just refer to MS projects in the following), the rules of the road when working with a research adviser, specific rules, tools and technique that must be used if you work with me as an advisor, and pitfalls you will want to avoid during the R&D process.

Failure to follow these requirements and recommendations if you are my advisee will most likely result in your project not receiving a passing grade.

A. MS Projects and Alternatives

Don't look at the MS project option as for a way to avoid a "scary" comprehensive exam. An MS project, like any R&D project, entails significant uncertainty and no guarantee of success. To be absolutely certain of your graduation date choose the comprehensive exam option and study hard. If you want to develop professional research, development, and communications skills then an MS project maybe for you, but be sure to read the rest of this document to understand what is involved.

A MS project involves both theoretical and hands on work. You will need to:

1. Get up to speed in a new subject area. This will typically require a much deeper knowledge of a

subject than obtained in a graduate or undergraduate course. Sources of such information include not only the technical literature, but standards bodies, industry consortia, open source projects, and possibly (with caution) company literature.

2. You will need to review (learn) about recent and state of the art techniques within your chosen topic area. This includes literature survey and analysis [1].
3. You will need to come up with an idea for something "new" to try within the above areas. This will be a significant challenge! See [1] for more on the notions of "newness" and various forms of intellectual property.
4. You will need to learn appropriate tools (typically open source software based) in which to implement your idea.
5. You need to figure out an essential part of your idea from step 3 that can be implemented with the tools, people, and time available.
6. You need to write up your work at each step of the process in accordance with professional technical writing standards, such as expected in IEEE, ACM publications or IETF, ITU-T, or other technical standards development organizations.

B. Rules of the Road

Some fundamental rules that you are **agreeing** to if you are my advisee:

1. This is **your project** not mine. You are responsible for all deliverables. Including but not limited to: topic selection, background education, literature survey, problem formulation, solution formulation, programming, and all write ups.
2. Your deadlines are **not** my deadlines. You are responsible for planning your project. I will typically need **one week** to review any item for review. Longer work, i.e., 4-12 page would typically require two weeks (industry standard for journals and conferences is 3 to 4 weeks)
3. *I have limited time* to share with any particular team of students. You should prepare for your meetings with me. It is best to send me a current version of your research notes (see section on incremental writing) or a list of questions/issues/problems ahead of time. You also agree that

- a. You will **not** submit writing to me that has been "padded" to meet some arbitrary length requirement.
 - b. You will not submit writing to me that you cannot explain or do not understand yourself. This doesn't include questions.
4. *Either* adviser (Dr. Bernstein) or advisee (student) can *terminate* the adviser-advisee relationship for any reason at any time. Termination of the relationship by me is **final** (pleas, bribes, harassment of any sort will not work). Main reasons I would terminate the relationship include:
- a. **Lack of contact:** if I haven't heard from an advisee (or team of advisees) for an extended period of time I will assume that the team has found another advisor or is pursuing a different option.
 - b. **Lack of progress/work**
 - c. Communications issues: This could happen if I offer advice and on multiple occasions you ignore it or misinterpret it.
 - d. Any *hint* of academic dishonesty on the student's part. See section IV.A.

C. Technical Writing versus Other Forms of Writing

Writing is a very important aspect of your MS project however technical/scientific writing is different from most other forms of writing in a number of significant ways. Although the scientific and technical literature is immense, it is somewhat hidden from the general public. Examples of technical writing include journal articles such as [2], technical books [3], technical magazine articles [4], conference papers [5], and patents [6].

There are a number of good books and websites on technical writing. My favorite book is [7] while some good websites include [8]–[10]. Some key differences from other types of writing that tend to trip up students include:

1. Emphasis on efficiency of exposition and compactness (**keep it short!**). You are expected to get your point across in as few words as possible. Extreme page or word count *limits* may be imposed by journals and conferences. This is exactly the opposite of what one experiences in school or early college where one is required to generate an essay or report at least N pages long! The reason page and word count limits are challenging in technical writing is that your paper needs to be *complete* in terms of content. Hence in technical writing there is no room for *fluff* or *padding*. Leave that to the marketing and sales literature. If your project report is *complete* but shorter than some arbitrary guideline I will personally defend it to the death¹!
2. Emphasis on explaining how this work (project) relates to other work in the field. This is a key ingredient in technical/scientific papers and it is achieved via citing other work in the field (references). Note that this is nearly opposite of what

is done in advertisements and marketing literature. In advertising a company will claim a wonderfully innovative and original *thingy*² while the reality is that their *thingy* is very similar to *thingys* from twenty or so other companies. It is the responsibility of the author to demonstrate how this work is different from other work. It is up to the author to show that they understand the field, not by re-explaining all the basics of a given topic, but by citing key papers, books or other materials that have done so.

3. All **claims** made in the paper **must** be backed by evidence or logic. This is another property that differentiates a "real" technical paper from various forms of marketing literature. If a reviewer reads a claim in your paper that isn't completely true, they will tend to dismiss the entire paper as rubbish and so will I.

Some particular techniques that are very helpful in good technical writing are:

1. Interplay between general concepts and specifics: Make sure the general concepts are clear before diving into specifics.
2. Use of figures: use block diagrams at different levels of details to help your reader understand the context and design of your work. Recommended drawing tools: PowerPoint and [Inkscape](#) (open source).
3. Use of tables to summarize information. These could include a breakdown of the problem space, proposed solution alternatives, software used, or experimental results.

II. WRITING TOOLS AND TECHNIQUES

Since technical writing is a key part of the R&D process it will also play a key part in communicating and working with your adviser.

A. Required Word Processing Tools & Techniques

Microsoft Word is required for all writing submitted to me. The IEEE journal [template](#) MUST be used. You MUST not change the styles from those given, i.e., leave font styles and font sizes as they are.

B. Writing Incrementally with MS Word

Writing is hard. Good writing is harder still. The best approach is to think about what you need to say then break that up into logical chunks. This is done by developing an **outline** and then filling in the pieces as your work progresses. Your initial outline will not be perfect however and MS word has features that make incremental writing into an outline and revision of outlines very easy:

1. "Heading" levels – You will organize your writing into logical "chunks" before you write lots of text. This is a "divide and conquer" approach and encourages thinking before writing and avoids "fluff".

¹ Hopefully we will not have to take such extreme measures. Typically an email to your research course instructor will suffice☺.

² A *thingy* is a place holder for some product, feature, or service implemented in hardware or software.

2. The MS Word "Navigation Pane". This is enabled via the "View/Navigation Pane Show" checkbox. This, when used with the "heading levels" will serve as a clickable table of contents and allows easy navigation around a document if it is sufficiently "divided into chunks". We will not use a separate table of contents.
3. The MS Word "Outline View". This is based on "heading levels" but understands nesting. It is particularly useful for rearranging the order of sections (headings and text) within your paper. Remember your initial outline is just a starting point and will change.

C. Review and Change Tracking

One of the main ways I can help you with your project is by reviewing your writing at intermediate steps along the way to producing your project report. To do this I'll use the following MS Word features:

1. Under MS Word's "review" tab. I'll use the feature to "track changes". I'll use this so you can see and differentiate my suggested changes from your text. This feature also allows you to "accept" or "reject" any changes I make to your document.
2. Also under MS word's review tab is the "comment" feature. I'll use this to point out issues with your document or ask questions. You can also use "comments" to respond back to me.

I use the above features all the time when I collaborate with colleagues and customers on papers, standards, patents and other documents.

D. Automatic Item Numbering and Cross References

Word and its plugins provide automatic numbering of items such as: (a) figures, (b) tables, (c) equations, and (d) references. You **must** use this automatic numbering feature. In addition not using such a feature means manually numbering such items which will require extensive updates when you need to add references, figures, tables, or rearrange sections of your document.

When you want to talk about a figure, table, etc. in your document you **must** use a cross-reference. MS word provides these via its "reference" tab. Click the "cross-reference" item to get a list of all the items in your document that can be referenced. MS word will make sure all the numbering stays consistent. For example in Figure 1 (this is the *cross reference*) we show a picture of a happy dog, while in Figure 2 (another *cross reference*) we show a diagram of a happy ;-) network. If you change the order of the dog and network diagrams (with their captions) the numbering of the figures and cross references will be updated automatically for you by word. You can make MS Word update the automatic item numbers (figure numbers in this case) with the commands ctrl-A (selecting the entire document), then hitting the F9 key.



Figure 1. My niece's dog, Moxie, enjoys the snow in Michigan.

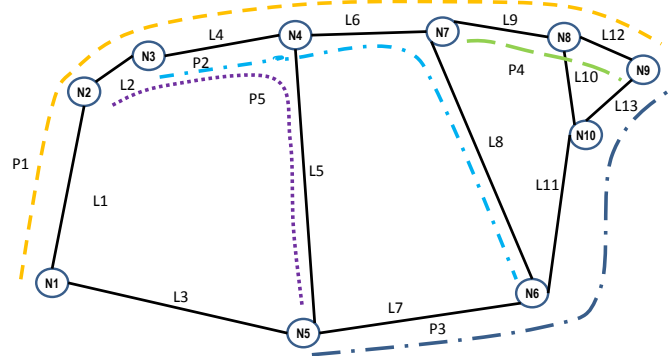


Figure 2. An example network with paths indicated by dashed lines.

E. Collecting and Citing your Bibliography: Zotero

Since collecting and organizing references is such a key part of any research project (not just in science and technology) many commercial and free tools have been developed to aid in this process.

If you are my advisee you **MUST** use the open source (free) Zotero (<https://www.zotero.org/>) software for collecting and organizing your references. There is extensive documentation including videos at the aforementioned website.

Zotero has an MS Word plugin that makes citing references in your documents painless and can automatically insert a bibliography anywhere in the document you desire. All citations and the bibliography in this document were done with the Zotero plugin. You do not need to manually track reference numbers. When you use Zotero to cite papers and such, Zotero will ask you about formatting for references, choose the IEEE format.

III. SOFTWARE DEVELOPMENT AS PART OF YOUR PROJECT

All students as part of their MS will need to produce original working software to demonstrate or simulate their idea. Students are encouraged to use as much 3rd party software as possible to accomplish their goal. However one must be very clear about what software the student is using and what the student wrote. This is explained in a project write up via block diagrams and tables. For example Table 1 shows all the software used to produce a set of network simulation examples for a [supplement](#) to an advanced networking course.

Table 1. Software used to generate EE283 network simulations.

Name	Version	Purpose
Python	2.7.5	General purpose programming language.
Matplotlib	1.4.3	Scientific charting library
SimPy	3.0.4	Python based discrete event simulation library
SimComponents.py	Not versioned	Network simulation component library by Dr. B.

You must keep track of all software used on the project, both third party and that written by you. This is a realistic requirement for in an actual company one needs to be concerned with the origin and licensing conditions of all 3rd party software. In addition version information for all software must be given so that your results can be replicated.

For non-trivial snippets of code that you may find on [StackOverflow](#) and other websites that you add to your code cite the URL of the code snippet source in a code comment.

IV. UNFORGIVABLES AND PITFALLS

A. Academic Dishonesty in Many Forms

I have **zero tolerance** for any form of academic dishonesty. I will terminate the adviser/advisee relationship at even the smallest hint of dishonesty. Unlike a class no warnings of proof is required on my part. Although there are a number of forms of academic dishonesty: Plagiarism, [Contract Cheating](#), Free-Riding, etc... They all come down to claiming someone else's work as your own. Whether a sentence, paragraph, figure, statistic, etc... you must cite all sources in all your writing.

In addition any attempt to subvert the academic system by *harassment*, *pleading*, *begging*, bribery, hacking systems, email forgery, etc... is cause for immediate termination of the relationship.

B. Project Management: You can't cram R&D

The **students are in charge** of project manage not the professor or adviser. The key steps in a MS project cannot be crammed. This includes responsibility for all the steps mentioned in section I.A. If you leave out a step such as the literature survey, I may not notice at the time, but it will become obvious in your final project write up.

C. Software Development

You will most likely need to need to learn tools many new tools such as programming languages, open source libraries and frameworks, operating systems, etc... Each comes with a learning curve that requires time and effort to overcome. In addition, you may have to spend time learning and evaluating tools that you may not end up using. This is a natural part of the process of software development. You must allocate ample time for software development.

REFERENCES

I used Zotero to generate this bibliography (list of references).

- [1] "Masters Projects and Thesis." [Online]. Available: <http://grotto-networking.com/msProjects.html#Intro>. [Accessed: 06-May-2015].
- [2] G. M. Bernstein, Y. Lee, A. Gavler, and J. Martensson, "Modeling WDM Wavelength Switching Systems for Use in GMPLS and Automated Path Computation," *J. Opt. Commun. Netw.*, vol. 1, no. 1, pp. 187–195, Jun. 2009.
- [3] G. Bernstein, B. Rajagopalan, and D. Saha, *Optical Network Control: Architecture, Protocols, and Standards*. Addison-Wesley Professional, 2003.
- [4] G. M. Bernstein, J. Yates, and D. Saha, "IP-centric control and management of optical transport networks," *IEEE Commun. Mag.*, vol. 38, no. 10, pp. 161–167, Oct. 2000.
- [5] G. Bernstein and Young Lee, "Extending GMPLS/PCE for use in Wavelength Switched Optical Networks," in *Optical Fiber communication/National Fiber Optic Engineers Conference, 2008. OFC/NFOEC 2008. Conference on, 2008*, pp. 1–3.
- [6] G. M. Bernstein and M. A. Lieberman, "United States Patent: 5007087 - Method and apparatus for generating secure random numbers using chaos," 5007087, 09-Apr-1991.
- [7] H. Michaelson, *How to Write and Publish Engineering Papers and Reports: Third Edition*, 3 edition. Phoenix, AZ: Greenwood, 1990.
- [8] "How to Write A Paper in Scientific Journal Style and Format: Table of Contents - Bates College." [Online]. Available: <http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html>. [Accessed: 01-May-2015].
- [9] "Purdue OWL: Writing Engineering Reports." [Online]. Available: <https://owl.english.purdue.edu/owl/resource/647/01/>. [Accessed: 01-May-2015].
- [10] "Purdue OWL: Handbook on Report Formats." [Online]. Available: <https://owl.english.purdue.edu/owl/resource/726/1/>. [Accessed: 01-May-2015].



Greg M. Bernstein (M'82–SM'14–F) Received is PhD, MS, and BS degrees in electrical engineering and computer science from the University of California at Berkeley. He is currently chief consultant at Grotto Networking where he has provided consulting to carriers, equipment vendors, and government agencies, e.g., DARPA. Previously he was the senior director of software at Lightera (acquired by Ciena). He played a major role in the standardization of generalized multi-protocol label switching (GMPLS) and more recently wavelength switched optical networking (WSON) extensions to GMPLS. In addition he has worked with both ITU-T and OIF standards development organizations. In addition to consulting he teaches and advises students at various universities.