

# A Roadmap for Graduate Students

by

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(This document was prepared to help our graduate students in their research)

## 1. The Objectives of a Doctoral Dissertation

Although there may be variations in the way different academic programs view the doctoral dissertation, the requirement appears generally aimed at achieving three objectives having to do with demonstrating the competence of the candidate to

- do independent research
- make a contribution to knowledge with the research
- document the research and make it available to the scholarly community (i.e., write the dissertation).

## 2. The Nature of the Dissertation Task

A doctoral dissertation is the documentation of independent research that makes a contribution to knowledge. It is not just a “paper” that is bigger than the ones students have written in connection with various courses. The factor of size, independent research, and contribution place the dissertation in a class apart from prior papers.

Doctoral students may wish to analyze the length of recent dissertations in their field as a rough indicator of expectations. The distribution will generally fit a log-normal distribution—that is, the mean is larger than the median because long dissertations are not offset by short dissertations. There is a natural lower limit, but not a corresponding upper limit.

The size of the dissertation makes it substantially different from any paper the student has ever done. It is also unstructured. Up to the point of

the dissertation, the student has performed academically in a highly structured environment. Professors who formerly told the student what to do and how to do it now act as if the student knows what to do. They say, “It’s your dissertation. What do you want to do? How do you want to approach the problem? What methodology are you going to use?”

The question of how good a dissertation should be is difficult to answer. There are students who never complete the dissertation because they view it as requiring such high quality that they don’t believe they can achieve that quality. The student should probably take a reasonable attitude toward the quality of the doctoral dissertation. One should do a good job as a beginning step in a career, but should not view it as his or her magnum opus. It is unlikely that a dissertation will be the highlight of a student’s career because it is usually done at the beginning of the scholarly career, not at the height. There are a few examples of scholars who have made their major contribution with their doctoral dissertation, but this is not normally so.

In summary, the dissertation task is to carry out a research project that contributes to knowledge and to document the project and its contribution in a written document.

## 3. The Life Cycle of a Dissertation Project

The dissertation project represents a process of reducing uncertainty. The student begins with the notion of doing research in a broad area of investigation in which there might be thousands of dissertation possibilities. The student must reduce the uncertainty by reducing the number of

possibilities he or she is going to consider. This is done by looking closely at several topics and evaluating each. One of the topics is selected and then further defined by the dissertation proposal. Uncertainty is again reduced when a detailed chapter outline is prepared. Uncertainty is eliminated when the research has been done, the text of the dissertation has been written, and the committee has approved it.

The process does not always move as smoothly as explained. The student may look at several topics, select one, do some investigation, but find that the topic will not work out. The candidate selects another topic and develops a new proposal. The proposal, when first presented, has many uncertainties and ambiguities. By working with the committee, the proposal is finally made sharper and more definite until finally the exact task to be performed has been defined. The life cycle of a dissertation can thus be thought of as going from the general to the specific. The events that mark the reduction in generality until a dissertation is finally accepted are as follows:

- Selection of general area for research
- Selection of several topics for evaluation
- Selection and exploration of one topic and completion of dissertation proposal
- Completion of detailed chapter outlines
- Completion of literature search
- Completion of research and analysis
- Completion of text of dissertation
- Acceptance by committee

The systematic management plan will illustrate how to proceed through these general steps, how to use various methods to focus on a particular problem, and how to obtain assistance from a dissertation committee and an advisor.

#### **4. The Overall Management Approach**

The management approach has the following three major elements:

- 1) Pre-dissertation stage activities
- 2) Selection of the dissertation topic
- 3) Management of research and writing

**1) Pre-dissertation stage activities:** If possible, the student should begin to think of the dissertation well before reaching dissertation stage. Ideally, the dissertation will initiate a line of research that can then be followed for some years. The choice should influence the planning of doctoral courses and especially the courses taken outside of the major field, such as research methodology and minor fields or supporting programs. The early selection of a research area will allow the candidate to obtain a desirable background, do pre-dissertation investigation as part of course work requirements, and develop committee contacts among professors who have an interest in the area.

**2) Selection of the Dissertation Topic:** In some cases, the dissertation topic is “assigned” by an advisor. In most instances, the selection of the dissertation topic is an iterative activity involving both student and faculty members. Rarely does a student have a well-defined topic at the beginning. Generally, the initial topic is poorly defined, too general, and too large in scope. It usually requires several iterations before the topic is refined and a good dissertation proposal developed. The systematic management approach begins by examining several possibilities, putting these into a topic analysis format, consulting with the advisor and dissertation committee, and selecting one of the topics to pursue in more detail. The selected topic is expanded into a dissertation proposal. The initial proposal is clarified, expanded, reduced, and refined, until it is an acceptable project of the scope and quality suitable for a doctoral dissertation.

**3) Management of Research and Writing:** Every student working on a dissertation should draw up a schedule for completion. The plan should show the candidate how much time is available and provide a good idea of the amount of time that can be spent on each of the various activities required for the dissertation. The candidate should use various methods for improving the working relationship with the advisor and the committee. These include written documents, summaries of meetings and discussions, issue summaries and chapter outlines for chapters, and agendas for meetings.

These activities generally help make the relationship between the advisor and the committee more productive. The candidate should actively plan and control the dissertation activities. A few hours each month spent in planning and control will generally increase the productivity of the work time.

## 5. Definition of Knowledge Work

A general definition of knowledge work is human mental work performed to generate useful information. In doing it, knowledge workers access data, use knowledge, employ mental models, and apply significant concentration and attention. The definition of knowledge work is relevant to the work of a doctoral student in doing research and writing a dissertation. The elements in the definition that describe the type of work, the objective, and four dominant process characteristics can be applied to doctoral dissertation work.

- *The type of work: human mental work.* The mental work involves human information processing. It is cognitive work rather than physical work.
- *The objective: to generate useful information.* Ideas, analyses, evaluations, instructions, programs, plans, assurances, reasoning, and arguments are examples of useful information.
- *Four dominant process characteristics:* In performing dissertation work, individuals perform processes that access data, access knowledge, employ mental models, and require significant concentration and attention.
  - *Access data.* Dissertation work involves acquisition of data, either by direct data capture procedures or by retrieving from stored data. Examples are searching the literature and collecting data for analysis.
  - *Access knowledge.* The person doing dissertation work must access knowledge to perform the

task. A knowledge worker either has the required knowledge (internal) or knows where and how to find it (external).

- *Employ mental models.* Individuals performing dissertation work employ mental models of the processes to be followed and the outputs to be produced. A set of research propositions and a research model generally underlie the approach to a dissertation.
- *Require significant concentration and attention.* The performance of dissertation work is not effortless; it requires mental or cognitive effort and significant concentration and attention. This characteristic makes a dissertation hard work. It is one reason that good management of the dissertation project can reduce the total time and improve the result.

Productivity in doing a dissertation follows the general principles for knowledge work productivity. There are essentially five ways productivity may be improved in doing a dissertation or other knowledge work:

- *Improve motivation.* The approach divides and structures individual activities. It provides for completion motivation by breaking the dissertation project into small subtasks. The subtasks allow motivational feedback from advisor and committee members.
- *Improve task management.* The approach emphasizes planning (a cognitive bargain), scheduling activities to reduce unproductive delays in the work and in relations with advisor and committee members, improving synergy among activities, scheduling for most productive utilization of time and energy, and applying stopping rules.

- *Conserve attention.* The approach emphasizes methods of conserving the time and mental effort of advisor and committee members in commenting on ideas, proposals, progress reports, and chapters. It also stresses the importance of selecting the patterns and structures early in the process so they can be automatic, developing key expertise to reduce effort, and reducing design effort by using existing patterns for format and structure of a dissertation.
- *Reduce errors and omissions.* The approach indicates the value of methods for careful work and documentation along with selection, learning, and use of procedures that will reduce “first-time” errors and omissions.
- *Eliminate redundant processes.* Planning is emphasized in the approach. This includes early selection of procedures and formats to reduce rework and eliminate redundant processes. There is a flow of work from ideas to proposal to dissertation that builds on prior work and reduces redundant processes.

## 6. Key Points in Doing Research

Once you finish your course work and your qualifier exam, you have only one job: produce research. Research is what gets you an MS, a Ph.D. and a job. The only function of upper year courses is to get you going on research. The only bottom line is research. Keep the followings in mind:

- Writing a thesis is not like anything that you have done before. Previously, all you had to do was to absorb material that was presented to you. Now you have to do original work yourself.
- Students often expect that they will do a thesis as follows: they will come across a problem that has to be solved (or one will be given to them), and they will solve it. Papers often read as if they had been written that way. But usually the process by which the

paper was written (and the problem defined) was much more indirect.

- Some students use the approach of trying to master everything relevant to a topic before they begin writing a thesis. This is a mistake. You will never feel that you have learned everything. The best thing to do is to start doing research, and then master whatever tools and auxiliary material you need as you go along. It is much better to present your work and look foolish because you didn't know something that you should have than to not have anything to present.
- Similarly, many students think that the way to write a thesis is to spend a long time developing a "topic," then, once the topic is well defined and approved by advisors, begin writing. This does not work. You can only really define your topic as you go along.
- Doing research is a skill. The only way to learn it is to do it. The sooner you start, the better. Your first few productions will be bad -- this happens to everybody. So don't be a perfectionist. Get practice going through the process.
- Second and third year topics courses are not like any other course you have taken before. The goal is not to master some material and take a test at the end. You are not being judged (as you are during the first one or two years). The only goal is to give you tools and to get you moving on research.
- See your advisors a lot. Students waste a huge amount of time by going off on tangents, reinventing the wheel, or trying to solve impossible problems. Use your advisors as a guide to where you should be going.
- Check the rules and other announcements related to your graduate studies/education, which are posted on the bulletin board or on the web pages of the department and/or

university. Ask about confusing parts after you read them carefully.

- Talk to your peers. You have to learn how to talk about your work. Also, listening to others talk about their work will help you develop a better feel for how research is done.
  - Don't be scared to write things down and show them to friends and advisors. Early criticism is essential in guiding you on the right path. Accepting criticism is a skill to be learned. Criticism hurts infinitely more when it is applied to a finished project that you have invested a lot of effort in. Remember, we do not expect the same quality output from grad students that we do from faculty, and we do not expect the same quality from early projects that we do from a dissertation. But if you don't produce any output, you will never get better.
  - Type your research findings using Latex. Typing your research results regularly will save you a lot of time. You can simply copy and paste them later on in writing your thesis. Spend some time to get master Latex since it will enable you to write your reports, technical papers and your thesis. Latex is ideal for writing scientific papers. Nowadays, people in academia are communicating with each other using Latex commands in their e-mails. Latex is very popular all around the world. There are different versions of Latex on Unix and Windows platforms. There are free downloads on the web. Search for Miktex (a base program for Latex), download a free version of it and install it. Also search for WinEdt, a beautiful visual text editor in order to type your Latex files, download a free version of it (if possible), and install it. Also get a recent version of Aladdin Ghostview (GSView) to view your postscript files (.ps files). Once you installed Miktex, Ghostview and WinEdt, you can create your input files in WinEdt and compile your files using Latex button in WinEdt. The compilation will automatically create a .dvi file, which can be viewed by
- pressing the DVI button. A .dvi file can be converted to a postscript (.ps) file by pressing dvi-to-ps (DVIPS) button in WinEdt. A .ps file can then be viewed by clicking on GSView button.
- Scientific works in progress will be given a technical report number. For example, TR-5 may denote the fifth Technical Report. These reports can either be finished projects such as seminar reports or drafts of the technical papers, which will be submitted to conferences and/or journals. One can get an idea of scientific research activities in the department by looking at these technical reports. People can easily reach others research by reading these technical reports.
  - Plan your seminar courses so that the first one should be a detailed literature search for your thesis. The second seminar course should be considered as for designing of your thesis and publishing your first results/findings. This way, you can publish your seminar results in national conferences.
  - If you are ambivalent as to what subject to work on or what advisor to work under, pick one and work quickly. If you take two months writing a paper on a subject that you subsequently decide does not interest you, then you have gained valuable experience doing research that can be applied elsewhere. If you spend one year writing the same paper, you will be trapped with a subject that you don't like.
  - Read journal articles and working papers, and go to seminars. This is the only way to learn what good research is like. But read papers intelligently: you don't have to go through most papers equation by equation. As your interests narrow down, there will be some papers that you do want to go through with a fine toothcomb. Your comfort with reading journal articles will grow with the number you read.
  - Keep your eye on the bottom line. Is the way in which you are spending your time

bringing you closer to producing research output?

## 7. Publication is Important for Your Thesis

You should be able to publish some part of your thesis in international conferences or journals. There are so many conferences going on all around the world nowadays. Sending your papers to international conferences before sending them to journals will be more reasonable since you can get good feedback from other participants in such conferences so that you can embellish your conference papers to make them journal papers later on. Also, submitting papers for conferences will save you some time with regard to keeping your work. Reviewer comments will also be very useful if you plan to modify your papers. Besides, the evaluation period for conferences is much shorter than that of journals. A few words about writing such papers: international conference papers are usually 4 or 5 pages long, at most 6 pages. Each such paper should include:

- An *Abstract*, which briefly explains the underlying problem,
- An *Introduction*, which motivates the current work in addition to some literature search,
- Other sections, which include *Problem Formulation* and *Solution*,
- Relevant *Simulation* and/or *Experimental Results*,
- A *Conclusion* section, which contain some concluding remarks and possible future work.
- *References*, which include the papers, books etc. that are related to the subject.

There are certain formatting rules such as IEEE conference paper format, which you should follow before sending the final camera-ready version of your papers. Nowadays electronic submission is the usual way of sending papers. On the other hand, publishing papers in international journals will generally take longer time. Regular journal papers will also contain above sections but things will be much more detailed and they will contain some other

sections as well. Journal papers can range from 15 to 30-35 pages, or even more pages. Again there are basic formatting rules, which should be followed before sending such papers. Reviewing process can take longer time and your paper can be accepted upon major or minor revision. Take reviewer comments into account and modify your papers accordingly. Don't forget that the originality of your work is quite important in acceptance of your papers. If your paper contains original ideas, one way or another it will be accepted if you are presenting it properly using proper language.

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