

Modeling, Virtual Environments & Simulation (MOVES)

Thesis Research Guide

Curriculum 399

This guide has been prepared for use by Modeling, Virtual Environments & Simulation (MOVES) students to assist them in their research and the writing of the master's thesis. It outlines the specific steps necessary to successfully complete a thesis of high quality. It has been written specifically for you, the student.

As appropriate, this guide will be revised to reflect changes in school policy, advances in research methodology, availability of new resources and the accumulated experience of both students and faculty. Student contributions to future revisions are most welcome. Please forward any comments, additions, deletions, or criticisms to your Academic Associate.

Note: This document is focused on the preparation, proposal and research elements of the thesis. Formatting and final approval for the thesis are not addressed within this guide as they are explicitly addressed within the Research and Sponsored Programs Naval Postgraduate School (NPS) Electronic Theses Website. Further resources for your thesis along with some excellent guidelines from NPS faculty can be found here:

<http://www.movesinstitute.org/~kolsch/npsthesis/ThesisGuidelines.html>

Prof. Mathias Kölsch
MOVES Academic Program Chair

CDR Duane Davis
MOVES Program Officer

TABLE OF CONTENTS

- I. Introduction
- II. Thesis Milestones
- III. Thesis Approach
- IV. Roles and Responsibilities in the Thesis Process
 - A. Duties of the Academic Associate
 - B. Duties of the Advisors (Primary Advisor and Co-Advisor)
 - C. Duties of the Second Reader
 - D. Duties of the Department Chairman
 - E. Responsibilities of the Thesis Sponsor
 - F. Responsibilities of the Program Officer
 - G. Student Responsibilities
 - H. Notes on Responsibilities
- V. Searching for and Selecting a Thesis Topic
- VI. Thesis Proposal
- VII. Approval of Completed Thesis
- VIII. Final Notes

I. INTRODUCTION

- A. The thesis is an integral part of the master's degree program at NPS.
 - 1. The primary objective of the thesis is to further your education. The thesis focuses on building and strengthening your independent abilities of inquiry.
 - 2. Secondly, the thesis may contribute to the professional body of knowledge in a given field through the resolution of a problem, a clearer understanding of relationships, or the improvement of a process.
- B. The thesis is a scholarly report of research and is not a staff study. Because of its scholarly nature, it must meet the rigorous academic requirements and standards, which are highlighted below:
 - 1. The thesis must have a valid focus. It must address a research question or hypothesis within a conceptual framework or theoretical body of knowledge.
 - 2. The research question should be specific, reasonable in scope (but not trivial), intellectually challenging, and capable of being answered through sound research.
 - 3. The information used must be obtained from primary sources or authoritative secondary sources.
 - 4. The research method(s) must be consistent with the theoretical framework.
 - 5. The use of statistical techniques or methods to support the analysis must be suitable and sound.
 - 6. The analysis must use the information collected.
 - 7. The conclusions must be supported by the analysis.
 - 8. All recommendations must relate to the findings and conclusions in a logical and consistent manner.
 - 9. The thesis should: flow smoothly; be grammatically correct; use references, footnotes and bibliographic citations in appropriate format; provide references to materials, opinions and ideas which are not those of the researcher; and be well written.
 - 10. The researcher must remain objective in the analysis and writing of the research report. However, subjective assessments may be included when clearly identified as such.
 - 11. Success in your thesis effort depends on a clear understanding by all people concerned of their responsibilities to each other and on their mutual agreement regarding the major milestones involved in producing a quality thesis.
- C. Theses fulfilling the research requirement for a Modeling, Virtual Environments & Simulation (MOVES) degree will emphasize quality throughout -- in the thesis proposal, the research, the writing, and in the support and assistance given you by faculty and staff.
 - 1. A good thesis is more concerned with quality of the inquiry process than with merely following a perfunctory model.

2. A careful reading of this thesis guide should lead you through the maze of the thesis process, answer most of your questions, and provide the foundation for a successful thesis.

II. THESIS MILESTONES

As in any production effort, it is important to prepare an outline of your plan, with milestones and constraints. The following chart illustrates the major thesis requirements along with approximate time estimates (individual theses do vary considerably). The thesis approval for MOVES students must be fully complete by the start of the student's last year of study (normally Fall for September graduates and Spring for March graduates).

| | L-3 QTR | L-2 QTR | L-1 QTR | L(AST) QTR |
|--|-------------------------------------|---------|---------|------------|
| 1. Select thesis problem/topic | Completed by start of quarter | | | |
| 2. Select primary thesis advisor | | | | |
| 3. Select co-advisor or second reader | | | | |
| 4. Submit proposal (completed start of last year of study) | | | | |
| 5. Design research strategy | | | | |
| 6. Arrange outside contacts | | | | |
| 7. Literature review | | | | |
| 8. Develop research methodology | | | | |
| 9. Collect data | | | | |
| 10. Conduct analysis, develop findings, conclusions | | | | |
| 11. Create necessary supporting material | | | | |
| 12. Write and proof thesis | | | | |
| 13. Submit draft to advisor(s) | | | | |
| 14. Rewrite/revise/PROOF | | | | |
| 15. Final draft to advisor(s) | | | | |
| 16. Proof and correct | | | | |
| 17. Advisors sign draft | | | | |
| 18. Final signatures | | | | |

You are encouraged to accelerate this process at any time. The length of the lines above is intended to convey a target period for completing a specific task. Keep in mind the necessity for, and the length of, turnaround times for the various procedures. Once you have agreed with your Primary Advisor and Co-Advisor / Second Reader on delivery dates, construct a detailed plan for yourself, tailored to your own pace and to the particular requirements of your project.

III. THESIS APPROACH

The preparation and search phase is an iterative process involving participation in seminars (within and external to the MV seminars), lab tours, personal interviews with faculty, and substantial literature review.

A. Preparation phase

1. Define the problem: To write a formal report of original research in a scholarly manner in partial completion of the requirements of a Master of Science degree.
2. Develop a milestone plan for completion, which represents a minimum schedule of progress for research and thesis completion.

B. Search phase

1. Determine topic -- research proposal.
2. Find Primary Advisor.
3. Identify Co-Advisor or Second Reader.

C. Research phase: develop experimental procedure / research approach to include:

1. Literature search
2. Rough outline -- revised throughout this phase
3. Data gathering
 - a. Questionnaire
 - b. Interviews
 - c. Existing data? -- Bibliography
 - d. Travel
 - e. Funds
4. Data analysis
 - a. Techniques
 - b. Computer program - tools

D. Writing phase (according to pace established by thesis reviewers)

1. Detailed outline
2. Graphics required (computer generated, drafting, and photo reduction)
3. Rough draft and editing
4. Smooth draft

IV. ROLES AND RESPONSIBILITIES IN THE THESIS PROCESS

The following paragraphs outline the primary responsibilities of the various parties in the thesis process. As in most relationships, there is always some room for negotiation between parties. Roles described include those of the Academic Associate, Advisors (Primary Advisor and Co-advisor), Second Reader, Sponsor, Department Chairman, Program Officer and YOU.

A. Duties of the Academic Associate

1. During the early part of September/March, for students graduating in September/March of the following year, conduct an orientation session for students to clarify the contents of this document, answer any questions concerning thesis requirements, review the mechanics of thesis production and, in general, help focus on the thesis task and reduce anxiety concerning its complexity.
2. Provide counsel on the appropriateness of thesis topics, or assist in reducing the range of choices to those most suitable.
3. Assist in identifying appropriate Advisors.
4. Maintain on-going contact throughout the thesis process to provide assistance and support when needed.

B. Duties of the Advisors (Primary Advisor and Co-Advisor)

1. General
 - a. The Primary Advisor has the primary responsibility for guiding your research content and style.
 - b. Both Advisors will examine your research for validity and soundness of analysis and conclusions, for the logical flow and development of material and rationale, and for the appropriateness of recommendations.
2. Specifically, the Advisors will:
 - a. Assist in determining what is feasible for you to thoroughly research in the available time.
 - b. If there will be a co-advisor, the Primary Advisor will help to decide on a reasonable choice of a Co-Advisor. This choice is frequently dictated by the nature of the thesis topic.
 - c. Jointly discuss and document a schedule of milestones to assess progress.
 - d. Suggest initial references to read and people to contact.
 - e. Meet with you regularly to monitor progress and provide consultation and direction. Joint meetings should occur at least weekly during the final quarter.
 - f. Review and critique the thesis outline.
 - g. Review and critique your work, offer suggestions for necessary revisions, and check for accuracy and completeness. The Advisor will not normally undertake responsibility for major editing or rewriting. This is the responsibility of the student.

3. It is very important for you to be quite clear as to what standards your Advisors expect you to meet and to understand any constraints that will exist during the process. Some of the things that are critical to know are:
 - a. What milestones do the Advisors require?
 - b. How quick will the turnaround times be?
 - c. What special format requirements does the Primary Advisor desire or prefer?
 - d. Will an Advisor be absent for any significant period? If so, do you still want to have that individual as an Advisor?
 4. Choosing a Primary Advisor and a Co-Advisor is a critical step. You should choose Advisors on the basis of their expertise or contribution to the field.
 5. Most students choose Advisors from within the MOVES Academic Faculty. However, the formal requirements are:
 - a. Every thesis must have a Primary Advisor.
 - b. Every thesis must also have either a Co-Advisor, or a Second Reader.
 - c. The Primary Advisor shall be a full-time member of the NPS faculty.
 - d. Co-Advisors and Second Readers are normally chosen from the NPS faculty.
 - e. At least one of the Advisors must be a MOVES Academic Faculty member.
 - f. At least one of the Advisors must hold a Ph.D. in MOVES or a related field (e.g. - Computer Science, Operations Research).
 - g. Exceptions can be approved by the MOVES Academic Program Chair.
 6. The Academic Associate may be consulted in the process of choosing an Advisor.
- C. Duties of the Second Reader
1. Second Readers differ substantially in the roles they may play in the thesis effort. Some want to be involved to the same extent as the Advisor; indeed you may find that the Second Reader is more involved than the Primary Advisor. In other situations, the Second Reader may only want to see the final product after the Primary Advisor has signed the rough draft. Most will play a role somewhere between these two extremes.
 2. At a minimum, the duties of the Second Reader include:
 - a. Providing quality control of the written product, ensuring it meets NPS standards.
 - b. Verifying that the thesis clearly and adequately communicates the research to someone who is not closely involved with the work.
 3. A Second Reader is required if there is only one Advisor; a Second Reader is not required if there are two Advisors.
 4. It is important to know what standards the Second Reader will use in determining whether a thesis is acceptable. You must determine the Second Reader's particular

expectations with regard to thesis form, turnaround time, supporting materials, etc.

D. Duties of the MOVES Academic Program Chair

1. The MOVES Academic Program Chair has the ultimate responsibility for certifying that MOVES theses meet the standards of the Naval Postgraduate School.
2. The administrative process for approval of topic selection and final written product is designed to facilitate the production effort and to ensure that quality standards are maintained.
3. Specifically, the MOVES Academic Program Chair will approve outside advisors and sign the final (smooth) thesis.

E. Responsibilities of the Thesis Sponsor

1. A sponsor is anyone who agrees to provide support to you in your thesis effort. Such support can take many forms, e.g. letters of introduction, personal interviews, computer time and support, access to data, and funding (travel, per-diem, and/or equipment).
2. Typical sponsors include functional or project offices, NPS faculty currently working on research grants, professional associations and institutions such as the Office of Naval Research (ONR), Space and Naval Warfare Systems Command (SPAWAR), or an industry association. The thesis proposal will assist in outlining most aspects of the research that a potential funding sponsor will want to know.
3. Some sponsors may agree to supply data or information as part of the research effort. Typically, these are unique to a specific research effort and not readily available in one of the generally accessible databases. Professional associations, companies and industry/trade associations are frequently excellent sources of information.
4. General support sponsorship primarily focuses on opening doors within Government agencies or civilian companies by demonstrating interest in the research results and asking that assistance and cooperation be extended to the researcher. When coordinating with an agency for sponsorship, ensure that agreements are documented in written format, such as a letter of introduction.

F. Responsibilities of the Program Officer

1. The role of the Program Officer is primarily one of administrative support and monitoring. Their staff can answer questions about thesis production "mechanics", and can assist you in preparing the required forms and reports.
2. The requirements for the Program officer include:
 - a. Maintaining a signed copy of the Thesis Proposal and all Thesis Reports.
 - b. Serving as a potential source for thesis topics (because of their close contact with curriculum sponsors).

G. Student Responsibilities

1. Obviously, the student has primary responsibility for the success or failure of their thesis project. In broad terms, the nature of that responsibility is to plan your work and work your plan!
2. More specifically, you are required to:
 - a. Select a thesis topic.
 - b. Select a Primary Advisor.
 - c. Select a Co-Advisor or Second Reader
 - d. Prepare a thesis proposal that includes research questions and milestones, and forward the same under cover of Thesis Report Number 1.
 - e. Prepare subsequent Thesis Reports:
 - 1) As required to document your progress. Currently a Thesis report is required week 1 of the sixth quarter (graduating quarter minus two) and week one of the seventh quarter (graduating quarter minus one).
 - 2) Anytime changes to your thesis result in an entirely new topic, or in major changes to your original Thesis Proposal.
 - 3) Anytime your Primary Advisor, Co-Advisor or Second Reader changes.
 - f. Report to the Primary Advisor/Co-Advisor regularly to inform them of progress or of any difficulties you encounter in your research and writing.
 - g. Research the literature to discover what others have done in similar topic areas.
 - h. Make necessary contacts to get information, data, computer assistance or other resources. These are long-lead time processes; therefore, plan and schedule accordingly.
 - i. Develop an analytical model, as appropriate, and test it for acceptability.
 - j. Study and understand this document as well as the resources available at the following web site: NPS Electronic Theses Website.
 - k. Ensure that the thesis represents your own original work and that any quotations or paraphrases from other sources, published or unpublished, are properly cited and included in the list of references.
 - l. Write your thesis and submit it to the Advisors in a timely fashion.
 - m. Determine what role the Co-Advisor/Second Reader wants to play in the discussion and review of your thesis.
 - n. Rewrite the thesis as requested. If necessary, hire someone to help with style and grammar.
 - o. Arrange for the typing of the final product; acquire the necessary signatures and fill out all the required forms.

H. Notes on Responsibilities

1. The above delineation of the duties and responsibilities of the key people involved with the thesis effort clearly gives you the bulk of the workload.
 - a. The Academic Associate will guide you in the thesis effort.
 - b. The Primary Advisor's and Co-Advisor's role is to keep you on track, and make sure that the effort is acceptable.
 - 1) Note that the duties of the Advisors do not include any writing task or major editorial effort.
 - 2) Most Advisors will encourage you to meet with them regularly.
 - c. The Second Reader's job is to help improve quality control.
2. If everyone, including you, attends to their duties, there will be little difficulty in obtaining the signature of the MOVES Academic Program Chair.
3. It is up to the student to plan and budget time to ensure successful completion of their thesis.

V. SEARCHING FOR AND SELECTING A THESIS TOPIC

A. Several points should be considered in the process of selecting an area for research.

1. The research study should be interesting to you.
 - a. It should motivate you to pursue the project vigorously and, particularly, to overcome the low periods you may experience when parts of the project become difficult.
 - b. This is perhaps the most significant research effort you will do for some time; therefore, it should have meaning and importance to you.
2. The topic should be researchable.
 - a. Materials should be available in the open literature (e.g. articles, books, reports).
 - b. Data should be accessible.
 - 1) Difficulties may be encountered if the data you seek are classified, proprietary, sensitive, highly controlled or if restrictions are placed on usage.
 - 2) Difficulties may also arise if points of contact (POCs) are not forthcoming with information.
 - 3) Corporation or company proprietary data may be a particular problem.
 - 4) You may have to consider classifying your thesis, although it is recommended that this be avoided to permit broader application and use by others.
 - 5) To gain some understanding for the literature available, check such sources as the electronic indexes such as academic journals,

LEXIS/NEXIS, as well as key periodicals in your field. Also check with library personnel if you are having difficulty locating literature.

3. There should be a perceived need for the research.
 - a. This need may take one of several forms.
 - b. Examples include:
 - 1) Contributing to resolving a known problem.
 - 2) Putting a problem in perspective.
 - 3) Assessing the impact of certain policies or procedures.
 - 4) Evaluating a policy or procedures.
 - 5) Tracing history of management events and decisions or making observations concerning implications of these decisions.
 - 6) Developing a model or assessment of an existing model.
 - 7) Developing an implementation methodology.
 - 8) Coming up with a final product which might be a model, case analysis, computer program or process.
 - 9) Participation in major experimental and analytical efforts by a sponsor or other appropriate institution.
 - c. The process of thesis research might be accomplished by analyzing a category of events, assessing the impact of certain issues, exploring how to accomplish something, analyzing a situation or examining various courses of action.
 - d. You can explore the need for your research work by communicating with your Academic Associate, potential Advisors and Second Readers, potential sponsors, and authorities in the field.
- B. To select a thesis topic, use as many resources as possible.
 1. Examples include reviewing, interviewing or reading such resources as:
 - a. Your Academic Associate and other professors in your field.
 - b. Materials from courses you have taken to identify where problems or issues exist that might interest you.
 - c. Topics announced in classes on topics of interest.
 - d. Previous tours of duty you might have had in the discipline where there are issues you found interesting.
 - e. Review MOVES theses written during the last four years. Access the documents electronically through the library, and carefully read the Future Work, Bibliography and Reference sections.
 - f. Sponsoring organizations such as Navy Modeling and Simulation Office (NMSO), Army Modeling & Simulation Office (AMSO), Marine Corps Modeling and Simulation Management Office (MCMsMO), Modeling and

Simulation Coordination Office (M&SCO), Defense Advanced Research Projects Agency (DARPA), Office of Naval Research (ONR), etc.

2. You may also:
 - a. Review the periodicals and journals in your field for current issues.
 - b. Look at sections entitled "Topics for Further Research" in completed theses in the Dudley Knox library.
 - c. Contact the principal offices in your field to determine if they have any areas which need attention.
 - d. If you know your assignment following graduation, contact your new office for issues of interest.
 - e. Look through topic listings that indicate areas of research.
 - f. Thumb through the proceedings of research symposia to identify research work now being performed or which is needed.
 - g. Search professor's bulletin boards or their Web pages for topic ideas.
 - h. Hear topics via "word-of-mouth" from other students.
 - i. Search the Knox Library's thesis catalog.
 - j. Discuss candidate ideas and resources with the NPS reference librarians.
3. Once you have selected a topic area
 - a. Get as much exposure as possible to the literature, such as:
 - 1) Major studies
 - 2) Journal articles
 - 3) Books
 - 4) Technical reports
 - b. Ask a librarian for help in locating material.
 - c. Read Exhaustively.
 - d. Establish limits for the subject of your research and define as carefully as possible the boundaries or scope of your research.
- C. The key to good topic selection is choosing a subject which is:
 1. Limited enough to allow exhaustive research;
 2. Yet wide enough to provide room for you to develop your own concepts, ideas, or propositions.

VI. THESIS PROPOSAL

- A. The thesis proposal is the key document in preparing for the thesis process. It performs several important functions in the process of communicating thesis activities.

1. The proposal focuses the research effort for you.
 2. It requires you to develop a specific research question and subsidiary research questions.
 3. It requires you to identify the methodologies you will employ in the research and the particular scope and limitations of your work.
 4. It forces you to give serious thought to the items which might be a major problem later on.
- B. The thesis proposal must be signed and approved by the start of your last year of study.
1. The proposal, once accepted, acts as an agreement (or a contract) among the student and the advisors regarding the areas to be investigated and the depth of analysis involved.
 2. It is intended to eliminate unfortunate surprises for the student, advisors, academic associate, and chair.
 3. The signed Thesis Proposal is kept on file in the program office.
 4. Any changes which may be required are facilitated by referring to the most current version of the proposal.
 - a. These may entail changes to the research design or methodology, or the scope of the thesis.
- C. The proposal serves as a useful planning document in the following ways:
1. It sets forth a schedule of key milestones to be reached and can be used to evaluate progress in completing the thesis.
 2. It identifies resources needed to complete the research work and lays out the nature and extent of resources that a potential sponsor may have to contribute.
 3. It assists in identifying the pertinent literature base and in focusing your examination of the open literature.
 4. It serves as a record for planning the thesis and serves as a reference to peers and subsequent thesis students.
- D. The MOVES Thesis Proposal Template is normally made available during the third quarter but may be obtained earlier through the Program Officer.
- E. The preliminary outline in the proposal is essential in organizing the detailed research and assisting the student in identifying the direction the research should take.
1. The outline assists you and your advisors in keeping track of what has been accomplished and what you have yet to complete.
 2. The preliminary outline is flexible and will most likely change as you develop greater knowledge of the topic, rearrange your priorities, or encounter unforeseen limitations.

VII. THESIS REPORT MEMORANDUM

- A. The Thesis Report Memorandum is the vehicle for submitting the Thesis Proposal, required updates the first week of the second-to-last (quarter six of an eight-quarter program) and next-to-last (quarter seven of an eight-quarter program) quarters of your program, and any changes which require an additional update to document and inform of those changes.
- B. Minor changes will not require a Thesis Report outside those normally required (as indicated above).
- C. Some changes will require only a Thesis Report memorandum detailing the changes (such as: change of an Advisor or a Second Reader but no change to the rest of the proposal)
- D. Substantive changes, such as change of main research question, will require as an enclosure to the Thesis Report memorandum a revised Thesis Proposal.

VIII. APPROVAL OF COMPLETED THESIS

- A. Thesis formatting and the approval process
 - 1. You will be required to attend a presentation on the thesis process, presented by the research office.
 - 2. Attendance at this presentation will be required no later than your graduating quarter.
 - a. Attending much earlier, approximately one year prior to graduation is strongly recommended.
 - b. The information gained from this presentation will save hours of reformatting or rewriting.
 - 3. The primary source for thesis templates, thesis formatting, and description of the thesis approval process is the following website: [Processing of Electronic Theses, Dissertations, MBA Professional Reports and Joint Applied Projects.](http://www.nps.edu/research/research1.html)
(<http://www.nps.edu/research/research1.html>)
- B. Title and Signature Pages
 - 1. The Title and Signature Pages for a MOVES Thesis will be made available to you by the start of the quarter before your graduating quarter.
 - 2. If you do not see these by then, ask the MOVES Academic Associate.

IX. FINAL NOTES

- A. Finally, remember that you are both the project manager and the project performer.
- B. Do not neglect the former role; project managers need to build a network of supporters and must keep the relevant decision-makers informed to ensure success for their projects.
- C. Manage your thesis effectively to ensure your success.