Software Engineering
Naval Postgraduate School
Monterey, California

DOCTOR OF PHILOSOPHY IN SOFTWARE ENGINEERING

SWE PH.D.

PROGRAM HANDBOOK

Approved by the SWE PhD Committee
Last modified December 16, 2009

PH.D. HANDBOOK CONTENTS

PROGRAM OBJECTIVE

The Ph.D. program in Software Engineering is specifically designed for DoD software practitioners who want to acquire the skill and knowledge to perform state-of-the art research on issues related to the development and evolution of large complex software systems, and to intelligently manage the research of other software practitioners. It offers the software professionals a unique program of study and advances software engineering principles and technology vital to DoD researchers and program managers. Delivery will be by distance learning as well as on campus.

There are institutional rules on all the Ph.D. programs at the Naval Postgraduate School (see Academic Council Policy Manual, Section 5.4). The rules described here supplement, but do not supplant, the institutional rules.

From the Academic Council Policy Manual (as of September 2006)

> *The degree Doctor of Philosophy is awarded as a result of meritorious and scholarly achievements in a particular field of study which has been approved by the Academic Council as within the purview of the Naval Postgraduate School. A candidate must exhibit faithful and scholarly application to all prescribed courses of study, achieve a high level of achievement, and establish an ability for original investigation leading to the advancement of fundamental knowledge.*
>
> *Any program leading to the degree Doctor of Philosophy requires the equivalent of at least three academic years of study beyond the baccalaureate level, with at least one academic year[1] (or its equivalent) being spent in residence at the Naval Postgraduate School.*

Equivalent Software Engineering Distance Learning Residency Requirement (as of September 2006)

Distance learning students can satisfy residency requirements by:

(1) Take a minimum of three graduate level Software Engineering seminars (approx. 20-40 hours of study time per week) either on campus or via distance learning;
(2) Register for a minimum of 8 units of thesis research each quarter when not taking NPS distance learning courses;
(3) Participate in a two-week on-campus orientation and intensive study retreat prior to taking the written qualifying examination;
(4) Conduct a two-week on-campus directed study prior to taking the oral qualifying examination;
(5) After advancement to candidacy, spend the equivalent of at least one week each quarter on campus conducting thesis research.
(6) The time spent satisfying each of the above requirements must be disjoint.

[1] An equivalent distance learning residency requirement has been established by the Software Engineering Group as approved by the Academic Council on 26 June 1999.

REQUIREMENTS FOR ENTRY

U.S. military officers, foreign military officers, U.S. government civilians and employees of foreign governments may apply. An applicant should have a Master's Degree (or in progress of getting a Master's Degree) in Software Engineering, Computer Science, or in a closely related field. Generally, an acceptable Ph.D. applicant must have above-average grades in a typical Master's degree program. The Ph.D. Program Committee will also take other evidence of research or academic ability into account in making a recommendation as to whether to admit an applicant.

DEGREE REQUIREMENTS

The student must complete the following steps, as detailed in the corresponding sections.

1. Satisfy the residency requirement
2. The following two requirements can be satisfied in any order, but must be completed before step 3.

    a) Form a Dissertation Committee
    b) Pass the Written Qualifying Examination

3. Advancement to Candidacy, both conditions a) and b) should be satisfied. Dissertation proposal should be submitted before the Oral Qualifying Examination.

    a) Dissertation proposal must be approved by the Dissertation Committee
    b) Pass the Oral Qualifying Examination

4. Pass the Final Oral Examination (Dissertation Defense)
5. Submit Approved Dissertation

APPLICATION PROCEDURE

Applicants must follow the standard procedures of their sponsoring organization in applying to a graduate education program, see Academic Council Policy Manual, Section 4.4. Applicants should have the sponsoring organization forward their letter of application to:

Director of Admissions (Code 01C3)
Naval Postgraduate School
1 University Circle, He-022
Monterey, CA 93943
Telephone: (831) 656-3093, DSN 756-3093
Fax: (831) 656-2891, DSN 756-2891
E-mail: grad-ed@nps.edu

The application should include:

- certified transcripts of all courses taken at the university level, including both undergraduate and graduate courses

- results of a recent GRE general test if the prospective student is not currently at the Naval Postgraduate School
- scores on the TOEFL examination if the prospective student is a foreign student who is not a native speaker of English

If available, the following should be included:
- any material demonstrating ability to perform research, e.g., Master's theses and research papers
- reference letters only if the writer can report direct knowledge of the candidate's technical and research abilities

For sample application letter, refer to page 23.

The Ph.D. Program Committee evaluates each applicant to gauge the minimum amount of time the applicant will need to complete the program (normal time is three years). The Software Engineering Department may impose the condition that the applicant obtains authorization for at least four years to complete the degree. Admitted Ph.D. students may begin in any quarter, but it is recommended that the student start in the Fall Quarter (beginning in October) due to the requirements and timing of the Written Qualifying Examination.

Applicants are cautioned that admission to the Ph.D. program does not guarantee successful completion of the program. It is significantly more difficult to assess the qualifications of a student for a Ph.D. admission than for other degrees. This is because the research work required for the Ph.D. requires significant creativity and independence. Past experience suggests that not all of the students admitted will successfully complete the program. The purpose of the Written Qualifying Examination is to give students early warning if they are likely to have trouble in our Ph.D. program. For self-assessment, prospective applicants can obtain copies of previous examinations together with solutions by contacting the Software Engineering Ph.D. Program Committee at the Naval Postgraduate School.

SEQUENCE OF EVENTS LEADING TO A PH.D. IN SOFTWARE ENGINEERING

A general outline for a student's progression through the Ph.D. program follows:

1. The student applies for admission to the Software Engineering Ph.D. program through the Director of Admissions. Upon satisfactory review of the package by the Software Engineering Ph.D. Committee and the Software Engineering Curricular Officer, the student is admitted to the program.

2. The Software Engineering Ph.D. committee nominates, for approval by the Academic Council, a dissertation committee, which henceforth bears the responsibility for the study program and for general guidance in the research program. The departmental Ph.D. committee names a member of the dissertation committee to be dissertation supervisor, and certifies to the Academic Council that the individual so named is qualified under the guidelines of this Policy Manual. Until the dissertation committee is named, the Software Engineering Ph.D. committee has the responsibility to oversee the student's study program.

3. When the student's study program is essentially complete, the Software Engineering Ph.D. committee, or the faculty it designates on its behalf, administers a written qualifying examination.

4. When the student has successfully passed the written qualifying examination and the dissertation proposal has been submitted to the dissertation committee, the Software Engineering Ph.D. committee, or the faculty it designates on its behalf, administers an oral qualifying examination.

5. Upon successful completion of the study program, language, or computing requirements, passage of the written and oral qualifying examinations, and approval of a dissertation topic, the student becomes eligible for advancement to candidacy. The departmental Ph.D. committee then recommends that the Academic Council advance the student to candidacy for the doctorate.

6. When the candidate's investigations are complete and the dissertation has been submitted, the dissertation committee administers a final oral dissertation defense.

7. After the unanimous recommendation of the dissertation committee to approve the final version of the dissertation, the Academic Council makes the final decision to recommend a candidate for the award of the Ph.D. degree.

FORMING A DISSERTATION COMMITTEE

The student must form a Dissertation Committee to oversee his or her program as soon as possible after admission to the Ph.D. program. The Dissertation Committee is responsible for supervising the candidate's completion of the degree, including completion of a course of study, dissertation research, and production of the dissertation document. The Dissertation Committee also administers and determines the results of the Oral Qualifying Examination and the Final Dissertation Defense. Once a Dissertation Committee is formed, the Ph.D. Program Committee nominates the Dissertation Committee for approval by the Academic Council. See page 24 for appointment of committee memorandum sample.

One of the members of the Committee from the Software Engineering Group must be designated as the Dissertation Supervisor (Advisor), and will be the student's primary technical contact; the Dissertation Supervisor must be knowledgeable about the proposed research area for the dissertation and should have prior personal experience on Dissertation committees. The student must therefore choose the general research area for the dissertation prior to forming the Dissertation Committee.

Each Dissertation Committee must have a Chair, who can be the same as the Dissertation Supervisor. The Chair of the dissertation Committee must have previously served as a dissertation supervisor. The Dissertation Committee must contain at least three members of the Software Engineering faculty (see the list at the end of this document).

At the time of approval of the Dissertation Committee, the student must also formulate a Study Plan that includes a list of courses to be validated and a timetable of when he or she expects to pass the various milestones of his/her Ph.D. program. The Study Plan should be developed in

consultation with the proposed Dissertation Supervisor. The Dissertation Committee members must agree that the Study Plan is acceptable when agreeing to serve on the Committee.

Ph.D. Committee, Dissertation Committee, and the Thesis Advisor
From the Academic Council Policy Manual (as of September 2006)

> *The departmental Ph.D. committee nominates a dissertation committee, to be approved by the Academic Council. One member of this committee is identified as the dissertation supervisor, and the departmental Ph.D. committee must certify to the Academic Council that the individual so named is qualified under the requirements of this Policy Manual. The student, in conjunction with the dissertation supervisor, identifies a dissertation topic, which must be approved by the dissertation committee. The departmental Ph.D. committee also designates the member of the dissertation committee who shall serve as dissertation committee chair, if that person is to be different from the dissertation supervisor.*

Role of the Departmental Ph.D. Committee
From the Academic Council Policy Manual (as of September 2006)

> *Each Department offering a Ph.D. degree must have a standing Ph.D. committee. It shall be the responsibility of the departmental Ph.D. committee to oversee the Ph.D. program for the Department.*

Among the duties of the departmental Ph.D. committee are the following:

1. Ensuring that the Ph.D. program designed for each student conforms to the minimum requirements imposed by the Academic Council in the Academic Council Policy Manual.

2. Determining any standing requirements, beyond those of the Academic Council, that must be fulfilled by all Ph.D. students in the Department.

3. Nominating, for approval by the Academic Council, the members of each Ph.D. student's dissertation committee, the dissertation supervisor, and certifying to the Council that the dissertation supervisor is qualified to hold that position.

4. Overseeing the administration of the written and oral qualifying examinations for each Ph.D. student, and insuring that the nature of those examinations conforms to the requirements of the Academic Council Policy Manual.

5. Requesting that the Academic Council advance a student to candidacy for the Ph.D. degree upon approval of a dissertation committee, dissertation topic, and successful completion of all screening, language, computing, and qualifying requirements and exams.

Prior to the naming of a dissertation committee and a dissertation supervisor, the departmental Ph.D. committee, with the help of the Student Mentoring Committee, has the responsibility of supervising the student's program of study, After the naming of the dissertation committee and dissertation supervisor, the departmental Ph.D. committee retains the responsibility of overseeing

the activities of dissertation supervisor and the dissertation committee, maintaining quality control of the departmental Ph.D. program. Members of the departmental Ph.D. committee must maintain active research programs in software engineering, and either served as the advisor of a PhD student who graduated within the last 6 years or as a dissertation committee member of a PhD student who graduated within the last 3 years. Members of the departmental Ph.D. committee are expected to participate in all committee decisions, and to send someone to represent them if they cannot attend a committee meeting.

Role of the Student Mentoring Sub-Committee
Software Engineering Policy

After passing the written qualifying examination and prior to the naming of a dissertation committee and a dissertation supervisor, the Software Engineer Ph.D. Student Mentoring Subcommittee has the responsibility of advising students and helping students to choose a dissertation topic and a dissertation supervisor.

Role of the Dissertation Supervisor
Software Engineering Policy

The Software Engineering Ph.D. Committee oversees the formation of the Dissertation Committee. Faculty without any prior experience advising Ph.D. students in Software Engineering or a closely related field must petition the Ph.D. Committee for permission to supervise a Ph.D. student. The petition must be in writing and should include a curricula vita and any other material validating the faculty member's academic qualifications.

From the Academic Council Policy Manual (as of September 2006)

> *The dissertation supervisor has the responsibility to supervise the student's program of study in accordance with the requirements of the major Department and Academic Council.*

The dissertation supervisor should have the following qualifications:

- a doctorate in his/her field of specialty;
- experience in thesis advising (e.g. being a member of a Dissertation Committee);
- activity and productivity in research, as evidenced by recent publications of his or her research in recognized journals and conference proceedings, or a broad reputation as a productive researcher in his or her field of specialty;
- other evidence may be considered which is pertinent to demonstrating research activity or productivity.

The dissertation supervisor should work with the Ph.D. students to write NSF-quality research proposals for nationally competitive research.

Role of the Dissertation Committee
From the Academic Council Policy Manual (as of September 2006)

> *The candidate's dissertation committee, once established, is responsible for supervising the*

candidate's completion of his/her degree, including completion of course of study, dissertation research, and production of the dissertation document. The dissertation committee is nominated by the departmental Ph.D. committee, and will consist of five or more members. Four of the committee members must be full-time NPS faculty. At least one of the NPS faculty members shall be from outside the department or interdisciplinary academic group that is granting the degree. One or more members of this committee may be from another university or appropriate institution. At least four members must have earned the doctorate and the committee may contain no more than two members who have not earned the doctorate. The departmental Ph.D. committee shall designate one or more members of the dissertation committee to be the dissertation supervisor.

WRITTEN QUALIFYING EXAMINATION

The purpose of the Written Qualifying Examination is to check each student's analytical abilities in the foundations of software engineering, their proposed research area, and solving problems in that area. These abilities are crucial for success in Ph.D. dissertation work.

Students typically complete the doctoral qualifying examination within one year of entering the Ph.D. program. There are two possible outcomes of the Written Qualifying Examination: Passed and Failed. If the student fails the first Written Qualifying Examination, the Software Engineering Ph.D. Program Committee may grant the privilege of a second examination opportunity. If granted, the second examination must be within 1 year of the first, and only two opportunities for passage are allowed (see Academic Council Policy Manual, Section 5.4.8).

Written Qualifying Examination questions will come from at least two subject areas determined by the Software Engineering Ph.D. Program Committee. There must be two faculty members, selected by the Software Engineering Ph.D. Program Committee, for each of the topics chosen for testing. To ensure breadth, a minimum of four faculty (at least two of whom are Software Engineering Group faculty) must be involved in the preparation and grading of the examination. The Written Qualifying Examination will be open notes/book/internet.

From the Academic Policy Manual (as of September 2006)

The written qualifying examination is a comprehensive test of the student's basic knowledge of and skills in the major area. The exam is the responsibility of the departmental Ph.D. committee, and is administered by this committee or by faculty members whom the departmental Ph.D. committee designates to act on its behalf.

The written exam is administered after the student's program of study is essentially completed.

An up-to-date written statement of the format and procedures of the examination must be filed by each Department with the Academic Council.

Passage of the written qualifying examination requires a unanimous vote of the departmental Ph.D. committee, or those faculty members designated to act on its behalf.

If the student fails the first written qualifying examination, the departmental Ph.D. committee may grant a second examination opportunity to the student. If the privilege of re-examination is granted, the time period within which it must be accomplished is specified by the departmental Ph.D. committee, but it shall not exceed 12 months. Only two opportunities for passage are allowed.

Topics for the Written Qualifying Examination

(A) REQUIRED AREA

Software Engineering

Fundamentals of Software Engineering

- Sets, set comprehensions, power sets, Cartesian products, relations, functions;
- Propositional calculus, syntax and semantics of propositional calculus, interpretation of propositional formulas, tautologies;
- Predicate calculus, syntax, terms and formulas, semantics of predicate calculus, models;
- Formal Methods concepts: role of formal methods in software engineering; when and where formal methods can and should be applied; benefits and disadvantages of using formal methods in an engineering discipline.

Software Engineering Core

- Requirements engineering, validation and management;
- Specification and verification of software;
- Software architecture and design patterns;
- Software quality assurance and testing;
- Software maintenance and evolution.

(B) CHOOSE ONE OF THE FOLLOWING

Computer Science

- Automata, languages, and complexity
- finite automata, regular expressions, context free grammars
- basic results of undecidability (Halting problem, Rice Theorem)
- Pumping lemmas for Regular and Context-Free languages
- Translators and compilers
- Operating Systems and Networks
- Artificial Intelligence and Machine Learning
- Information Assurance and Database

Management and Economics

- Software Cost Estimation & Analysis
- Project Scheduling & Optimization
- Software Risk Assessment & Management
- Project Process Improvement

Systems Engineering

Mathematical fundamentals
- Probability and statistics
- Calculus and analytic geometry

System architecture and design
- Functional architecture and design
- Physical architecture and design
- System decomposition and integration

System suitability
- Reliability modeling and design
- Maintainability modeling and design
- Availability modeling and design
- Human factors

System assessment
- Modeling and simulation
- Verification and validation
- Test and evaluation

Computer-based systems
- Real-time, embedded systems
- Network-centric and distributed systems
- Enterprise systems

MINOR REQUIREMENTS

The Software Engineering Ph.D. Program does not have any minor requirements.

Ph.D. SEMINAR REQUIREMENTS

All students who have not advanced to candidacy (Phases I and II) are required to take Ph.D. seminars and get a passing grade for the seminars.

SEMI-ANNUAL PROGRESS REPORT REQUIREMENTS

Students with dissertation advisors should send their progress reports to their dissertation committee at least once every six months. Students without advisors should send their progress reports at least once every six months to the student mentoring subcommittee.

DISSERTATION PROPOSAL

A dissertation proposal should be submitted to the Dissertation Committee at least one week before the Oral Qualifying Examination. The purpose of the dissertation proposal is to provide the Dissertation Committee with the information needed to determine whether the proposed research topic is suitable for a Ph.D. dissertation. The proposal should describe the student's best current estimate of their research plan. The details in the proposal may be changed later as the research subject is understood in more detail. (See page 30 for a sample dissertation proposal outline.)

ORAL QUALIFYING EXAMINATION

Usually within one year and no more than two years (in which case a special extension request should be approved by Software Engineering PhD Program Committee) after the successful completion of the Written Qualifying Examination, the student must successfully complete the Oral Qualifying Examination. Any courses in the study plan must be completed before the student can take the Oral Qualifying Examination. The student gets only two chances to pass the Oral Qualifying Examination (see Academic Policy Manual, Section 5.4.9, shown below).

The Oral Qualifying Examination is administered by the student's Dissertation Committee. The Dissertation Committee Chairman schedules the oral portion of the Qualifying Examination and is responsible for arranging an Academic Council Representative to attend the oral qualifying examination. The student submits a dissertation proposal to the Dissertation Committee. See page 25 for sample notification memorandum.

The Dissertation Committee asks any questions that it feels may help decide whether the student has sufficiently broad knowledge of the dissertation topic and sufficient analytic capability to begin full-time Ph.D. research. Time permitting, other faculty members in attendance may also ask questions of the student. The questions may be on any reasonable topic.

When the Dissertation Committee is satisfied that the student has been questioned thoroughly, the student leaves the room, the Dissertation Committee discusses concerns and votes on whether to pass the student; a unanimous vote is required. The final overall decision regarding pass or fail of the entire Qualifying Examination is made by the Dissertation Committee after the oral examination is completed.

The final result of the Written and Oral Qualifying Examinations must be reported to the Curricular Officer for Software Engineering Programs, the Associate Provost for Instruction, and to the Academic Council not later than two weeks after the scheduled date of the oral qualifying examination. Each member of the departmental Ph.D. committee, or those designated on its behalf, shall sign the report. Sample Pass/Fail memorandum is on page 26. Copies of the memo should be provided to the SWE PhD Committee Chair.

The Academic Council representative must submit a written report on the oral qualifying examination. The report is sent to the Academic Council to verify that the oral examination was conducted in accordance with the rules of the Academic Council.

From the Academic Council Policy Manual Section 5.4.9 (as of September 2006)

The oral qualifying examination is the culmination of the course of study. The purpose of the oral qualifying examination is to test basic knowledge and creative ability and to demonstrate the student's capacity to use material from the course of study. The oral qualifying examination shall contain no prepared presentation; its format shall be exclusively question-and-answer.

Passage of the oral qualifying examination requires a unanimous vote of the examiners. All departmental Ph.D. committee members or those designated on their behalf must be present during all phases of the oral exam. There must be a minimum of three examiners.

Whenever the Academic Council Representative becomes of the opinion that the examination is not being conducted in accordance with the Policy of the Academic Council, the Representative should suspend the examination and require that the Oral Examination be rescheduled. The Representative should report the reasons for this decision to the Academic Council and to the Departmental Ph.D. Committee concerned as soon as possible. Such a finding should never be deemed a "failure" of the Qualifying Examination.

The extent of participation of all parties is determined by the departmental Ph.D. committee or those designated to act on its behalf.

The Academic Council representative must attend all phases of the oral examination, and shall report to the Academic Council that the examination was conducted in accordance with the rules of this Policy Manual. Attendance at the oral qualifying exam is delineated in Table 5.1.

If the student fails the first oral qualifying examination, the departmental Ph.D. committee may grant a second examination opportunity to the student. If the privilege of re-examination is granted, the time period within which it must be accomplished is specified by the departmental Ph.D. committee, but it shall not exceed 12 months. Only two opportunities for passage is allowed.

Table 5.1: Attendance and Voting Privileges for Oral Qualifying Examinations.

CATEGORY	***ORAL QUALIFYING EXAMINATION***
Departmental Ph.D. Committee members or those acting on its behalf	*A, B, C, D*
Academic Council Representative	*A, B, C*
Other faculty	*A, B*
Examinee	*A*
Students, Staff, and Visitors	*A*

Phase A: may attend Interrogation Phase
B: may attend Comment Phase
C: may attend Voting Phase
D: may Vote.

ADVANCEMENT TO CANDIDACY

The following requirements must be satisfied before a student can be advanced to candidacy for the Ph.D. degree:

1. Approval of the dissertation topic
2. Passing the Written Qualifying Examination
3. Passing the Oral Qualifying Examination

Upon successful completion of the Oral Qualifying Examination, the student must petition the Academic Council for "advancement to candidacy for the doctorate." A memo to the Academic Council from the departmental Ph.D committee must be prepared stating that the requirements for advancement to candidacy have been successfully completed. The Academic Council notifies candidates of advancement to candidacy in writing.

DISSERTATION GUIDELINES

Dissertation Topic
From the Academic Council Policy Manual (as of September 2006)

> *The distinct requirement of the doctorate is the successful completion of a scholarly investigation leading to the original and significant contribution to knowledge in the candidate's major area of study. The subject of the investigation must be approved by the dissertation committee, and must be submitted to the Council no later than the time of the request for advancement to candidacy.*
>
> *A minimum of six months must elapse between successful completion of the oral qualifying examination and the defense of the dissertation.*

Final Dissertation Guidelines

When the dissertation has been revised and clarified to the satisfaction of each member of the Dissertation Committee, each signs it. The Thesis Processor checks the dissertation format, and finally the Degree Program Chair and Associate Provost for Instruction sign it.

DISSERTATION DEFENSE

At least six months after passing the Qualifying Examination, when the dissertation research is almost complete, and a draft of the dissertation has been finished and is available, the Final Oral Examination (also known as the dissertation defense) occurs. On the first week of Academic Quarter when the student plans to graduate he/she should notify SwE Ph.D. Program Committee Chair or Secretary. The final draft of the dissertation should be submitted for the Dissertation Committee members approval no later than 4 weeks before the scheduled final examination. Dissertation Committee members should notify Dissertation Committee Chair about their approval/disapproval of the dissertation draft.

Additional requirements for disseminating the results of dissertation research

The memo requesting the final oral examination should be accompanied by a list of accomplished actions to communicate the dissertation research results to the community, in particular:

(i) by the time of final oral examination the student must have authored or co-authored at least two papers describing the contributions of the dissertation research that are accepted or at least fully submitted to peer-reviewed conferences, workshops, or research journals;
(ii) by the time of final oral examination the student must have published an NPS Technical Report summarizing the research contributions of the dissertation (approx. 20-30 pages long);
(iii) no later than two weeks preceding the final oral examination the student must give a talk about the dissertation research contributions at either a CS departmental seminar or SWE PhD seminar ("dry run").

All those actions should be documented in an appendix to the memo requesting the final oral examination.

No later than one week before the final examination student should provide Dissertation Committee with copies of presentation transparencies for the feedback.

No later than one week before the final examination an email and a written notification should be distributed notifying CS Department (and/or GSOIS) faculty and students about time and venue of the scheduled dissertation defense, including the title and abstract of the dissertation.

Dissertation Committee Chair is responsible for arranging an Academic Council representative to attend the final examination. Sample dissertation defense memorandum is on page 28. This examination is administered by the Dissertation Committee and consists of the following:

1. An open (public) presentation of the findings of the research by the candidate, including response to questions from the audience within an allotted time period.
2. A question and comment phase open to all NPS Software Engineering faculty and students.
3. A closed session involving only the members of the student's Dissertation Committee and the Academic Council Representative. A unanimous vote by the Dissertation Committee is required for a successful outcome.

Dissertation Defense
From the Academic Council Policy Manual (as of September 2006)

> *When the dissertation research has been completed, the Ph.D. candidate prepares a draft of the dissertation and provides a copy to each member of the dissertation committee for approval. Upon the dissertation committee's unanimous acceptance of the draft as the basis for a dissertation defense, the dissertation committee chair notifies the departmental Ph.D. committee and provides it with a draft of the dissertation. The dissertation committee chair*

schedules the final dissertation defense. This examination must be scheduled later than one week after the submission of the draft of the dissertation to the departmental Ph.D. committee.

All members of the dissertation committee are required to attend the final defense and the entire Academic Council is invited to attend. The Academic Council shall designate a representative, who must attend the dissertation defense.

In the final dissertation defense, the candidate presents the dissertation and is subject to such questions as the entire dissertation committee deem appropriate. The extent of participation of all parties is determined by the dissertation committee chair.

Attendance at the final dissertation oral examination is delineated in Table 5.2.

The Academic Council representative must submit a written report on the dissertation defense. The report is sent to the Academic Council to verify that the defense was conducted in accordance with the rules of the Academic Council.

The Academic Council representative must submit a written report on the dissertation defense. The report is sent to the Academic Council to verify that the defense was conducted in accordance with the rules of the Academic Council. Whenever the Academic Council Representative becomes of the opinion that the defense is not being conducted in accordance with the Policy of the Academic Council, the Representative should suspend the defense and require that the Dissertation Defense be rescheduled. The Representative should report the reasons for this decision to the Academic Council and to the Departmental Ph.D. Committee concerned as soon as possible. Such a finding should never be deemed a "failure" of the Dissertation Defense.

Table 5.2: Attendance and Voting Privileges for Dissertation Defenses.

CATEGORY	***ORAL FINAL EXAM*** *(Dissertation Defense)*
Dissertation Committee	*A, B, C, D*
Academic Council Representative	*A, B, C*
Other faculty	*A, B*
Examinee	*A*
Students, Staff, and Visitors	*A*

Phase A: may attend Interrogation Phase
B: may attend Comment Phase
C: may attend Voting Phase
D: may Vote.

Report of Completion of Dissertation and Successful Defense

The results of the final dissertation defense and completion of the dissertation document are reported to the Academic Council, the report bearing the signatures of all the members of the dissertation committee and Software Engineering PhD Committee Chair. Copies of the memo should be provided to the SWE PhD Committee Chair and to the CS Department Chair.

If the candidate is passed, the report shall also include: nomination of the successful candidate for the award of the degree, Doctor of Philosophy (sample memorandum on page 30).

ON-LINE DISSERTATION SUBMISSION PROCEDURE

All DL graduates are encouraged to use SharePoint if possible for their thesis. You should receive an email notifying you of your URL – this is your thesis workspace. If not, email Rhoda Lynch (rlynch@nps.edu) for your URL. FAQ's can be accessed from the following URL: http://www.nps.navy.mil/ITACS/KB/browseCategories.asp

DL Students must use a VPN client connection. The VPN client must be installed on the student's home PC. To obtain the VPN client, go to the following link and click on available software: https://www.nps.navy.mil/ITACS/SoftwareLib/index.htm. If you have problems, contact Rhoda Lynch at (831) 656-3128 or rlynch@nps.edu.

On-line submission details and dissertation templates can be found at www.nps.edu/research/research1.html. Here is a summary of the procedure:

1. E-mail draft thesis as a Word file to NPS Thesis Processor at thesisdraft@nps.edu. If using SharePoint, email URL.

2. Thesis will be returned by e-mail within two days with corrections/comments by NPS Thesis Processor.

3. Student makes necessary corrections recommended by NPS Thesis Processor--corrections are made in word processing version; then corrected version is converted to PDF.

4. To check for corrections in Word 2003, go to arrows in Toolbar by Show button, click accept/reject changes. Click arrow again to take you to the next correction. You can accept (or reject), and it will allow you to make the changes in your thesis.

5. Combine final thesis into one PDF file.

6. Print out PDF version of thesis and provide to advisor (if advisor requests).

7. Download and complete Thesis Release Form (Thesis Release form provides General Info on thesis, release to WWW, Distribution Statement, applicable technology areas related to thesis).

8. Print your Signature Page from your thesis.

9. Obtain necessary signatures on final PDF of thesis. Thesis office does not require hard copy.

10. Obtain necessary approvals/signatures on Thesis Release Form and Signature Page.

11. Create Special Abstract with email addresses in Word and save as separate file.

12. Prepare Color Page Print Request. (if needed)

13. E-mail final version of thesis (or SharePoint URL) as one PDF file and special abstract as Word file to YOUR Thesis Processor (whoever did your initial draft review):
    ThesisFinal@nps.edu if Pam Silva was your Processor
    nmaniego@nps.edu if Nita was your Processor

14. When e-mail is received from Thesis Processor and the final version (PDF) of thesis and Special Abstract is approved, you will be emailed that as soon as the Thesis Advisor in your department brings the signed original Signature Page, original signed Thesis Release Form, and Color Page Print Request (if needed) to the Thesis Processor, your green card will be completed and given to the Thesis Advisor to mail to you**.**

TIME LIMITS

Students have one year from the date of admission to complete the written qualifying examination.

Students have one year from the passing the written qualifying exam to the passing of oral exam, and one year from passing the oral exam to the advancement to candidacy.
Those who have advanced to candidacy have five additional years from that event to complete their degree.

From the Academic Council Policy Manual (as of September 2006)

> *All requirements for completing the Ph.D. degree must be completed within a period of five years after advancement to candidacy.*

Restoring a Lapsed Candidacy

(Approved by the NPS Academic Council: May 5, 1995)

Due to time limitations for completion of the Ph.D. program and the unique demands faced by NPS students once they have completed their residence, there may be instances in which a student wishes to renew their pursuit of a Ph.D. after their candidacy has lapsed. The following procedure is designed for renewing Ph.D. candidacy:

1. The student initiates the request (to the Department) for reinstatement of Ph.D. candidacy.
2. The departmental Ph.D. committee, or special committee the designate, evaluates the reinstatement request. The committee shall seek answers to the following questions:
    - Should the candidacy be reinstated?
    - What will be required to reinstate candidacy (e.g., course work, written and/ or oral qualifying examinations for both major and minor areas of concentration.)

Any request by the student to waive retaking the qualifying examinations should be submitted in writing at the beginning of the process.

1. The departmental Ph.D. Committee makes a recommendation to the Academic Council.
2. The Academic Council decides whether to accept or reject the departmental Ph.D. committee's recommendation.
3. If the student's request is approved by the Academic Council, the Department Chair instructs the student on their status and what will be necessary to reinstate the candidacy.

TUITION FOR DL STUDY

DL students not paying the tuition will be considered by the SWE PhD Program Committee for suspension from the Program.

PROCEDURES FOR GRADUATING PH.D. STUDENTS

By Week 12 of the quarter before graduation:
- Student submit draft of complete dissertation to his/her dissertation committee

By Week 1 of the graduating quarter:

- Student submit draft to thesis processor for format check according to Step 1 of the On-line Dissertation Submission procedure
- Student send the following information to the Ph.D. Program Secretary at maugusto@nps.edu
  Full name (how name should appear on diploma)
  Mailing address for the diploma
  Will student be attending graduation at NPS?

By Week 3:

- Student gets feedback from advisor and thesis processor and revises draft accordingly
- The Ph.D. Program Committee Secretary will provide graduating student's information to Ms. Maricel Eddington (Code CS)

By Week 4:

- Student provides revised dissertation draft and presentation slides to all committee members

By Week 6:

- Committee members provide feedback to student whether dissertation is ready for final defense
- If ready, student schedules final defense by week 8
- If not ready, student withdraws from the graduation list

By Week 8:

- Conduct the final defense
- Withdrawal deadline for graduation
- While student is at NPS, contact the following:
  Ms. Jeane Kays, Academic Council – to complete National Science Foundation Survey (831-656-2592, jwkays@nps.edu)
  Ms. Sonya Solomon, Graduation Coordinator – for graduation program information (831-656-2075, ssolomon@nps.edu)
  Ms. Sharee Kelso, Academic Services – for Cap & Gown and Dissertation Title (831-656-2371, skelso@nps.edu)
- Student prepares final version of dissertation responding to issues raised by the committee in the final defense.

By Week 11:

- Graduating student's final week to obtain all necessary signatures for the completed dissertation, dissertation release and security form.

Week 12:

- Graduating students must be present on during the graduation week to attend the commencement rehearsal

FACULTY OF SOFTWARE ENGINEERING AT NAVAL POSTGRADUATE SCHOOL

Auguston, Mikhail, Associate Professor, Ph.D., Glushkov Institute of Cybernetics, USSR, 1983.
Programming language design and implementation, Software testing and debugging automation, Formal Methods in Software Engineering, Systems and Software Architecture.

Berzins, Valdis, Professor, Ph.D., Massachusetts Institute of Technology, 1979.
Automated decision support for developing and assessing software requirements, Software merging for computer-aided maintenance, Automatic program generation from problem descriptions.

Butler, Jon, Professor, Ph.D., Ohio State University, 1973. IEEE Fellow.
System Design, Multiple-Valued Logic, Number Systems, and Combinatorial Mathematics.

Denning, Peter, Professor, Ph.D., Massachusetts Institute of Technology, 1968. IEEE Fellow, ACM Fellow and AAAS Fellow.
Great principles of computing, innovation practice, performance modeling and evaluation, design principles, workflow mapping and analysis, hastily formed networks.

Drusinsky, Doron, Associate Professor, Ph.D., Weizmann Institute of Science, Rehovot, Israel, 1988.
Harel statecharts, UML, Verification, Formal Methods, Software Testing, Run time Verification, Temporal Pattern Matching, Automatic Test Generation, Real Time Model Checking, Real Time, Low Impact, On-line business rule and security checking, Temporal Logic, Metric Temporal Logic, Probabilistic Temporal Logic, Extended Regular Expressions, Visualization, Programming Applications of Formal Methods, Knowledge models, Temporal Intrusion Pattern Detection.

Goshorn, Rachel, Assistant Professor, Ph.D., University of California – San Diego, 2006.

Kamel, Magdi, Associate Professor, Ph.D., University of Pennsylvania, 1988.
Database Management Systems, Data Warehousing, Data Mining, Knowledge Base and Expert Systems, Web Technologies, Application Development Methodologies.

Kölsch, Mathias, Assistant Professor, Ph.D., University of California - Santa Barbara, 2004.
Computer vision, virtual and augmented environments, robotics, mobile and wearable computing, vision-based interfaces, human-computer interaction, gesture recognition, sensor networks.

Lundy, Bert, Associate Professor, Ph.D., Georgia Institute of Technology, 1988.
Communications networks, including high speed network protocols, formal specification and analysis of protocols, and in applications of high-speed networks.

Luqi, Professor, Ph.D., University of Minnesota, 1986. IEEE Fellow.
Document Conversion; Reliable Architecture for Flexible Systems; Software-intensive System Safety; Collaborative and Network Centric Applications; Highly Selective Searching; System Modeling and Automation; System Re-engineering; Computer-Aided Prototyping; Specification Languages; Engineering Automation for System Requirements; Design Methodology; Real-Time and Embedded Systems; Software Evolution & Tools; Signal Processing & Control System Design; Command and Control Systems.

Martell, Craig, Associate Professor, Ph.D., University of Pennsylvania, 2005.
Logic; Rule-based and Statistical Artificial intelligence; Natural Language Processing; Automatic code generation and error-checking; Robotics; Software requirements for Autonomous Systems.

Michael, Bret, Associate Professor, Ph.D., George Mason University, 1993.

Distributed computing, system dependability, system-of-systems engineering, software system safety and reliability, software reuse, and software evolution.

Osmundson, John, Research Associate Professor, Ph.D., University of Maryland, 1970.
Analysis, modeling, and simulation of distributed, time-critical information systems. Application of systems engineering, and computer modeling and simulation expertise to the development of system architectures, performance models, and system trades of time-critical systems.

Otani, Thomas, Associate Professor, Ph.D., University of California – San Diego, 1983.
Database Modeling, Software Visualization, Enterprise Application Development, OOP Education.

Riehle, Richard, Visiting Professor, Ph.D., Naval Postgraduate School, 2008, Software Architecture, Software Engineering Best Practices, Object Technology in Software Engineering, Deception Strategies in Computer Security, Engineering Rationale for Software Engineering

Rowe, Neil, Professor, Ph.D., Stanford University, 1983.
Applications of artificial intelligence to software engineering, including data mining, inference of plans and goals, natural-language processing, image processing, and support of logical reasoning about software.

Alan B. Shaffer, CDR, U.S. Navy, Permanent Military Professor, CDR, U.S. Navy, Permanent Military Professor , PhD in Computer Science, Naval Postgraduate School, 2008, Information Assurance, High Assurance System Engineering, Secure systems development and verification, Secure System Engineering.

Shebalin, Paul, Senior Lecturer. D.Sc., The George Washington University, 1997.
System requirements modeling, System design methodologies, Enterprise systems engineering, Agent-based systems modeling, Real-time embedded computer system and software design and development.

Shing, Man-Tak, Associate Professor, Ph.D., University of California – San Diego, 1981.
Real-time system modeling, specification and design, validation and run-time monitoring of temporal assertions, software architectures, computer-aided prototyping tools.

Whitcomb, Clifford, Associate Professor, Ph.D., University of Maryland, 1998.
Naval construction and engineering, Six Sigma, Design for Six Sigma, naval systems engineering, naval surface combatant and submarine design and production, robust design and production, submarine propulsion systems, electric power systems engineering, computer and internet-aided product development, multidisciplinary design optimization, and multiple criteria decision making

Xie, Goeffrey, Associate Professor, Ph.D., University of Texas - Austin, 1996.
Real-time networking and multimedia systems.

Sample Admission Application Letter

[Click **here** and type return address]

[Enter date here]

Director of Admissions (Code 01B3)
Naval Postgraduate School
589 Dyer Rd., Rm. 103C
Monterey, CA 93943-5100

To Director of Admissions:

Please accept my application to the Ph.D. Program in Software Engineering at the Naval Postgraduate School. I have enclosed the following application materials:

Certified transcripts from [Enter Academic Institution here[2]]

Certified transcripts from [Enter Academic Institution here[3]]

Results from a recent GRE general test[4]

Master's Thesis entitled [Enter thesis title here[5]]

Research paper entitled [Enter paper title here[6]]

Reference letter from [Enter name of reference here[7]]

Thank you for your consideration.

Sincerely,

[Click **here** and type your name]
[Click **here** and type job title]

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2 Transcripts for all undergraduate and graduate courses taken at the university level should be included.
3 Transcripts for all undergraduate and graduate courses taken at the university level should be included. Repeat this line as many times as needed to cover all courses taken.
4 Only necessary if the prospective student is not currently enrolled at NPS.
5 Only include when available, Delete when not available, Repeat as needed.
6 Only include when available, Delete when not available, Repeat as needed.
7 Only include when available, Delete when not available, Repeat as needed.

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: Chair, Software Engineering Ph.D. Program Committee
To: Academic Council

Subj: Appointment of Dissertation Committee

1. <NAME> was accepted into the Software Engineering Ph.D. program on <DATE>.

2. The Software Engineering Ph.D. Program Committee requests the following dissertation committee be formed to guide their research.

   <COMMITTEE MEMBERS, their FIELDS OF EXPERTISE, their DEPARTMENT and INSTITUTION AFFILIATIONS>

3. <NAME> will conduct his research in the area of <AREA OF RESEARCH>.

4. To allow <NAME> to more effectively organize a program of study, action on this request is requested at the earliest convenience of the Council.

_____
<Name>
Chair, Software Engineering Ph.D. Program Committee

_____
<Name>
Chair, Computer Science Department

Copy to:
<Ph.D. Candidate>
<Dissertation Committee Members>

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: <NAME> (Chair, Dissertation Committee for <NAME>)
Code <CODE>, <Department Name>
Naval Postgraduate School
Monterey, CA 93943
Via: <NAME> (Chair, Software Engineering Ph.D. Program Committee)
To: Academic Council
Code O1B, Associate Provost for Instruction
Naval Postgraduate School
Monterey, CA 93943

Subj: Ph.D. Oral Qualifying Examination

1. In accordance with Academic Council Policy, the purpose of this memorandum is to inform the Academic Council of the upcoming Ph.D. Oral Qualifying Examination for my Ph.D. Student, <NAME>.

2. I have arranged for <NAME> Ph.D. Oral Qualifying Examination to be held at <DATE/TIME> in <LOCATION>.

3. We request attendance by a representative of the Academic Council.

4. If you have any question, please give me a call at <PHONE>.

_____
<Name>
<Title>

Copy to:
<Name>, Chair, Ph.D. Program Committee
<Dissertation Committee Members>
<Representative NAME>
<Ph.D. Candidate>

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: Chair, Dissertation Committee
To: Academic Council, Code O1B
Via: Chair, Software Engineering Ph.D. Program Committee
Subj: Result of Ph.D. Oral Qualifying Examination

1. Results of Dissertation Committee's Ph.D. Oral Qualifying Examination of <S_NAME>.

   <P_Name> (Dissertation Supervisor): Pass/Fail_____

   <Committee Member>: Pass/Fail_____

   <Committee Member>: Pass/Fail_____

   <Committee Member>: Pass/Fail_____

   <Committee Member>: Pass/Fail_____

2. As Chairman of the Ph.D. Dissertation Committee, I am hereby informing the Academic Council of the Dissertation Committee's decision to pass ( )/fail ( ) <S_NAME> on the Ph.D. Oral Qualifying Examination.

_____
<Name>
Chair, Dissertation Committee

Copy to:
<P_Name> Chairman, Dissertation Committee
<Software Engineering Curricular Officer>
<Ph.D. Candidate>

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: Chair, Software Engineering Ph.D. Program Committee
To: Academic Council, Code O1B

Subj: Advancement to Candidacy for <S_Name>

1. The dissertation committee has approved the dissertation topic proposed by <S_NAME>

   <P_Name> (Dissertation Supervisor): _____

   <Committee Member>: _____

   <Committee Member>: _____

   <Committee Member>: _____

   <Committee Member>: _____

2. The student completed all the other necessary requirements of Ph.D. Candidacy as outlined by the Academic Council and Software Engineering PhD Program. I consequently do recommend <S_NAME> to be advanced to candidacy at this time.

_____
<Name>
Chair, Software Engineering Ph.D. Program Committee

Copy to:
<P_Name> Chairman, Dissertation Committee
<Ph.D. Candidate>

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: Chair, Dissertation Committee
Via: <Name>, Chair, Software Engineering Ph.D. Program Committee
To: Academic Council, Code O1B

Subj: Dissertation Defense for <S_Name>

1. The Dissertation Committee has received a draft dissertation and determined that <NAME> is ready for a dissertation defense.

   <P_Name> (Dissertation Supervisor): Agree/Disagree_____

   <Committee Member>: Agree/Disagree_____

   <Committee Member>: Agree/Disagree_____

   <Committee Member>: Agree/Disagree_____

   <Committee Member>: Agree/Disagree_____

2. <S_NAME> will appear before the Dissertation Committee on <DATE> at <TIME> in <LOCATION> to defense his/her doctoral dissertation entitled "<TITLE>"

3. We request attendance by a representative of the Academic Council.

_____
<Name>
Chair, Dissertation Committee

Appendix: actions completed for communicating the results of the dissertation research

Copy to:
Associate Provost for Instruction, Code 01B
<Dissertation Committee members>
<Ph.D. Candidate>

Sample Appendix to the memorandum about readiness for the final oral examination

The following actions communicating the results of the dissertation research have been accomplished:

1) The following papers representing the contributions of the dissertation research have been accepted or fully submitted to peer-reviewed conferences/workshops or research journals:
    a) < paper 1's title, authors, where and when it has been accepted/submitted >
    b) < paper 2's title, authors, where and when it has been accepted/submitted >
    c) ……..
2) The following NPS Technical Report summarizing the research contributions of the dissertation has been published: …..
3) The dissertation research contributions have been presented at the following seminar(s) and/or conference(s): < date, venue, title of the talk >…

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: Chair, Software Engineering Ph.D. Program Committee
To: Academic Council, Code O1B

Subj: Results of Dissertation Defense

1. <NAME> has successfully completed all the requirements for a Ph.D. in Software Engineering. His dissertation entitled: "<TITLE>" was successfully defended before this committee on <DATE OF DEFENSE>.

_____
<Name>
<Title>
Chair, Dissertation Committee

_____
< Committee Member >
<Title>

_____
<Committee Member>
<Title>

_____
<Committee Member>
<Title>

_____
<Committee Member>
<Title>

2. This committee nominates <NAME> for the degree, Doctor of Philosophy in Software Engineering.

_____
<Name>
Chair, Software Engineering PhD Program Committee

_____
<Name>
Chair, Computer Science Department

Copy to:
Dissertation Committee
Chair, Computer Science
Chair, Ph.D. Committee

Software Engineering
Naval Postgraduate School
Monterey, California

<DATE>

MEMORANDUM

From: Chair, Software Engineering Ph.D. Program Committee
To: Chair, Academic Council Doctoral Committee, Code O1B

Subj: Dissertation Committee Appointment Change

1) List of faculty and their affiliations in the previous dissertation committee

2) <State the requested changes and provide justifications here.>

3) List of faculty and their affiliations in the new dissertation committee

_____
<Name>
Chair, Software Engineering Ph.D. Program Committee

_____
<Name>
Chair, Computer Science Department

Copy to:
<P_Name> Chairman, Dissertation Committee
Dissertation Committee members
<Ph.D. Candidate>

DISSERTATION PROPOSAL

<AUTHOR>
<DATE>

I Proposed title of dissertation

II Goals and proposed new contribution.
- A. Introduction to the problem.
- B. Significance of the problem and its potential impact.
- C. Specific goals of proposed research – which subproblems will be solved by the work you propose to do, how do they relate to the overall problem.
- D. Proposed advances to the state-of-the art – in what sense will your proposed work improve over the best previous results, for each issue you plan to address.

III Research strategy and proposed approach.
- A. Tactics for producing the proposed new contribution
- B. Methods to substantiate new contributions including proposed experiments, measurements or theoretical analysis.
- C. Expected delivery of products, if any.

IV Assessment of previous work. For each issue you plan to address in your contributions, find the best relevant previous publications.
- A. Summarize the results and assess their significance in the context of your problem.
- B. Explain the relation to your work – which parts will you use, or is this one of the best previous competing solutions you will improve over.
- C. Point out weaknesses
- D. Explain how you will overcome the weakness or improve on previous results, if you plan to do so.

V Tentative chapter outline for dissertation.
Typically,

Chapter 1 Introduction
Chapter 2 Assessment of previous work
Middle chapters explain your main results, analysis of measurements, experimental results or theoretical analysis of performance, accuracy, or other measures of how good your contribution is.
Last chapter – conclusion and recommendations for future work.

VI Research plan and proposed schedule.

VII List of references.

SAMPLE PH.D. DISSERTATION TOPICS

(1) The U.S. Army Crusader Project

(2) Drive-by-Wire Technology

(3) The Bradley Software Architecture and Acquisition Project (Army Acquisition Corp)

(4) Vehicle Control Software Standards, Requirements Specification

(5) Vehicle Domain-Specific Reusable Components

(6) Software Architecture for Autonomous Vehicles

(7) Software Automated Control Software Generator

(8) Tank Traffic Controls Systems

(9) Software and Systems Interoperability

(10) Software Technology for Battlefield Integration

(11) Architecture for Semi-Automated Software Reliability Prediction and Error Correction Process

(12) Virtual Environment for Systematic Vehicle Software Demonstration

(13) Light-Weight Inferencing Technology

(14) Architecture for Semi-Automated Risk Assessment and Error Correction Process

(15) Wireless Control Software

(16) Distributed Software Design/Development Environment

(17) Architecture for Component-Based System Integration

(18) Agent-Based Network Maximization

(19) Software Evolution Control and Support