ABET
Self-Study Report

for the

Master of Science in
Systems Engineering Program

at

Naval Postgraduate School

Monterey, California

May 31, 2019

CONFIDENTIAL

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Acronyms List

ACRONYM	MEANING
AA	Academic Associate
ACE	American Council on Education
ARSENL	Advanced Robotic Systems Engineering Laboratory
ASEIL	Autonomous Systems Engineering Integration Lab
ASNE	American Society of Naval Engineers
CED3	Center for Educational Design, Development and Distribution
CERDEC	Communications-Electronics Research, Development and Engineering Center
CDIO	Conceive-Design-Implement-Operate
CI	Continuous Improvement
CR	Curriculum Review
CRADA	Cooperative Research and Development Agreement
CSEP	Certified Systems Engineering Professional
DASN RDT&E	Deputy Assistant Secretary of the Navy for Research, Development, Test and Evaluation
DL	Distance Learning
DON	Department of the Navy
DT&E	Developmental Test and Evaluation
ET	Education Technician
ESR	Educational Skill Requirements
GPA	Grade Point Average
GSEAS	Graduate School of Engineering and Applied Sciences
HPCC	High-Performance Computing Center
INCOSE	International Council on Systems Engineering
IRRA	Institutional Research, Reporting, & Analysis
ITACS	Information Technology and Communications Services
LRC	Learning Resource Center
M&S	Modeling and Simulation
MARCORSYSCOM	Marine Corp Systems Command
MSSE	Master of Science in Systems Engineering
NAVAIR	Naval Air Systems Command
NPS	Naval Postgraduate School
NSAM	Naval Support Activity Monterey
NTT	Non-Tenure Track
P&T	Promotion and Tenure
PEO	Program Educational Objectives
PO	Program Officer

PT	Part-time
QPR	Quality Point Rating
RA	Research Associates/Assistants
SNAME	Society of Naval Architects and Marine Engineers
SE DL	Systems Engineering Distance Learning
SE	Systems Engineering
SEA	Systems Engineering Analysis
SECNAV	Secretary of the Navy
SEOC	Systems Engineering Oversight Council
SEP	Systems Engineering Plan
SES	Senior Executive Service
SEEC	Systems Engineering Educational Consortium
SESG	Systems Engineering Stakeholders Group
SoS	System of Systems
SO	Student Outcomes
SSP	Director, Strategic Systems Programs
SSR	Self-Study Report
T&E	Test and Evaluation
TOA	Total Obligation Authority
TSSE	Total Ship Systems Engineering
TT	Tenure Track
URL	Unrestricted Line Officers
USMC	United States Marine Corps
USNTPS	United States Naval Test Pilot School
VADM	Vice Admiral
VPAA	Vice Provost of Academic Affairs
WSCUC	Western Association of Schools and Colleges Senior College and University Commission

Master's Level Program Self-Study Report
for
EAC of ABET
Reaccreditation

BACKGROUND INFORMATION (*)

A. Contact Information

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B. Program History

Include the year implemented and the date of the last general review. Summarize major program changes with an emphasis on changes occurring since the last general review.

The major program is summarized, along with changes with an emphasis on changes occurring since the last general review. The year the program was implemented, and the date of the last general review are included.

The Naval Postgraduate School (NPS) celebrated its centennial in 2009 to 2010. In its first hundred years, it has been the graduate school for officers of the US naval services. It was founded after the Great White Fleet journey around the world revealed that officers needed specialized, advanced knowledge in the new technologies (e.g., wireless radio) that were entering the Navy as well as better understanding of the existing core technologies (e.g., steam propulsion) upon which the Navy relied. The programs of NPS have always been based on the

needs of the Navy, and as those needs have changed, the portfolio of programs offered by the university has changed.

Over the last two decades, it became apparent to the leadership of the Navy and Marine Corps that the competence of naval personnel (both civilian and uniformed) in systems engineering was insufficient to properly acquire and field major combat systems. This view was articulated up and down the chain of command, including by the Secretary of the Navy. NPS responded in several ways, including distance learning programs, certificate programs, and a flagship resident program.

The resident Master of Science in Systems Engineering Program was developed in 2004-2006 at the request of Vice Admiral (VADM) Balisle, USN, the commander of the Naval Sea Systems Command, to address the shortfall in the education of Navy officers. In March of 2005, an advisory board consisting of the thirteen Navy engineering duty admirals approved the initial curricular design and authorized the first class to begin in summer of 2006. Seven officers were admitted.

Engineering Duty Officers are those officers in the Navy who are responsible for the technical processes of the Navy. The Navy's Engineering Duty Officer web site explains:

> Engineering Duty Officers ensure that our Naval and Joint Forces operate and fight with the most capable platforms possible. We are involved with the design, acquisition, construction, repair, maintenance, conversion, overhaul, and disposal of ships, submarines, aircraft carriers and the systems on those platforms (weapons, command and control, communications, computers, etc.). ED Officers are unique to the navy because we all start our career as URL[1] officers. First, we learn how to operate ships or submarines. Next, all ED's obtain technical/engineering masters degrees. Then, we combine that operational experience and technical knowledge to become the technical business leaders for the navy.

The importance of this engineering duty career field was stated by VADM Balisle in 2006 when he directed the creation of this program:

> "1.6% of our officers' corps direct and execute about 1/3rd of the Navy's Total Obligation Authority (TOA). Let me just suggest that it is because of their education that they can effectively direct and orchestrate the efforts of highly technical industries, producing and maintaining the ships and systems that our Sailors rely on every day. It's a crude measure, but considering these few officers, the ROI is staggeringly high. Perhaps more to the point (but harder to measure) is that by virtue of their education they save the Navy huge sums by catching errors, oversights, and mistakes early in the design, construction, and repair of ships and systems; by designing and conducting test programs that illuminate weaknesses early; by effectively translating the needs of our warriors into the language of engineering, production, and business; and by being the warriors' eyes and ears in the factories, shipyards, and on the deckplates as we deliver and modernize our ships and systems."

[1] A URL officer is an unrestricted line officer who is qualified to command a warship.

The Master of Science in Systems Engineering program primarily serves these engineering duty officers and their aviation counterparts (who are called aviation engineering duty officers).

The flag advisory board directed that the program be ABET accredited. To meet that directive and to gain the benefits of the accreditation process as soon as possible, the program was presented off-cycle in 2010 from the other three ABET programs on campus, which were reviewed in 2007 and reaccredited in 2008. It was the SE program's intention to merge with the cycle of the other programs at the next general review; hence, the program submitted a self-study report at the general review in 2013-14. The SE department ABET programs are now on-cycle for review with all other NPS ABET programs, so the department is submitting a self-study report for the general review in 2019-2020.

The initial program design in 2006 assumed that officers would need a significant number of undergraduate courses in systems areas. That assumption proved to be invalid, as undergraduate systems courses were not needed for the graduate program. Based on student feedback, better information on student backgrounds, and the publication of an International Council on Systems Engineering (INCOSE) reference curriculum, and again with the active involvement of the engineering admirals in the Navy, the curriculum was re-designed effective with the class that entered in 2008. That class graduated in the spring and summer of 2010. Since then, the curriculum has remained fairly stable.

Since the initial accreditation visit, as part of assessment continuous and improvement, several significant changes were made to the program. The original program had 9 core systems courses with project work embedded vertically in the courses. Our assessment was that this was not as effective as intended and did not best support our student outcomes. The current resident program has 8 core courses and 3 new stand-alone project-based courses. This redesign involved several trades, but those trades have worked out well since this implementation.

The residential program in systems engineering presented for re-accreditation in this self-study is but one of six graduate programs leading to degrees that are offered by the Department of Systems Engineering. The distance learning version of the program is presented separately for re-accreditation in an accompanying self-study. The other four degree programs (the doctoral program, systems engineering management, systems engineering analysis, and engineering systems) and the systems engineering certificate are not presented for accreditation at this time.

All of the SE programs have continued to experience consistent numbers of students since the initial accreditation. In 2012, our previous record year, the resident ABET SE program graduated 27 students and the DL SE ABET program graduated 122. In this 2018 record year, the resident ABET accredited SE program graduated 33 students and the DL ABET SE program graduated 105. The portfolio of all SE programs graduated 201 degree students in AY2018, which is one fourth of the entire campus production.

We have maintained quality through the dedicated efforts of the current faculty and staff. In 2019, U.S. News and World Report released its annual rankings of the top graduate engineering schools in the country. The Department of Systems Engineering ranked tied for 29th in the nation on the list of industrial, manufacturing, and systems engineering programs. This was the highest ranked program in the NPS Graduate School of Engineering and Applied Sciences.

C. Options

List and describe any options, tracks, concentrations, etc. included in the program.

Program options, tracks, concentrations, etc. included in the program are listed and described.

Students who execute the full core curriculum as described in Students and Curriculum section, paragraph II Student Program and Educational Goals below fully qualify for the Master of Science in Systems Engineering degree, however, Naval Engineering Duty Officer students sponsored by the Naval Sea Systems Command must meet additional "educational skill requirements" (ESRs). U.S. Navy students take one of two domain application tracks to meet to the additional ESRs. The tracks available to resident students are in combat systems, and total ship systems design. Those domain tracks also call courses offered by the other engineering departments on campus. A current list of the courses associated with these two tracks is in Exhibit 1.

Students sponsored by Naval Air Systems Command who are graduates of the United States Naval Test Pilot School are not required to take an application track at NPS. The one year of test pilot school satisfies the "education skill requirement" for a domain track in naval aviation systems.

D. Program Delivery Modes

Describe the delivery modes used by this program, e.g., days, evenings, weekends, cooperative education, traditional lecture/laboratory, off-campus, distance education, web-based, etc.

The delivery modes used by this program, e.g., days, evenings, weekends, cooperative education, traditional lecture/laboratory, off-campus, distance education, web-based, etc. are described.

This program is delivered in residence using the traditional face-to-face lecture/laboratory mode during the day to full-time students, with one exception. Qualified members of the local NPS staff are permitted to enroll as part-time residential students, and several NPS staff members have done so to date. Resident courses are supported by web-based systems, notably Sakai, a web-based course management and collaborative learning environment.

E. Program Locations

Include all locations where the program or a portion of the program is regularly offered (this would also include dual degrees, international partnerships, etc.).

All locations where the program or a portion of the program is regularly offered (this would also include dual degrees, international partnerships, etc.) are described.

The students receive instruction at the NPS campus in Monterey, CA.

F. Public Disclosure

Provide information concerning all the places where the Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is posted or made accessible to the public. If this information is posted to the Web, please provide the URLs.

Information concerning all the places where the Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is posted or made accessible to the public is provided, including the URLs.

SE Website:
MSSE Program Accreditation

Student Outcomes

Program Educational Objectives

NPS Academic Catalog:
Program Education Objectives (PEO), Student Outcomes (SO)

Annual student enrollment and graduation data is only made public in the NPS Factbook and accessible via the NPS Institutional Research web page.

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

Summarize the Deficiencies, Weaknesses, or Concerns remaining from the most recent ABET Final Statement. Describe the actions taken to address them, including effective dates of actions, if applicable. If this is an initial accreditation, it should be so indicated.

The only Concern remaining from the most recent ABET Final Statement in 2014 is summarized. The actions taken to address the concern, including effective dates of actions, if applicable, are described.

From ABET Final Statement of Accreditation to Naval Postgraduate School, August 11, 2014, the remaining Program Concern is:

Criterion 4. Continuous Improvement This criterion requires that the program regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. While the program defines six student outcomes and maps them to the student outcomes (a) through (k), it is difficult to discern how attainment of each of the (a) through (k) outcomes is being assessed and evaluated. Therefore, it is difficult to evaluate

how the assessments these student outcomes articulated in the baccalaureate level general criteria are used as input in the continuous improvement of the program. Thus, future compliance with this criterion may be jeopardized.

- Due-process response: The EAC acknowledges documentation stating that the program has decided to use ABET student outcomes (a) through (k) for assessment in the continuous improvement process with a resulting update of the assessment process. The changes in the assessment process are currently being implemented. See Exhibit 2 for the original communication with ABET.

- The concern remains unresolved.

The SE department has had CI processes in place since our initial accreditation in 2010. The SE department CI program from 2010 through 2015 was called the Overall Curriculum Evaluation and Assessment Network (OCEAN). The set of OCEAN processes was our CI process implementation that covered all curricula and degrees offered by the SE department. OCEAN was documented in SE department instructions and standard work packages (SWP). The SE department regularly assessed and evaluated many sources of information and used the results to improve various aspects of our graduate programs. OCEAN was an attempt to take a holistic view of assessment and evaluation of our education programs, not only ABET programs. The use of OCEAN was terminated in 2015 as being too unwieldy in the amount of data collection, analysis, and evaluation needed. The department simplified our CI process by focusing on the efforts that relate to assessment of ABET EAC student outcomes, separating out other curriculum and departmental CI efforts, to be able to implement our CI process more concisely and to be able to communicate the results of CI efforts more effectively to the faculty and outside parties.

The updated list of opportunities for assessment of information used for potential feedback on various aspects of program performance as related to student outcomes was developed in academic year (AY) 2016 and is shown in Table 1. These items are reviewed periodically for any changes needed for student learning, instruction, and program CI.

Table 1. Sources of Information for Program Assessment and Continuous Improvement

Item #	**Item and Description**	**Periodicity**
1	Student capstone project report and thesis outcome evaluations, for evidence of attainment of student outcomes, with data recorded on an on-line NPS-wide Capstone Assessment Instrument and used for assessment, analysis, and evaluation.	Annual
2	Student course work for evidence of attainment of student outcomes.	As needed

3	Major Area Sponsor curriculum review held every two years.	Bi-annual

The items in Table 1 are used on an ongoing basis for CI and determining if program changes are needed.

For the assessment of our student outcomes the department institutes a CI process based on whether student outcomes are attained. Item 1 is the primary quantitative measure of attaining student outcomes. Item 2 refers to the use of specific course work for quantitative assessment, analysis, and evaluation of student outcomes, particularly systems analysis course work and teamwork assessments during project-based courses. SE Department Instruction – Faculty 1.4, Exhibit 3 provides a description of the methods used to gather data and conduct assessment, analysis, and evaluation against student outcomes for our CI process. The assessment, analysis, and evaluation results are presented in department and faculty meetings for status and decisions related to program quality. Item 3 refers to our Curriculum Review process, where the major area sponsor conducts a formal curriculum review every two years, during which the entire curriculum is examined to determine if it is meeting the objectives, educational skill requirements (ESR), and outcomes defined for the program, and to provide feedback on the program. The major area sponsor is typically joined by other major defense systems engineering organization leaders for a more comprehensive program review participation. The major area sponsor is part of the overarching Navy structure that specifically identifies the flag-level sponsors responsible for any NPS curriculum, as required by NPS Instruction 1550.1G, Guidelines for Conducting Curricular Reviews. For our resident systems engineering program, the systems engineering 580 curriculum, the major area sponsor is the Director, Strategic Systems Programs (SSP), currently VADM Johnny Wolfe.

Summary of Major Continuous Improvement Activities 2014 – 2018

Due to the fact that there were several changes in the way data had to be sourced for assessment and used for evaluation for CI, some of the major the program changes are summarized for the period from 2014 – 2018 to give an indication of the focus the faculty had on implementing CI.

The six student outcomes in 2013 were based on major program sponsor Educational Skill Requirements (ESR) which were mapped to ABET Criterion 3 (a) through (k) outcomes to ensure coverage. Based on the in initial ABET Concern presented in late 2013, the NPS SE department created new program student outcomes in 2014 explicitly integrating Criterion 3 (a) through (k) with the curriculum ESR. This was done because both the ESR and the ABET Student Outcomes form the fundamental basis for assessing our systems engineering students. In addition, the SE department redesigned our processes to allow specific and explicit assessment and evaluation based on these new student outcomes. The updated process was implemented in September 2014, in time for the start of our regular 2015 academic year.

The new seven program student outcomes were published in the catalog. They were:

1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.

2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.

3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.

4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.

5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.

6. Demonstrate an understanding of professional and ethical responsibility.

7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.

The department then redesigned our systems engineering Capstone Evaluation Form by annotating each item with the respective ABET EAC Criterion 3 (a) through (k) student outcomes including rubrics for scoring each respective student outcome. The updated Capstone Evaluation Form was published to the faculty to improve our assessment capability, provide for better inter-rater reliability, and provide the basis for making quantitative student outcome evaluation decisions that considered both ESR and Criterion 3.

During 2014, NPS institutional leadership decided to develop an institution-wide capstone assessment instrument to be required for assessment of all NPS theses and capstone projects.

The SE department had members on the NPS team developing the new assessment instrument and related rubrics. This instrument was put in place at the end of calendar year 2014, one quarter into academic year 2015, as a mandatory assessment.

The SE department faculty met in October 2015 and reviewed a new mapping of the student outcomes to the NPS Capstone Assessment Instrument that was developed as a basis for program assessment. The faculty decided that as the new capstone instrument was mandated by NPS, that also using the SE department Capstone Evaluation Form was a duplication of effort. The NPS Capstone Assessment Instrument became the new basis for gathering most of the quantitative data for assessing student outcomes from 2015 onward.

The SE department reviewed the teaching of ethics, writing, and critical thinking for the program. These topics were taught in a seminar format under a generic course title, SE3810. The course contents were determined to be important enough to create new specific course numbers for topics that relate to educational strategies for student outcomes 5, 6, and 7, rather than a generic seminar course. New courses SE3811 Critical Thinking in Systems Engineering, SE3812 Ethics in Systems Engineering, SE3813 Technical Writing for a Systems Engineer I, and SE3814 Technical Writing for a Systems Engineer II were added to the student course curricula in the resident program to be used starting in academic year 2016.

During academic year 2017, student outcomes 3 and 6 were scheduled for assessment. The source of information to map to student outcomes 3 and 6 was reviewed, with the faculty deciding that Student Outcome 3 best mapped to an assessment of student work in SE3250 and student outcome 6 mapped to a combination of NPS Capstone Assessment Instrument results. In addition, a faculty review of our analysis methods in 2017 yielded a better way to analyze and report our student attainment of outcomes. Previously, we translated the NPS Capstone Assessment Instrument results to a five point Likert scale, and averaged the results. Since the Capstone Assessment Instrument has scales as “Acceptable”, “Nearing Proficient”, “Proficient”, “Nearing Advanced”, and “Advanced”, it was determined that it would be better to report the number of students attaining “Proficient” or above on a cumulative basis. The faculty then selected threshold and goal values as targets, with the threshold set at 75% of students achieving “Proficient” of above, and a goal value of 90% of students achieving “Proficient” or above. These changes went into effect beginning in academic year 2017. It was also decided to go back and rerun the analysis for academic year 2016, in order to use this as check on the previous year’s results. That way, by the end of academic year 2018, we had a complete collection of at least a once through analysis of all student outcome results using the same new analysis and evaluation method.

During academic year 2018, student outcomes 1, 4, and 7 were scheduled for assessment. It was determined that student outcome 4 required a more direct course-level evaluation of teamwork of students in SE3203, the last quarter of the three course SE project sequence. A team of faculty who teach SE3203 collectively developed a spreadsheet to allow instructors to directly assess student performance of teamwork and assess student attainment of student outcome 4. The faculty implemented a new standardized spreadsheet and rubric to assess student teamwork aspects, and to rate student teams. The ratings form the basis of the data for assessing, analyzing, and evaluating attainment of student outcome 4. Student outcome 7 is

assessed based on a combination of NPS Capstone Assessment Instrument results that related to life-long learning and knowledge of contemporary issues.

In addition, the faculty met to discuss the ABET EAC changes for student outcomes for masters programs. The faculty decided to use the two ABET EAC suggested student outcomes as the basis of our new outcomes. The faculty also decided to use all of the NPS Capstone Assessment Instrument outcomes as the basis for quantitative input for assessing student attainment of these new student outcomes, as well as for analysis and evaluation for CI.
The two new masters program student outcomes were published in the catalog at the beginning of AY19, replacing the previous seven student outcomes. In order to achieve the objectives for the SE masters program, the new outcomes are to produce graduates where:

1. Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.
2. Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET EAC accredited undergraduate degree meet these post-secondary requirements.

All of the NPS Capstone Assessment Instrument outcomes will be used to assess attainment of the new masters program student outcomes beginning in AY19. The masters-level student outcomes and related assessment schedule is described in the Program Educational Objectives and Student Outcomes section of this self-study report.

Program Continuous Improvement Concern Summary

In summary, the SE department has put in place updated student outcome assessment and continuous improvement processes. Based on the program Concern from 2014, we focused our CI efforts to organize and implement a more cohesive CI process based on assessment, analysis, and evaluation of program aspects directly related to attainment of our program student outcomes.

GENERAL CRITERIA FOR MASTER'S LEVEL PROGRAMS

STUDENTS AND CURRICULUM

For the sections below, attach any written policies that apply.

NOTE: "Post-secondary education and/or professional experiences" refers to intermediate and advanced academic and/or professional knowledge, skills and competencies leading to a first and/or second tertiary degree (such as a baccalaureate or master's degree) or equivalent qualification.

I. Verification of Post-Secondary Education and Professional Experiences

Summarize the procedure that verifies that students in the program have had a post-secondary educational and/or professional experiences that

- supports that attainment of student outcomes as defined in the general criteria for baccalaureate programs, Criterion 3;
- includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experiences that meets the requirements in the general criteria for baccalaureate programs, Criterion 5;
- satisfies the curricular components of the baccalaureate level program criteria relevant to the master's level program name.

The procedure is described that verifies that students in the program have had a post-secondary educational and/or professional experience that

- supports that attainment of student outcomes as defined in the general criteria for baccalaureate programs, Criterion 3;
- includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experiences that meets the requirements in the general criteria for baccalaureate programs, Criterion 5;
- satisfies the curricular components of the baccalaureate level program criteria relevant to the master's level program name.

Under the provisions of 10 USC Chap 605, students at NPS are either officers of the US Navy, officers of another US service, officers of an allied nation's armed forces, civilian employees of the federal government, or employees of major defense contractors. By law, the Master of Science in Systems Engineering Program admits no students without one of these affiliations. Students are sponsored by their home organization, which pays all tuition and fees. Students incur service obligations with their home organization for attending the program. Students are Naval Engineering Duty Officers and unrestricted line officers (URL), as well as officers from other US services and international services.

Our residential programs have the charge to be prepared to take officers who may lack preparation for graduate education and to deliver undergraduate material, if necessary, to prepare them for graduate study in their assigned fields. This flexible admissions policy for technical curricula is one of the distinctive competencies of NPS and a primary reason that the Navy maintains its own graduate school instead of using civilian graduate schools. (The other competency is the unique defense relevance of our programs).

Officers of the Navy are detailed to attend NPS to qualify for future assignments requiring graduate education. Those requirements vary by billet, and are called educational skill requirements, or ESRs. Satisfaction of these ESRs qualifies an officer with a special identifier, called a subspecialty code, or "p-code." These ESRs are a superset of the degree requirements and the student outcomes. The systems engineering program supports the 5800 p-code, which applies to selected engineering billets in the Navy's various systems commands.

NPS maintains a school-wide policy for student enrollments as detailed in the catalog. Individual departments evaluate transcripts of students applying to their program. In the Systems Engineering program, the Academic Associate (an experienced faculty member) and the Program Officer (a military officer assigned to NPS) evaluate the transcripts provided. The Academic Associate and Program Officer make recommendations regarding the number of refresher quarters, and the program length needed to complete the program of study (including educational skill requirements) for students deemed acceptable candidates. In particular, they ascertain whether the student has an undergraduate ABET engineering degree or its equivalent. If the applicant does not, they determine what additional courses are necessary for the student to meet both the master's degree requirements and the ABET undergraduate engineering requirements. This may require a longer program and is negotiated with the student's sponsor prior to the student being accepted for admission.

In the last four academic years, 91 of 134 students admitted to the MSSE program had ABET EAC undergraduate engineering degrees. The program has a detailed process for analyzing the undergraduate records of those it admits who do not have an ABET accredited undergraduate engineering degree and designing a remediation plan to address their undergraduate shortcomings. The transcripts and the SE Checklist for BSSE Undergraduate Equivalency for those 43 who did not have an ABET accredited undergraduate engineering degree, and requested to be assessed for equivalency for the MSSE degree, and were found to meet equivalency, will be available for review during the site visit. Three representative student transcripts and the SE Checklist for BSSE Undergraduate Equivalency used in the process of establishing undergraduate equivalency are included in Exhibit 4.

The minimum undergraduate GPA for admission (using NPS rules for calculation) is a 2.2. NPS counts all repeated courses in its calculation of this GPA; for example, a student who initially failed calculus and then retook it has both grades counted. The NPS Admissions Office performs these GPA calculations. The department is authorized to grant waivers for cause and may do so in the future for those assessed as likely to succeed in the program, particularly for graduates of the Naval Academy who have repeated courses.

Neither the Navy nor NPS require students to take the GREs. NPS does not track the percentile rank in the undergraduate program.

II. Student Program of Study and Educational Goals

Summarize the procedure by which a program of study and education goals are developed for each student, and how these will lead to a mastery of a specific field of study or area of professional practice (consistent with the program name) at an advanced (beyond baccalaureate) level. Describe how the procedure ensures that each student's program of study at the master's level includes one academic year of full-time study (equivalent to at least 30 semester hours) beyond the baccalaureate level program.

The procedure by which a program of study and education goals are developed for each student, and how these will lead to a mastery of a specific field of study or area of professional practice (consistent with the program name) at an advanced (beyond baccalaureate) level is summarized. A description of how the procedure ensures that each student's program of study at the master's level includes one academic year of full-time study (equivalent to at least 30 semester hours) beyond the baccalaureate level program is provided.

The resident program is a systems centric systems engineering program as defined by Fabrycky in "Systems Engineering: Its Emerging Academic and Professional Attributes", ASEE, 2010. The resident program includes a set of courses, documented in Appendix A-1, that requires a common core of 8 courses, a 3-course project sequence, a set of at least two focused systems engineering electives, and a thesis (SE0811 (0-8) for 3 qtrs.). The requirements for a thesis, or a capstone project report which is considered a thesis equivalent, are documented in Appendix A-2. Most students are required or elect to add a domain track of seven courses and, depending on their next assignment, the Navy may specify additional courses for naval officers.

The eight core courses are

1. SE3100 Fundamentals of Systems Engineering (3-2)
2. SI3400 Fundamentals of Engineering Project Management (3-2)
3. SE3302 System Suitability (3-2)
4. SE4150 Systems Architecting and Design (3-2)
5. SE3011 Engineering Economics and Cost Estimation (3-0)
6. SE3250 Capability Engineering (3-2)
7. SE4115 Combat Systems Integration (4-2)
8. OS3180 Probability and Statistics for Systems Engineering (4-1)

The three-course project sequence for Combat Systems track students is

1. SE3201 Engineering Systems Conceptualization (2-4)
2. SE3202 Engineering Systems Design (2-4)
3. SE3203 Engineering Systems Implementation and Operation (2-4)

The three-course project sequence for Ship Systems track students is

1. TS4001 Integration of Naval Engineering Systems (3-2)
2. TS4002 Ship Design Integration (2-4)
3. TS4003 Total Ship Systems Engineering (2-4)

The two focused SE Electives are normally chosen from the following routinely offered elective courses

1. SE4003 Software Systems Engineering (3-2)
2. SE4353 Risk Analysis and Management for Engineering Systems (3-2)
3. SE4354[2] System Verification and Validation (4-0)
4. OS4680 Naval Systems Analysis (4-0)

The three-course thesis sequence for all resident masters students is

1. SE0811 Thesis in Systems Engineering (0-8)

The normal SE resident masters program exceeds the minimum requirements, 45 credits, for an NPS master's degree due to additional educational skill requirements imposed by the Navy. As a result, most students require a minimum of seven quarters to complete the curriculum.

Students from other services or countries are not required to meet the Navy's educational skill requirements. Most, but not all, take a selection of electives of their own choosing, beyond the core courses. Some complete the degree requirements in fewer quarters.
All students complete a capstone thesis.

III. Evaluating Student Performance

Summarize the process by which student performance is evaluated and student progress is monitored. Include information on how the mastery of an advanced field of study or area of professional practice is demonstrated by and evaluated for each student.

The process by which student progress is monitored and performance is evaluated is summarized. Information on how the mastery of an advanced field of study or area of professional practice is demonstrated by and evaluated for each student is included.

The SE department continuously monitors student progress. The SE department has a civilian faculty member, Senior Lecturer Mark Stevens, responsible as Academic Associate (AA) to oversee the students in the Master of Science in Systems Engineering program.

The AA monitors student performance through the local academic management system (called Python). This includes quarterly reports on students with low grades, incompletes, insufficient course load, and other triggers. The AA meets with all students each quarter, and solicits

[2] SE4354, former course title, "Systems Test and Evaluation" was approved by the NPS Academic Council and updated to "System Verification and Validation", March 2019. The Academic Catalog and other publications will reflect this change.

feedback on the courses just taken, those currently underway, and any barriers to success. Any issues identified are presented to the department chair.

Student progress is also monitored by the Program Officer (PO), a senior active duty Navy officer assigned to the program to ensure that curriculum requirements and the needs of the Navy and DoD are satisfied. Program Officers also monitor academic performance. Students who do not maintain the GPA required for graduation are placed on probation and counseled in writing.

The AA is the primary advisor of students on academic matters. The PO, the department chair, and other faculty assist him. There are few major program choices for the student; choice of the domain track is the primary one. Since that is both an academic choice and a career choice, as it affects potential assignments after graduation, the PO assists in that counseling. Student academic plans are entered into Python by the students with the assistance of an Education Technician (ET), and are approved by the AA and PO. Any student course changes must also be approved by them, usually after a significant discussion with the student to ensure her or she understands the issues.

Since all students are currently employed by the US Government, career counseling needs are less than at other schools. The PO is responsible for counseling military officers on their career issues and progression, and in particular works to coordinate the post-graduation assignments of the officer students.

Faculty who identify concerns with students routinely inform the AA and/or the PO. This monitoring by the AA and PO is aided by an assigned Educational Technician and by the Python student management system, which automatically generates notifications of low student academic performance.

Documenting and tracking prerequisites is managed primarily through the Python academic management system. Prerequisites for the program tracks are by design self-contained and internally consistent. A student will rarely deviate from the assigned track due to external circumstances. Prerequisites may be waived under these circumstances only with the consent of the instructor, program officer, and the academic associate.

The mastery of an advanced field of study or area of professional practice is demonstrated by each student through successful completion of a course of study with a GPA of at least 3.0 and completion of masters thesis or capstone report. Each student's thesis or capstone report is evaluated by an advisor and second reader using the NPS Capstone Assessment Instrument.

Advising Students

Students are ordered into the program by their warfare community or command, and their primary curricular choices are to select a domain track and a thesis topic with advisor. The AA and PO must approve all of these options. They meet with students to inform them of their options and to assist them in making their decisions; these meetings include a group orientation upon enrollment, quarterly feedback sessions, and individual meetings as necessary. The

formal choices are recorded in Python with notes by students, AA, and PO. The AA, PO, and Chair have open door policies for student access. Records are kept in Python of all academic actions, showing the interaction between students and advisors. The educational technician also keeps both paper and digital files.

Students with academic performance issues are flagged by Python and then are counseled by the AA and PO.

Students who must demonstrate undergraduate ABET equivalency are a point of special attention and receive careful advising as to what coursework they need and how to count courses to satisfy both the undergraduate and graduate requirements.

Thesis advisors play a special role in the mentoring of officers. It is not unusual for the relationship to persist long after the student graduates. For example, during one of the commencements in 2009, ADM Mike Mullen, then Chairman of the Joint Chiefs of Staff, the senior military officer of all US services, made a point of recognizing the long-lasting influence his thesis advisor had over his career and the value he placed on that relationship.

Career Guidance

Students are all employed during their studies, either by the US government, the allied nation, or a sponsoring defense contractor. Each also owes a 'pay-back' period to their sponsor upon completion of the curriculum. Therefore, there is much less career advising required in our program than in the typical engineering program, where job placement is a paramount concern. The senior military officers assigned to the NPS as faculty provide counseling to US officers about military career issues. For SE students, this is done by CDR Todd Greene, USN, the current SE Program Officer.

NPS does not admit transfer engineering students.

Students may petition the NPS academic council for transfer of up to 12 quarter credit hours for relevant graduate courses completed at another institution, but no more that 25% of the minimum course credit hours required for the NPS degree. The minimum number of required course credits for the masters degree is 36, not including the thesis credits, so no more than 9 credit hours would be approved for transfer to meet course credit requirements. The registrar would verify the transcripts.

By policy set by the NPS Academic Council, Naval Nuclear Power School graduates receive NPS graduate credits on their NPS transcript for completion of their course work. These courses can be used for meeting engineering school prerequisites or undergraduate ABET EAC course equivalency, if needed.

NPS also allows the SE department (as well as the other departments) to automatically grant students who are completing their degree in conjunction with attendance at the USNTPS permission to transfer up to 12 hours of 4000 level credit from the Test Pilot School. The USNTPS has a standard year-long technical curriculum and provides transcripts to NPS when

this credit is claimed. These credits have been used to meet p-code requirements and to establish undergraduate ABET equivalency. When this is done, supporting evidence materials are included in the ABET equivalency documentation. These credits may also be used by students to meet graduation requirements.

NPS does not award graduate course credit for work experience. The SE department does allow for military experience documented by the American Council on Education (ACE) credits to count towards undergraduate course equivalency, when appropriate.

IV. Graduation Requirements

Summarize the graduation requirements for the master's level program and the process for ensuring and documenting that each graduate completes all graduation requirements for the program. State the name of the degree awarded (Master of Science in Chemical Engineering, Master in Computer Science, Master of Engineering in Electrical Engineering, etc.)

The graduation requirements for the MSSE program and the process for ensuring and documenting that each graduate completes all graduation requirements for the program is summarized. The name of the degree awarded is Master of Science in Systems Engineering.

To earn the Master of Science in Systems Engineering, a student must satisfy the following requirements, taken from the NPS catalog:

Master of Science in Systems Engineering

Requirements for the degree of Master of Science in Systems Engineering:

1. An ABET EAC accredited Bachelor of Science degree in an engineering discipline or established equivalency.
2. Completion of an approved study program that includes:
    a. A minimum of 36 quarter credit hours of 3000 and 4000 level courses, 16 of which must be at the 4000 level.
    b. A four-course core in systems engineering fundamentals and methods.
3. Completion of a 12-quarter credit hour equivalent team systems engineering project. An acceptable individual thesis may be substituted for the team project if approved by the Department Chair.

The current 'approved study program' described in the degree requirements contains the courses described above. The program requirements are updated as part of the continuous improvement process, while the degree requirements change much more slowly. The use of the phrase 'approved study program' acknowledges this.

The graduation requirements for the MSSE are tracked by the Python student information system. There are several checks. The initial student program is checked to assure that it meets graduation requirements by the educational technician, PO, and AA. The default programs exceed the degree requirements with comfortable margins. The quarter before graduation an audit is done, with particular attention to graduate GPA, the requirement that sufficient 4000 level courses have been completed, and the total number of graduate credits.

The educational technician prepares a list of graduates in the graduation quarter. The AA, PO, and Chair each verify again that graduation requirements have been met before the department Chair signs the degree nominations.

The university registrar also checks to verify that the university minimums have been met for all graduating students. This final check occurs before the NPS Academic Council approves the degree nominations and forwards them to the President to award the degrees.

The PO verifies that all educational skill requirements have been met for Navy students and assigns them a p-code. That personnel action of the Navy is independent of the department.

A student cannot graduate before a capstone thesis or project report has been evaluated and signed by the advisors and department Chair and has been accepted by the thesis processing office.

All graduates demonstrate their ability to apply advanced level knowledge in a specialized area of SE through the thesis or capstone project process. All are rigorously performed with the intention of producing results worthy of publication in peer-refereed, archival journals or conferences, either as a stand-alone piece of work or as part of a stream of thesis work performed under the same faculty member or same faculty research team.

All resident students present their thesis research results just prior to graduation at a systems engineering department colloquium, SE3000, to an audience consisting of systems engineering faculty and students.

All student theses or capstone project reports are evaluated using a common NPS Capstone Assessment Instrument. This on-line instrument is filled out by the student advisor, co-advisor, and/or second reader. These capstone assessments are used as a primary basis for assessment of student outcomes as described in our Program Educational Objectives and Student Outcomes section of this self-study report. The assessment instrument and associated rubric are provided in Exhibit 5.

Areas of specialization often align with required course focus sequences, but students are encouraged to work with faculty outside the SE program in order to promote interdisciplinary integration to benefit the department and the student's integration skills.

SE students perform research in a variety of areas including concept definition, process decision making, architecture modeling, risk analysis, and capability engineering, among others. The student thesis frequently focuses on a domain of application, usually from the associated track.

All theses from the life of the program will be available for review during the site visit.

V. Transcripts of Recent Graduates

The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. The

program of study and educational goals for these graduates should accompany the transcripts. **These transcripts and accompanying material will be requested separately by the Team Chair**. State how the program and any program options are designated on the transcript. (See 2019-2020 APPM, Section I.E.4.a.).

The program will provide transcripts from recent graduates to the team chair when, and as, requested.

A graduate of the ABET accredited program lists the Master of Science in Systems Engineering as the degree.

The heading of the NPS transcript contains administrative information, including the student's name, rank and specialty within the Navy or other service, the primary curriculum for the degree being pursued at NPS, and the type and source of the student's undergraduate degree.

The body of the transcript lists courses by number and title taken during any particular Academic year and quarter. NPS has four full academic quarters, numbered 1 through 4 in any given academic year. Each academic year starts in September, so the first quarter corresponds to fall, second to winter, third to spring and fourth to summer. Credit hours are listed in terms of lecture and lab hours. Lab hours count for ½ of a lecture credit hour for the calculation of total credits per course. Quality Points are calculated by multiplying the total credits for a course by the numerical equivalent of the letter grade earned in the course. An A is worth 4.0 points, a B is 3.0 points, and so forth with plus and minus grades increased or decreased by 1/3 of a point from the base grade as appropriate, (except in the case of an A, there is no A+). Seminars, thesis credits, and any pass/fail courses do not count towards the student's overall Quality Point Rating (QPR).

Following the completed courses, the transcript lists the degree awarded and the date. If a thesis or capstone project was required and completed for the degree, the title will also appear in this section.

PROGRAM EDUCATIONAL OBJECTIVES AND STUDENT OUTCOMES

This section refers to the requirements found in Section I.A.6.a of the 2019-2020 Accreditation Policy and Procedure Manual.

I. Program Educational Objectives

List the program educational objectives for the master's level program and state where they may be found by the general public as required by APPM Section I.A.6.a.

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. The SE department has a documented, systematically utilized process involving our program constituencies for the

periodic review of our program educational objectives to ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria.

Mission Statement

The purpose of the school is specified in law:

> "Sec.7041. Function There is a United States Naval Postgraduate School, the primary function of which is to provide advanced instruction and professional and technical education and research opportunities for commissioned officers of the naval service in--
> (1) their practical and theoretical duties;
> (2) the science, physics, and systems engineering of current and future naval warfare doctrine, operations, and systems; and
> (3) the integration of naval operations and systems into joint, combined, and multinational operations." (Title 10, United States Code)

Mission Statement:

The Naval Postgraduate School provides relevant and unique advanced education and research programs to increase the combat effectiveness of commissioned officers of the naval service to enhance the security of the United States. In support of the foregoing and to sustain academic excellence, NPS will foster a program of relevant and meritorious thesis and research experiences for NPS students that informs the curricula, supports the needs of the Navy and Department of Defense, and builds the intellectual capital of NPS faculty. To support the core Navy mission, NPS' programs are inherently joint, inter-agency, and international. The Graduate School of Engineering and Applied Sciences (GSEAS) supports the Navy and the Department of Defense by educating future leaders to lead, innovate and manage in a changing, highly technological world, and by conducting research recognized internationally for its relevance to national defense and academic quality (NPS Catalog).

The mission of the Department of Systems Engineering is:

to provide relevant, tailored, and unique advanced education and research programs in Systems Engineering in order to increase the combat effectiveness of U.S. and Allied armed forces and to enhance the security of the United States (NPS Catalog).

Program Educational Objectives

The program educational objectives (PEO) are published in the catalog. The general public can access the catalog on the NPS website. They are reproduced here:

> *The overall educational objective of the Systems Engineering program is to support the NPS mission by producing graduates who have, at an advanced level, knowledge and technical competence in systems engineering and an application domain; and who can use that knowledge and competence to support national security. Specific program objectives (i.e., skills and abilities that graduates can bring to their position after having graduated from NPS and receiving 3-5 more years of on-the-job training and professional development) are:*

- *Technical Leadership: Graduates will be known and respected for applying their engineering knowledge in leadership roles along diverse career paths in government service.*
- *Program Management: Graduates will be known and respected for their research, design, development, procurement, integration, maintenance, and life-cycle management of systems for defense and national security.*
- *Operational Utilization: Graduates will be known and respected for their application of systems engineering in diverse military settings and understand its capabilities and limitations.*

The PEO are derived from curriculum educational skill requirements (ESR). All US Navy graduate education curricula are categorized using numbers. Each curriculum is required to have a set of ESR. NPS Instruction 1550.1G Guidelines for Conducting Curricular Reviews is the governing instruction for maintenance of fully-funded graduate education programs. The 580 curriculum is the resident systems engineering masters education program. The following paragraph and list of ESR is taken from the Systems Engineering Curriculum 580 section of the NPS Academic Catalog.

Officers entering the Systems Engineering curriculum will be offered the necessary preparatory-level courses to satisfy the equivalent of a baccalaureate degree in engineering. They shall meet, as a minimum, the requirements set forth by the Engineering Accreditation Commission of ABET. At the graduate level, the officer will acquire the competence to effectively contribute as a systems engineer to naval systems research, design, development, maintenance and acquisition. The officer will gain the ability to effectively integrate future technological, engineering, and acquisition approaches with existing practice through a combination of core systems engineering courses, specialization studies, and project/thesis research. An officer will meet the below-listed ESRs through the completion of a program of study determined by the officer, the Program Officer, and the Academic Associate. Individual programs, and how they support the officer's attainment of the ESR, will be specifically designed to meet the needs of the Navy and the officer's interests.

1. **Undergraduate Mathematics and Basic Sciences:** Understand and apply engineering-baccalaureate-equivalent mathematics and basic sciences. For mathematics, this includes single- and multi-variable differential and integral calculus, ordinary differential equations, probability, and statistics. Basic sciences include physics, chemistry, and terrestrial sciences. This can be met by the appropriate undergraduate work.
2. **Capability Engineering:** Model and analyze military operations in the context of achieving needed capability. Apply model-based systems engineering approaches, based on UML or SysML, and modeling and simulation techniques, and be able to assess legacy systems, emerging technological concepts, and as-yet-to-be-developed concepts into the joint warfighting environment considering technology readiness levels, effectiveness, cost, and risk. Understand the process of warfighting gaps to synthesis of as-yet-realized system concepts to meet emerging capability needs. Understand and apply modeling and simulation to include deterministic and stochastic modeling of systems, economic models, cost models, and life-cycle suitability analyses.

This includes the ability to develop original discrete-event and continuous run-time simulations, as well some familiarity with large-scale government and commercial warfighting simulations.

3. **System Architecting:** Perform system architecting, applying and integrating methods for both software and hardware aspects. Construct feasible system functional and physical architectures that represent a balanced approach to meeting stakeholder needs and expectations, stated, implied, and derived system requirements, and suitability objectives such as being open, modular, extensible, maintainable, and reusable. Understand system architecture frameworks and their role in architecture development. Use model-based systems engineering techniques, based on UML or SySML to create, define, and develop system architectures. Develop, analyze, and compare alternative architectures against appropriate, system-level evaluation criteria and select the best based on quantitative and qualitative analysis, as appropriate.
4. **System Design:** Understand and apply the system design process in a holistic context, applying and integrating methods for both software and hardware aspects including identifying capability need, defining requirements, conducting functional analysis and allocation to hardware, software, and human elements, creating a system functional design, designing a system, deriving and defining requirement specifications, allocating requirement specifications to sub-systems (for hardware, software, and human elements), design for suitability, including reliability, availability, maintainability, operability, and logistical supportability, perform system assessment by conducting trade-off studies, evaluating system design alternatives against system capability need expressed as military effectiveness, estimating and analyzing the system cost and risk, including risk mitigation strategies, integrating human elements into the system design, and analyzing and planning for system testing and evaluation.
5. **Engineering Design Analysis:** Understand and apply core qualitative and quantitative methods of engineering design analysis, to include problem formulation, alternatives development, alternatives modeling and evaluation, alternatives comparison, optimization, decision analysis, failure analysis, risk analysis, and futures analysis. Mathematical techniques may include multiple criteria optimization, design of experiments, response surface methods, set-based design, real options, systems dynamics, and probabilistic analyses.
6. **System Integration and Development:** Apply the core skills of system integration and development to include integrating relevant technological disciplines that bear on the system effectiveness and cost, including weapons, sensor and information systems, while being responsive to realistic military capability need and warfighting effectiveness, requirements, functions, specifications, cost, and risk. Integrate systems and analyze aspects during the entire life-cycle. Understand system realization methods and processes, including prototyping and production. Apply production quality methods for continuous process improvement, such as statistical process control, lean, and six sigma.
7. **System Test & Evaluation:** Apply the core skills of system test and evaluation to include system effectiveness while being responsive to realistic military capability need and warfighting effectiveness, requirements, functions, and specifications. Evaluate

systems and analyze test and evaluation aspects during the entire life-cycle using inferential statistics methods, including design of experiments (DOE) and analysis of variance (ANOVA). Apply fundamental verification and validation principles to systems development methods.

8. **Human Systems Integration:** Address human factors during requirements definition, as well as workload, safety, training, operability and ergonomics during design. Conduct functional analysis and allocation to human elements, performing cost-risk-effectiveness trade-offs among hardware, software, and human elements. Evaluate proposed designs for man-machine integration, human performance testing, and usability during development test and evaluation. Understand basic human biology as applied to human systems.
9. **Project Management:** Work as a team member or leader on a military systems engineering project. Demonstrate an understanding of project management principles. Demonstrate competence in the planning and management of complex projects. Understand the principles of and apply current industry approaches and technology to manage systems design, integration, test, and evaluation for large engineering projects.
10. **Specialization:** Demonstrate in-depth understanding of the principles, technologies, and systems used in at least one major specialty area. These areas can be specific warfare areas, such as combat systems, total ship systems, EW, IW, avionics, undersea warfare, or net-centric systems, a single traditional engineering specialty, such as mechanical, electrical, software, aerospace engineering, or naval architecture, or specialized disciplines such as human factors, availability, or safety. Demonstrate in-depth understanding of the scientific and engineering principles of the respective specialty, such as sensors, weapons, C4I systems, information systems, ship structures, hydrodynamics, power systems, and reliability. Demonstrate broad understanding of systems context of the specialization. Apply that understanding to the design of system components, sub-systems, and interfaces in the holistic context of the engineering of systems.
11. **Cyber*:** Understand and apply the fundamentals of the underlying principles of cyber infrastructure and systems; inherent vulnerabilities and threats, including industrial control systems; and defensive security procedures. (*ESR required for 14XX designators only)
12. **Thesis:** Conduct independent analysis and research in the area of Systems Engineering, and show proficiency in presenting the results in writing and orally by means of a thesis and command-oriented briefing appropriate to this curriculum.

Program Educational Objectives and Educational Skill Requirements perform similar functions as the basis for defining what students should be able to achieve within several years of graduation from the MSSE program. In addition, both ESR and PEO are directed at the same set of stakeholders for our graduates. Since ESR are tied directly to billets and jobs in defense systems engineering, ESR are used as the basis for review, with PEO being mapped to them to provide traceability from ESR to PEO. In this way, if changes are required to ESR, changes needed to PEO can be determined. The mapping of PEO to ESR is provided in Table 2.

Table 2. ESR to PEO Mapping

	Technical Leadership	Program Management	Operational Utilization
Basic Math and Science	X	X	X
Capability Engineering	X		X
System Architecting	X		X
System Design	X		X
Engineering Design Analysis	X		X
System Integration and Development	X		X
System Test & Evaluation	X		X
Human Systems Integration	X	X	X
Project Management		X	
Specialization	X		X
Cyber	X	X	X
Thesis	X		

Consistency of the Program Educational Objectives with the Mission of the Institution

NPS exists to increase the combat effectiveness of the Naval Services, and the other Armed Forces of the United States and its allies. Graduates of the systems engineering program serve in the Department of Defense and provide technical leadership to the services. The program in systems engineering is specifically mentioned by the United States Code.

The first objective addresses the technical leadership roles graduates will assume in the systems command and operational assignments of the Navy. It is common to the engineering programs of GSEAS.

The second objective contributes to the mission of NPS to increase the combat effectiveness of the forces by preparing graduates to design, acquire, maintain, and manage the combat and other systems of the defense establishment.

The third objective contributes to the mission of NPS to increase the combat effectiveness of the forces by specifically preparing graduates to effectively employ systems engineering in diverse military settings.

Program Constituencies

Our primary program constituencies are represented by the systems engineering curriculum major area sponsor. The major area sponsor is part of the overarching Navy structure that specifically identifies the flag-level sponsors responsible for the curriculum ESR. For the residential systems engineering program, the 580 curriculum sponsor is the Director, Strategic Systems Programs (SSP), VADM Johnny Wolfe. The major area sponsor conducts formal curriculum reviews every two years, during which the entire curriculum is examined to determine if it is meeting the objectives and outcomes defined for the program. There is another constituent group that is focused upon overall Department of the Navy SE needs and

satisfying those needs through education. The Systems Engineering Stakeholders Group (SESG) includes representatives from each of the major commands employing systems engineers, including the Deputy Assistant Secretary of the Navy for Research, Development, Test and Evaluation (DASN RDT&E), the Naval Sea Systems Command, the Naval Air Systems Command, the Space and Naval Warfare Systems Command, and the Marine Corps Systems Command. The SESG has a working group of deputies that meets biweekly via telcon, and twice a year in person, on Navy systems engineering issues. It has a subcommittee on systems education educational issues, the Systems Engineering Education Continuum (SEEC). The SESG leadership includes the engineering leadership of the Chief Systems Engineer of the Navy, and the Chief Engineers and Technical Directors of the Naval Sea Systems Command, the Naval Air Systems Command, the Space and Naval Warfare Systems Command, and the Marine Corps Systems Command. These flag officers (Admirals and Generals) and Senior Executive Service (SES) civilians on the SESG manage the organizations that employ nearly all of our graduates.
Other constituency groups include the faculty, students, and alumni.

The first formal curriculum review took place in August 2008, and the most recent review took place in November 2018. The most recent meeting of the SESG occurred at NPS in February 2019.

Graduate education is formally part of the workforce development plan for the engineering work force of the Navy, both uniformed and civilian, and the NPS ESR and PEO align with that workforce development plan. The ESR and PEO both meet the needs of these constituencies by increasing the competency of the engineering workforce.

Process for Review of the Program Educational Objectives

The ESR are reviewed by the major area sponsor every other year accomplished at the Curriculum Review. Since the PEO are mapped to the ESR, the PEO are reviewed every two years, as well. In addition, the SESG at times reviews the curriculum, though not on any specified schedule. Records of the 2018 CR meeting and the 2019 SESG meeting are attached as Exhibit 6.

The face-to-face feedback from the major student employers as representatives attending the CR and SESG are used to assure that the ESR, and thus the PEO, are consistent with the institutional mission, meeting the needs of the constituencies, and align with the ABET EAC criteria.

II. Student Outcomes

List the student outcomes for the master's level program and state where they may be found by the general public as required by APPM Section I.A.6.a. (For integrated baccalaureate-master's programs, these will be in addition to the student outcomes defined in Criterion 3 of the baccalaureate level criteria.)

- It is suggested that one of the student outcomes reflect the requirement stated in the Students and Curriculum section of the master's level program criteria: *The master's level engineering program must require each student to demonstrate a mastery of a specific field*

of study or area of professional practice consistent with the master's program name and at a level beyond the minimum requirements of baccalaureate level programs.

- A second student outcome can be related to students meeting their specific educational goals.
- Any other student outcomes defined by the program can be included.

The program student outcomes are in a state of transition. For our program record year of 2018 for this self-study report we are referencing the student outcomes that were in place at the beginning of that year. As the ABET EAC has created a new set of student outcomes specific to masters programs, we have updated our student outcomes as of academic year 2019, starting in the Fall quarter of calendar year 2018. We will first describe the student outcomes for 2018, and then present the new student outcomes for 2019 that conform to the new ABET EAC masters program requirements.

The seven student outcomes for the systems engineering program as published in the catalog for our self-study report record year 2018 are:

1. *Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.*
2. *Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.*
3. *Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.*
4. *Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.*

5. *Demonstrate an ability to communicate effectively through written and oral presentation of technical material.*
6. *Demonstrate an understanding of professional and ethical responsibility.*
7. *Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.*

These student outcomes were developed based on synthesizing our sponsor ESR with integration of Criterion 3 (a) – (k) in 2014. We map out the ABET EAC Criterion 3 (a) – (k) student outcomes to our student outcomes in Table 3 to show how these are integrated into our program.

Table 3. NPS Program Student Outcomes Mapped to Criterion 3 (a) – (k)

	Broad education	*Design a system*	*Systems analysis*	*Function on teams*	*Communication*	*Professional and ethical responsibility*	*Life-long learning and knowledge of contemporary issues*
a. Math and science	X						
b. Design and construct experiments	X		X				
c. Design a system		X					
d. Function on multi-disciplinary teams				X			
e. Solve engineering problems							
f. Professional and ethical responsibility						X	
g. Communicate effectively					X		
h. Broad education	X						
i. Life-long learning							X
j. Contemporary issues							X
k. Modern engineering tools	X	X	X				

The program educational objectives map to the student outcomes as indicated in Table 4.

Table 4. NPS Program Educational Objectives Mapped to NPS Student Outcomes

	Leadership	**Program Management**	**Operational Utilization**
Broad education	X	X	X
Application of SE methods & processes		X	X
Core skills of systems analysis		X	X
Teamwork	X	X	X
Oral and written communications	X	X	X
Ethical responsibility	X	X	X
Life-long learning and contemporary issues	X	X	X

The two new student outcomes for the systems engineering program published in the catalog as of Fall quarter Academic Year 2019 are:

In order to achieve the objectives for the SE masters programs, the new outcomes are to produce graduates where:

1. Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.
2. Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET EAC accredited undergraduate degree meet these post-secondary requirements.

The program educational objectives map to the current student outcomes as indicated in Table 5.

Table 5. Program Objectives Mapped to New Student Outcomes

	Leadership	Program Management	Operational Utilization
Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.	X	X	X
Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET EAC accredited undergraduate degree meet these post-secondary requirements.	X	X	X

PROGRAM QUALITY

This section of your Self-Study Report should document your processes for regularly assessing, maintaining, and enhancing the quality of the program. Assessment is defined as one or more processes that identify, collect, and prepare the data necessary for evaluation.

The Program Quality section documents our processes for regularly assessing, maintaining, and enhancing the quality of the program. Assessment is defined as one or more processes that identify, collect, and prepare the data for analysis and subsequently for evaluation.

I. Assessment Processes

Provide a description of the assessment processes used to gather the data upon which the evaluation of the program quality is based; include the frequency with which these assessment processes are carried out.

The assessment processes used to gather the data upon which the evaluation of the program quality is based, is described, including the frequency with which these assessment processes are carried out.

The systems engineering department uses a documented assessment process to collect data from various sources that is used as our basis of assessment of student outcomes. The primary focus is to measure attainment of student outcomes for of our ABET EAC program.

We assess and analyze using both direct measures, using student work related to learning objectives, and indirect measures, using instruments based on assessing student capstone products, either theses or capstone project reports. The data is analyzed annually to assess student attainment of student outcomes and to guide improvements in delivery of learning at the departmental level, and to report to accreditation agencies, such as WSCUC and ABET.

Data used to derive the analyses is obtained from various institutional and departmental resources, which capture student capstone project report and thesis assessment data on a quarterly basis. Table 6 identifies the sources of data for our assessment of attainment of student outcomes.

Table 6. Sources of Assessment Data

Item #	Item and Description	Periodicity
1	Student capstone project report and thesis outcome evaluations, for evidence of attainment of student outcomes, with data recorded on an on-line NPS-wide Capstone Assessment Instrument and used for assessment, analysis, and evaluation.	Annual
2	Student course work for evidence of attainment of student outcomes.	As needed

Item 1 is the primary quantitative measure of attaining student outcomes. Item 2 refers to the use of specific course work for quantitative assessment, analysis, and evaluation of student outcomes, particularly systems analysis course work and teamwork assessments during project-based courses. SE Department Instruction – Faculty 1.4 provides a description of the methods used to gather data and conduct assessment, analysis, and evaluation of student outcomes. Our student outcomes are assessed using data from the capstone evaluations and specific course outcomes. The mapping of student outcomes to the sources of information for the capstone and course assessments is documented in a series of tables, one for each outcome. These are shown in Table 7. Table 8 shows the periodicity of student outcome assessment by academic year.

Table 7. Outcome Assessments Documentation

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where Data are Collected	Length of Assessment Cycle (yrs)	Year(s)/ quarter(s) of Data Collection	Target for Performance	Actual Performance Attained
Student Outcome 1							
Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	SE3100, SE3302, SE4150	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2015 Wtr 2018	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed
Student Outcome 2							
Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	SE3100 SE4150	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2016 Wtr 2019	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where Data are Collected	Length of Assessment Cycle (yrs)	Year(s)/ quarter(s) of Data Collection	Target for Performance	Actual Performance Attained
Student Outcome 3							
Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	OS3180, SE3011, SE3250	Coursework evaluation	SE3250	3	Wtr 2014 Wtr 2017	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed
Student Outcome 4							
Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	SE3811 Critical Thinking; SE3812 Ethics in Systems Engineering: Soft Skills, Teaming, MBTI and ILS; SI3400 Fundamentals of Project Management (for project planning and management); SE3201, SE3202, SE3203 Project Advisor perspectives on Team Projects	NPS Capstone Evaluation Form (2015 only)	Theses and Project Reports	3	Wtr 2015 Wtr 2018	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed
		Project advisor and co-advisor coursework evaluation (2018 only)	SE3203				Value as computed
Student Outcome 5							
Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	SE3813 Technical Writing for Systems Engineers I, SE3814 Technical Writing for Systems Engineers II, Thesis	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2016 Wtr 2019	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where Data are Collected	Length of Assessment Cycle (yrs)	Year(s)/ quarter(s) of Data Collection	Target for Performance	Actual Performance Attained
Student Outcome 6							
Demonstrate an understanding of professional and ethical responsibility.	SE3811 Critical Thinking, SE3812 Ethics in Systems Engineering, SE3201, SE3202, SE3203, Thesis	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2014 Wtr 2017	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed
Student Outcome 7							
Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	SE3811 Critical Thinking, SE3812 Ethics in Systems Engineering, Thesis	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2015 Wtr 2018	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Student outcome analyses are conducted every year on two to three student outcomes per year. Table 8 shows the periodicity for these assessments.

Table 8. Data Collection Cycle for Seven Student Outcomes

Student Outcomes	AY 14	AY 15	AY 16	AY 17	AY 18
1. Broad education		●			●
2. Application of SE methods & processes			●		
3. Core skills of systems analysis	●			●	
4. Teamwork		●			●
5. Oral and written communications			●		
6. Ethical responsibility	●			●	
7. Life-long learning and contemporary issues		●			●

Both NPS Capstone Assessment Instrument data and specific course data are collected from some of the core SE courses and used as the basis for student outcome attainment. SE Department Instruction – Faculty 1.4 provides a description of the methods used to gather data and conduct assessment, analysis, and evaluation against student outcomes for our CI process. Each year, two or three outcomes are assessed, which results in all outcomes being assessed twice in any six-year period.

Student Outcome Analysis Findings

Two primary methods are used to assess the attainment of student outcomes. The first is an assessment of each capstone project report or thesis by the advisor, co-advisor, and/or second reader against the NPS Capstone Assessment Instrument outcomes. The second is course-level assessment of student work assessed for those student outcome portions that are not covered by the NPS Capstone Assessment Instrument. Each evaluator assesses each student work sample (thesis or project report for capstone and student assignment samples for course-level assessments) each outcome using a five-level scale and a rubric.

Capstone thesis or project report evaluations are performed for all capstone projects and theses in SE programs, with “all” meaning that at least two capstone evaluation reviews are completed for each project report or thesis. The NPS Python on-line instrument enforces a workflow where students cannot graduate unless their capstone product, either a thesis or capstone project report, has been assessed by at least 2 people. The raw assessment data from

the NPS Capstone Assessment Instrument is collected quarterly and sent from the NPS Institutional Research, Reporting, & Analysis (IRRA) office to the SE department. The data in the IRRA spreadsheets is collected quarterly and organized for annual assessment. The IRRA data is disaggregated so that assessment of only ABET EAC MSSE students for their program is accomplished. The data is processed in a SE department developed spreadsheet that computes the number of students attaining our desired value for each student outcome due for assessment in a specific academic year. The results are analyzed to determine if threshold or goal values have been attained. If the analysis results indicate that a threshold value has not been attained, the results are evaluated to determine if any actions should be taken to the program to improve the respective student outcome results. If evaluation indicates a change may be needed, the results are discussed by the faculty to determine a course of action appropriate to the situation. Any changes needed and actions taken are documented with follow up presented back to the faculty and/or program constituencies, as needed. Details of the results of all student outcome assessment, analyses, and evaluation are maintained in SE department share drive folder for archiving and access, and will be made available for review upon request.

Student Outcome Assessment Results for AY14 - AY18

Student outcomes for the program have been assessed for all years that the program has been in existence. The results from 2014 – 2018 are shown in Table 9. The target for the student outcome assessment results has a threshold value of >4.0 in AY14 and AY15 based on the use of the SE Capstone Evaluation Form. The target for the student outcome assessment results from AY16 onwards has a threshold value of 75% and a goal value of 90%. Student outcome assessment results that are below the target for performance are marked in red. The data, spreadsheets, and evaluation forms used for assessment, analysis, and evaluation of student outcome attainment from 2014 through 2018 will be made available during the visit.

Table 9. MSSE Student Outcome Assessments for AY14-AY18

Number	Student Outcome	AY14	AY15	AY16	AY17	AY18
1	Broad education		4.44			91%
2	Application of SE methods & processes			89%		
3	Core skills of systems analysis	4.51			89%	
4	Teamwork		5.00			84%
5	Oral and written communications			92%		
6	Ethical responsibility	4.63			79%	
7	Life-long learning/ Contemporary Issues		5.00			94% 100%

Generally, the results from 2014 – 2018 indicate that all student outcomes were attained.

II. Maintenance and Enhancement of the Program

Describe how the results of assessment processes are used to maintain and enhance the program. Describe any changes that have been made for the purpose of enhancing the program and the results of those changes (whether or not effective) in those cases where re-assessment of the results has been completed. Indicate any significant future program improvement plans based upon recent assessments. Provide a brief rationale for each of these planned changes.

This section describes how the results of assessment processes are used for maintenance and enhancement to continuously improve program. Any changes that have been made for the purpose of enhancing the program are described. Any significant future program improvement plans based upon recent assessments are indicated. A brief rationale for each of these planned changes is provided.

Continuous Improvement

For the quantitative assessment of our student outcomes the department institutes a continuous improvement process based on whether student outcomes are attained. SE Department Instruction – Faculty 1.4 provides a description of the methods used to gather data and conduct assessment, analysis, and evaluation against student outcomes for our CI process. The assessment, analysis, and evaluation results are presented in department and faculty meetings for status and decisions related to program quality. This part of our CI process is

communicated with the faculty through discussions and decisions in faculty or departmental meetings held every Wednesday throughout the academic year. The Curriculum Review process, where the major area sponsor conducts a formal curriculum review every two years, during which the entire curriculum is examined to determine if it is meeting the objectives, educational skill requirements (ESR), and outcomes defined for the program, can also be used to provide feedback for CI of the program. The major area sponsor is typically joined by other major defense systems engineering organization leaders for a more comprehensive program review participation. The major area sponsor is part of the overarching Navy structure that specifically identifies the flag-level sponsors responsible for any NPS curriculum, as required by NPS Instruction 1550.1G, Guidelines for Conducting Curricular Reviews. For our resident systems engineering program, the systems engineering 580 curriculum, the major area sponsor is the Director, Strategic Systems Programs (SSP), currently VADM Johnny Wolfe.

Faculty Evaluation Review Results

Generally, the results from 2014-2018 indicate that all student outcomes were attained, and no actions were taken with regard to program improvement based on these results.

Outcomes Assessment Improvement

In 2017 it was determined that it would be better to report the percentage of the number of students attaining “Proficient” or above on a cumulative basis as the metric for determining attainment of student outcomes. This replaced the previous method of averaging the scoring scale results translated to a 1 – 5 scale. The threshold was set at 75% of students achieving “Proficient” of above, and the goal value of 90% of students achieving “Proficient” or above.

During academic year 2018, student outcomes 1, 4, and 7 were scheduled for assessment. It was determined that student outcome 4 required more formal evaluation of teamwork of students in SE3203, the last quarter of the 3 course SE project sequence. A team of faculty who teach SE3203 collectively developed a spreadsheet to allow instructors to assess student performance of teamwork, and to directly assess student attainment of student outcome 4. The faculty implemented the new standardized spreadsheet and rubric to assess student teamwork aspects, and to rate student teams. The ratings form the basis for the data for assessing attainment of student outcome 4.

Other improvements

We make improvements to our programs on a regular basis based on other evidence besides student outcome assessment. One particular improvement to the program is for the topics of ethics, writing, and critical thinking. Since the beginning of our program, these were taught in a seminar format under a generic course title, SE3810. The course contents were determined to be important enough to the attainment of student outcomes to create new specific course numbers for topics that relate to educational strategies for student outcomes 5, 6, and 7, rather than a generic seminar course. New courses SE3811 Critical Thinking in Systems Engineering, SE3812 Ethics in Systems Engineering, SE3813 Technical Writing for a Systems Engineer I, and SE3814 Technical Writing for a Systems Engineer II were added to the student course curricula in the resident program to be used starting in academic year 2016.

We added a requirement for resident students to present their thesis research results to the systems engineering faculty and students at the SE colloquium, SE3000. This was implemented in AY2016.

III. Additional Information

Copies of any of the assessment instruments or materials referenced in I. and II. must be available for review at the time of the visit. Other information such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made could also be included.

Copies of any of the assessment instruments or materials referenced in I. and II. will be available for review at the time of the visit.

The ABET EAC developed new requirements for masters program student outcomes. The faculty met to discuss the ABET EAC changes for student outcomes for masters programs. The faculty decided to use the two ABET EAC suggested student outcomes as the basis of our new outcomes. The faculty also decided to use all of the NPS Capstone Assessment Instrument outcomes as the basis for quantitative input for assessing student attainment of these new student outcomes.

Masters Program New Student Outcome Assessment

The new masters student outcomes will be assessed each year, as there are only two outcomes, and all assessment data is available for each capstone thesis or report for each quarter of each academic year from the NPS Capstone Assessment Instrument. Table 10 summarizes the periodicity of assessment of the new masters program student outcomes.

Table 10. Data Collection Cycle for New Masters Student Outcomes AY19 and Beyond

Student Outcomes	AY 19	AY 20	AY 21	AY 22	AY 23
Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.	●	●	●	●	●
Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET EAC accredited undergraduate degree meet these post-secondary requirements.	●	●	●	●	●

The old seven student outcomes have been revised to the two new masters student outcomes. The assessments of the two student outcomes derive from the NPS Capstone Assessment Instrument, which has seven outcomes, not to be confused with the old seven student outcomes. The faculty feels confident that using the NPS Capstone Assessment Instrument should provide a reasonably good basis for conducting assessment, analysis, and evaluation of these new masters-level student outcomes beginning in AY19. The second student outcome only applies to students who do not have an undergraduate ABET EAC accredited degree. Those students only will be assessed and evaluated for attainment of that student outcome by the Academic Associate and Program Officer using the existing equivalency process. The faculty will monitor all of the new student outcome results and whether the threshold and goal values continue to reflect intended indications of attainment going forward, as the use of these levels are relatively new.

The new masters program student outcomes were published in the catalog by September 2018 to be ready at the beginning of AY19. These student outcomes are now being used as the basis for assessing student attainment and for analyzing and evaluating for our CI process beginning in AY19. All of the NPS Capstone Assessment Instrument outcomes will be used to assess attainment of program student outcomes. Tables 11 - 13 show what the student outcome attainment results would have been, using the new method to be applied beginning in 2019. These results are for information only, as the analyses were not completed during the actual AY shown. The percentages shown in Tables 11 - 13 indicate the percentage of students who attained a rating of "Proficient" or higher from the NPS Capstone Assessment Instrument results. The target value for attainment is 75%. An updated version of SE Department Instruction – Faculty 1.4 provides a description of the new methods used to gather data and conduct assessment, analysis, and evaluation against student outcomes for our CI process. This updated instruction will be made available for review at the time of the visit.

Table 11. New MSSE Student Outcome Attainment Method AY16

MSSE Student Outcome Attainment	**AY16**						
NPS Capstone Assessment Tool Outcome	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.	87%	89%	89%	89%	94%	100%	100%
2. Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET	Quantitative results are not generally applicable. Student outcome only applies to students requiring undergraduate equivalency.						

EAC accredited undergraduate degree meet these post-secondary requirements.	

Table 12. New MSSE Student Outcome Attainment Method AY17

MSSE Student Outcome Attainment	AY17						
NPS Capstone Assessment Tool Outcome	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.	85%	70%	70%	77%	89%	76%	100%
2. Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET EAC accredited undergraduate degree meet these post-secondary requirements.	Quantitative results are not generally applicable. Student outcome only applies to students requiring undergraduate equivalency.						

Table 13. New MSSE Student Outcome Attainment Method AY18

MSSE Student Outcome Attainment	AY18						
NPS Capstone Assessment Tool Outcome	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Each student will demonstrate a mastery of systems engineering and complete at least one year of study, or at least 45 quarter credit hours, beyond a baccalaureate level program.	91%	88%	94%	91%	88%	100%	100%
2. Each student will have had post-secondary educational and/or professional experiences that supports that attainment of student outcomes as defined in the ABET EAC general criteria for baccalaureate programs, Criterion 3; and includes at least one year of math and basic science, at least one-and-a-half years of engineering topics, and a major design experience that meets the requirements in the general criteria for baccalaureate programs, Criterion 5. Students that have attained an ABET EAC accredited undergraduate degree meet these post-secondary requirements.	Quantitative results are not generally applicable. Student outcome only applies to students requiring undergraduate equivalency.						

Table 12 shows that NPS Capstone Assessment Instrument outcomes 2 and 3 fell short of the target of 75%, so these parts of the overall student outcome attainment would be analyzed and

evaluated to determine possible root causes, the results presented to the faculty, and a decision made if any actions were needed to remedy the situation.

Copies of any of the assessment instruments or materials will be available for review at the time of the visit. Other information such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made will be available for review at the time of the visit.

Documentation will be displayed during the site visit. This includes sample capstone thesis and project reports, as well as the capstone assessments and the NPS Capstone Assessment Instrument. Access will be provided to review SE department and faculty meeting minutes and presentations.

FACULTY

I. Faculty Qualifications

Describe the qualifications of the faculty, demonstrating appropriate education and/or experience to teach master's level courses. Describe how they are adequate to cover all the curricular areas of the master's level program. This description should include the composition, size, credentials, and experience of the faculty. Complete Table M-1 (*). Include faculty resumes in Appendix B.

This section describes the qualifications of the faculty, demonstrating appropriate education and/or experience to teach master's level courses. Also presented is a description on how they are adequate to cover all the curricular areas of the master's level program. This description includes the composition, size, credentials, and experience of the faculty. Table M-1 summarizes faculty qualifications. Faculty resumes are included in Appendix B.

The faculty numbers reported in this section are for the record year. The program faculty is composed primarily of full-time members of the Department of Systems Engineering. The department maintains a portfolio of faculty expertise and backgrounds, including those with significant industrial and military experience in systems engineering. It is a well-qualified, experienced, and expert faculty.

There are 15 tenure track (TT) and 22 full-time non-tenure track (NTT) faculty in the department faculty. Six of those 22 NTT faculty are Faculty Associates – Research or Education for the department. The department also has two Military Faculty (MILFAC), one is here as a MILFAC PMP (Permanent Military Professor), and the other is a MILFAC who will have transitioned out of the military to a NTT Faculty Associate – Researcher for the department in April 2019.

There are three part-time (PT) faculty members in the department. Faculty from other departments also support the department in the domain tracks and in refresher courses.

The academic credentials of the department are presented in Table M-1. All of the fifteen T/TT faculty have earned PhDs. Four of the 22 full-time NTT faculty have earned doctoral degrees; others have MS degrees and one has a BS degree. Four are pursuing engineering PhDs. The three PT faculty have credentials ranging from a PhD, MS degree, and a single BS. The faculty member with the BS degree has forty years shipbuilding experience, including being the lead systems engineer for Northrop Grumman Ship Systems.

Three of the fifteen TT faculty have significant industrial experience (Harney at Lockheed Martin, Giammarco at Communications-Electronics Research, Development and Engineering Center (CERDEC), Madachy at Cost Xpert Group). Others have significant military experience (Giammarco at US Army RDECOM, Paulo at the US Military Academy and with the US Army, and Whitcomb with the US Navy).

Twelve of the full-time NTT have significant military experience, primarily at the Naval Systems Commands that sponsor our programs. One of the part-time NTT faculty was the

chief ship systems engineer for Northrop Grumman for the LPD17 (Solitario). The others have significant industry experience and in government.

One of the faculty is a licensed professional engineer (Stevens). Two faculty members are Fellows; a Fellow with the Russian Aviation and Aeronautics Academy of Sciences, an Associate Fellow of the American Institute of Aeronautics and Astronautics, and a Scientific Advisor for the Russian and International Engineering Academy (Yakimenko); the other is a Fellow of the International Council on Systems Engineering (INCOSE) and a Fellow of the Society of Naval Architects and Marine Engineers (SNAME) (Whitcomb). One faculty member is the Editor in Chief of the journal Systems Engineering and is a member of the Editorial Board of the journal Systems (Whitcomb); another serves on the editorial board of the journal Systems (Giachetti). Several faculty members are Certified Systems Engineering Professionals (CSEP). Several are local and national officers of professional societies, and others have been past officers of INCOSE and the American Society of Naval Engineers (ASNE).

Twenty-three of the faculty are members of INCOSE. Many are members of other professional societies, as well, such as SNAME, ASNE, IEEE and INFORMS.

A sense of the range of experience and qualification can be gained by reading the faculty vitas in Appendix B and by examining Table M-1.

The department also has access to the talents of faculty members from other departments who have joint appointments with the SE department. They come from the Departments of Defense Analysis, Operations Research, and the Graduate School of Business and Public Policy.

Faculty Competencies

The program has sufficient faculty to cover the competencies required by its program. Two tables are presented below. The first is faculty by area of specialization, and the second is area of specialization by faculty.

Table 14. Faculty by Competency

Faculty (TT)	**Areas of Specialization**
Beery	Systems Analysis, Modeling & Simulation
Giachetti	Systems architecture
Giammarco	Architecture, software engineering, communications systems
Harney	Combat systems, lasers, lidar, WMD
Hernandez	Modeling and simulation, test and evaluation
Klamo	Hydrodynamics
Madachy	Software engineering; cost estimation
O'Halloran	Reliability
Papoulias	Naval architecture
Paulo	Combat modeling, unmanned systems
Pollman	Combat Systems

Semmens	Agent-based modelling, geographic information systems analysis, experimental design
Van Bossuyt	Risk Analysis, system design
Whitcomb	Ship design, model-based systems engineering, systems architecture
Yakimenko	Controls, aerospace systems

Faculty (NTT – Full-time)	**Areas of Specialization**
Berlitz	Engineering communications
Boensel	Systems analysis, systems modeling
Carlson	Aviation systems
Dillard	Project management, acquisition management
Gehris	Software engineering
Green	Ship systems, naval architecture
Holness	Human Systems
Kwinn	SE methods
Miller	C4ISR systems, network-centric systems, systems architecture
Muehlbach	Naval systems, pedagogy
Owen	Acquisition management
Parker	Systems Dynamics, Modeling and Simulation
Rhoades	Aero systems, simulation, risk
Stevens	Combat systems, SE methods
Sweeney	Program management, energy
Vaneman	System of systems engineering and integration, systems of systems governance, systems architecture and design, model-based systems engineering
Johnson	Networked systems

Faculty (NTT Part-time)	**Areas of Specialization**
Anderson	Cost engineering
Ferreiro	Systems engineering, technology evolution, and complex systems management
Solitario	Ship design and ship systems

Table 15. Specialization Area by Faculty

Area of Specialization	**Faculty**
SE Fundamentals	Hernandez, Carlson, Whitcomb
Systems Architecture	Giachetti, Miller, Whitcomb, Giammarco
Systems Analysis	Anderson, Boensel, Paulo, Rhoades, Hernandez

Ship Systems	Green, Klamo, Papoulias, Stevens, Whitcomb
Combat Systems	Harney, Stevens, Pollman
Aviation Systems	Carlson, Yakimenko, Boensel, Rhoades
System-of-Systems	Vaneman, Giammarco, Whitcomb
Net-centric Systems	Miller, Johnson
Reliability	O'Halloran
Robotics and Unmanned systems	Yakimenko
Affordability	Madachy, Anderson

II. Faculty Workload

Complete Table M-2 (*), Faculty Workload Summary and describe this information in terms of workload expectations or requirements.

In this section the faculty workload is described in terms of workload expectations or requirements. Table M-2, Faculty Workload Summary, is included.

Faculty workload differs between TT and NTT faculty. TT faculty are on a nine-month pay model, during which time they are expected to teach four sections, provide thesis advising as needed, provide institutional service, and conduct institutionally supported research. Faculty desiring coverage for the remaining quarter either support themselves by their other research funds or by teaching two additional courses.

Full-time NTT faculty are expected to teach two courses per quarter and to provide institutional service as needed.

Part-time faculty are compensated by the task assigned. Compensation for part-time adjuncts is very generous when compared to national standards.

The workload for the department is presented in Table M-2.

III. Faculty Size

Discuss the adequacy of the size of the faculty and describe the extent and quality of faculty involvement in interactions with students in the master's level program, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners including employers of students.

In this section, the adequacy of the size of the faculty is discussed. The extent and quality of faculty involvement in interactions with students in the master's level program, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners including employers of students is described.

The size of the faculty is adequate for the resident program.

There is an adequate number of tenure-track faculty in the department to shoulder the responsibilities of so many graduate students. There are sufficient numbers of qualified faculty to serve as thesis advisors for the resident program and to cover the routine governance tasks for supporting students and other service activities.

In June 2013, the NPS Provost, GSEAS Dean, and Department Chairman reached an agreement to increase the number of TT lines in SE over the next several years to achieve parity with the other engineering departments and to improve the workload for TT faculty. We have hired an adequate number of faculty since then, and we continue to assess and add TT lines, as needed.

The department has only four full professors, and so there is a shortage of senior faculty to share the major governance burdens. This is a consequence of being a young department and has been easing naturally over time.

Interactions with Students

There is a high degree of faculty-student interaction. SE department class size is typically no larger than 20. This makes in-class interaction possible on a more personal level. Many of the department's courses have labs and this provides another opportunity for faculty and students to interact. All students attend an SE department orientation session when they first arrive on campus. Each quarter students meet with the AA and PO to discuss how things are going from an academic, professional, and family perspective. Outside class, most faculty post office hours or have an open-door policy. The most important interaction between faculty and students occurs during the student's thesis research. During the course of their research, students typically work on topics related to faculty research programs and interact closely with the faculty. Additionally, there is a quarterly reception for SE program graduates preceding the graduation exercises, a reception for all NPS graduates following graduation and other social events during each quarter that provide opportunities for faculty-student interaction.

Faculty Service

There are adequate numbers of faculty for university service activities. Faculty serve on the academic council, the faculty council, and various committees. The department has provided faculty to assist with the periodic campus accreditation actions by WSCUC.

Interactions with Industry

Interactions with industry and government are high, by the very nature of the institution. Our research programs are sponsored and funded by Navy and defense proponents. Additional Cooperative Research and Development Agreements (CRADAs) have been held with Northrop Grumman, Lockheed Martin, and others. Capstone research projects, with their requirement for active external stakeholders, keep both faculty and students in constant touch with industry and government. Additionally, members of the department serve in INCOSE, ASNE, and in various governmental councils.

IV. Professional Development

Provide detailed descriptions of professional development activities for each faculty member.

Detailed descriptions of professional development activities for faculty members are provided.

There are two paths for professional development of new faculty. Tenure track faculty receive two years of research initiation support, which generally covers one quarter or 65 days salary with a travel and equipment budget to support the faculty member's research and development. Non-tenure track faculty do not receive similar start-up funds.

Faculty receive an initial orientation from the Department Chair. They also receive instruction in design of instruction materials from the NPS Center for Educational Design, Development and Distribution (CED3).

Instruction is monitored, and all faculty are coached as necessary. Sustaining activities are funded out of research funds and the associated indirect. The department has strong representation at research conferences and has always found funds for faculty to travel to conferences if their research activities did not support it.

Tenure track faculty are on a six-year tenure clock and receive mentoring as to their progress. Once tenured, they continue to receive mentoring until promoted to full professor. This process is described in the NPS promotion and tenure policy documents.

Tenure track faculty are eligible to apply for sabbaticals every six years. Professors Oleg Yakimenko and Clifford Whitcomb have completed sabbaticals recently.

Non-tenure track faculty members participate in research activities at a high rate.

Four of the non-tenure track and research faculty are enrolled in PhD programs with the support of the department. These faculty members include Gary Parker and Chris Wolfgeher in NPS SE doctoral programs, and Joe Sweeney and Mike Green in doctoral programs at other institutions. All are progressing well in their programs. One faculty member, Bonnie Johnson, recently completed her PhD in systems engineering from NPS in 2019.

V. Authority and Responsibility of Faculty

Describe the role played by the faculty with respect to course creation, modification, and evaluation, their role in the assessment, maintenance, and enhancement of the master's level program. Describe the roles of others on campus, e.g., dean or provost, with respect to these areas.

Leadership Responsibilities

The program is led by the Chairman of the Department of Systems Engineering, currently Professor Ron Giachetti. Professor Giachetti assumed duties as the chair in July 2015.

The responsibilities of a chair are given in the NPS faculty handbook[3]:

[3] NPS Faculty Handbook, August 24, 2016, p.7

Chairs of Academic Units. Academic Units are defined as the Academic Departments, Academic Groups, Centers, and Institutes, and include GSBPP, where the Chair's duties are the responsibility of the Dean. Chairs of Academic Units plan and administer the educational, personnel, and financial activities of their respective Academic Units. Chairs provide leadership across the program, department, school, and campus in a variety of roles, and significant off-campus service to the DoN and others. Chairs of Academic Units report to their School Dean.

Authority and Responsibility of Faculty

At NPS, courses may be proposed by any faculty member. They are routed for approval to the Chair, Dean, and Vice Provost for Academic Affairs, and then considered by the academic council. Several courses have been approved without difficulty since the previous self-study.

Each course is assigned a faculty member as course coordinator. That course coordinator has the following responsibilities:

a. Maintain the course syllabus. Make minor changes as necessary. Assure that the content is current and is sufficient to support the outcomes and ESRS that are mapped to the course.
b. Maintain a reference set of instructional materials for the course and provide the set to faculty assigned to teach the course.
c. Select the texts to be used in the course.
d. Assist faculty assigned to teach the course as necessary. This includes, but is not limited to:
    i. Assisting in the design of assessment instruments for the course
    ii. Advising on grading issues
e. Propose major changes to the course to the chairman as needed.
f. Review all course journals submitted by faculty teaching the course.
g. Enforce the course syllabus. In particular, assure that faculty members teaching the course comply with the texts, topics, and outline prescribed for the course.
h. Prepare a report on the course each winter quarter, noting from the course journals any strengths and weaknesses of the course, and making any recommendations for improvement or change. In particular, discuss how well the course is supporting the outcomes and ESRs mapped to it.
i. Assess student portfolios for student outcomes for the year.

The course coordinator assures the consistency and quality of the course. Additional assessment of course quality comes from teaching observations, student feedback, thesis assessment, and portfolio assessment. The department policy on course coordinators may be viewed in Exhibit 7.

ABET Table M-1. Faculty Qualifications

Systems Engineering

*Denotes DL faculty.

Faculty Name	Highest Degree Earned - Field and Year	Rank	Type of Academic Appointment TT, T, NTT	FT or PT	Years of Experience			Professional Registration/ Certification	Level of Activity		
					Govt./ Ind. Practice	Teaching	This Inst.		Professional Organizations	Professional Development	Consulting or summer work in industry
Anderson, Timothy P.*	MS, Operations Research (1994)	I	NTT	PT	23	15	14	1	H	H	H
Beery, Paul T.	PhD, Systems Engineering (2016)	AST	TT	FT	10	3	3	0	L	H	L
Berlitz, Barbara J.	JD (1985)	I	NTT	FT	24	13	9	0	L	H	L
Boensel, Matthew G.	MS, Operations Research (1988)	I	NTT	FT	38	20	20	1	L	M	L
Carlson, Ronald R.*	MS, National Security and Strategic Studies (1997)	I	NTT	FT	27	10	10	0	M	H	L
Dillard, John T.	MS, Systems Management (1985)	I	NTT	FT	44	21	20	1	L	H	L
Eldred, Ross A.	MS, Systems Engineering (2015)	I	MILFAC[4]	FT	11	1	1	2	M	H	L
Ferreiro, Larrie D.*	PhD, History of Engineering, Science and Technology Studies (2004)	O	OT[5]	PT	38	13	1	5	H	L	L
Gehris, Rama D.*	PhD, Systems Engineering (2008)	I	NTT	FT	25	10	7	0	L	L	L
Giachetti, Ronald E.	PhD, Industrial Engineering (1996)	P	T	FT	6	19	8	0	H	H	L

[4] MILFAC = Military Faculty
[5] OT = Works for another federal agency

Giammarco, Kristin M.*	PhD, Software Engineering (2012)	ASC	TT	FT	17	10	10	0	M	H	L
Giles, Kathleen B.	PhD, Systems Engineering (2018)	O	MILFAC PMP[6]	FT	20	1	1	0	L	H	L
Green, John M.*	MBA, Management Science (1998)	I	NTT	FT	41	20	16	1	H	H	L
Harney, Robert C.	PhD, Engineering of Applied Science (1976)	ASC	T	FT	29	26	23	0	L	M	L
Hernandez, Alejandro	PhD, Operations Research (2008)	ASC	TT	FT	33	15	13	0	H	M	L
Holness, Karen S.*	PhD, Industrial and Systems Engineering (2008)	I	NTT	FT	13	5	4	0	L	M	L
Johnson, Bonnie W.*	MS, Systems Engineering (2002)	I	NTT	FT	20	13	13	0	H	H	L
Klamo, Joseph T.	PhD, Fluid Mechanics / Mechanical Engineering (2007)	AST	TT	FT	11	5	3	0	M	H	L
Kwinn, Brigitte T.*	MS, Systems Engineering (1994)	I	NTT	FT	34	16	10	0	L	M	L
Madachy, Raymond J.*	PhD, Industrial and Systems Engineering (1994)	P	T	FT	25	13	10	0	H	M	L
Miller, Gregory A.	MS, Electrical Engineering (1992)	I	NTT	FT	35	15	15	5	M	H	L
Muehlbach, Donald S.*	PhD, Postsecondary and Adult Education (2008)	I	NTT	FT	43	10	10	1	M	M	H
O'Halloran, Bryan M.	PhD, Mechanical Engineering (2013)	AST	TT	FT	8	3	2	0	H	H	L
Owen, Walter E.*	DPA, Public Administration (2003)	O	NTT	FT	43	26	26	0	M	H	L
Papoulias, Fotis A.	PhD, Naval Architecture and	ASC	T	FT	29	30	29	0	M	H	L

[6] Military Faculty, Permanent Military Professor (PMP) Program

	Marine Engineering (1987)										
Parker, Gary W.	MS, Systems Engineering (1986)	O	NTT	FT	41	8	8	0	L	H	L
Paulo, Eugene P.	PhD, Industrial Engineering (1998)	ASC	T	FT	37	20	18	0	L	H	L
Pollman, Anthony G.	PhD, Mechanical Engineering (2011)	AST	TT	FT	22	8	2	1	M	H	M
Rhoades, Mark M.	MS, Systems Engineering Management (2006)	I	NTT	FT	28	17	17	1	M	M	M
Semmens, Robert	PhD, Learning Sciences and Technology Design (2017)	AST	TT	FT	8	1	0	0	L	H	L
Solitario, William A.	BS, Chemical Engineering (1962)	I	NTT	PT	42	12	12	0	L	L	L
Stevens, Mark R.	MS, Physics (1988)	I	NTT	FT	38	21	15	2	M	L	L
Sweeney, Joseph W.	MS, Aeronautical Engineering (1987)	I	NTT	FT	32	14	12	7	M	H	L
Van Bossuyt, Douglas	PhD, Mechanical Engineering (2012)	AST	TT	FT	18	12	1	2	H	H	H
Vaneman, Warren K.*	PhD, Industrial and Systems Engineering (2002)	I	NTT	FT	32	12	7	2	M	M	M
Whitcomb, Clifford A.*	PhD, Mechanical Engineering (1998)	P	T	FT	41	21	14	0	H	H	L
Yakimenko, Oleg A.	PhD, Operations Research (1996)	P	T	FT	32	30	20	1	H	H	L

Return to Faculty Qualification section

ABET Table M-2. Faculty Workload Summary

Systems Engineering

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Anderson, Timothy P.	PT	SE 3011, Q4 - SUMMER - AY 2018, "Engineering Economics and Cost Estimation", (3) OS 4012, Q3 - SPRING - AY 2018, "Cost Estimation III: Risk and Uncertainty Analysis", (3) SE 3011, Q3 - SPRING - AY 2018, "Engineering Economics and Cost Estimation", (3) SE 3011, Q2 - WINTER - AY 2018, "Engineering Economics and Cost Estimation", (3) SE 3011, Q1 - FALL - AY 2018, "Engineering Economics and Cost Estimation", (3)	100%	0%	0%	100%
Beery, Paul T.	FT	SE 3203, Q3 - SPRING - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3202, Q2 - WINTER - AY 2018, "Engineering Systems Design", (6) SE 3201, Q1 - FALL - AY 2018, "Engineering Systems Conceptualization", (6) SE 4150, Q1 - FALL - AY 2018, "Systems Architecting and Design", (5)	40%	40%	20%	100%

Berlitz, Barbara J.	FT	SE 3812, Q4 - SUMMER - AY 2018, "Ethics in Systems Engineering", (2) SE 3814, Q4 - SUMMER - AY 2018, "Technical Writing for Systems Engineering II", (2) SE 3811, Q3 - SPRING - AY 2018, "Critical Thinking in Systems Engineering", (2) SE 3813, Q3 - SPRING - AY 2018, "Technical Writing for a Systems Engineering I", (2) SE 3812, Q2 - WINTER - AY 2018, "Ethics in Systems Engineering", (2) SE 3814, Q2 - WINTER - AY 2018, "Technical Writing for Systems Engineering II", (2) SE 3811, Q1 - FALL - AY 2018, "Critical Thinking in Systems Engineering", (2) SE 3813, Q1 - FALL - AY 2018, "Technical Writing for a Systems Engineering I", (2)	100%	0%	0%	100%
Boensel, Matthew G.	FT	SE 3011, Q4 - SUMMER - AY 2018, "Engineering Economics and Cost Estimation", (3) SE 3250, Q4 - SUMMER - AY 2018, "Capability Engineering", (5) OS 4680, Q3 - SPRING - AY 2018, "Naval Systems Analysis", (4) SE 3250, Q3 - SPRING - AY 2018, "Capability Engineering", (5) SE 3250, Q2 - WINTER - AY 2018, "Capability Engineering", (5) OS 4680, Q1 - FALL - AY 2018, "Naval Systems Analysis", (4) SE 3250, Q1 - FALL - AY 2018, "Capability Engineering", (5)	70%	0%	30%	100%
Carlson, Ronald R.	FT	SE 3100, Q3 - SPRING - AY 2018, "Fundamentals of Systems Engineering", (5) SE 4414, Q3 - SPRING - AY 2018, "LSI - Leadership in System Integration", (4) SE 3203, Q2 - WINTER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3413, Q2 - WINTER - AY 2018, "System of Systems Integration, Qualification and Lifecycle", (5) SE 3202, Q1 - FALL - AY 2018, "Engineering Systems Design", (6)	60%	20%	20%	100%

Dillard, John T.	FT	MN 3301, Q3 - SPRING - AY 2018, "Acquisition of Defense Systems", (4) MN 3222, Q2 - WINTER - AY 2018, "Principles of Acquisition and Program Management II", (3) MN 3221, Q1 - FALL - AY 2018, "Principles of Acquisition and Program Management I", (3) MN 3331, Q1 - FALL - AY 2018, "Principles of Acquisition and Program Management", (6) MN 4307, Q1 - FALL - AY 2018, "Program Management Policy and Control", (4)	60%	20%	20%	100%
Eldred, Ross A.	FT	SE 3202, Q4 - SUMMER - AY 2018, "Engineering Systems Design", (6) SE 3201, Q3 - SPRING - AY 2018, "Engineering Systems Conceptualization", (6) SE 3302, Q3 - SPRING - AY 2018, "System Suitability", (5)	40%	50%	10%	100%
Ferreiro, Larrie D.	PT	SE 3910, Q4 - SUMMER - AY 2018, "System Evolution and Technology Assessment", (4) SE 3910, Q2 - WINTER - AY 2018, "System Evolution and Technology Assessment", (4)	100%	0%	0%	100%
Gehris, Rama D.	FT	SE 3201, Q4 - SUMMER - AY 2018, "Engineering Systems Conceptualization", (6) SE 4003, Q4 - SUMMER - AY 2018, "Systems Software Engineering", (5) SE 3250, Q3 - SPRING - AY 2018, "Capability Engineering", (5) SE 3203, Q2 - WINTER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 4003, Q2 - WINTER - AY 2018, "Systems Software Engineering", (5) SE 3202, Q1 - FALL - AY 2018, "Engineering Systems Design", (6) SE 3302, Q1 - FALL - AY 2018, "System Suitability", (5)	80%	10%	10%	100%
Giachetti, Ronald E.	FT	SE 4150, Q2 - WINTER - AY 2018, "Systems Architecting and Design", (5) SE 3100, Q1 - FALL - AY 2018, "Fundamentals of Systems Engineering", (5)	30%	20%	50%	100%

Giammarco, Kristin M.	FT	SE 4930, Q4 - SUMMER - AY 2018, "Model-Based Systems Engineering", (5) SI 4022, Q3 - SPRING - AY 2018, "Systems Architecture for Product Development", (4) MN 3108, Q1 - FALL - AY 2018, "Leadership in Product Development", (5)	50%	30%	20%	100%
Giles, Kathleen B.	FT	SE 4354[7], Q4 - SUMMER - AY 2018, "Systems Test and Evaluation", (4) MN 3331, Q3 - SPRING - AY 2018, "Principles of Acquisition and Program Management", (6) SE 4354, Q2 - WINTER - AY 2018, "Systems Test and Evaluation", (4)	50%	40%	10%	100%
Green, John M.	FT	SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 4150, Q4 - SUMMER - AY 2018, "Systems Architecting and Design", (5) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) SE 3203, Q3 - SPRING - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6) SE 3202, Q2 - WINTER - AY 2018, "Engineering Systems Design", (6) SE 3201, Q1 - FALL - AY 2018, "Engineering Systems Conceptualization", (6)	70%	30%	0%	100%

[7] SE4354 course title “Systems Test and Evaluation” was approved by the NPS Academic Council and updated to “System Verification and Validation, March 2019. The Academic Catalog and other publications will reflect this change.

Harney, Robert C.	FT	SE 4115, Q4 - SUMMER - AY 2018, "Combat Systems Integration", (6) SE 3121, Q3 - SPRING - AY 2018, "Introduction to C4ISR", (5) SE 4113, Q3 - SPRING - AY 2018, "Combat Systems Engineering IV- Unconventional Weapons", (5) SE 4115, Q2 - WINTER - AY 2018, "Combat Systems Integration", (6) SE 4113, Q1 - FALL - AY 2018, "Combat Systems Engineering IV- Unconventional Weapons", (5)	60%	20%	20%	100%
Hernandez, Alejandro D.S.	FT	SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6)	50%	30%	20%	100%
Holness, Karen S.	FT	SE 3100, Q4 - SUMMER - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3100, Q3 - SPRING - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6) SE 3100, Q1 - FALL - AY 2018, "Fundamentals of Systems Engineering", (5)	50%	40%	10%	100%

Johnson, Bonnie W.	FT	SE 3100, Q4 - SUMMER - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) SE 3910, Q3 - SPRING - AY 2018, "System Evolution and Technology Assessment", (4) SE 3100, Q2 - WINTER - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6) SE 3910, Q1 - FALL - AY 2018, "System Evolution and Technology Assessment", (4)	60%	40%	0%	100%
Klamo, Joseph T.	FT	SE 3302, Q3 - SPRING - AY 2018, "System Suitability", (5) SE 3302, Q2 - WINTER - AY 2018, "System Suitability", (5) SE 3203, Q1 - FALL - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3302, Q1 - FALL - AY 2018, "System Suitability", (5)	50%	40%	10%	100%
Kwinn, Brigitte T.	FT	SI 3400, Q4 - SUMMER - AY 2018, "Fundamentals of Engineering Project Management", (5) SE 3100, Q3 - SPRING - AY 2018, "Fundamentals of Systems Engineering", (5) SI 3400, Q3 - SPRING - AY 2018, "Fundamentals of Engineering Project Management", (5) SI 3400, Q2 - WINTER - AY 2018, "Fundamentals of Engineering Project Management", (5) SI 4021, Q2 - WINTER - AY 2018, "Systems Engineering for Product Development", (4) SE 3100, Q1 - FALL - AY 2018, "Fundamentals of Systems Engineering", (5) SI 3400, Q1 - FALL - AY 2018, "Fundamentals of Engineering Project Management", (5)	80%	0%	20%	100%
Madachy, Raymond J.	FT	SE 4003, Q3 - SPRING - AY 2018, "Systems Software Engineering", (5) SE 4003, Q2 - WINTER - AY 2018, "Systems Software Engineering", (5) SE 4003, Q1 - FALL - AY 2018, "Systems Software Engineering", (5)	60%	20%	20%	100%

Miller, Gregory A.	FT	SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) SI 3400, Q4 - SUMMER - AY 2018, "Fundamentals of Engineering Project Management", (5) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) SE 4150, Q3 - SPRING - AY 2018, "Systems Architecting and Design", (5) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6) SI 3400, Q2 - WINTER - AY 2018, "Fundamentals of Engineering Project Management", (5) SE 3121, Q1 - FALL - AY 2018, "Introduction to C4ISR", (3) SE 3203, Q1 - FALL - AY 2018, "Engineering Systems Implementation & Operation", (6)	70%	20%	10%	100%
Muehlbach, Donald S.	FT	SE 3302, Q4 - SUMMER - AY 2018, "System Suitability", (5) SE 4151, Q4 - SUMMER - AY 2018, "Systems Integration and Development", (5) SE 4011, Q3 - SPRING - AY 2018, "Systems Engineering for Acquisition Managers", (5) SE 4151, Q3 - SPRING - AY 2018, "Systems Integration and Development", (5) SE 3100, Q2 - WINTER - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3303, Q2 - WINTER - AY 2018, "System Assessment", (5) SE 4151, Q2 - WINTER - AY 2018, "Systems Integration and Development", (5) SE 4151, Q1 - FALL - AY 2018, "Systems Integration and Development", (5)	100%	0%	0%	100%
O'Halloran, Bryan M.	FT	SE 3302, Q4 - SUMMER - AY 2018, "System Suitability", (5) SE 4353, Q2 - WINTER - AY 2018, "Risk Analysis and Management for Engineering Systems", (5) ME 4753, Q1 - FALL - AY 2018, "Risk Analysis and Management for Engineering Systems", (5) SE 4353, Q1 - FALL - AY 2018, "Risk Analysis and Management for Engineering Systems", (5)	50%	40%	10%	100%
Owen, Walter E.	FT	MN 3108, Q1 - FALL - AY 2018, "Leadership in Product Development", (5)	20%	20%	60%	100%

Papoulias, Fotis A.	FT	SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) TS 4002, Q4 - SUMMER - AY 2018, "Ship Design Integration", (6) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) TS 4001, Q3 - SPRING - AY 2018, "Integration of Naval Engineering Systems", (5) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6) TS 3001, Q2 - WINTER - AY 2018, "Fundamental Principles of Naval Architecture", (5) SE 3100, Q1 - FALL - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3203, Q1 - FALL - AY 2018, "Engineering Systems Implementation & Operation", (6)	50%	20%	30%	100%
Parker, Gary W.	FT	SE3121, Q1 - FALL - AY 2018, "Introduction to C4ISR", (3)	5%	85%	10%	100%
Paulo, Eugene P.	FT	SE 3203, Q4 - SUMMER - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3202, Q3 - SPRING - AY 2018, "Engineering Systems Design", (6) SE 3203, Q3 - SPRING - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 3201, Q2 - WINTER - AY 2018, "Engineering Systems Conceptualization", (6) SE 3202, Q2 - WINTER - AY 2018, "Engineering Systems Design", (6) MV 3101, Q1 - FALL - AY 2018, "Introduction to Department of Defense Modeling and Simulation", (4) SE 3201, Q1 - FALL - AY 2018, "Engineering Systems Conceptualization", (6) SE 3203, Q1 - FALL - AY 2018, "Engineering Systems Implementation & Operation", (6)	50%	40%	10%	100%

Pollman, Anthony G.	FT	SE 4112, Q4 - SUMMER - AY 2018, "Combat Systems Engineering III", (6) SE 3110, Q3 - SPRING - AY 2018, "Applied Fundamentals of Combat Systems", (3) SE 4112, Q2 - WINTER - AY 2018, "Combat Systems Engineering III", (6)	50%	40%	10%	100%
Rhoades, Mark M.	FT	SE 3201, Q4 - SUMMER - AY 2018, "Engineering Systems Conceptualization", (6) SE 4150, Q4 - SUMMER - AY 2018, "Systems Architecting and Design", (5) SE 3203, Q3 - SPRING - AY 2018, "Engineering Systems Implementation & Operation", (6) SE 4353, Q3 - SPRING - AY 2018, "Risk Analysis and Management for Engineering Systems", (5) SE 3202, Q2 - WINTER - AY 2018, "Engineering Systems Design", (6) SE 3302, Q2 - WINTER - AY 2018, "System Suitability", (5) SE 3201, Q1 - FALL - AY 2018, "Engineering Systems Conceptualization", (6) SE 4150, Q1 - FALL - AY 2018, "Systems Architecting and Design", (5)	70%	10%	20%	100%
Semmens, Robert	FT	New hire started in FALL - AY2019	-	-	-	100%
Solitario, William A.	PT	SE 3000, Q4 - SUMMER - AY 2018, "Systems Engineering Colloquium", (1) SE 3000, Q3 - SPRING - AY 2018, "Systems Engineering Colloquium", (1) SE 3000, Q2 - WINTER - AY 2018, "Systems Engineering Colloquium", (1) SE 3000, Q1 - FALL - AY 2018, "Systems Engineering Colloquium", (1)	100%	0%	0%	100%

Stevens, Mark R.	FT	SE 3250, Q4 - SUMMER - AY 2018, "Capability Engineering", (5) SE 3112, Q3 - SPRING - AY 2018, "Combat Systems Engineering I- Intro to Sensors", (6) SE 3113, Q3 - SPRING - AY 2018, "Combat Systems Engineering II- Conventional Weapons", (6) SE 2003, Q2 - WINTER - AY 2018, "Introduction to Mechanical Systems", (6) SE 2101, Q2 - WINTER - AY 2018, "Introduction to Electromagnetic Systems", (6) SE 3112, Q1 - FALL - AY 2018, "Combat Systems Engineering I- Intro to Sensors", (6) SE 3113, Q1 - FALL - AY 2018, "Combat Systems Engineering II- Conventional Weapons", (6)	60%	10%	30%	100%
Sweeney, Joseph W.	FT	SE 3011, Q4 - SUMMER - AY 2018, "Engineering Economics and Cost Estimation", (3) SE 3202, Q4 - SUMMER - AY 2018, "Engineering Systems Design", (6) SE 3011, Q3 - SPRING - AY 2018, "Engineering Economics and Cost Estimation", (3) SE 3201, Q3 - SPRING - AY 2018, "Engineering Systems Conceptualization", (6) SE 3011, Q2 - WINTER - AY 2018, "Engineering Economics and Cost Estimation", (3) SI 3400, Q2 - WINTER - AY 2018, "Fundamentals of Engineering Project Management", (5) SI 3400, Q1 - FALL - AY 2018, "Fundamentals of Engineering Project Management", (5)	70%	20%	10%	100%
Van Bossuyt, Douglas	FT	SE 4150, Q4 - SUMMER - AY 2018, "Systems Architecting and Design", (5) SE 4150, Q3 - SPRING - AY 2018, "Systems Architecting and Design", (5)	50%	40%	10%	100%

Vaneman, Warren K.	FT	SE 4414, Q3 - SPRING - AY 2018, "LSI - Leadership in System Integration", (4) SE 4930, Q3 - SPRING - AY 2018, "Model-Based Systems Engineering", (5) SE 4930, Q2 - WINTER - AY 2018, "Model-Based Systems Engineering", (5) SE 3412, Q1 - FALL - AY 2018, "System of Systems Design and Development", (5) SE 4950, Q1 - FALL - AY 2018, "System of Systems Engineering", (4)	60%	30%	10%	100%
Whitcomb, Clifford A.	FT	SE 4950, Q4 - SUMMER - AY 2018, "System of Systems Engineering", (4) SE 4950, Q3 - SPRING - AY 2018, "System of Systems Engineering", (4) SE 3100, Q2 - WINTER - AY 2018, "Fundamentals of Systems Engineering", (5) SE 3100, Q1 - FALL - AY 2018, "Fundamentals of Systems Engineering", (5)	50%	25%	25%	100%
Yakimenko, Oleg A.	FT	SE 3203, Q2 - WINTER - AY 2018, "Engineering Systems Implementation & Operation", (6) AE 2440, Q1 - FALL - AY 2018, "Introduction to Scientific Programming", (5) SE 2440, Q1 - FALL - AY 2018, "Introduction to Scientific Programming", (5) SE 3202, Q1 - FALL - AY 2018, "Engineering Systems Design", (6)	50%	40%	10%	100%

Return to Faculty Workload Section

FACILITIES

I. Student Communication and Learning

Describe the system in place to allow effective communication with students in the master's level program to provide an atmosphere conducive to learning and support student success in the program. This could include classroom and office facilities, remote learning systems, or other interactive resources.

The system in place to allow effective communication with students in the master's level program to provide an atmosphere conducive to learning and support student success in the program is described. This includes classroom and office facilities, remote learning systems, and other interactive resources.

SE resident students are assigned lockers and/or cubicles on the first floor of Bullard Hall. This area is surrounded by labs, teaching labs, faculty offices, staff offices, and conference rooms. There is easy access to the main faculty and staff offices and lab spaces on the second floor of Bullard Hall. The students are highly integrated into the facilities provided. The faculty conduct student interactions outside the classroom by proximity to these student spaces, as well as during lab sessions, especially for students conducting research in faculty labs for their masters level research. The department also provides remote computational resources for everything from basic word processing and spreadsheet access, remote meeting capability using Blackboard Collaborate and Zoom, to advanced computational capabilities.

There is adequate classroom space to support the program. Classrooms are centrally managed on campus.

Office space has always been limited but to date as expansion has occurred, adequate space has been provided although some resident faculty are forced to share office space. Available space in the current building is fully utilized.

Offices (Administrative, Faculty, Clerical, Teaching Assistants)

The Systems Engineering department is responsible both for its instructional faculty and staff. The department has approximately 45 faculty and staff housed in Bullard Hall with a few others housed in other buildings.

Faculty members are housed in individual standard NPS offices (nominal 9 x 18 feet), with the exception of the Chair of the Systems Engineering department, who has the use of a double-sized offices. Staff personnel, research assistants, and doctoral students are normally housed two per standard NPS office. The Department Office is a double-sized office and houses two administrative personnel. There are no teaching assistants to house.

Most offices are along external walls and have windows. The few that are not, have adequate lighting and ventilation. The office spaces have recently been carpeted and painted. Most have relatively new furniture with a desk, table, bookcases, file cabinet, and several chairs at a

minimum. The few that do not are due to personal preferences for the old furniture they have. They provide adequate privacy to meet with students. Every office has at least one telephone and one network drop. The department provides every faculty and staff member with a computer and upgrades the computers when requested. The department maintains several networked printers (high-speed B/W, color, and large format) available for use by all faculty and staff. Office software is provided and maintained by the IT department and upgraded regularly.

Classrooms and associated equipment

Classrooms are centrally managed and scheduled by NPS. The department has use of two classrooms in Bullard Hall and four classrooms in the adjacent Watkins Hall, as well as many others across campus. Two conference rooms with video transmission and reception often double as hybrid (mixed resident and distance learning) classrooms for a few courses with limited enrollments, notably those in the doctoral program. The Computation Lab with its multi-projector, fully-networked, interactive computer system is commonly used as a classroom for computer-intensive courses. Standard classrooms are equipped with a computer console and overhead projector for instructor use as well as whiteboards and/or blackboards. Any non-standard audiovisual needs (such as video recording and streaming, etc.) can be accommodated by audiovisual office on an as-needed basis. The classrooms commonly used for teaching systems engineering courses have large tables with movable chairs. The tables are large enough to accommodate books, notebooks, and laptop computers without overcrowding. Power outlets and network drops are available for student use. Technology in the classrooms is upgraded regularly every two to three years. Classrooms are available in capacities ranging from 18 to over 100 students. Many accommodate 30 students without crowding. Most faculty members consider the classrooms to be adequate for their teaching purposes if not better than adequate.

II. Laboratories

Describe the laboratory facilities available to support student success in the program. This can include remote access or virtual laboratories. Provide an assessment of these facilities in how they are representative of current professional practice.

The laboratory facilities available to support student success in the program are described. This includes both remote access or virtual laboratories. An assessment of what these facilities provide in how they are representative of current professional practice.

Instructional laboratory facilities, used primarily for domain track courses, are satisfactory and always improving. This is not unexpected in a relatively young program, particularly given the budget pressures of the past few years.

Several lab spaces are worth describing; the RoboDojo, Autonomous Systems Engineering and Integration Lab (ASEIL) and Advanced Robotic Systems Engineering Laboratory (ARSENL). The RoboDojo was developed initially as a lab for SE students to design, build, and test robotic and autonomous systems. The lab included 3D printers, a laser cutter, and other computer-based fabrication and programming equipment, as well as bench testing space. The SE department championed the initial development of this lab, but has since successfully

championed transitioning the space to an NPS-wide maker space, building capability and capacity to allow all NPS students to make use of the space for research or just for general interest. The ASEIL laboratory provides space for experiments involving control systems and permitting operation of both ground and air vehicles. The lab has a number of control systems workstations and vehicles as well as an instrumented indoor range area for vehicle operation. Active ongoing research in the ARSENL laboratory on the Aerial Combat Swarms project represents an integrated concept generation, modeling, simulation, and field experimentation effort to design, develop, and deploy a swarm versus swarm UAV live-fly engagement experiment. In addition to UAVs, the lab also conducts research with unmanned ground and surface vehicles.

NPS has a space management policy and plan, and the program complies with that plan. The Dean of GSEAS allocates space within the engineering school. At present the department occupies most of the second floor of Bullard Hall and roughly half of the first floor and it has three faculty members with research labs in other buildings (two in Watkins Hall and one in Halligan Hall).

Laboratory facilities

The Systems Engineering department has satisfactory and always improving laboratory facilities (space and equipment) to satisfy all desired program objectives and learning outcomes in its instructional functions.

A laboratory working plan was developed to identify specific courses requiring lab components along with the estimated space and equipment requirements to provide those components. Laboratory content that was similar was assumed to be consolidated into a single laboratory space. Exercises that involved specialized equipment, significant hazards, specialized environmental conditions, or equipment not amenable to repeated setup and teardown were allocated separate laboratory spaces. The number of students in each section and the number of sections per quarter were considered in sizing the spaces and the amount of equipment needed. The vision statement specified that unless impractical, student membership on teams performing a lab should be no larger than four and preferably three. This plan is adjusted as new courses are developed, older courses become inactive, and student enrollments change.

Table 16. Laboratory Requirements for the Systems Engineering Department

Laboratory Name	Teaching/Research	Location	Sq. Ft.
Autonomous Sys Eng. & Integration Lab (ASEIL)	Teaching	Bu201L	688
Mechanical Assembly and Integration Area	Support	Bu201M	355
Electrical Assembly and Integration Area	Support	Bu201P	355
Systems Computation Lab	Teaching	Bu212A (servers) Bu212C-D	808
Laser/Lidar Development Lab	Teaching	Bu221	324
SSP & N8F Electromechanical Systems Lab	Teaching	Bu224A	803
Advanced Fabrication Lab	Teaching/Support	Bu224B-C	713

Ship & Combat Systems Lab	Teaching	Bu208	1052
SEA/CDIO Project Labs	Teaching	Bu100A-C	3x518
Design Commons	Teaching	King001	1200
Advanced Robotic Systems Eng. Lab	Research	Ha033b	648
Autonomous Air Vehicle Lab	Research (Yakimenko)	Wa207	574
Remote Testing Facilities	Teaching/Research	N/A	N/A

Table 17. Courses Supported by Laboratories in the SE Department

Laboratory Name	Location	Sq. Ft.	Courses Supported
Autonomous Sys Eng. & Integration Lab (ASEIL)	Bu201L	688	SE2801, SE4910, SE3201, SE3202, SE3202
Mechanical Assembly and Integration Area	Bu201M	355	All
Electrical Assembly and Integration Area	Bu201P	355	All
Systems Computation Lab	Bu212C-D	808	All
Laser/Lidar Development Lab	Bu221	324	SE42112
SSP & N8F Electromechanical Systems Lab	Bu224A	803	SE2003, SE2101, SE3113, SE3121, SE4113
Advanced Fabrication Lab	Bu224B-C	713	All
Ship & Combat Systems Lab	Bu208	1052	SE3112, SE3113, SE4112, SE4115, TS4000, SE3121
SEA/CDIO Project Labs	Bu100A-C	3x518	SI0810 (multiple sections), SE3201, SE3202, SE3203
Design Commons	King001	1200	All
Advanced Robotic Systems Eng. Lab	Ha033b	648	SE3201, SE3202, SE3203
Autonomous Air Vehicle Lab	Wa207	574	SE3201, SE3202, SE3203
Remote Testing Facilities	External	N/A	SE3201, SE3202, SE3203

Funding for equipment has been satisfactory.

The SE laboratories were originally organized around five functional units: the demonstrations lab, the computation lab, the projects lab, the foundations lab, and the applications lab. Each lab often utilized multiple spaces and any single space might be used by multiple labs. This division has proved troublesome, so laboratories are now organized around individual laboratory spaces. These are described below.

Advanced Robotic Systems Engineering Lab (Ha033b – 648 sq.ft.)
The Advanced Robotic Systems Engineering Lab provides space for computation, networking, electrical, and mechanical systems design, fabrication, and integration of software and hardware elements. This laboratory is adequately equipped although a larger space would be desirable

Autonomous Systems Engineering & Integration Lab (ASEIL) (Bu201L – 688 sq.ft.)
The Autonomous Systems Integration Laboratory provides space for experiments involving control systems and permitting operation of both ground and air vehicles. The lab has a number of control systems workstations and vehicles as well as an instrumented indoor range area for vehicle operation. This laboratory is adequately equipped although a larger space would be desirable.

Mechanical Assembly and Integration Area (Bu201M – 355 sq.ft.)
The Mechanical Assembly Area provides mechanical fabrication support for instructional laboratories, student projects, and research. It houses a number of machine and hand tools and has a small supply of materials available for general use. Limited space is available for

assembling mechanical projects. This laboratory is adequately equipped although a larger space would be desirable.

Electrical Assembly and Integration Area (Bu201P – 355 sq.ft.)
The Electrical Assembly Area provides electrical and electronic fabrication support for instructional laboratories, student projects, and research. It houses a collection of electronic test equipment and a small supply of electronic components available for general use. Several workstations are available for assembling electronic projects. This laboratory is adequately equipped although a larger space would be desirable.

Systems Computation Lab (Bu212C-D – 808 sq.ft.)
The Computation Lab provides exceptionally substantial computational support for large-scale simulation, modeling, and systems engineering projects. It provides a general-purpose computing facility for students and faculty and serves as a classroom for computer-intensive courses. The laboratory has 50 interconnected processors with remote access and workstations for 24 students and multiple projectors and screens for interactive display of all processors. This laboratory is fully operational with first-rate equipment and software. The processors and workstations were last replaced in 2018. The lab is supplemented by another 30 servers (Bu212A) that have the same software load and are available for remote login via a Citrix server. The servers were replaced in 2016. They are also used for batch computing. The following software applications are available on all computers in the laboratory.

- Ad-aware SE Personal
- Adobe Acrobat Distiller XI
- Adobe Acrobat XI Professional
- Adobe FormsCentral
- ALOHA
- Cameo Enterprise Architecture Version 18.5
- CORE 9.0 University Edition
- Dropbox
- Cyberlink PowerDVD
- Extendsim9
- Internet Explorer
- Ivanti Management
- Java
- JMP 13
- MathType 6
- Matlab R2017a
- Microsoft Edge
- Microsoft Office 2016 Professional Suite (Access, Word, PowerPoint, Excel, OneNote, Outlook, Access, Project, Publisher, Visio) and Tools
- Microsoft OneDrive for Business
- Minitab 17 Statistical Software
- PuTTY suite
- PLTS

- PuTTY
- Sigma
- Simio Visual Studio
- Skype for Business
- STK11
- STK Support Tools
- VideoLAN
- Visio 2016
- Symantec EndPoint Protection
- Windows accessories
- Windows Administrative Tools
- Windows Ease of Access/Speech Recognition
- Windows Media Player
- Windows System Software

Laser/Lidar Development Lab (Bu221 – 324 sq.ft.)
The Laser/Lidar provides space for conducting experiments with optical systems that require darkened conditions, such as optical imaging and night vision devices. The lab is adequately equipped and of reasonable size.

SSP & N8F Electromechanical Systems Lab (Bu224A – 803 sq.ft.)
The Electromechanical Systems Lab provides space for conducting introductory experiments in mechanics, thermodynamics, electricity, and magnetism. An adequate number of student workstations each with computer data acquisition and a full complement of general purpose lab equipment and specialized experimental setups are available. This laboratory is adequately equipped and of reasonable size.

Advanced Fabrication Lab (Bu224B-C – 713 sq.ft.)
The Advanced Fabrication Lab provides space for modern fabrication systems. The lab contains multiple 3D printers capable of printing plastic (PLA), reinforced (carbon fiber, Kevlar) plastic, nylon, and 17-4 stainless steel. The lab provides capabilities for micro and electronic manufacturing. The lab also provides the facility for the department's virtual and augmented reality systems.

Ship & Combat Systems Lab (Bu208 – 1052 sq.ft.)
The Combat Systems Lab provides space for conducting experiments in support of the courses in the Combat Systems track. Experiments provide hands-on experience with important concepts and permits direct observation of critical phenomena associated with sensors, weapons, and sensor/weapon networks. Equipment is available to support a wide range of experiments for the 3000-level courses. The physical space has been upgraded and expanded in size to provide for up to six student workstations if needed. The lab is fully operational and highly utilized.

SEA/CDIO Project Labs (Bu100A-C – 3x518 sq.ft.)
The SEA/CDIO Projects Labs consist of several spaces that provide an environment in which students in the MSSE program can work together on the team-based CDIO (conceive-design-

implement-operate) projects. Students in the SEA (Systems Engineering Analysis) curriculum do a project rather than a thesis, the projects last 9-12 months, and multiple projects have been conducted simultaneously. Spaces have computer resources, bench space for assembling the CDIO hardware, and equipment to support frequent team meetings with presentations. The CDIO projects share spaces with the SEA projects. There is a dedicated CDIO teaching space, called the Design Commons, located in King Hall.

Design Commons (King001 – 1200 sq. ft.)
The Design Commons space provides an environment in which students can work together on the team-based CDIO (conceive-design-implement-operate) projects that are part of the 580 curriculum (resident MSSE program). The main room is approximately 1200 sq. ft. with five work stations, each having a large screen presentation device capable of connecting to several laptop computers. This is augmented with three 4'x6' glass boards mounted on the walls, and 17 mobile two-sided glass boards, each 24"w x 60"h. The room can be configured in typical classroom format or be divided into team sections with 15 trapezoidal tables, 35 chairs, and several tall work tables. There is an additional overflow room of about 800 sq. ft. when additional space is desired. This space has been used for rocket assemblies, class labs, and conferences.

Remote Testing Facilities
The department leverages two proximal regional facilities for remote testing of autonomous systems and related subsystems. Camp Roberts is a California National Guard Post in central California, located approximately two hours from NPS. Operated at Camp Roberts are MacMillan Airfield and restricted airspace R-2504. These facilities provide the capability for large-scale aerial systems testing and enable operation of related communications subsystems. Impossible City is a Military Operations on Urban Terrain (MOUT) training site located on the closed Fort Ord Army post, approximately ten miles from NPS. The MOUT site provides a field experimentation site for air and ground autonomous systems and subsystems. Given the nature of the MOUT, this site provides enhanced realism and possibilities for systems testing.

For a listing of the major pieces of equipment used by the program in support of instruction, see Appendix C.

III. Computing Resources

Describe any computing resources (workstations, servers, storage, networks including software) which are used by the students in the master's level program to achieve their educational goals. Assess the availability and adequacy of these facilities to support the scholarly and professional activities of the students and faculty in the program.

Computing resources (workstations, servers, storage, networks including software) which are used by the students in the master's level program to achieve their educational goals are described. The availability and adequacy of these facilities to support the scholarly and professional activities of the students and faculty in the program are assessed.

Resources and support for computing used in student homework, class projects, and thesis research are sufficient. Resources and support for computing in instructional labs is adequate.

In addition to the computer resources in instructional labs and the systems engineering computation lab described in Part A, the campus operates a number of other computing resources. There are several dozen general purpose computer labs or learning resource centers (LRC). These are equipped and maintained by the NPS ITACS organization. Each LRC contains a number of network-connected desktop computers (typical 10 to 30 in each center) with several networked printers. The computers are loaded with standard office software and also a number of technical software packages (such as Matlab/Simulink and toolboxes, statistical packages, graphical information systems, program management software, etc.). Departments are surveyed once a year to determine which programs should be included in the standard image placed on every machine. The LRCs are adequate for all student activities except computationally-intensive research. To accommodate this last item, NPS also operates a High-Performance Computing Center (HPCC) with a multi-processing supercomputer for research purposes. The HPCC currently (2012) has 1496 CPUs with 4.7 TB RAM producing 13.2 TFlops of processing capacity. This is regularly upgraded to increase processing power in pace with increases in demand for processing. Average usage is about 50% of capacity. The center is sufficient to support all research on campus requiring a supercomputer. NPS also has access to much larger supercomputers operated by other Department of Defense entities.

IV. Guidance

Describe how students in the master's level program are provided with appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories.

This section describes how students in the master's level program are provided with appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories.

Guidance is provided on an as-needed basis prior to usage of any tools and equipment. All students sign an ITACS appropriate use statement during in processing. Standard computing and laboratory resources are covered throughout the applicable course when appropriate. Under student projects and thesis work, students meet with faculty and laboratory staff to identify resources needed to support the student project.

When guidance is required for safety reasons, training is performed through a combination of pre-usage literature and hands-on demonstrations. Once students have been evaluated and shown competent and compliant with all safety requirements, training is logged, and the equipment approved for their usage is noted. At any point that the student needs to use additional tools or equipment, training is again provided, and approval is logged. Equipment and facilities requiring safety training are designated by the Naval Support Activity Monterey or the Naval Postgraduate School through safety officials formally designated by the governing authority and trained by cognizant safety organizations of the U.S. Government. The Graduate School of Engineering or the Systems Engineering Department may also designate specific equipment for additional control and training.

V. Maintenance and Upgrading of Facilities

Describe the policies and procedures for maintaining and upgrading the tools, equipment, computing resources, and laboratories used by students and faculty in the master's level program.

The policies and procedures for maintaining and upgrading the tools, equipment, computing resources, and laboratories used by students and faculty in the master's level program is described.

NPS has a laboratory recapitalization program. Each year (typically after NPS receives its budget from the Navy) the Administration identifies a portion of the budget to be used for lab recap. This budget is divided among the four schools but not yet released to the schools. The GSEAS Dean then requests inputs from the Departments for replacement and/or new lab equipment to support instructional activities. The inputs are then prioritized by joint discussions between the Dean and all of the Department Chairs. This results in a GSEAS priority list. The priority list is presented to the Provost's office who then finalizes the allocations. The Provost's office then approves the release of funds to the schools, which are then free to execute purchase requisitions. Typically, the entire recap budget is not released immediately. Some is held for contingencies. In the occasional event that these funds are not consumed by other pressing needs, more money is released to the schools for year-end acquisition of items on the initial priority list.

VI. Library Services

Describe and evaluate the capability of the library (or libraries) to serve the master's level program including the adequacy of the library's technical collection relative to the needs of the program and the faculty; the adequacy of the process by which faculty may request the library to add physical and/or remotely accessible books, subscriptions, databases, and other resources; the library's on-line search and retrieval system; and any other library services relevant to the needs of the program and faculty scholarship and professional development.

In this section, the capability of the library (or libraries) to serve the master's level program including the adequacy of the library's technical collection relative to the needs of the program and the faculty; the adequacy of the process by which faculty may request the library to add physical and/or remotely accessible books, subscriptions, databases, and other resources; the library's on-line search and retrieval system; and any other library services relevant to the needs of the program and faculty scholarship and professional development is described and evaluated.

The library does an admirable job of trying to serve the needs of all faculty members and students. The library has identified a representative to address SE department library needs. This individual frequently attends department meetings and regular solicits inputs from faculty as to which new books the library should obtain and to which journals the library should subscribe. Requests from faculty members for new books or subscriptions are handled quickly and almost always successfully. The library has access to a number of electronic databases (such as Lexis/Nexis) and has an expanding collection of electronic journals. The library catalog is entirely electronic. Multiple terminals are available throughout the library for

accessing the catalog, electronic documents and databases, and journals. These terminals are networked to a number of printers permitting students and faculty to make print copies of information. Many library resources are available to any computer connected to the NPS Intranet.

There is a fully-staffed reference desk. Individuals at the desk are widely knowledgeable of sources of information and are capable of finding even obscure references. The library participates in national interlibrary loan collaborations, so it is rare that desired information cannot be obtained. These services are available to students as well as faculty.

As there is limited on-campus study space for students, the library provides a large number of carrels for individual research and study, as well as rooms that can be reserved for student meetings and group study.

The department holds an orientation session for each incoming cohort of students (resident as well as distance learning). At each orientation session the systems engineering library liaison, Glen Koue from the library staff, provides briefings and live demonstrations on the resources available in the library, the services the library can provide to students, how to arrange access to those resources, and in general, how to use a library for research and study.

The library has a limited budget and a large constituency. Its collections are limited to subjects matching departmental offerings and the majority of faculty research interests. It makes up for this limitation by its connections to other libraries and its interlibrary loan program. Nevertheless, the library does an outstanding job at satisfying the needs of the department's students and its faculty members, except for a few with the most eclectic interests.

The Dudley Knox Library consistently receives the highest customer satisfaction ratings (>90%) of all NPS services (based on results from quarterly student exit surveys and biennial faculty/staff surveys). The chief administrative officer and Director of the Dudley Knox Library, Thomas Rosko, was appointed University Librarian in March 2019. Before arriving at NPS, Rosko was at the Massachusetts Institute of Technology (MIT) where he was Head, Institute Archives & Special Collections at the MIT Libraries from 2003 to 2019. Prior to MIT, he held archives and library positions at the University of Kentucky, New York University/The New-York Historical Society, and Princeton University. The former University Librarian, Eleanor Uhlinger, was honored with the Navy Superior Civilian Service Award for exemplary service as the NPS University Librarian from March 2006 until May 2018.

The excellent support provided by the library is considered an institutional strength.

VII. Overall Comments on Facilities

Describe how the program ensures the facilities, tools, and equipment used in the program are safe for their intended purposes (See the 2019-2020 APPM I.E.5.b.(1)).

How the program ensures the facilities, tools, and equipment used in the program are safe for their intended purposes is described.

The identification of hazards in each laboratory is done through a combination of internal surveys by departmental personnel, pre-use certification inspections by representatives from the NPS Safety Office (for specific hazards such a lasers or nuclear radiation sources), annual inspections by Naval Support Activity Monterey (NSAM), and annual surveys conducted by the Navy Bureau of Medicine and Surgery's Industrial Hygienist. Reports summarizing the department's safety, training, and maintenance programs are forwarded to the Navy's regional organization NSAM as well as the Naval Postgraduate School's Research and Academic Deans.

The department has assigned the laboratory supervisor to be the point of contact with the NPS Safety Office and other safety organizations. The laboratory supervisor is tasked with maintaining all departmental facilities in a safe and health-maintaining state. Laboratories, work spaces, and other departmental spaces are maintained in a clean and orderly state. Tools and equipment not in routine use are stored in an orderly fashion. Tools and equipment are maintained in operating condition. When maintenance is required, the affected equipment is marked inoperable and repairs are made as rapidly as possible.

INSTITUTIONAL SUPPORT

I. Leadership

Describe the leadership of the master's level program and discuss its adequacy to ensure the quality and continuity of the program and how the leadership is involved in decisions that affect the program.

The leadership of the master's level program is described and its adequacy to ensure the quality and continuity of the program is explained. A description of how the leadership is involved in decisions that affect the program is included.

Since NPS is a graduate-level university, essentially all faculty, staff, and resources are focused on graduate education, especially for masters programs due to the far smaller number of doctoral students enrolled. At the program level, there are several key faculty who manage each department business line. The department chair has overall responsibility for the program. He assigns personnel to the other duties, approves new cohort starts and tracks, supervises the business risk of the program, assigns faculty to teach, and manages key stakeholder relations. As the DL program is the largest business line of the department by both dollars and students, it commands the regular and careful attention of the chair. The assistant chair directly supports the department chair with key roles in matching faculty to teaching assignments, monitoring accreditation programs, monitoring and tracking budgets, and other duties as assigned by the chair.

The curricular decisions are separated from the business side through the use of the AA and PO team, Mark Stevens and CDR Todd Greene, USN. They have responsibility for screening applicants, monitoring student success, and approving the few student academic requests that arise under the cohort model. With the chair, they approve the tracks proposed by the sponsor.

Faculty scheduling for courses is centrally managed by a Faculty Associate - Education and approved by the department chair. Departmental faculty at Monterey serve both the resident and DL programs. Off-campus faculty serve the DL program almost exclusively.

The resident and DL programs are integrated seamlessly into the departmental quality assurance programs.

II. Program Budget and Financial Support

1. Describe the process used to establish the program's budget and provide evidence of continuity of institutional support for the master's level program. Include the sources of financial support including both permanent (recurring) and temporary (one-time) funds.
2. To the extent not described above, describe how resources are provided to acquire, maintain, and upgrade the infrastructures, facilities, and equipment used in the master's level program.
3. Assess the adequacy of the resources described in this section with respect to the students in the program being able to attain their educational goals.

The process used to establish the program's budget is described, along with evidence of continuity of institutional support for our master's level program. The sources of financial support including both permanent (recurring) and temporary (one-time) funds is described. How resources are provided to acquire, maintain, and upgrade the infrastructures, facilities, and equipment used in the master's level program is also explained. The adequacy of the resources described in this section with respect to the students in the program being able to attain their educational goals is assessed.

From the top down, the Navy provides the school a funding amount that varies each year based on budget pressures at the federal level. It is not tied to student enrollments yet the school is expected to take all Naval (US Navy and United States Marine Corps (USMC) officers assigned to the campus. Students from other US services are funded at the "marginal" cost of admitting one additional student, and those funds are provided on a per-capita basis by their services. Officers from other nations are funded either by their country or the US state department; prices are set on market rates.

Non-resident SE programs are funded separately on a per capita basis, and do not affect the funding of the resident program.

The 580 curriculum sponsor provides additional funds to the SSP Chair Professor to assist with expenses of the program not covered by tuition, such as student travel. Currently that funding is typically $250K per year and is shared with the residential education program.

NPS receives mission funding for active duty Navy and Marine Corps officers. That money is allocated to departments for instruction as follows:

1. The number of qualifying sections from the previous four quarters is calculated. This number is adjusted for known changes in the program that would change the number of sections to be offered in the future. This number we will call S.
2. The TT workload assumes that four sections will be taught in nine months. So the number of TT faculty is multiplied by four, and if that product is less than S, nine months of the average TT salary is credited to the program for each TT faculty member.
3. If there are excess TT faculty, then funding is only provided for S/4 TT faculty members.
4. If there are insufficient TT faculty, the remaining sections are funded, eight sections per work year, at the average NTT salary.
5. In each of the last two years, that budget number has been decreased five percent to promote economies by the departments.
6. A small amount (usually $16K) is provided to each department for office supplies and other department non-labor needs.

The mission funds provided cover instruction, thesis advising, institutional service, faculty service, and institutionally funded research for new faculty.

SE has met payroll and stayed within budget for each of the last five years.

Program Financial Support

There are five streams of funding for the SE department. They include the "mission funds" described in the previous paragraph, tuition for DL programs (which does not affect the resident program), research dollars, indirect charges on research dollars, and separate funds provided by sponsors for the program.

In FY18, these amounts totaled:

Table 18. Sources of Funding for the SE Department, FY18

Type	Amount
Mission Funding	$3.024M
Research Funding	$2.720M
Sponsor Funding	$0.561M
Tuition for DL Program	$4.087M

Table 18 indicates that about 27.3% of the funding of the department is provided by mission funds. The Mission Funding reported in Table 18 includes funds originally allocated to the SE department, plus additional funds beyond the original allocation for SE faculty assuming workload for teaching courses offered by other departments, lab recapitalization funding and funding for naval officers in SE DL programs.

Adequacy of Budget

Funds are allocated to the Engineering School, GSEAS, by the campus based on an analysis of the needs of each department using an objective formula from the Vice Provost of Academic Affairs (VPAA). The GSEAS Dean then allocates that budget to departments based on an internal GSEAS process. The budgets in the past 5 years have been adequate.

III. Staffing

Describe the adequacy of the staff (administrative, instructional, and technical) and institutional services provided to the master's level program. Discuss methods used to retain and train staff.

The adequacy of the staff (administrative, instructional, and technical) and institutional services provided to the master's level program is described. The methods used to retain and train staff are explained.

The department has adequate staffing to fulfill its mission. The department staff includes administrative staff, technical staff to maintain laboratory equipment, and instructional support staff. The administrative and instructional support staff includes a Faculty Associate for Education with responsibility for faculty scheduling, budget analysis, and educational process effectiveness. In addition, the department has lab technicians, educational technicians and educational assessment contractor support. These positions are well-compensated, and the work command climate is superb, and the department has had its pick of the staff across campus, who compete fiercely for these positions.

Staff are trained using standard campus processes where available, using Navy training courses where appropriate, and by tailored instruction. Staff are also eligible to enroll in NPS degree programs at no charge, and several do.

IV. Faculty Hiring and Retention

1. Describe the process for hiring of new faculty.
2. Describe strategies used to retain current qualified faculty.

The process for hiring of new faculty is described, as well as the strategies used to retain current qualified faculty.

The Provost has a process to establish a need and business case for new faculty, and once that is satisfied, the department receives authority to recruit. Faculty positions are advertised on the NPS website, and for tenure-track positions, nationally. A department search committee writes the ad and conducts initial screening of applicants. Finalists are brought to campus for a two day visit that includes giving a seminar and meeting with faculty and leadership. The NPS President makes offers of employment based on the recommendation of the Chair, Dean, and Provost.

The department has had some retention difficulty with entry and mid-level faculty in the recent past. This has also been a challenge across campus. SE has been able to adequately hire new faculty to maintain required faculty numbers. NPS salary scales are very competitive at the lecturer, senior lecturer, assistant professor, and associate professor levels. Cost of living remains a challenge in the Monterey area, and has presented challenges in hiring some junior faculty members. The campus has some authority to match formal offers that exceed the federal pay cap.

Our biggest tool for retention of both faculty and staff is the ongoing maintenance of an excellent command climate. People love to work in this department because the leadership is competent and caring, the students are amazing, and the work is important.

Offsetting the department command climate, the overall employment climate for federal employees has been deteriorating at times recently. There have been pay freezes and reductions in the ability to use retention incentives across campus for more than 7 years. There have been non-paid furlough days along with government shutdowns that translated to faculty losing significant pay in past years, which stress faculty and make mission accomplishment significantly more difficult. Travel controls have greatly increased faculty frustration. These trends have been improving lately, but the impacts persist, so there is a still a risk that the program, and NPS as a whole will lose key faculty and will be challenged to replace them with equally qualified faculty.

V. Support of Faculty Professional Development

Describe the adequacy of support for faculty professional development, how such activities such as sabbaticals, travel, workshops, seminars, etc., are planned and supported.

The adequacy of support for faculty professional development, how such activities such as sabbaticals, travel, workshops, seminars, etc., are planned and supported is described.

New TT faculty members receive generous research initiation funds provided through the Dean of Research. The labor and non-labor amounts will vary based on the individual TT research program set up costs, averaging about $200K over two years. The funds are available to TT faculty who support either the resident or DL programs. The department has had support for several TT faculty members, namely Kristin Giammarco, Andy Hernandez, Bryan O'Halloran, Douglas Van Bossuyt, Paul Beery, Tony Pollman, Joe Klamo, and Rob Semmens at this level of support over the past several years.

Every member of the faculty also has an opportunity to take an instructional improvement offered by the Faculty Development Office and the campus Center for Educational Design, Development, and Distribution (CED3). Several SE faculty members have taken advantage of professional development opportunities offered by the NPS Director of Faculty Development, Ali Rodgers, over the past several years. The NPS Faculty Development office provides a regular set of offerings, and SE faculty have taken courses in instructional practices, pedagogical approaches to teaching and learning, and educational effectiveness. Bryan O'Halloran, Douglas Van Bossuyt, Paul Beery, Tony Pollman, Katy Giles and Joe Sweeney all have participated in faculty teaching development activities during the ABET year of record.

The department has a weekly seminar series for its faculty and graduate students. NPS has a guest speaker program that brings distinguished members of government to campus about five times per quarter to lecture students and faculty. Departments notify each other of their seminar speakers and all are invited. All of the SE seminars are broadcast and remote faculty are free to participate. Many of the other seminars are, as well.

NPS runs a sabbatical program, which tenured department members have used. Professors Oleg Yakimenko and Cliff Whitcomb have completed sabbaticals since 2014.

Research programs provide funds to support travel to professional meetings. In the past several years in the SE department, funding has been found for every reasonable faculty travel request for professional development.

The faculty workload model also provides TT faculty with some institutionally funded research time.

NTT faculty without a doctoral degree can enroll in NPS doctoral programs at no cost; all faculty members are free to take any course on campus at no cost.

In general, support of faculty professional development is considered adequate.

Support of Facilities and Equipment

The resources for the acquisition, maintenance, and operation of facilities and equipment appropriate for the program have been adequate.

Lab space is considered adequate.

Lab technical staff is adequate.

Adequacy of Support Personnel and Institutional Services

As described in Appendix D, support to the program is provided across campus. All aspects of the institutional services and support personnel are considered adequate.

EXHIBITS.

Exhibit 1. Curriculum Track Courses

SE (580) Combat Systems Track Course Matrix (as of January 2018) – With Refresher

Refresher Summer/Winter 15-7	**SE1001** Math I for SEA (4-2)	**SE2003** Fundamentals of Mechanical Systems (4-2)	**SE1002** Math II for SEA (3-1)	**SE2101** Fundamentals of Electromagnetic Systems (4-2)	
QTR 1 Fall/Spring 16-7	**SE3100** Fundamentals of Systems Engineering (3-2)	**SE2440** Intro to Scientific Computing (3-2)	**OS3180** Probability and Statistics for SE (4-1)	**SE 3112** Combat Sys Engineering I (Sensor Fund.) (4-2)	**SE3811** Critical Thinking (2-0)
QTR 2 Winter/Summer 15-6	**SI3400** Engineering Project Management (3-2)	**SE 3250** Capabilities Engineering (3-2)	**SE 3011** Engineering Cost Estimation (3-0)	**SE 4112** Combat Sys Engineering II (Sensors Tech) (4-2)	**SE3812** Engineering Ethics (2-0)
QTR 3 Spring/Fall 15-6	**SE3302** Systems Suitability (3-2)	**SE4150** System Architecting and Design (3-2)	**SE 3121** Introduction to C4ISR (3-0)	**SE 3113** Combat Sys Engineering II (Weapons) (4-2)	**SE3813** Technical Writing I (2-0)
QTR 4 Summer/Winter 15+?-6+?	**SE 4115** Combat Systems Integration (4-2)	**SE4354/OA4603** Test & Evaluation (4-0)	Track Elective (?-?)	**SE3201** Engineering Systems Conceptualization (2-4)	**SE3814** Technical Writing II (2-0)
QTR 5 Fall/Spring 10-14	**OS 4680** Naval Systems Analysis (4-0)	**SE 4113** Unconventional Weapons (CBNRE) (3-2)	**SE0811** Thesis Research (0-8)	**SE3202** Engineering Systems Design (2-4)	**SE3000** SE Colloquium (1-0)
QTR 6 Winter/Summer 7-22	**EO 2701** Introduction to Cyber Systems (4-2)	**SE0811** Thesis Research (0-8)	**SE0811** Thesis Research (0-8)	**SE3203** Engineering Systems Implementation (2-4)	**SE3000** SE Colloquium (1-0)
QTR 7 Spring/Fall 7+? – 16+?	SE Elective (?-?)	SE Elective (?-?)	**SE0811** Thesis Research (0-8)	Track Elective (?-?)	**SE3000** SE Colloquium (1-0)

Foundation Skills
SE Core
SE Electives
Track Courses
Thesis Slots
Project Sequence
Graduate Success/ Professional Development

SE (580) Ship Systems Track Course Matrix (As of January 2018) – Fall Entry, Summer Refresher

Refresher Summer 15-7	SE1001 Math I for SEA (4-2)	SE2003 Fundamentals of Mechanical Systems (4-2)	SE1002 Math II for SEA (3-1)	SE2101 Fundamentals of Electromagnetic Systems (4-2)	
QTR 1 Fall 16-7	SE3100 Fundamentals of Systems Engineering (3-2)	SE2440 Intro to Scientific Programming (3-2)	OS3180 Probability and Statistics for SE (4-1)	SE 3112 Combat Sys Engineering I (Sensor Fund.) (4-2)	SE3811 Critical Thinking (2-0)
QTR 2 Winter 15-8	SI3400 Engineering Project Management (3-2)	SE 3250 Capabilities Engineering (3-2)	TS 3001 Fundamentals of Naval Architecture (3-2)	SE 4112 Combat Sys Engineering III (Sensor Tech) (4-2)	SE3812 Engineering Ethics (2-0)
QTR 3 Spring 15-8	SE3302 Systems Suitability (3-2)	SE4150 System Architecting and Design (3-2)	TS4001 Integration of Naval Engineering Systems (3-2)	SE 3113 Combat Sys Engineering II (Weapons) (4-2)	SE3813 Technical Writing I (2-0)
QTR 4 Summer 15-6	SE 3011 Engineering Cost Estimation (3-0)	SE 4115 Combat/Ship Systems Integration (4-2)	SE4354/OA4603 Test & Evaluation (4-0)	TS4002 Ship Design Integration (2-4)	SE3814 Technical Writing II (2-0)
QTR 5 Fall 13-6	OS 4680 Naval Systems Analysis (4-0)	SE 3121 Introduction to C4ISR (3-0)	TS3000 Electrical Power Engineering (3-2)	TS4003 Total Ship Systems Engineering (2-4)	SE3000 SE Colloquium (1-0)
QTR 6 Winter 5+?–18+?	EO 2701 Introduction to Cyber Systems (4-2)	SE Elective (?-?)	SE 0811 Thesis Research (0-8)	SE 0811 Thesis Research (0-8)	SE3000 SE Colloquium (1-0)
QTR 7 Spring 1+?–16+?	SE Elective (?-?)	Track Elective (?-?)	SE 0811 Thesis Research (0-8)	SE 0811 Thesis Research (0-8)	SE3000 SE Colloquium (1-0)

Foundation Skills
SE Core
SE Electives
Track Courses
Thesis Slots
Project Sequence
Graduate Success/ Professional Development

SE (580) Ship Systems Track Course Matrix (As of January 2018) –Spring Entry, Winter Refresher

Refresher Winter 15-7	**SE1001** Math I for SEA (4-2)	**SE2003** Fundamentals of Mechanical Systems (4-2)	**SE1002** Math II for SEA (3-1)	**SE2101** Fundamentals of Electromagnetic Systems (4-2)	
QTR 1 Spring 16-7	**SE3100** Fundamentals of Systems Engineering (3-2)	**SE2440** Intro to Scientific Programming (3-2)	**OS3180** Probability and Statistics for SE (4-1)	**SE 3112** Combat Sys Engineering I (Sensor Fund.) (4-2)	**SE3811** Critical Thinking (2-0)
QTR 2 Summer 15-6	**SI3400** Engineering Project Management (3-2)	**SE 3250** Capabilities Engineering (3-2)	**SE 3011** Engineering Cost Estimation (3-0)	**SE 4112** Combat Sys Engineering III (Sensor Tech)s (4-2)	**SE3812** Engineering Ethics (2-0)
QTR 3 Fall 15-8	**SE3302** Systems Suitability (3-2)	**SE4150** System Architecting and Design (3-2)	**TS3000** Electrical Power Engineering (3-2)	**SE 3113** Combat Sys Engineering II (Weapons) (4-2)	**SE3813** Technical Writing I (2-0)
QTR 4 Winter 16+?-4+?	**SE 4115** Combat Systems Integration (4-2)	**SE4354/OA4603** Test & Evaluation (4-0)	Track Elective (?-?)	**TS 3001** Fundamentals of Naval Architecture (3-2)	**SE3814** Technical Writing II (2-0)
QTR 5 Spring 11-10	**OS 4680** Naval Systems Analysis (4-0)	**SE 0811** Thesis Research (0-8)	**TS4001** Integration of Naval Systems Engineering (3-2)	**SE 3121** Introduction to C4ISR (3-0)	**SE3000** SE Colloquium (1-0)
QTR 6 Summer 7-22	**EO 2701** Introduction to Cyber Systems (4-2)	**SE 0811** Thesis Research (0-8)	**SE 0811** Thesis Research (0-8)	**TS4002** Ship Design Integration (2-4)	**SE3000** SE Colloquium (1-0)
QTR 7 Fall 9+?–12+?	SE Elective (?-?)	SE Elective (?-?)	**SE 0811** Thesis Research (0-8)	**TS4003** Total Ship Systems Engineering (2-4)	**SE3000** SE Colloquium (1-0)

Foundation Skills
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Exhibit 2. Criterion 4. Continuous Improvement Due-process Response

(From the ABET Final Statement to the NPS GSEAS Dean, August 11, 2014: Systems Engineering section only; pages 12-15)

FINAL STATEMENT **NAVAL POSTGRADUATE SCHOOL**

Systems Engineering
Program

General Criteria for Masters Level Programs
Program Criteria for Systems and Similarly Named Engineering Programs

Introduction

The resident master of science in systems engineering (MSSE) program was first accredited in 2011 and is located within the Department of Systems Engineering. It is one of nine units in the Graduate School of Engineering and Applied Sciences. The program was developed in 2006 to address the needs of the Navy. The program is designed to provide three primary domain tracks: combat systems, ship systems, and systems engineering and integration. In 2013, the program enrolled 74 students and produced 34 graduates. The program has 25 full-time and two part-time faculty members who support the resident program.

The institution did not provide a seven-day response to correct any factual errors for this program.

The General Criteria for Masters Level Programs require the fulfillment of the baccalaureate level general criteria. Shortcomings related to this requirement are cited below with reference to each relevant numbered criterion included in the General Criteria for Baccalaureate Level Programs.

Program Strength

1. The program is valued highly by its sponsors and its primary constituency – the United States Navy. The commitment to the program on the part of these constituents and the value they perceive the program has are demonstrated by their active involvement on the Systems Engineering Oversight Council and their request to grow the number of cohorts in the program. This strong association has resulted in continuous quality improvements within the program curriculum.

Program Weaknesses

1. Criterion 7. Facilities This criterion requires that modern tools, equipment, computing resources and laboratories be available, accessible, and systematically maintained and upgraded. While there is evidence that modern tools, equipment and laboratories are available, the number

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available and availability of access to equipment and facilities is not sufficient to meet the needs of the growing program. Therefore strength of compliance with this criterion is lacking.

- Due-process response: The EAC acknowledges receipt of documentation indicating that the program has purchased and installed equipment, including a 3-D printer, a laser cutter, cameras and computing hardware. In addition, two laboratories have been upgraded with new laboratory benches. The program has reached agreements with other programs to share over 5000 square feet of laboratory space. In addition, two rooms totaling 1000 square feet have been transferred to the program.

- The weakness is resolved.

2. Criterion 8. Institutional Support This criterion requires that resources including institutional services, financial support, and staff (both administrative and technical) provided to the program be adequate to meet program needs. While the enrollment in the program has doubled over the past three years, institutional resources do not appear to be provided proportionally to the program. Consequently, program needs are barely met and important program related operations (such as course level assessment and evaluation, monitoring students for course selection, undergraduate equivalency checking) are not fully executed. This criterion also requires institutional support sufficient to acquire, maintain, and operate infrastructure, facilities, and equipment. The necessary support for additional infrastructure, facilities, and equipment has not kept up with the enrollment growth. The funding for instructional laboratories and equipment has seen a significant decrease, with no funding provided in FY11 and FY13. Less than five percent of the five year lab capitalization plan has been funded. Continued lack of funding will negatively affect the quality of the program, limiting its ability to make necessary continuous quality improvements.Strength of compliance with this criterion is lacking.

   - Due-process response: The EAC acknowledges receipt of documentation stating that the program has received an increase in program funding and a one-time grant of $75,000 for addressing program needs. Academic associates are now receiving a 25 percent release from teaching to accomplish student advising and equivalency verification. Three staff members have been assigned responsibilities to address undergraduate equivalency and

student outcome assessment. Approximately $700,000 has been provided for equipment purchases.

- The weakness is resolved.

Program Concerns

1. Criterion 1. Students This criterion requires that student progress be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. A number of instances of students taking courses without the required prerequisites, course substitutions, or permission of instructor were noted. These instances occurred when the courses were electives taken outside of the systems engineering program. This inconsistent monitoring of student progress could place future compliance with this criterion in jeopardy.

   - Due-process response: The EAC acknowledges receipt of documentation that indicates the program has made appropriate changes in the monitoring of student progress to eliminate prerequisite violations.

   - The concern is resolved.

2. Criterion 4. Continuous Improvement This criterion requires that the program regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. While the program defines six student outcomes and maps them to the student outcomes (a) through (k), it is difficult to discern how attainment of each of the (a) through (k) outcomes is being assessed and evaluated. Therefore, it is difficult to evaluate how the assessments these student outcomes articulated in the baccalaureate level general criteria are used as input in the continuous improvement of the program. Thus, future compliance with this criterion may be jeopardized.

   - Due-process response: The EAC acknowledges documentation stating that the program has decided to use ABET student outcomes (a) through (k) for assessment in the continuous improvement process with a resulting update of the assessment process. The changes in the assessment process are currently being implemented.

- The concern remains unresolved.

3. General Criteria for Masters Level Programs The criteria for masters level programs include fulfillment of the baccalaureate level general criteria. A documented process is in place to establish undergraduate equivalency for students without an ABET EAC accredited undergraduate degree, and all transcripts examined provided evidence that students met graduation requirements. The process, however, showed numerous irregularities and inconsistencies. Although all transcripts examined demonstrated this requirement was met, these irregularities and inconsistencies suggest that future compliance with this criterion may be jeopardized.

   - Due-process response: The EAC acknowledges receipt of documentation stating that the program has allocated additional staff to address irregularities and inconsistences in the evaluation of undergraduate transcripts. In addition, academic advisors have been given a 25 percent assignment for advising.

   - The concern is resolved.

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Exhibit 3. SE Department Instruction – Faculty 1.4

SEDEPTINST FAC 1.4
12 Feb 2018

SEDEPT INSTRUCTION - FACULTY 1.4

From: Chair, System Engineering Department

Subj: CONTINUOUS IMPROVEMENT PROCESS – ASSESSMENT OF STUDENT OUTCOMES

Ref: (a) ABET Policy and Procedure Manual, 1 April 2017
(b) ABET Engineering Accreditation Commission (EAC) Criteria for Accrediting Engineering Programs, 20 October 2017
(c) Secretary of the Navy Manual 5210.1 (Records Management Manual), January 2012

Encl: (1) SE Program Student Outcomes
(2) ABET Criterion 3 Student Outcomes
(3) SE Student Outcome Assessment Matrices
(4) SE Data Collection and Assessment Schedules
(5) Program Educational Objectives (PEO) and Educational Skill Requirements (ESR)
(6) Activities for Possible Feedback for Program Improvement

1. Purpose

a. The primary purpose of this instruction is to provide SE department faculty with Continuous Improvement (CI) process information and procedural guidance for assessing, analyzing, evaluating and documenting student outcomes (Enclosure 1). This information is used as an indicator as to how well the student outcomes are attained by students for program quality assessment. A secondary purpose is to provide a process for periodic review of program educational objectives (PEO).

b. The SE program student outcomes are derived from a combination of ESR (Enclosure 5) and ABET Criterion 3 (Enclosure 3). The Systems Engineering (SE) department uses assessment of student outcomes as the main basis of our CI program. The CI program's data collection, analysis, evaluation, and documentation provides the SE department with assessment and reporting structures to help guide decision-making for program improvement. The CI program is part of a holistic framework to measure, analyze, assess, track, and continually improve progress for student achievement of learning outcomes towards development of critical skills and competencies in systems engineering and related areas in the interests of mission accomplishment. CI analysis and reporting also supports ABET accreditation, information for SE department strategic planning vision and goals, sponsor program reviews, as well as SE data and reporting for Naval

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Postgraduate School (NPS) accreditation by the WASC Senior College and University Commission (WSCUC).

c. The department uses program educational objectives (PEO) to document what students are expected to attain within about 3-5 years after graduation. The SE PEO are tied closely to Educational Skill Requirements for a respective program. Review of the ESR during formal Curriculum Reviews (CR) is used as the basis for periodic verification of PEO. Enclosure 5 includes the PEO, ESR, and a mapping of PEO to ESR for reference.

2. Cancellation. This instruction supersedes SEDEPTINST FAC 1.4 (Student Portfolios – Faculty Analysis and Assessment of a Course) dated 15 October 2015.

3. Responsibilities.

a. Department Chair. The SE Department Chair ("the Chair") has overall accountability and responsibility for the SE Department's CI program. The Chair provides the overall direction to department faculty and staff to execute the CI program, and ensure adequate resources are available to support the program. The Chair represents the SE Department to higher academic administration in the presentation of CI results and improvement actions. The Chair appoints or recruits departmental personnel to assist in the administration and execution of the CI program as required. The Chair may choose to delegate some CI responsibilities to other departmental faculty as necessary.

b. Department ABET Coordinator. The SE Department's ABET Coordinator ("ABET Coordinator") is a faculty volunteer or appointee by the Chair, and is responsible for the overall supervision of the department's efforts to attain or retain ABET accreditation of specific SE degree programs (References a and b). The ABET Coordinator assigns faculty and/or staff members to assist in the data collection and assessment process. There is significant overlap between the SE department CI program and the ABET program accreditation reporting, since ABET accreditation efforts depend in part on assessment of student outcomes and the successful operation of a CI process. The SE department CI program may include assessments of items that are outside the interest of the ABET EAC accreditation that may be useful to provide information about the status of our general curriculum (Enclosure 6). The ABET Coordinator typically presents the CI results annually. The ABET Coordinator may determine that if the results of student outcome assessment indicate that all target attainment values are met in an AY, a full formal faculty briefing may not be necessary. Results of all student outcome assessments shall be posted to the SE department share drive folder for access by the SE department faculty and staff at any time. The ABET Coordinator and the SE staff involved in data analysis shall maintain and archive all spreadsheets used for assessment.

c. Faculty. The faculty reviews the results of CI efforts to determine how well students have met the student outcomes. The ABET Coordinator typically presents the results annually. The ABET Coordinator is responsible for the presentation of the results based on the data

collected and analyzed from a previous academic year (AY). For example, the faculty meets during AY19 to review the evaluation of the data collected and analyzed in AY18 that gives evidence to support the achievement of the specific student outcomes under consideration during AY18.

d. Course Coordinators. The Course Coordinators shall prepare overall course assessments, based on analysis of the course journals from the instructors teaching a course in an AY. These assessments may provide insight into student learning that might be useful in mitigating any shortfalls in attainment of student outcomes, in general. Course Coordinators post overall course assessments for their respective courses to the appropriate course journal folder.

e. Course Instructors. The instructors for each course taught in the SE Department are responsible for preparing and submitting a course journal every quarter for each class taught that quarter. The course journals provide the documentation and raw data needed by the Course Coordinator to perform some of the student outcome assessments. Course journals may provide insight into student learning that might be useful in mitigating any shortfalls in attainment of student outcomes, in general. As part of the course journal, instructors shall include samples of student work from that course sufficient to support the assessment of student attainment of learning outcomes. Typically, the final project provides the best source for assessing student outcomes for a course. Instructors shall post course journals on the department shared drive by course, then AY, then academic quarter.

f. Capstone/thesis advisor(s) and second readers. The NPS Capstone/Thesis Assessment process is a campus-wide standard process. Capstone/thesis advisor(s) and second readers are responsible for completing an NPS Capstone Assessment Instrument evaluation for each capstone report or thesis during the student's graduation quarter. Each reviewer evaluates each capstone project report or thesis against each outcome using a five-level scale and a rubric in an on-line format. Each advisor, co-advisor, and/or second reader for the capstone report or thesis must individually complete an assessment; the departmental goal is to have at two assessments of each report. Python enforces a workflow such that a student capstone project report or thesis cannot proceed to final approval unless the advisor, co-advisor, and/or second reader have completed the evaluation. The Chair may choose at this/her discretion to withhold departmental approval of a capstone report/thesis until completion of the assessment by the advisors.

4. Data Collection. Raw data collected from several sources is used as the input to the SE department assessment spreadsheets. In general, specific student outcome data is analyzed on a three-year cycle where each outcome is assessed every three years over a six-year full cycle. Because there are seven outcomes, this means that the data collection process takes place for two to three outcomes per year. Assessment is done on an AY basis. The data sources are:

a. NPS Capstone Assessment Instrument. Data from the NPS Capstone Assessment Instrument is used to assess attainment of student outcomes 1, 2, 5, 6, and 7. The capstone assessment data is supplied to the SE department from the NPS Institutional Research, Reporting, & Analysis (IRRA) office via a spreadsheet.

b. Systems Analysis. Data for student outcome 3 assessment is obtained from SE3250 Capability Engineering coursework and exams. This data is provided to the ABET Coordinator by the SE3250 Course Coordinator, who determines the best learning objective evidence to be used as the basis of assessment.

c. Teamwork and Project Management. Data for student outcome 4 assessment is obtained from faculty evaluations of project teams during SE3203. The evaluation is conducted using a SE department created evaluation form deployed as a spreadsheet. The spreadsheet data is provided to the SE3203 Course Coordinator, who organizes the data for submission to the ABET Coordinator for analysis.

All source data used for assessment is stored and archived on the SE share drive.

5. Assessment of Student Outcomes

a. Method. All data collected is organized and disaggregated so that assessment of only students for a respective program is accomplished. Only student data from respective ABET accredited degree programs are to be used as a basis for those assessment calculations. Enclosure 3 summarizes the educational strategies, data sources, and target attainment values related to each student outcome. The data is processed in a SE department developed spreadsheet that computes the number of students attaining our desired value for each student outcome due for assessment in a specific AY. Each spreadsheet contains detailed instructions as to the organization and calculation of attainment results. The results are analyzed to determine if threshold or goal values have been attained. If the analysis results indicate that a threshold value has not been attained, the results are evaluated to determine if any actions should be taken to the program to improve the respective student outcome results. If evaluation indicates a change may be needed, the results are discussed by the faculty to determine a course of action appropriate to the situation. Any changes needed and actions taken are documented with follow up presented back to the faculty and/or program constituencies, as needed. Details of the results of all student outcome assessment, analyses, and evaluation are maintained in SE department share drive folder for archiving and access.

b. Assessment Schedule. The SE Department uses a three-year rotating data collection and assessment cycle that results in each outcome being assessed twice within a six-year period. Note that this means that every student outcome is not assessed every year. The assessment schedule lags the data collection schedule (Enclosure 4) by one year. The SE Chair may modify the outcomes assessed (with sufficient lead-time to modify data collection) to support curriculum reviews or other departmental requirements.

c. Achievement Targets. The achievement target for the assessments is 75% of students achieving a level of "proficient" or higher on a cumulative basis. The target may be refined as we gain more experience in our student outcome assessment and student performance.

d. Interpretation of Results. The assessments measure attainment of student outcomes. If all scores meet or exceed the target levels, this indicates that the program is operating in a satisfactory manner, and changes probably are not needed. If scores are less than the target value for any student outcome, this may indicate a need to change some part of a program. The faculty should evaluate and investigate the possible root causes and decide if any changes should be made or not, including rationale. Any proposed changes to the curriculum shall be documented and shared with the faculty before making any permanent changes. A summary of the results of these assessments shall be shared with faculty, as well as respective curriculum sponsors either annually or during regularly scheduled CR.

6. Records Management. Records created as a result of this instruction, regardless of media and format, will be managed per Secretary of the Navy Manual 5210.1 of January 2012 (reference c).

7. Review and Effective Date. The SE Department will review this instruction annually on the anniversary of its effective date to ensure applicability, currency, and consistency with applicable policies and directives. This instruction will automatically expire five years after effective date unless reissued or canceled prior to the five-year anniversary date, or an extension has been granted.

8. Forms or Information Management Control. When a directive mandates the use of a form or contains an information collection requirement (reports), the form number and title of the form or the report control symbol and title of the information collection requirement, or both, must be identified in the last paragraph of the instruction. Also state where the forms may be obtained and how information should be submitted.

RONALD E. GIACHETTI
Professor and Chair, Systems Engineering

Releasability and distribution:
This instruction is cleared for public release and is available electronically via the System Engineering Department share drive.

ENCLOSURE 1. SE Program Student Outcomes

There are seven systems engineering student outcomes that are the same for both the MSSE and MSSE-DL programs. These are published in the academic catalogue. They are:

1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.

2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.

3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization and trade-space management, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.

4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions and apply interpersonal skills in communications. Demonstrate competence in the planning and management of authentic systems engineering projects.

5. Demonstrate effective communication through written and oral presentation of technical material.

6. Demonstrate an understanding of professional and ethical responsibility.

7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.

ENCLOSURE 2. ABET Criterion 3 Student Outcomes

Reference (b) provides the following definition of the term student outcomes:

"Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program."

"**Criterion 3. Student Outcomes**
The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

a. an ability to apply knowledge of mathematics, science, and engineering

b. an ability to design and conduct experiments, as well as to analyze and interpret data

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d. an ability to function on multidisciplinary teams

e. an ability to identify, formulate, and solve engineering problems

f. an understanding of professional and ethical responsibility

g. an ability to communicate effectively

h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i. a recognition of the need for, and an ability to engage in life-long learning

j. a knowledge of contemporary issues

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice."

These student outcomes were developed based on synthesizing our sponsor ESR with integration of Criterion 3 (a) – (k). ABET EAC Criterion 3 (a) – (k) are mapped to student outcomes in Table 1 to show how these are integrated into our program.

Table 1. NPS Program Student Outcomes Mapped to Criterion 3 (a) – (k)

	Broad education	*Design a system*	*Systems analysis*	*Function on teams*	*Communication*	*Professional and ethical responsibility*	*Life-long learning and knowledge of contemporary issues*
a. Math and science	X						
b. Design and construct experiments	X		X				
c. Design a system		X					
d. Function on multi-disciplinary teams				X			
e. Solve engineering problems							
f. Professional and ethical responsibility						X	
g. Communicate effectively					X		
h. Broad education	X						
i. Life-long learning							X
j. Contemporary issues							X
k. Modern engineering tools	X	X	X				

ENCLOSURE 3. SE Student Outcome Assessment Matrices

Tables 2 – 8 summarize student outcome educational strategies, methods of assessment, where data are collected, schedules, and targets.

Table 2. Outcome Assessments Documentation Student Outcome 1

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	SE3100, SE3302, SE4150	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2015 Wtr 2018	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Table 3. Outcome Assessments Documentation Student Outcome 2

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	SE3100 SE4150	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2016 Wtr 2019	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Table 4. Outcome Assessments Documentation Student Outcome 3

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	OS3180, SE3011, SE3250	Coursework evaluation	SE3250	3	Wtr 2014 Wtr 2017	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Table 5. Outcome Assessments Documentation Student Outcome 4

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	SE3811 Critical Thinking SE3812 Ethics in Systems Engineering: Soft Skills, Teaming, MBTI and ILS SI3400 Fundamentals of Project Management (for project planning and management) SE3201, SE3202, SE3203 Project Advisor perspectives on Team Projects	NPS Capstone Evaluation Form (2015 only)	Theses and Project Reports	3	Wtr 2015 Wtr 2018	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed
		Project advisor and co-advisor teamwork evaluation (2018 only)	SE3203				Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Table 6. Outcome Assessments Documentation Student Outcome 5

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	SE3813 Technical Writing for Systems Engineers I, SE3814 Technical Writing for Systems Engineers II, Thesis	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2016 Wtr 2019	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Table 7. Outcome Assessments Documentation Student Outcome 6

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate an understanding of professional and ethical responsibility.	SE3811 Critical Thinking, SE3812 Ethics in Systems Engineering, SE3201, SE3202, SE3203, Thesis	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2014 Wtr 2017	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

Table 8. Outcome Assessments Documentation Student Outcome 7

Performance Criteria	Educational Strategies	Method(s) of Assessment	Where data are collected	Length of assessment cycle (yrs)	Year(s)/quarter(s) of data collection	Target for Performance	Actual Performance Attained
Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	SE3811 Critical Thinking, SE3812 Ethics in Systems Engineering, Thesis	NPS Capstone Assessment Instrument	Theses and Project Reports	3	Wtr 2015 Wtr 2018	Mean > 4.0 Or Proficient or Higher Goal 90% Threshold 75%	Value as computed

If actual performance attained is greater than the target for performance, then this is satisfactory, and no corrective action is necessary. If actual performance attained is below the target for performance, then investigation, analysis, and corrective action or continued monitoring may be required.

ENCLOSURE 4. SE Data Collection and Assessment Schedules

Table 9 shows a six-year data collection cycle where data supporting each outcome is collected every three years.

Table 9. Data Collection Cycle for Seven Student Outcomes

Student Outcomes	AY 14	AY 15	AY 16	AY 17	AY 18
1. Broad education		●			●
2. Application of SE methods & processes			●		
3. Core skills of systems analysis	●			●	
4. Teamwork		●			●
5. Oral and written communications			●		
6. Ethical responsibility	●			●	
7. Life-long learning and contemporary issues		●			●

ENCLOSURE 5. Program Educational Objectives (PEO) and Educational Skill Requirements (ESR)

The program educational objectives (PEO) are published in the catalog. The general public can access the catalog on the NPS website. They are reproduced here:

> The overall educational objective of the Systems Engineering program is to support the NPS mission by producing graduates who have, at an advanced level, knowledge and technical competence in systems engineering and an application domain; and who can use that knowledge and competence to support national security. Specific program objectives (i.e., skills and abilities that graduates can bring to their position after having graduated from NPS and receiving 3-5 more years of on-the-job training and professional development) are:
>
> - Technical Leadership: Graduates will be known and respected for applying their engineering knowledge in leadership roles along diverse career paths in government service.
> - Program Management: Graduates will be known and respected for their research, design, development, procurement, integration, maintenance, and life-cycle management of systems for defense and national security.
> - Operational Utilization: Graduates will be known and respected for their application of systems engineering in diverse military settings and understand its capabilities and limitations.

The PEO are derived from curriculum educational skill requirements (ESR). Each curriculum is required to have a set of ESR. NPS Instruction 1550.1G Guidelines for Conducting Curricular Reviews is the governing instruction for maintenance of fully-funded graduate education programs. The 580 curriculum is the resident systems engineering masters education program. The following paragraph and list of ESR is taken from the Systems Engineering Curriculum 580 section of the NPS Academic Catalog.

Officers entering the Systems Engineering curriculum will be offered the necessary preparatory-level courses to satisfy the equivalent of a baccalaureate degree in engineering. They shall meet, as a minimum, the requirements set forth by the Engineering Accreditation Commission of ABET. At the graduate level, the officer will acquire the competence to effectively contribute as a systems engineer to naval systems research, design, development, maintenance and acquisition. The officer will gain the ability to effectively integrate future technological, engineering, and acquisition approaches with existing practice through a combination of core systems engineering courses, specialization studies, and project/thesis research. An officer will meet the below-listed ESRs through the completion of a program of study determined by the officer, the Program Officer, and the Academic Associate. Individual programs, and how they support the officer's attainment of the ESRs, will be specifically designed to meet the needs of the Navy and the officer's interests.

1. **Undergraduate Mathematics and Basic Sciences:** Understand and apply engineering-baccalaureate-equivalent mathematics and basic sciences. For mathematics, this includes

single- and multi-variable differential and integral calculus, ordinary differential equations, probability, and statistics. Basic sciences include physics, chemistry, and terrestrial sciences. This can be met by the appropriate undergraduate work.

2. **Capability Engineering:** Model and analyze military operations in the context of achieving needed capability. Apply model-based systems engineering approaches, based on UML or SysML, and modeling and simulation techniques, and be able to assess legacy systems, emerging technological concepts, and as-yet-to-be-developed concepts into the joint warfighting environment considering technology readiness levels, effectiveness, cost, and risk. Understand the process of warfighting gaps to synthesis of as-yet-realized system concepts to meet emerging capability needs. Understand and apply modeling and simulation to include deterministic and stochastic modeling of systems, economic models, cost models, and life-cycle suitability analyses. This includes the ability to develop original discrete-event and continuous run-time simulations, as well some familiarity with large-scale government and commercial warfighting simulations.
3. **System Architecting:** Perform system architecting, applying and integrating methods for both software and hardware aspects. Construct feasible system functional and physical architectures that represent a balanced approach to meeting stakeholder needs and expectations, stated, implied, and derived system requirements, and suitability objectives such as being open, modular, extensible, maintainable, and reusable. Understand system architecture frameworks and their role in architecture development. Use model-based systems engineering techniques, based on UML or SySML to create, define, and develop system architectures. Develop, analyze, and compare alternative architectures against appropriate, system-level evaluation criteria and select the best based on quantitative and qualitative analysis, as appropriate.
4. **System Design:** Understand and apply the system design process in a holistic context, applying and integrating methods for both software and hardware aspects including identifying capability need, defining requirements, conducting functional analysis and allocation to hardware, software, and human elements, creating a system functional design, designing a system, deriving and defining requirement specifications, allocating requirement specifications to sub-systems (for hardware, software, and human elements), design for suitability, including reliability, availability, maintainability, operability, and logistical supportability, perform system assessment by conducting trade-off studies, evaluating system design alternatives against system capability need expressed as military effectiveness, estimating and analyzing the system cost and risk, including risk mitigation strategies, integrating human elements into the system design, and analyzing and planning for system testing and evaluation.
5. **Engineering Design Analysis:** Understand and apply core qualitative and quantitative methods of engineering design analysis, to include problem formulation, alternatives development, alternatives modeling and evaluation, alternatives comparison, optimization, decision analysis, failure analysis, risk analysis, and futures analysis. Mathematical techniques may include multiple criteria optimization, design of experiments, response surface methods, set-based design, real options, systems dynamics, and probabilistic analyses.

6. **System Integration and Development:** Apply the core skills of system integration and development to include integrating relevant technological disciplines that bear on the system effectiveness and cost, including weapons, sensor and information systems, while being responsive to realistic military capability need and warfighting effectiveness, requirements, functions, specifications, cost, and risk. Integrate systems and analyze aspects during the entire life-cycle. Understand system realization methods and processes, including prototyping and production. Apply production quality methods for continuous process improvement, such as statistical process control, lean, and six sigma.
7. **System Test & Evaluation:** Apply the core skills of system test and evaluation to include system effectiveness while being responsive to realistic military capability need and warfighting effectiveness, requirements, functions, and specifications. Evaluate systems and analyze test and evaluation aspects during the entire life-cycle using inferential statistics methods, including design of experiments (DOE) and analysis of variance (ANOVA). Apply fundamental verification and validation principles to systems development methods.
8. **Human Systems Integration:** Address human factors during requirements definition, as well as workload, safety, training, operability and ergonomics during design. Conduct functional analysis and allocation to human elements, performing cost-risk-effectiveness trade-offs among hardware, software, and human elements. Evaluate proposed designs for man-machine integration, human performance testing, and usability during development test and evaluation. Understand basic human biology as applied to human systems.
9. **Project Management:** Work as a team member or leader on a military systems engineering project. Demonstrate an understanding of project management principles. Demonstrate competence in the planning and management of complex projects. Understand the principles of and apply current industry approaches and technology to manage systems design, integration, test, and evaluation for large engineering projects.
10. **Specialization:** Demonstrate in-depth understanding of the principles, technologies, and systems used in at least one major specialty area. These areas can be specific warfare areas, such as combat systems, total ship systems, EW, IW, avionics, undersea warfare, or net-centric systems, a single traditional engineering specialty, such as mechanical, electrical, software, aerospace engineering, or naval architecture, or specialized disciplines such as human factors, availability, or safety. Demonstrate in-depth understanding of the scientific and engineering principles of the respective specialty, such as sensors, weapons, C4I systems, information systems, ship structures, hydrodynamics, power systems, and reliability. Demonstrate broad understanding of systems context of the specialization. Apply that understanding to the design of system components, sub-systems, and interfaces in the holistic context of the engineering of systems.
11. **Cyber*:** Understand and apply the fundamentals of the underlying principles of cyber infrastructure and systems; inherent vulnerabilities and threats, including industrial control systems; and defensive security procedures. (*ESR required for 14XX designators only)

12. **Thesis:** Conduct independent analysis and research in the area of Systems Engineering, and show proficiency in presenting the results in writing and orally by means of a thesis and command-oriented briefing appropriate to this curriculum.

Program Educational Objectives and Educational Skill Requirements perform similar functions as the basis for defining what students should be able to achieve within several years of graduation from a masters program. In addition, both ESR and PEO are directed at the same set of stakeholders for our graduates. Since ESR are tied directly to billets and jobs in defense systems engineering, ESR are used as the basis for review, with PEO being mapped to them to provide traceability from ESR to PEO. In this way, if changes are required to ESR, changes needed to PEO can be determined. The mapping of PEO to ESR is provided in Table 10.

Table 10. ESR to PEO Mapping

	Technical Leadership	Program Management	Operational Utilization
Basic Math and Science	X	X	X
Capability Engineering	X		X
System Architecting	X		X
System Design	X		X
Engineering Design Analysis	X		X
System Integration and Development	X		X
System Test & Evaluation	X		X
Human Systems Integration	X	X	X
Project Management		X	
Specialization	X		X
Cyber	X	X	X
Thesis	X		

ENCLOSURE 6. Activities for Possible Feedback for Program Improvement

The list of opportunities for feedback on various aspects of program performance is shown in Table 11.

Table 11. Sources of Information for Program Assessment.

Item #	Item and Description	Review Periodicity
1	Student capstone project report and thesis outcome evaluations for evidence of achievement of student outcomes, as recorded on an on-line NPS-wide Capstone Assessment Instrument.	Annual
2	Student course work for evidence of attainment of student outcomes.	As needed
3	Feedback from the major sponsor curriculum review process every two years, available in PowerPoint presentation and letter form.	Bi-annual
4	Systems Engineering Stakeholders Group (SESG) and Systems Engineering Educational Consortium (SEEC) meetings held twice a year, as recorded in presentations and minutes.	Semi-Annual
5	Department and faculty meetings, held weekly.	Weekly
6	Student Course Evaluation Form (CEF) evaluations, completed by students for every quarter for every course taught and reviewed by the SE department Chair.	Quarterly
7	Student feedback sessions, held every quarter for resident students.	Quarterly
8	Student exit surveys, completed before graduation.	Annually
9	Course journals, completed every quarter, and course coordinator summary reports based on course journals, completed annually.	Annual
10	Suggestions for improvement in the annual faculty activity reports.	Annual
11	Results of faculty studies, as performed.	As completed
12	Results of inspections, such as the annual safety inspection of the labs and department spaces.	As completed

13	Published curricular benchmarks, such as the INCOSE reference curriculum article in Insight from 2007, the Fabrycky 2010 article on graduate SE programs, the 2012 Graduate Reference Curriculum for Systems Engineering, and the INCOSE Certification Exam assessment form in 2019.	As completed
14	Student Learning Confidence surveys, completed at various times when necessary during some part of the program, and analyzed by the SE department Chair. These are typically only used when a sponsor requires specific feedback on how their students perceive various aspects of their education and learning.	As needed

The items in Table 11 are used on an ongoing basis for determining if program changes are needed. Items 1, 2, and 3 are used as sources of data as a regular part of our CI process for primary quantitative measures of attaining student outcomes. Items 3 and 4 offer opportunities for presentation of results to stakeholders and for feedback from stakeholders. Item 5, weekly department and faculty meetings, are the primary means of communicating efforts, conducting dialogue, providing status, proposing changes, and making decisions regarding the program. The rest of the items provide sources of information that are used for program improvement efforts if the results indicate that a change might be necessary.

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Exhibit 4. Student Transcript Analysis Forms

Department of Systems Engineering
Checklist for BSSE Degree Equivalence

The Department of Systems Engineering at the Naval Postgraduate School is accredited at the advanced level through the Accreditation Board of Engineering and Technology. Students earning a Master of Science in Systems Engineering at NPS, must either have attained an ABET accredited undergraduate Systems Engineering degree, or earned the equivalency of a Bachelor of Science Degree in Systems Engineering. Some courses from the student's undergraduate institution may count toward that equivalency, even though his/her final undergraduate may not have been in Systems Engineering. Some courses taken at NPS may also be applied to meeting this undergraduate equivalency. This checklist is provided to document the completion of that equivalency.

First and Last Name: **Geoffrey Fastabend**
Quarter enrolled at NPS: **March 2016**
Exp. Graduation: **December 2017**

Do you have an ABET accredited BSSE Degree? if **YES**, use "Tab" **ABET BSSE**, if **NO**, complete the rest of this checklist.
If unsure check ABET web site here

Undergraduate Institutions Attended	Degree Earned	Type in Dates [From and To]
United States Naval Academy	Mathematics	2004-2006, 2009-2011

BSSE Equivalence Summary			
I. Mathematics II. Basic Science	Total Mathematics & Basic Science Credits **45 required**	MET	**109.50**
III. General Education			**91.50**
IV. A. Engineering Science			**61.50**
B. Engineering Design			**12.00**
Total Engineering Science Credits (Sect IV. A, C and D (Engineering Science Hours))			**90.50**
Total Engineering Design Credits (Sect IV. B, C and D (Engineering Design Hours))			**12.00**
	Total Engineering Science and Design Credits **67 ½ required**	MET	**102.50**
V. Group Capstone Design Project	**Taking [course w/major design experience]**	MET	
All categories above must be **MET** for the minimum requirements for the equivalency of the BSSE degree.		MET	

I certify that the information on this checklist is correct at the time of my graduation, and accurately documents courses I have completed to satisfy BSSE equivalence.

Student Signature: FASTABEND.GEOFFREY.EAR L.1152764835 Digitally signed by FASTABEND.GEOFFREY.EARL.1152764835 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=FASTABEND.GEOFFREY.EARL.1152764835 Date: 2017.12.11 10:15:50 -08'00'

Processing BSSE checklist: Upon completion, create form to PDF. (Click the Acrobat tab from the Tool bar, then click Create PDF), E-sign cover page (hand written signature, okay) forward to the Academic Associate for review/signature.

Department of Systems Engineering

I certify that this student ----Has MET---- the minimum requirements for the equivalency of the BSSE degree.

Academic Associate: STEVENS.MARK.RICHARD.11539 61251 Digitally signed by STEVENS.MARK.RICHARD.1153961251 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=STEVENS.MARK.RICHARD.1153961251 Date: 2017.12.11 11:15:54 -08'00'

Forward ↓

A-K outcomes satisfied and filed.

Program Officer: GREENE.TODD.REYNOLDS.1028140220 Digitally signed by GREENE.TODD.REYNOLDS.1028140220 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GREENE.TODD.REYNOLDS.1028140220 Date: 2017.12.12 12:05:46 -08'00'

Forward ↓

Department Chair: GIACHETTI.RONALD.E.1407150984 Digitally signed by GIACHETTI.RONALD.E.1407150984 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GIACHETTI.RONALD.E.1407150984 Date: 2017.12.12 10:49:20 -08'00'

Forward ↓

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I. MATHEMATICS

A. A minimum of one year (45 quarter credit hours or 30 semester credit hours) of a combination of college-level mathematics and basic sciences (some with experimental experience) is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
United States Naval Academy	SM131	Calculus I			3.0
United States Naval Academy	SM122	Calculus II			4.0
United States Naval Academy	SM221	Calculus III W Vector Fields			4.0
United States Naval Academy	SM261	Matrix Theory			3.0
United States Naval Academy	SM280	Topics in Mathematics			1.0
United States Naval Academy	SM291	Fundamentals of Mathematics I			3.0
United States Naval Academy	SM222	Differential Equations with Matrices			4.0
United States Naval Academy	SM233	Introduction to Applied Mathematics			3.0
United States Naval Academy	SM365	Introduction to Scientific Computing			4.0
United States Naval Academy	SM331	Advanced Calculus I			4.0
United States Naval Academy	SM239	Probability and Statistics I			3.0
United States Naval Academy	SM339	Applied Statistics I			3.0
United States Naval Academy	SA401	Linear Models and Optimization			3.0
United States Naval Academy	SM342	Discrete Mathematics			3.0
United States Naval Academy	SA421	Simulation Modeling			3.0
United States Naval Academy	SM421	Actuarial Modeling			3.0
United States Naval Academy	SM474	SMP Capstone			3.0

		Total Quarter Credit Hours	0.0		
		Total Lab Credit Hours		0	
		Total Semester Credit Hours			54.0
		Total Math Credits			81.00

II. BASIC SCIENCES

A. A minimum of one year (45 quarter credit hours or 30 semester credit hours) of a combination of college-level mathematics and basic sciences (some with experimental experience) is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
United States Naval Academy	SC111	Foundations of Chemistry I			4.0
United States Naval Academy	SC112	Foundations of Chemistry II			4.0
United States Naval Academy	SP211	General Physics I			4.0
United States Naval Academy	SP212	General Physics II			4.0
United States Naval Academy	SO244	Basic Atmospheric Processes			3.0

		Total Quarter Credit Hours	0.0		
		Total Lab Credit Hours		0	
		Total Semester Credit Hours			19.0
		Total Mathematics & Basic Science Credits (45 required)			109.50

III. GENERAL EDUCATION

A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives is required List subjects other than mathematics, basic science, computer science, and engineering – for example, Humanities and Social Sciences. Examples of traditional subjects in these areas are philosophy, religions, history, literature, fine arts, sociology, psychology, political science, anthropology, economics, and foreign language. Examples of non-acceptable courses include physical education.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
United States Naval Academy	FP130	US Government and Constitutional Development			3.0
United States Naval Academy	NL112	Leadership and Human behavior			2.0
United States Naval Academy	HE111	Rhetoric and introduction to literature I			3.0
United States Naval Academy	NS100	Fundamentals of Naval Science			4.0
United States Naval Academy	HH104	American Naval History			3.0
United States Naval Academy	HE112	Rhetoric and introduction to literature II			3.0
United States Naval Academy	HH205	Western Civilization: Culture, Ethics and Society			3.0
United States Naval Academy	NN204	Navigation and Piloting			3.0
United States Naval Academy	HH206	Civilization and the Atlantic Community since 1776			3.0

United States Naval Academy	NE203	Ethics and Moral Reasoning for the Naval Leader			3.0
United States Naval Academy	FS202	Intermediate Spanish II			3.0
United States Naval Academy	FS201	Intermediate Spanish I			3.0
United States Naval Academy	FS104	Basic Spanish II			3.0
United States Naval Academy	FS103	Basic Spanish I			3.0
United States Naval Academy	NL310	Leadership: Theory and Application			3.0
United States Naval Academy	FS485	Spanish Beyond Immersion			3.0
United States Naval Academy	NS300	Naval Warfare			1.0
United States Naval Academy	FS412	Contemporary Latin American Civilization			3.0
United States Naval Academy	FS486A	Latin American Culture through Film			3.0
United States Naval Academy	FS422	Spanish American Literature			3.0
United States Naval Academy	NS422	JO Practicum			1.0
United States Naval Academy	NL400	Law for the Junior Officer			2.0
		Total Quarter Credit Hours	**0.0**		
		Total Lab Credit Hours		**0**	
		Total Semester Credit Hours			**61.00**
		Total General Education Credits			**91.50**

IV. ENGINEERING SCIENCE AND ENGINEERING DESIGN

One and one half years (67 ½ quarter credit hours or 45 semester credit hours) of engineering topics, consisting of engineering science and engineering design appropriate to the field of study are required.

A. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering on the other. List all engineering science courses, passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours (weekly lecture hours plus one half of lab hours).

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
United States Naval Academy	EE301	Electrical Fundamentals and applications			4.0
United States Naval Academy	ES360	Control systems Laboratory			1.0
United States Naval Academy	EE302	Electronic Communications Systems and Digital Communications			4.0
United States Naval Academy	EM300	Principles of Propulsion			4.0
United States Naval Academy	EM300L	Principles of Propulsion Lab			1.0
United States Naval Academy	EN400	Principles of Ship Performance			4.0
United States Naval Academy	ES300	Naval Weapons Systems			3.0
Naval Postgraduate School	SE3112	Cbt Systems Eng. I - Sensor Fund.	4	2	
Naval Postgraduate School	SE3113	Cbt Systems Eng. II - Weapons	4	2	
Naval Postgraduate School	SE3121	Intro to C4ISR	3	0	
Naval Postgraduate School	SE4112	Cbt Systems Eng. III - Sensor Tech.	4	2	
Naval Postgraduate School	SE4003	Software Systems Engineering	3	2	
Naval Postgraduate School	TS3000	Electrical Power Engineering	3	2	
Naval Postgraduate School	TS3001	Naval Architecture	3	2	
		Total Quarter Credit Hours	**30.0**		
		Total Lab Credit Hours		**12**	
		Total Semester Credit Hours			**21.0**
		Total Engineering Science Credits			**61.50**

B. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. List all engineering design courses, not in the curriculum list in Part IV.A, passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
Naval Postgraduate School	SE3201	Engineering Systems Conceptualizatino	2	4	
Naval Postgraduate School	SE3202	Engineering Systems Design	2	4	
Naval Postgraduate School	SE3203	Engineering Systems Implementation & Operation	2	4	
		Total Quarter Credit Hours	**12.0**		
		Total Lab Credit Hours		**12**	
		Total Semester Credit Hours			**0.0**
		Total Engineering Design Credits			**12.00**

C. DoD officers are entitled to certain college credit based on service schools attended (Nuclear Power School, DCA School, MPA School, etc.) If you have attended any technical DoD schools, including in a prior enlisted status, list those service schools by Title. See your Program Officer for evaluation of those courses based on publications by the American Council on Education. If applicable, the Engineering Science Hours may be added to the total as identified below.

University	Course Number	Title	Engr Semester Credit Hrs.	Engr Design Semester Credit Hrs.
Nuclear Power School	NU3009	Electrical Power Engineering and Machinery theory	5.0	
Nuclear Power School	NU3159	Heat Transfer	4.0	
Nuclear Power School	NU3209	Deformation, Fracture and Failure Analysis	4.0	
Nuclear Power School	NU3249	Power Plant Sytems	4.0	
Nuclear Power School	NU3819	Radiological Fundamentals	4.0	
Nuclear Power School	NU4809	Reactor Dynamics	4.0	
Nuclear Power School	NU4819	Reactor Operations	4.0	
		Total Service Related Systems Engr Science Credit Hours	29	
		Systems Engineering Semester Hours converted to Quarter Credit Hours	43.5	
		Total Service Related Engineering Design Credit Hours		0.0
		Engineering Science Semester Hours converted to Quarter Hours		0.00

D. NPS/Test Pilot School program.		MM/Year of completion	
☑ box if you have completed the TPS phase of the program.	☐	N/A	

Academic Policy Manual (Transferring Credit 6.6.3). A special dispensation exists for students in the Cooperative NPS/Test Pilot School Program. Students in this program may be granted 12 hours of 4000-level credits upon graduation from the TPS phase of the program. A copy of the TPS transcripts is required to be eligible for this benefit. Forward copy to NPS Registrar@nps.edu

V. GROUP CAPSTONE DESIGN PROJECT

Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. A major design experience at or beyond the advanced undergraduate level is the minimum requirement. Briefly describe your major design experience. This requirement can be satisfied by completing a course with a major design experience that has been previously approved by the NPS SE department curriculum committee.

Taking [course w/major design experience]

I. Background

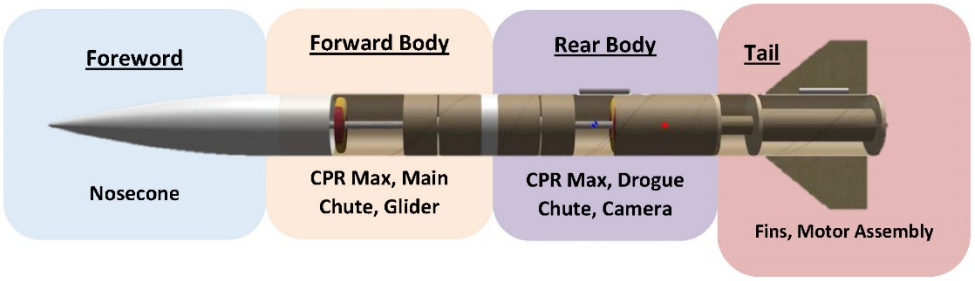
The project team utilized different portions of a ½ scale Patriot Missile kit from Public Missiles. Together the students applied the Systems Engineering techniques to explore how a system development moves through four phases of idea conception, design, implementation and operation. The goals of this project included: successfully build and model the rocket, successfully deploy a payload package, successfully recover all payloads and the rocket.

A. System Operational Concept

Once the rocket was built, it was brought to a launch site in Mojave, CA. The rocket propellant was shipped by a third party and installed on site by qualified personnel. The rocket was then be placed on a stationary launch rail and fired. The rocket was designed to reach its maximum velocity and the engine will burn out. The piston ejector will force the rocket main airframe to separate from the payload causing the parachute to eject and the rocket will drift to the ground.

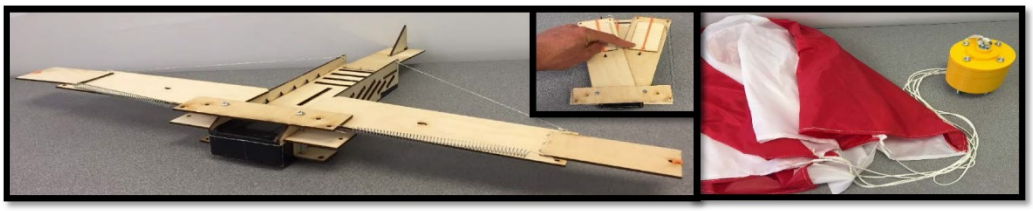
B. System Description

The rocket kit that was utilized was the ½ scale Patriot missile made by Public Missile. The rocket was separated into four sections, the forward section which contains the nosecone, the forward body section which contains the glider, CPR Max, and main parachute, the rear body section which houses the aft part of the CPR Max, drogue chute and camera, and finally the tail section which holds the fins and motor assembly. Figure 1 depicts the various sections and shows the relevant components.



The construction of this rocket was more complicated as there were many aspects that were more sophisticated than the first rocket build (design class number two). Opposed to one piston with one parachute, there were two pistons with two parachutes. Instead of the motor initiating a charge to push the piston up, there were four charges set off by programed avionics. While the first rocket used one Raven and had no payload, the second rocket utilized two Ravens and had two payload sections. Lastly, the diameter and length of the second rocket was roughly twice the size of the first rocket build making it more difficult to secure and assemble the different parts. The construction was completed utilizing some of the instructions from the Public Missiles' package and some of the instructions from the supplemental CPR Max kit. All other modifications were done using an analysis of alternatives. Similar to the scaled composites tour, the group used two existing kits combined with custom modifications to make the product we desired.

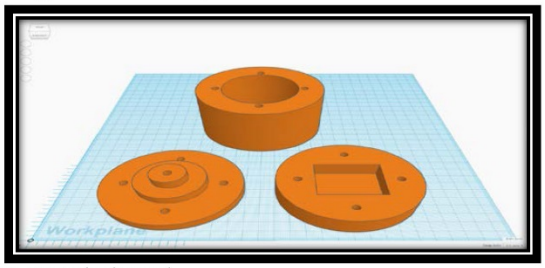
Fin jigs were utilized in order to ensure perfect alignment of the fins during construction which was imperative to ensure a stable flight. Sufficient dry times were allowed for the epoxy in a well ventilated room and all areas where epoxy was applied was either sanded or scored before hand to ensure proper adhesion.



After the rocket was finished the group noticed that in order to fit both surveillance payloads into the rocket, an additional two inch ring needed to be added between the nose cone and forward body section. To ensure the weight of the rocket was correct to ensure stable flight by having the center of mass as far as possible from the center of thrust, the group added 1000 grams of a metal and epoxy mixture into the inside tip of the nose cone. The quick fix moved the center of mass up approximately 5 inches and proved to be a wise choice to guarantee stable flight. The mounting lugs were mounted between the fins and at the center of gravity.

2. Payload Construction

The designing of the payload sections was first done with pencil and paper in order to formulate general designs. The 360 camera landing pod was then created in the open source TINKERCAD software, saved as a .STL file and was 3D printed in the robo dojo lab. Fasteners were purchased from Home Depot. Figure 3 below provides a design view of the objects created in TINKERCAD.



KERCAD rendering of 360 camera landing pod

The glider was designed in Corel Draw at the Robo Dojo and was laser cut on thin alder plywood. The fasteners and springs were purchased from the Home Depot. In order to have the various sections pop out during flight after being folded in the rocket, springs and rubber bands were utilized to provide the necessary tension.

II. Testing and Evaluation

A. Flight Testing

The flight was conducted on August 19, 2017 at the Friends of Amateur Rocketry site in Mojave, CA. The FAR site is located in the Fremont Valley between the Rand and El Paso mountains. These mountains shield the launch site from some of the high altitude winds, however the Santa Anna winds have a tendency to increase later in the day as temperatures rise during the summer months. Mojave and Ridgecrest may have 45-MPH winds and FAR site can be calm. The motor was loaded on site and then installed in the rocket.

Rocket lift off was initially slow due to the heavy size of the rocket, but sufficient thrust was achieved and liftoff occurred in a timely fashion. There was a slight rotation to the rocket due to a light wind that was encountered during the time of launch. Burnout occurred without issue and the rocket promptly achieved apogee. At this point the first charge from the CPR-Max was discharged expelling the drogue chute along with the high altitude reconnaissance package. The high altitude payload quickly deployed its small parachute and slowed its descent to the ground.

During descent at 1250 feet the second charge was ignited releasing the main parachute and the reconnaissance glider. The payload cleanly exited the rocket and presented no collision threat. All payload were recovered on the ground with no sustained damage and with slight preparation time would be deployable immediately.

Section to be filled out by Academic Associate after reviewing the student academic background, identifying the evidence that satisfied the criteria.

Student name: Fastabend, Geoffrey Cohort: Dec. 2017

Student has demonstrated that he/she has:	*Satisfied by (Check all that apply)*			
	Course Work	*Design Experience*	*Work or Military Experience*	*Comments*
An ability to apply knowledge of mathematics, science, and engineering	✓	✓		
An ability to design and conduct experiments, as well as to analyze and interpret data	✓			
An ability to design a system, component, or process to meet desired needs	✓	✓		
An ability to function on multidisciplinary teams	✓	✓		
An ability to identify, formulate, and solve engineering problems	✓	✓		
An understanding of professional and ethical responsibility	✓		✓	
An ability to communicate effectively	✓		✓	
The broad education necessary to understand the impact of engineering solutions in a global and societal context	✓			
A recognition of the need for, and an ability to engage in life-long learning	✓		✓	
A knowledge of contemporary issues	✓		✓	
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	✓			

Completed by: STEVENS.MARK.RICHARD.1153961251 Digitally signed by STEVENS.MARK.RICHARD.1153961251 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=STEVENS.MARK.RICHARD.1153961251 Date: 2017.12.01 14:07:58 -08'00'.

Student: **Fastabend, Geoffrey**

Minimal degree requirements
Worksheet for MSSE

ABET undergraduate			
Total grad course credits	39.5	ok	Must exceed 36 hours
Total 4000 level course credits	16	ok	Must exceed 16 hours
Thesis /Capstone	16	ok	Must exceed 12 hours

Credits	Courses Included?	Core	Thesis / capstone	3000 level credits	4000 level credits	
			16	23.5	16	
4	1	SE3100		4		Core. Absence / substitution requires approval of chair
4	1	SI3400		4		Core. Absence / substitution requires approval of chair
4	1	SE3302		4		Core. Absence / substitution requires approval of chair
4	1	SE4150			4	Core. Absence / substitution requires approval of chair
4	4	Thesis/Capstone	16			
		Others				
3	1	SE3011		3		
4		SE3101		0		
4		SE3112		0		
4		SE3113		0		
3		SE3121		0		
3		SE3122		0		
3		SE3123		0		
4.5	1	OS3180		4.5		
4	1	SE3250		4		
3.5		OS/OA3401		0		
2		SE3811/12		0		
3		SE3900		0		
4		SE4003			0	
4		SE4112			0	
4		SE4113			0	
4	1	SE4115			4	
4		SE4151			0	
4		SE 4353/ME4745/OS4010			0	
4	1	SE4354/OA4603			4	
3		SE4900			0	
4		MN4310			0	
4	1	OS4680			4	
5		ME3240		0		
4		TS3001		0		
3		ME4901			0	
4		TS3000		0		
4.5		ME4751			0	

Department of Systems Engineering
Checklist for BSSE Degree Equivalence

The Department of Systems Engineering at the Naval Postgraduate School is accredited at the advanced level through the Accreditation Board of Engineering and Technology. Students earning a Master of Science in Systems Engineering at NPS, must either have attained an ABET accredited undergraduate Systems Engineering degree, or earned the equivalency of a Bachelor of Science Degree in Systems Engineering. Some courses from the student's undergraduate institution may count toward that equivalency, even though his/her final undergraduate may not have been in Systems Engineering. Some courses taken at NPS may also be applied to meeting this undergraduate equivalency. This checklist is provided to document the completion of that equivalency.

First and **L**ast Name: **Alexander Samaniego**
Quarter enrolled at NPS: **March 2016**
Exp. Graduation: **December 2017**

Do you have an ABET accredited BSSE Degree? if **YES**, use "Tab" **ABET BSSE**, if **NO**, complete the rest of this checklist.
If unsure check ABET web site here

Undergraduate Institutions Attended	Degree Earned	Type in Dates [From and To]
U.S. Naval Academy	BS Applied Mathematics	August 2007 - March 2011

BSSE Equivalence Summary			
I. Mathematics II. Basic Science	Total Mathematics & Basic Science Credits **45 required**	**MET**	**102.00**
III. General Education			**63.00**
IV. A. Engineering Science			**60.50**
B. Engineering Design			**12.00**
Total Engineering Science Credits (Sect IV. A, C and D (Engineering Science Hours))			**60.50**
Total Engineering Design Credits (Sect IV. B, C and D (Engineering Design Hours))			**41.00**
	Total Engineering Science and Design Credits **67 ½ required**	**MET**	**101.50**
V. Group Capstone Design Project	**Taking [course w/major design experience]**	**MET**	
All categories above must be **MET** for the minimum requirements for the equivalency of the BSSE degree.		**MET**	

I certify that the information on this checklist is correct at the time of my graduation, and accurately documents courses I have completed to satisfy BSSE equivalence.

Student Signature: SAMANIEGO.ALEXANDER.KYLE.1299132850 Digitally signed by SAMANIEGO.ALEXANDER.KYLE.1299132850 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=SAMANIEGO.ALEXANDER.KYLE.1299132850 Date: 2017.12.08 16:41:23 -08'00'

Processing BSSE checklist: Upon completion, create form to PDF. (Click the Acrobat tab from the Tool bar, then click Create PDF), E-sign cover page (hand written signature, okay) forward to the Academic Associate for review/signature.

Department of Systems Engineering

I certify that this student ----Has MET---- the minimum requirements for the equivalency of the BSSE degree.

Academic Associate: STEVENS.MARK.RICHARD.1153961251 Digitally signed by STEVENS.MARK.RICHARD.1153961251 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=STEVENS.MARK.RICHARD.1153961251 Date: 2017.12.11 11:17:42 -08'00'

Forward ↓

A-K outcomes satisfied and filed.

Program Officer: GREENE.TODD.REYNOLDS.1028140220 Digitally signed by GREENE.TODD.REYNOLDS.1028140220 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GREENE.TODD.REYNOLDS.1028140220 Date: 2017.12.12 12:07:11 -08'00'

Forward ↓

Department Chair: GIACHETTI.RONALD.E.1407150984 Digitally signed by GIACHETTI.RONALD.E.1407150984 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GIACHETTI.RONALD.E.1407150984 Date: 2017.12.12 10:50:51 -08'00'

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I. MATHEMATICS

A. A minimum of one year (45 quarter credit hours or 30 semester credit hours) of a combination of college-level mathematics and basic sciences (some with experimental experience) is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
U.S. Naval Academy	SM121	Calculus I			4.0
U.S. Naval Academy	SM122	Calculus II			4.0
U.S. Naval Academy	SM221	Calc III with Vector Fields			4.0
U.S. Naval Academy	SM280	Topics in Mathematics			1.0
U.S. Naval Academy	SM222	Differential Equations with Matrices			4.0
U.S. Naval Academy	SM261	Matrix Theory			3.0
U.S. Naval Academy	SM233	Intro to Applied Mathematics			3.0
U.S. Naval Academy	SM291	Fundamentals of Mathematics			3.0
U.S. Naval Academy	SM239	Probability and Statistics I			3.0
U.S. Naval Academy	SM331	Advanced Calculus I			4.0
U.S. Naval Academy	SM365	Intro to Scientific Computing			4.0
U.S. Naval Academy	SM342	Discrete Mathematics			3.0
U.S. Naval Academy	SA430	Logistics			3.0
U.S. Naval Academy	SA410	Applications of Search and Detection			3.0
U.S. Naval Academy	SM279	Multivariable Calculus			3.0
		Total Quarter Credit Hours	0.0		
		Total Lab Credit Hours		0	
		Total Semester Credit Hours			49.0
		Total Math Credits			73.50

II. BASIC SCIENCES					
A. A minimum of one year (45 quarter credit hours or 30 semester credit hours) of a combination of college-level mathematics and basic sciences (some with experimental experience) is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.					
University	**Course Number**	**Title**	**Quarter Credit Hrs.**	**Quarter Lab Hrs.**	**Semester Credit Hrs.**
U.S. Naval Academy	SC111	Foundations of Chemistry I			4.0
U.S. Naval Academy	SC112	Foundations of Chemistry II			4.0
U.S. Naval Academy	SP211	General Physics I			4.0
U.S. Naval Academy	SP212	General Physics II			4.0
U.S. Naval Academy	SP350	The Physics of Motorsports			3.0
		Total Quarter Credit Hours	**0.0**		
		Total Lab Credit Hours		**0**	
		Total Semester Credit Hours			**19.0**
		Total Mathematics & Basic Science Credits **(45 required)**			**102.00**

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III. GENERAL EDUCATION

A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives is required List subjects other than mathematics, basic science, computer science, and engineering – for example, Humanities and Social Sciences. Examples of traditional subjects in these areas are philosophy, religions, history, literature, fine arts, sociology, psychology, political science, anthropology, economics, and foreign language. Examples of non-acceptable courses include physical education.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
U.S. Naval Academy	NS101	Seamanship			2.0
U.S. Naval Academy	NL110	Preparing to Lead			2.0
U.S. Naval Academy	HH104	American Naval History			3.0
U.S. Naval Academy	HE111W	Rhetoric and Intro to Literature I			3.0
U.S. Naval Academy	NN101	Intro to Navigation			2.0
U.S. Naval Academy	FP130	U.S. Government			3.0
U.S. Naval Academy	HE112W	Rhetoric and Intro to Literature II			3.0
U.S. Naval Academy	HH215	The West in a Global Context			3.0
U.S. Naval Academy	NN200	Navigation and Piloting			2.0
U.S. Naval Academy	HH216	The West in the Modern World			3.0
U.S. Naval Academy	NE203	Ethics and Moral Reasoning			3.0
U.S. Naval Academy	NL310	Leadership			3.0
U.S. Naval Academy	NL450	Social Inequality			3.0
U.S. Naval Academy	NS300	Naval Warfare			1.0
U.S. Naval Academy	NL400	Law for the Junior Officer			2.0
U.S. Naval Academy	NS422	JO Practicum			1.0
U.S. Naval Academy	FE210	Intro to Economics			3.0
		Total Quarter Credit Hours	0.0		
		Total Lab Credit Hours		0	
		Total Semester Credit Hours			42.00

Total General Education Credits	**63.00**

IV. ENGINEERING SCIENCE AND ENGINEERING DESIGN

One and one half years (67 ½ quarter credit hours or 45 semester credit hours) of engineering topics, consisting of engineering science and engineering design appropriate to the field of study are required.

A. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering on the other. List all engineering science courses, passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours (weekly lecture hours plus one half of lab hours).

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
U.S. Naval Academy	EE301	Electrical Fundamentals and Apps.			4.0
U.S. Naval Academy	ES360	Control Systems Lab			1.0
U.S. Naval Academy	EE302	Electronic Comm Sys and Digital Com			4.0
U.S. Naval Academy	EM300	Principles of Propulsion			4.0
U.S. Naval Academy	ES300	Naval Weapons Systems			3.0
U.S. Naval Academy	EN400	Principles of Ship Performance			4.0
U.S. Naval Academy	EM486J	Naval Applications of Lasers			3.0
Naval Postgraduate School	SE3112	Cbt. Systems Engr. I - Sensor Fund.	4	2	
Naval Postgraduate School	SE3113	Cbt. Systems Engr. II - Weapons	4	2	
Naval Postgraduate School	SE4112	Cbt. Systems Engr. III - Sensor Tech	4	2	
Naval Postgraduate School	SE3121	Intro to C4ISR	3	0	
Naval Postgraduate School	TS3000	Electrical Power Engineering	3	2	
Naval Postgraduate School	TS3001	Naval Architecture	3	2	
		Total Quarter Credit Hours	**26.0**		
		Total Lab Credit Hours		**10**	
		Total Semester Credit Hours			**23.0**
		Total Engineering Science Credits			**60.50**

B. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. List all engineering design courses, not in the curriculum list in Part IV.A, passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
Naval Postgraduate School	SE3201	Engineering Systems Conceptualization	2	4	
Naval Postgraduate School	SE3202	Engineering Systems Design	2	4	
Naval Postgraduate School	SE3203	Engineering Systems Implementation & Operation	2	4	
		Total Quarter Credit Hours	**12.0**		
		Total Lab Credit Hours		**12**	

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Total Semester Credit Hours	**0.0**
Total Engineering Design Credits	**12.00**

C. DoD officers are entitled to certain college credit based on service schools attended (Nuclear Power School, DCA School, MPA School, etc.) If you have attended any technical DoD schools, including in a prior enlisted status, list those service schools by Title. See your Program Officer for evaluation of those courses based on publications by the American Council on Education. If applicable, the Engineering Science Hours may be added to the total as identified below.

University	Course Number	Title	Engr Semester Credit Hrs.	Engr Design Semester Credit Hrs.
Nuclear Power School	NU3009	Electrical Power Engineering and Machine Theory		5.0
Nuclear Power School	NU3159	Heat Transfer		4.0
Nuclear Power School	NU3209	Deformation, Fracture and Failure Analysis		4.0
Nuclear Power School	NU3249	Power Plant Systems		4.0
Nuclear Power School	NU3819	Radiological Fundamentals		4.0
Nuclear Power School	NU4809	Reactor Dynamics		4.0
Nuclear Power School	NU4819	Reactor Operations		4.0
		Total Service Related Systems Engr Science Credit Hours	**0**	
		Systems Engineering Semester Hours converted to Quarter Credit Hours	**0.0**	
		Total Service Related Engineering Design Credit Hours		**29.0**
		Engineering Science Semester Hours converted to Quarter Hours		**43.50**

D. NPS/Test Pilot School program.		**MM/Year of completion**	
☑ box if you have completed the TPS phase of the program.	☐	N/A	

Academic Policy Manual (Transferring Credit 6.6.3). A special dispensation exists for students in the Cooperative NPS/Test Pilot School Program. Students in this program may be granted 12 hours of 4000-level credits upon graduation from the TPS phase of the program. A copy of the TPS transcripts is required to be eligible for this benefit. Forward copy to NPS Registrar@nps.edu

V. GROUP CAPSTONE DESIGN PROJECT

Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. A major design experience at or beyond the advanced undergraduate level is the minimum requirement. Briefly describe your major design experience. This requirement can be satisfied by completing a course with a major design experience that has been previously approved by the NPS SE department curriculum committee.

Taking [course w/major design experience]

I. Background

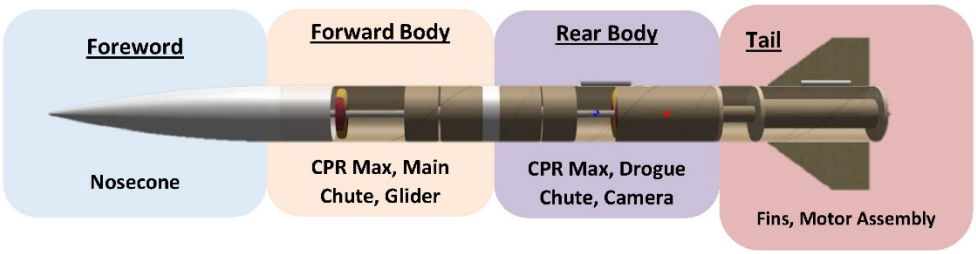
The project team utilized different portions of a ½ scale Patriot Missile kit from Public Missiles. Together the students applied the Systems Engineering techniques to explore how a system development moves through four phases of idea conception, design, implementation and operation. The goals of this project included: successfully build and model the rocket, successfully deploy a payload package, successfully recover all payloads and the rocket.

A. System Operational Concept

Once the rocket was built, it was brought to a launch site in Mojave, CA. The rocket propellant was shipped by a third party and installed on site by qualified personnel. The rocket was then be placed on a stationary launch rail and fired. The rocket was designed to reach its maximum velocity and the engine will burn out. The piston ejector will force the rocket main airframe to separate from the payload causing the parachute to eject and the rocket will drift to the ground.

B. System Description

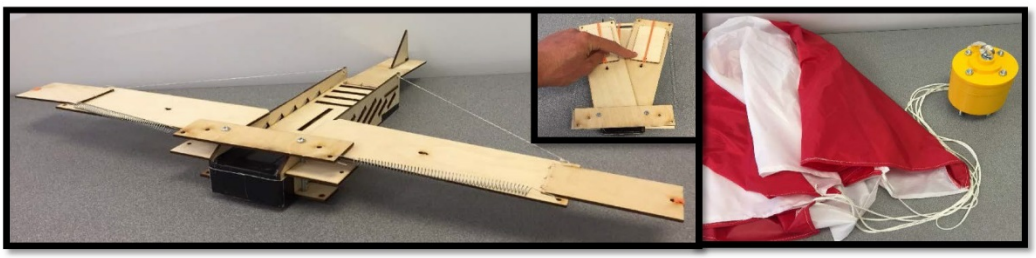
The rocket kit that was utilized was the ½ scale Patriot missile made by Public Missile. The rocket was separated into four sections, the forward section which contains the nosecone, the forward body section which contains the glider, CPR Max, and main parachute, the rear body section which houses the aft part of the CPR Max, drogue chute and camera, and finally the tail section which holds the fins and motor assembly. Figure 1 depicts the various sections and shows the relevant components.



Page 8 of 11

The construction of this rocket was more complicated as there were many aspects that were more sophisticated than the first rocket build (design class number two). Opposed to one piston with one parachute, there were two pistons with two parachutes. Instead of the motor initiating a charge to push the piston up, there were four charges set off by programed avionics. While the first rocket used one Raven and had no payload, the second rocket utilized two Ravens and had two payload sections. Lastly, the diameter and length of the second rocket was roughly twice the size of the first rocket build making it more difficult to secure and assemble the different parts. The construction was completed utilizing some of the instructions from the Public Missiles' package and some of the instructions from the supplemental CPR Max kit. All other modifications were done using an analysis of alternatives. Similar to the scaled composites tour, the group used two existing kits combined with custom modifications to make the product we desired.

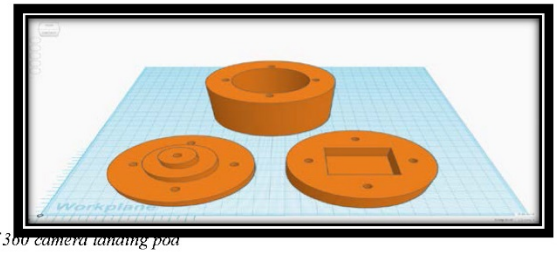
Fin jigs were utilized in order to ensure perfect alignment of the fins during construction which was imperative to ensure a stable flight. Sufficient dry times were allowed for the epoxy in a well ventilated room and all areas where epoxy was applied was either sanded or scored before hand to ensure proper adhesion.



After the rocket was finished the group noticed that in order to fit both surveillance payloads into the rocket, an additional two inch ring needed to be added between the nose cone and forward body section. To ensure the weight of the rocket was correct to ensure stable flight by having the center of mass as far as possible from the center of thrust, the group added 1000 grams of a metal and epoxy mixture into the inside tip of the nose cone. The quick fix moved the center of mass up approximately 5 inches and proved to be a wise choice to guarantee stable flight. The mounting lugs were mounted between the fins and at the center of gravity.

2. Payload Construction

The designing of the payload sections was first done with pencil and paper in order to formulate general designs. The 360 camera landing pod was then created in the open source TINKERCAD software, saved as a .STL file and was 3D printed in the robo dojo lab. Fasteners were purchased from Home Depot. Figure 3 below provides a design view of the objects created in TINKERCAD.



KERCAD rendering of 360 camera landing pod

The glider was designed in Corel Draw at the Robo Dojo and was laser cut on thin alder plywood. The fasteners and springs were purchased from the Home Depot. In order to have the various sections pop out during flight after being folded in the rocket, springs and rubber bands were utilized to provide the necessary tension.

II. Testing and Evaluation

A. Flight Testing

The flight was conducted on August 19, 2017 at the Friends of Amateur Rocketry site in Mojave, CA. The FAR site is located in the Fremont Valley between the Rand and El Paso mountains. These mountains shield the launch site from some of the high altitude winds, however the Santa Anna winds have a tendency to increase later in the day as temperatures rise during the summer months. Mojave and Ridgecrest may have 45-MPH winds and FAR site can be calm. The motor was loaded on site and then installed in the rocket.

Rocket lift off was initially slow due to the heavy size of the rocket, but sufficient thrust was achieved and liftoff occurred in a timely fashion. There was a slight rotation to the rocket due to a light wind that was encountered during the time of launch. Burnout occurred without issue and the rocket promptly achieved apogee. At this point the first charge from the CPR-Max was discharged expelling the drogue chute along with the high altitude reconnaissance package. The high altitude payload quickly deployed its small parachute and slowed its descent to the ground.

During descent at 1250 feet the second charge was ignited releasing the main parachute and the reconnaissance glider. The payload cleanly exited the rocket and presented no collision threat. All payload were recovered on the ground with no sustained damage and with slight preparation time would be deployable immediately.

The initial simulations indicated that the rocket would achieve an altitude of about 800 meters or 2600 feet. The acquired data from the rocket shows that the rocket came in at a peak around 2200 feet. The deployment times were consistent with the model and payload deployments occurred as programed.

III. Lessons Learned

With the increased tensions around the world it is important to understand how combat systems are developed, tested and implemented in order to prepare for the future. Proper planning and execution are intended to help avoid all future problems, but there are always lessons to be learned, even after an iterative process has been used. Initial construction did not have any significant problems as properly following the directions yielded success. One frustrating piece in the construction is that the CPR Max provided cables for integrating switches, but the limited length provided requires extending the length, which can introduce significant electronic errors. Early construction of the nose cone caused issues with adjusting the center of gravity of the rocket once payloads were completed. Part of this issue was that the payloads were created after the rocket construction without proper planning for weight restrictions as the weights were not yet known. This required cutting into the nose cone in order to install additional weights to balance out the stability.

Post launch analysis of the CPR Max revealed that one electrical connection from one altimeter had failed. This Raven was inactive during the flight and provided no redundant data, but due to building the rocket with an additional Raven, one set of data and deployment charges were ignited. This just proves the importance of having a redundant system so that proper information can be achieved.

Iterative testing is vital to mission success. During payload development various iterations of the system were tried and tested. Early versions of the glider failed flight tests and the overall design required readjustment. This learning process enabled a more successful launch and recovery of data.

Section to be filled out by Academic Associate after reviewing the student academic background, identifying the evidence that satisfied the criteria.

Student name: Samaniego, Alex Cohort: Dec. 2017

Student has demonstrated that he/she has:	*Satisfied by (Check all that apply)*			
	Course Work	*Design Experience*	*Work or Military Experience*	*Comments*
An ability to apply knowledge of mathematics, science, and engineering	✓	✓		
An ability to design and conduct experiments, as well as to analyze and interpret data	✓			
An ability to design a system, component, or process to meet desired needs	✓	✓		
An ability to function on multidisciplinary teams	✓	✓		
An ability to identify, formulate, and solve engineering problems	✓	✓		
An understanding of professional and ethical responsibility	✓		✓	
An ability to communicate effectively	✓		✓	
The broad education necessary to understand the impact of engineering solutions in a global and societal context	✓			
A recognition of the need for, and an ability to engage in life-long learning	✓		✓	
A knowledge of contemporary issues	✓		✓	
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	✓			

Completed by: STEVENS.MARK.RICHARD.1153961251 Digitally signed by STEVENS.MARK.RICHARD.1153961251 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=STEVENS.MARK.RICHARD.1153961251 Date: 2017.12.01 14:07:59 -08'00'.

Student: **Samaniego, Alex**

Minimal degree requirements
Worksheet for MSSE

ABET undergraduate			
Total grad course credits	39.5	ok	Must exceed 36 hours
Total 4000 level course credits	16	ok	Must exceed 16 hours
Thesis /Capstone	16	ok	Must exceed 12 hours

Credits	Courses Included?	Core	Thesis / capstone	3000 level credits	4000 level credits	
			16	23.5	16	
4	1	SE3100		4		Core. Absence / substitution requires approval of chair
4	1	SI3400		4		Core. Absence / substitution requires approval of chair
4	1	SE3302		4		Core. Absence / substitution requires approval of chair
4	1	SE4150			4	Core. Absence / substitution requires approval of chair
4	4	Thesis/Capstone	16			
		Others				
3	1	SE3011		3		
4		SE3101		0		
4		SE3112		0		
4		SE3113		0		
3		SE3121		0		
3		SE3122		0		
3		SE3123		0		
4.5	1	OS3180		4.5		
4	1	SE3250		4		
3.5		OS/OA3401		0		
2		SE3811/12		0		
3		SE3900		0		
4		SE4003			0	
4		SE4112			0	
4		SE4113			0	
4	1	SE4115			4	
4		SE4151			0	
4		SE 4353/ME4745/OS4010			0	
4	1	SE4354/OA4603			4	
3		SE4900			0	
4		MN4310			0	
4	1	OS4680			4	
5		ME3240		0		
4		TS3001		0		
3		ME4901			0	
4		TS3000		0		
4.5		ME4751			0	

Department of Systems Engineering
Checklist for BSSE Degree Equivalence

The Department of Systems Engineering at the Naval Postgraduate School is accredited at the advanced level through the Accreditation Board of Engineering and Technology. Students earning a Master of Science in Systems Engineering at NPS, must either have attained an ABET accredited undergraduate Systems Engineering degree, or earned the equivalency of a Bachelor of Science Degree in Systems Engineering. Some courses from the student's undergraduate institution may count toward that equivalency, even though his/her final undergraduate may not have been in Systems Engineering. Some courses taken at NPS may also be applied to meeting this undergraduate equivalency. This checklist is provided to document the completion of that equivalency.

First and **L**ast Name: **Andrew Whitmer**
Quarter enrolled at NPS: **December 2015**
Exp. Graduation: **June 2018**

Do you have an ABET accredited BSSE Degree? if **YES**, use "Tab" **ABET BSSE**, if **NO**, complete the rest of this checklist.
If unsure check ABET web site here

Undergraduate Institutions Attended	Degree Earned	Type in Dates [From and To]
University of Tennessee	BS - Physics	

BSSE Equivalence Summary			
I. Mathematics II. Basic Science	Total Mathematics & Basic Science Credits **45 required**	MET	**119.00**
III. General Education			**46.00**
IV. A. Engineering Science			**61.00**
B. Engineering Design			**20.00**
Total Engineering Science Credits (Sect IV. A, C and D (Engineering Science Hours))			**61.00**
Total Engineering Design Credits (Sect IV. B, C and D (Engineering Design Hours))			**20.00**
	Total Engineering Science and Design Credits **67 ½ required**	MET	**81.00**
V. Group Capstone Design Project	**Taking [course w/major design experience]**	MET	
All categories above must be **MET** for the minimum requirements for the equivalency of the BSSE degree.		MET	

I certify that the information on this checklist is correct at the time of my graduation, and accurately documents courses I have completed to satisfy BSSE equivalence.

Student Signature: WHITMER.ANDREW.ROBERT.1400746245 Digitally signed by WHITMER.ANDREW.ROBERT.1400746245 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=WHITMER.ANDREW.ROBERT.1400746245 Date: 2018.06.05 14:51:31 -07'00'

Processing BSSE checklist: Upon completion, create form to PDF. (Click the Acrobat tab from the Tool bar, then click Create PDF), E-sign cover page (hand written signature, okay) forward to the Academic Associate for review/signature.

Department of Systems Engineering

I certify that this student ----Has MET---- the minimum requirements for the equivalency of the BSSE degree.

Academic Associate: STEVENS.MARK.RICHARD.1153961251 Digitally signed by STEVENS.MARK.RICHARD.1153961251 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=STEVENS.MARK.RICHARD.1153961251 Date: 2018.06.05 15:17:00 -07'00'

Forward ↓ **A-K outcomes satisfied and filed.**

Program Officer: GREENE.TODD.REYNOLDS.1028140220 Digitally signed by GREENE.TODD.REYNOLDS.1028140220 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GREENE.TODD.REYNOLDS.1028140220 Date: 2018.06.06 14:03:40 -07'00'

Forward ↓

Department Chair: GIACHETTI.RONALD.E.1407150984 Digitally signed by GIACHETTI.RONALD.E.1407150984 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GIACHETTI.RONALD.E.1407150984 Date: 2018.06.06 16:09:37 -07'00'

Forward ↓

SE Program Office **Modified - July 2015**

Page 1 of 8

I. MATHEMATICS

A. A minimum of one year (45 quarter credit hours or 30 semester credit hours) of a combination of college-level mathematics and basic sciences (some with experimental experience) is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
University of Tennesee	MA141	Calculus I			4.0
University of Tennesee	MA 142	Calculus II			4.0
University of Tennesee	MA241	Calculus III			4.0
University of Tennesee	MA231	Differential Equations I			3.0
NPS	SE1001	Math for SE I	4	2	
NPS	SE1002	Math for SE II	3	1	
		Total Quarter Credit Hours	**8.5**		
		Total Lab Credit Hours		**3**	
		Total Semester Credit Hours			**15.0**
		Total Math Credits			**31.00**

Page 2 of 8

II. BASIC SCIENCES

A. A minimum of one year (45 quarter credit hours or 30 semester credit hours) of a combination of college-level mathematics and basic sciences (some with experimental experience) is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
University of Tennesee	Chem 120	General Chemistry I			4.0
University of Tennesee	Chem 130	General Chemistry II			4.0
University of Tennesee	Chem 350	Organic Chemistry I			3.0
University of Tennesee	Bio 130	Biodiversity			4.0
University of Tennesee	Bio 140	Organization & Function of Cells			4.0
University of Tennesee	PH137	Fund. Physics for Physics Majors I			5.0
University of Tennesee	PH138	Fund. Physics for Physics Majors II			5.0
University of Tennesee	PH250	Modern Physics			4.0
University of Tennesee	PH311	Mechanics I			3.0
University of Tennesee	PH312	Mechanics II			3.0
University of Tennesee	PH321	Thermal Physics			3.0
University of Tennesee	PH421	Modern Optics			4.0
University of Tennesee	PH431	Electricity and Magnetism I			3.0
University of Tennesee	PH432	Electricity and Magnetism II			3.0
NPS	SE2003	Fundamentals of Mechanical Systems	4	2	
NPS	SE2101	Fundamentals of EM Systems	4	2	
		Total Quarter Credit Hours	**10.0**		
		Total Lab Credit Hours		**4**	
		Total Semester Credit Hours			**52.0**
		Total Mathematics & Basic Science Credits **(45 required)**			**119.00**

III. GENERAL EDUCATION

A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives is required List subjects other than mathematics, basic science, computer science, and engineering – for example, Humanities and Social Sciences. Examples of traditional subjects in these areas are philosophy, religions, history, literature, fine arts, sociology, psychology, political science, anthropology, economics, and foreign language. Examples of non-acceptable courses include physical education.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
University of Tennesee	Engl101	English Comp I	3		
University of Tennesee	Psyc110	General Psychology	3		
University of Tennesee	Engl102	English Comp II	3		
University of Tennesee	Phil246	Bioethics	3		
University of Tennesee	PolSci102	Intro to Political Science	3		
University of Tennesee	Spanish 150	Intermed. Spanish Transition	3		
University of Tennesee	Music120	History of Rock	3		
University of Tennesee	Comm240	Business/Professional Comm.	3		
University of Tennesee	Hist255	Intro to Latin American Studies I	3		
University of Tennesee	Spanish 211	Intermediate Spanish I	3		
University of Tennesee	Health 110	Personal Health/Wellness	3		
University of Tennesee	Hist 256	Intro to Latin American Studies II	3		
University of Tennesee	Spanish 212	Intermediate Spanish II	3		
University of Tennesee	CompSci102	Intro to Computer Science	4		
University of Tennesee	Anthro360	North American Prehistory	3		
		Total Quarter Credit Hours	**46.0**		
		Total Lab Credit Hours		**0**	
		Total Semester Credit Hours			**0.00**
		Total General Education Credits			**46.00**

IV. ENGINEERING SCIENCE AND ENGINEERING DESIGN

One and one half years (67 ½ quarter credit hours or 45 semester credit hours) of engineering topics, consisting of engineering science and engineering design appropriate to the field of study are required.

A. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering on the other. List all engineering science courses, passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours (weekly lecture hours plus one half of lab hours).

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
NPS	AE2440	Intro to Scientifica Computing	4	2	
NPS	SE3112	Combat Sys. Engr I (Sensor Fund.)	4	2	
NPS	SE3113	Combat Sys. Engr II (Weapons)	4	2	
NPS	SE3121	Intro to C4ISR	3	2	
NPS	SE3250	Capabilities Engineering	3	2	
NPS	SE4112	Combat Sys. Engr III (Sensor Systems)	4	2	
NPS	SE4113	Unconventional Weapons	3	2	
NPS	SE4115	Combat Sys. Integration	4	2	
NUS	DTS5702	C3 Systems	4	0	
NUS	DTS5709	Sensor Technology and Systems	4	0	
NUS	DTS5726	Fund of SE and Architecting	4	0	
NUS	DTS5703	Operations Research	4	0	
NUS	DTS5705	Guided Weapons	4	0	
NUS	DTS5715	Information Assurance	4	0	
		Total Quarter Credit Hours	**61.0**		
		Total Lab Credit Hours		**16**	
		Total Semester Credit Hours			**0.0**
		Total Engineering Science Credits			**61.00**

B. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. List all engineering design courses, not in the curriculum list in Part IV.A, passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

University	Course Number	Title	Quarter Credit Hrs.	Quarter Lab Hrs.	Semester Credit Hrs.
NPS	SE3201	Engineering Systems Concept.	2	4	
NPS	SE3202	Engineering Systems Design	2	4	
NPS	SE3203	Engineering Systems Impl/Operation	2	4	
NUS	DTS5701	Large Scale Systems Engineering	4	0	
NUS	DTS5730	Graduate Seminar - Defense Tech	4	0	
		Total Quarter Credit Hours	**20.0**		
		Total Lab Credit Hours		**12**	
		Total Semester Credit Hours			**0.0**
		Total Engineering Design Credits			**20.00**

C. DoD officers are entitled to certain college credit based on service schools attended (Nuclear Power School, DCA School, MPA School, etc.) If you have attended any technical DoD schools, including in a prior enlisted status, list those service schools by Title. See your Program Officer for evaluation of those courses based on publications by the American Council on Education. If applicable, the Engineering Science Hours may be added to the total as identified below.

University	Course Number	Title	Engr Semester Credit Hrs.	Engr Design Semester Credit Hrs.
		Total Service Related Systems Engr Science Credit Hours	0	
		Systems Engineering Semester Hours converted to Quarter Credit Hours	0.0	
			Total Service Related Engineering Design Credit Hours	0.0
			Engineering Science Semester Hours converted to Quarter Hours	0.00

D. NPS/Test Pilot School program.		**MM/Year of completion**	
☑ box if you have completed the TPS phase of the program.	☐	N/A	

Academic Policy Manual (Transferring Credit 6.6.3). A special dispensation exists for students in the Cooperative NPS/Test Pilot School Program. Students in this program may be granted 12 hours of 4000-level credits upon graduation from the TPS phase of the program. A copy of the TPS transcripts is required to be eligible for this benefit. Forward copy to NPS Registrar@nps.edu

V. GROUP CAPSTONE DESIGN PROJECT
Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. A major design experience at or beyond the advanced undergraduate level is the minimum requirement. Briefly describe your major design experience. This requirement can be satisfied by completing a course with a major design experience that has been previously approved by the NPS SE department curriculum committee.
Taking [course w/major design experience]

The goal of the integrated project was to designed a cost-effective and resilient unmanned and manned system of systems capable of contributing to the Distributed Maritime Operations concept in the 2030-2035 timeframe. The design's contributions were focused on conducting a wide range of military operations in support of offensive operations in the air, surface, undersea, and cyber domains. Ultimately, system requirements were generated for platforms, sensors, active decoy package, manning, communication, and network connectivity. In order to complete the task, the group completed the following: define the task, identify the problem and solution spaces, develop a representative discrete event simulation model, and analyze the alternative force compositions in terms of the ability to perform the fundamental principles of distributed maritime operations.

The primary line of effort in the project was in defining the functional and physical architectures of the system, creating the discrete event simulation, and analyzing the data. Functional and physical architectures were created using CORE software. The discrete event simulation was created using ExtendSIM software. The discrete event simulation contained 149 individual platforms each capable of the tactical employment of electronic warfare systems as well as offensive and defensive countermeasures. 30,720 simulation runs were conducted, ultimately taking a total of 240 hours of computing time. The data was then analyzed using JMP software regression analysis tools in order to guide decision making on the optimal solution. In the end, we

The integrated project spanned a timeframe of 9 months using a mix of international and domestic students. It involved a significant amount of teamwork, especially in regards to defining the problem, creating architectures, and developing the discrete event simulation model.

Section to be filled out by Academic Associate after reviewing the student academic background, identifying the evidence that satisfied the criteria.

Student name: Whitmer, Andrew Cohort: Jun 2018

Student has demonstrated that he/she has:	*Satisfied by (Check all that apply)*			
	Course Work	*Design Experience*	*Work or Military Experience*	*Comments*
An ability to apply knowledge of mathematics, science, and engineering	✓	✓		
An ability to design and conduct experiments, as well as to analyze and interpret data	✓			
An ability to design a system, component, or process to meet desired needs	✓	✓		
An ability to function on multidisciplinary teams	✓	✓		
An ability to identify, formulate, and solve engineering problems	✓			
An understanding of professional and ethical responsibility	✓		✓	
An ability to communicate effectively	✓		✓	
The broad education necessary to understand the impact of engineering solutions in a global and societal context	✓		✓	
A recognition of the need for, and an ability to engage in life-long learning	✓		✓	
A knowledge of contemporary issues	✓		✓	
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	✓	✓		

Completed by: STEVENS.MARK.RICHARD.1153961251 Digitally signed by STEVENS.MARK.RICHARD.1153961251 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=STEVENS.MARK.RICHARD.1153961251 Date: 2018.06.05 14:14:42 -07'00'.

Student: **Whitmer, Andrew**

Minimal degree requirements
Worksheet for MSSE

ABET undergraduate			
Total grad course credits	37.5	ok	Must exceed 36 hours
Total 4000 level course credits	16	ok	Must exceed 16 hours
Thesis /Capstone	12	ok	Must exceed 12 hours

Credits	Courses Included?	Core	Thesis / capstone 12	3000 level credits 21.5	4000 level credits 16	
4	1	SE3100		4		Core. Absence / substitution requires approval of chair
4	1	SI3400		4		Core. Absence / substitution requires approval of chair
4	1	SE3302		4		Core. Absence / substitution requires approval of chair
4	1	SE4150			4	Core. Absence / substitution requires approval of chair
4	3	Thesis/Capstone	12			
		Others				
3	1	SE3011		3		
4		SE3101		0		
4		SE3112		0		
4		SE3113		0		
3		SE3121		0		
3		SE3122		0		
3		SE3123		0		
4.5	1	OS3180		4.5		
4		SE3250		0		
3.5		OS/OA3401		0		
2	1	SE3811/12		2		
3		SE3900		0		
4		SE4003			0	
4		SE4112			0	
4		SE4113			0	
4		SE4115			0	
4		SE4151			0	
4	1	SE 4353/ME4745/OS4010			4	
4	1	SE4354/OA4603			4	
3		SE4900			0	
4		MN4310			0	
4	1	OS4680			4	
5		ME3240		0		
4		TS3001		0		
3		ME4901			0	
4		TS3000		0		
4.5		ME4751			0	

Return to Main Document

Exhibit *5*. *NPS Capstone Assessment Instrument*

NPS Thesis/Capstone Instrument

The thesis/capstone assessment is filled out when faculty members approve the thesis or final project report. However, the thesis/capstone assessment is not about assessing the acceptability of the thesis/final project or assessing the role of faculty/advisors in the thesis/final project process. Instead, thesis/capstone assessment is an opportunity to comment on the degree to which students, through the thesis/final project report, demonstrate achievement of learning objectives we set for our programs. The primary goal of thesis/capstone assessments is to help identify possible areas within our programs where we need to improve.

Please reference the NPS Capstone Rubric for further definition of each dimension along the five-point scales.

PART I: STUDENT LEARNING OUTCOMES

This assessment tool measures outcomes related to the student's learning within an NPS academic program. Select the level of student achievement using the measures that the NPS faculty have identified as the set of fundamental program/student learning outcomes common to all masters programs at NPS.

	Acceptable 1	Nearing Proficient 2	Proficient 3	Nearing Advanced 4	Advanced 5
1. **Subject Matter Competence:** Student demonstrates graduate-level knowledge and competencies in their academic field.	●	●	●	●	●
2. **Methods and Technical Merit**: Student demonstrates the ability to apply technical expertise and appropriate methodological rigor in conducting research and analysis.	●	●	●	●	●
3. **Critical Thinking**: Student demonstrates the ability to apply critical thinking and logical reasoning to research questions and to implement creative or innovative approaches to answer them.	●	●	●	●	●
4. **Written Communication:** Student demonstrates proficiency in communicating and presenting the written results of their inquiry in a thesis or final project report appropriate to their academic program.	●	●	●	●	●
5. **Oral Communication (optional)**: Student demonstrates proficiency in communicating and presenting the results of their inquiry in a thesis or final project report in an oral presentation. (***Note**: this dimension is optional – complete if it applies to your curriculum or department.)*	●	●	●	●	●

PART II: THESIS/FINAL PROJECT REPORT RELEVANCE

NPS programs provide graduate education with specific relevance to the defense and national security communities. Select the level that the thesis or final project report achieves for the stated measures that the NPS faculty have identified as important for all masters programs at NPS.

	Not Relevant	Minimally Relevant	Relevant	Highly Relevant	Fully Relevant
6. **Defense Relevance**: The thesis or final project addresses a problem of relevance in the defense or national security community.	●	●	●	●	●
7. **Relevance to Curriculum:** The thesis or final project is closely aligned with the student's assigned curriculum.	●	●	●	●	●

PART III: POTENTIAL FOR PUBLICATION

Assess whether the content of this thesis/final project approaches standards for academic ☐ or practitioner ☐ publications (check one or both if applicable).

	No Potential	Low Potential	Moderate Potential	Significant Potential	High Potential
8. **Potential for Publication** (***Note**: this question is optional – complete only when it applies to your curriculum or department.)*	●	●	●	●	●

NPS Capstone Instrument

Please enter any comments you have about this thesis/final report or the student's mastery of academic objectives in general:	

NPS Thesis/Capstone Rubric

Analytic Capstone Dimensions Scale 1—5 points for each dimension	Acceptable	Nearing Proficient	Proficient	Nearing Advanced	Advanced
Part I: STUDENT LEARNING OUTCOMES					
Subject Matter Competence	Basic academic subject matter expertise applied. Clearly articulates the basic disciplinary foundations defining a theoretical framework that supports the research. Contextualizes appropriate research questions within the discipline.	Relationship between research questions and scientific endeavors or previous and competing works in the discipline were referenced but not clearly defined.	Appropriate subject matter expertise applied to develop insight to explain the relationship between the research questions and scientific endeavors and/or previous and competing works. Identifies inconsistencies in theory and findings; cites areas and issues pertinent to future studies.	Gaps in research findings noted; opportunity for further investigations cited. A credible argument that the study contributes to knowledge in the field or profession is presented. Demonstrates the ability to integrate a body of advanced knowledge in research.	Demonstrates ability to integrate a body of advanced knowledge in research with distinction; evidenced by appropriate levels of analysis, inference, interpretation, and judgment. Discusses alternative views including conflicts in theory, methodology, evidence and conclusions; or gaps in research & scholarship to assess strengths and weaknesses.
Methods & Technical Merit	Problem statement and method applied mimics previous work. Proposed methods and analyses allow the purpose(s) and hypotheses to be examined. Key terminology, methods, and assessment measures adequately described.	Methods provide some evidence of appropriate preparation and knowledge based on background review of the literature. In most cases, analysis of the research questions produce accurate results. Presentation of technical concepts and conclusions appears stilted or definition like.	Methods demonstrate appropriate preparation and knowledge based on background review of the literature. Competently implements methods appropriate to purpose, question(s) and hypothesis or approach. Analysis of results reflects technical expertise and an understanding of the appropriate methodological process(es) in conducting research.	Analyses, inferences, interpretations, and judgments are technically sound. Technical concepts understandably presented and clearly summarized.	Applies appropriate professional standards. Measures of success are well defined with metrics and goals. Some evidence of innovation and risk in applying the chosen approach. Methods are technically challenging. Approach is well executed and accurate. Consideration is given to expansion and wider use of research.
Critical Thinking	Purpose, questions, and hypotheses or approach clearly stated. Concepts and variables under study are utilized and presented but only superficially explored or articulated. Assumptions lack clarity and are not explicitly stated or are implied. Implications of the research not well explained.	Significance of the research is adequately presented. Considers alternative points of view. Data and related information used are relevant and adequate for the research. Assumptions clearly and explicitly stated. Implications of the research are clearly presented.	Significance of the research is presented and relationships between concepts and/or variables under study are examined in an original way. Recognizes key concepts and ideas used by others. A new perspective on previous research is presented.	Novel approach extends or uniquely applies previous research to a significant problem. Concepts and variables under study provide useful results specific to the research, with implications clearly and accurately presented.	Approach is presented and articulated clearly and uniquely, and its original significance to the profession/field is demonstrated. Meaningful relationships between concepts and/or variables under study are analyzed and add a creative and logical perspective on previous research regarding the topic. Credible argument that the study uniquely and significantly contributes to knowledge in the field/profession is presented.
Written Communication	Thesis/capstone project follows a standard form and has a scholarly appearance. Written with correct grammar, spelling, punctuation, word choice and syntax; does not exhibit over-reliance on limited sources. Includes correct citations for: direct quotations, paraphrasing, facts, and references to research studies; in-text citations are found in reference list. Inferences, analysis and judgments included but cohesive understanding is not articulated.	Thesis/capstone project examines and describes data and evidence and is presented in an organized manner. Interpretation of evidence, statements, graphics, and questions are implicit—lacking clarity and precision. Organization is uneven with some sections of the thesis more effective than others. Ideas and information are not always connected with transitions; some ideas may appear illogical and unrelated.	Accurately interprets evidence, statements, graphics, and questions. Identifies relevant arguments, including pros and cons. The thesis/capstone project is written in scholarly language—accurate, balanced, and objective. Subheadings are used to identify the logic and movement.	Contains some interpretations, analyses, and judgments that are not fully explained. Thesis develops ideas cogently, organizes them logically within paragraphs, and connects them with effective transitions.	Identifies/discusses the salient arguments, reasons and claims, including pros and cons. Thoughtfully analyzes major alternatives, Justifies key results and procedures; explains assumptions and reasons. The thesis/capstone project is logically and comprehensively organized and transitions between chapters are smooth and coherent. Writing is clear, precise and avoids redundancy. The chapters add up to an integrated whole.
Optional - Oral Communication *(**Note**: this dimension is optional – complete only when applicable. The rating will not be included in the total score.)*	Results are simply stated in an objective manner.	Inconsistent quality of response, at times halting or hesitant. Sporadic confidence throughout presentation.	Results of the data collection are described limitedly to reveal meaningful relationships that exist in the data. Variables have been considered as alternative explanations but have not been completely identified and/or analyzed. No mention of limitations to instrumental measures.	Confident delivery both verbally and nonverbally. Answered questions directly and adequately.	Results are interpreted, which allows for a speculation on new/hidden relationships. Internal and external variables have been considered as alternative explanations and any problems associated with data have been thoroughly identified and explained. Limitations to measures have been identified, and explained.

Return to Main Document

Exhibit 6. Curriculum Review Report and SESG Meeting Minutes

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON DC 20350-2000

1500
Ser N12/009
4 Feb 19

From: Director, Total Force Manpower, Training and Education Requirements Division (N12)
To: Director, Strategic Systems Program

Subj: REPORT OF CURRICULUM REVIEW OF RESIDENT CURRICULUM SYSTEMS ENGINEERING (580)

Ref: (a) SECNAVINST 1524.2C
(b) OPNAVINST 1520.23C w/CH-1

Encl: (1) SSP ltr 1550 Ser SP00/112118000 of 27 Nov 18

1. Per references (a) and (b), enclosure (1) is approved.

DAVID R. MENZEN

Copy to:
NPS Monterey CA

DEPARTMENT OF THE NAVY
NAVAL POSTGRADUATE SCHOOL
1 UNIVERSITY CIR
MONTEREY, CA 93943-5000

IN REPLY REFER TO:
1550
Ser 00/875
DEC 14 2018

FIRST ENDORSEMENT on Director, Strategic Systems Programs ltr 1550
Ser SP00/112118000 of 27 Nov 2018

From: President, Naval Postgraduate School
To: Director, Total Force Manpower, Training and Education Requirements Division (OPNAV N12)

Subj: REPORT OF CURRICULUM REVIEW OF RESIDENT CURRICULUM SYSTEMS ENGINEERING (580)

1. Forwarded, recommending approval.

RONALD A. ROUTE
Vice Admiral, U.S. Navy (Ret.)

Copy to:
SSP
OPNAV N1
OPNAV N45
OPNAV N127
NAVSEA 00T1

3

DEPARTMENT OF THE NAVY
DIRECTOR STRATEGIC SYSTEMS PROGRAMS
1250 10TH STREET SE, SUITE 3600
WASHINGTON NAVY YARD, DC 20374-5127

IN REPLY REFER TO:
1550
Ser SP00/112118000
27 Nov 18

From: Director, Strategic Systems Programs
To: Director, Total Force Manpower, Training and Education Requirements Division (OPNAV N12)
Via: President, Naval Postgraduate School

Subj: REPORT OF CURRICULUM REVIEW OF RESIDENT CURRICULUM SYSTEMS ENGINEERING (580)

Ref: (a) SECNAVINST 1524.2C
(b) OPNAVINST 1520.23C
(c) NAVMILPERSINST 15839 Volume 1 Part B
(d) NAVPGSCOLINST 1550.1G

Encl: (1) Curriculum Review Participants
(2) Previous (FY17-19) Core Skill Requirements for Resident Curriculum 580
(3) 2019-21 Core Skill Requirements for Resident Curricula 580
(4) 2019-21 Educational Skill Requirements for Resident Curriculum 580
(5) 2019-21 Sample Curriculum Matrix for Curriculum 580
(6) ESR to Course Crosswalk
(7) Cost Analysis
(8) Subspecialty Fit-Fill and Utilization Data
(9) Action Items

1. In accordance with references (a) through (d), a detailed review of the Systems Engineering (SE) curriculum was conducted on 27 November 2018. Senior participants conducting the review were the curriculum sponsor, VADM Johnny Wolfe, Director of Strategic Systems Programs; and Dr. Steven Lerman, Provost, Naval Postgraduate School (NPS). The curriculum meets the sponsor's requirements.

2. The following programs were included in the review: Resident Systems Engineering Master's Degree (580); Systems Engineering PhD (581); the Systems Engineering Certificates (232, 242, 282); and the Systems Engineering Distance Learning Master's Degrees (311, 312, 721).

3. The following issues were discussed during the review:

a. Update and clarification of Core Skill Requirements, and Educational Skill Requirements.
b. Program health, billet coding, quotas vs fills, and opportunities for growth.

Subj: REPORT OF CURRICULUM REVIEW OF RESIDENT CURRICULUM SYSTEMS ENGINEERING (580)

4. The Systems Engineering curriculum was successfully and favorably reviewed. The program continues to build upon its relevance in meeting the needs of the U.S. Navy and the Department of Defense.

J. R. WOLFE, JR

Copy to:
OPNAV N1
OPNAV N45
OPNAV N127
NAVSEA 00T1

SYSTEMS ENGINEERING (580)
CURRICULUM REVIEW PARTICIPANTS

Visitors:

VADM Johnny Wolfe, Director, Strategic Systems Programs

CDR Bill Harley, SME, Strategic Systems Programs

NPS:

Dr. Steven Lerman, Provost, NPS

Dr. Doug Moses, Vice Provost for Academic Affairs, NPS

Dr. Clyde Scandrett, Dean, GSEAS, NPS

Col. Timothy Sands, USAF, Military Associate Dean, GSEAS, NPS

Dr. Ron Giachetti, Chairman, SE Department, NPS

CDR Douglas Jones, Director of Programs, NPS

CDR Todd Greene, Program Officer, NPS

Enclosure (1)

PREVIOUS (FY17-19) CORE SKILL REQUIREMENTS (CSRs)
SYSTEMS ENGINEERING
5801P, 5802P, 5803P, 5804P
Curriculum 580

Billet subspecialty coding is to be based on the minimum education/training/experience level required for optimum performance. Systems Engineering/5800P subspecialty coding is justified when, in addition to the general criteria stated in NAVPERS 15839 series (Manual of Navy Officer Manpower and Personnel Classification) Part B, the following specific criteria are satisfied:

1. Description of CSR Competencies. In order to achieve the goals for the SE masters programs, the outcomes are to produce graduates who:

a. **CSR-1:** Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.

b. **CSR-2:** Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.

c. **CSR-3:** Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.

d. **CSR-4:** Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.

Enclosure (2)

e. **CSR-5:** Demonstrate an ability to communicate effectively through written and oral presentation of technical material.

f. **CSR-6:** Demonstrate an understanding of professional and ethical responsibility.

g. **CSR-7:** Demonstrate recognition of, the need for, and an ability to engage in, life-long learning and knowledge of contemporary issues.

2. Applicable Officer Designators:
111X / 112X / 130X / 114X / 115X / 116X / 117X / 118X / 119X / 13XX / 14XX / 15XX

3. Applicable Billet Designator:

111X / 112X / 130X/ 114X / 13XX / 14XX

4. Educational and Significant Experience Criteria: Coded billets are authorized when the functions of the billet include the CSR competencies listed above (in paragraph 1). For additional clarification regarding definition of suffixes, refer to the NAVPERS 15839I, Vol 1.

a. Subspecialty Code Suffixes Authorized.

580X Subspecialty Code Suffixes Authorized				
Billet	**Officer**	**Suffix**	**Definition**	**Notes**
X	X	C	Proven Doctor of Philosophy	1a
X	X	D	Doctor of Philosophy	1
	X	F	Proven Master's Degree that does not meet all ESRs	2a
	X	G	Master's Degree that does not meet all ESRs	2
X		H	Master's Degree desired, not required	3
	X	I	Immediate Graduate Education Program (IGEP)	4
	X	L	Certificate degree at the Master's level	5
X	X	P	Master's Degree in approved Navy subspecialty	6
X	X	Q	Proven Master's Degree	6a
X	X	R	Proven Significant Experience	7a
X	X	S	Significant Experience obtained through OJT	7

Note 1: D-coded billets are authorized when the billet's primary duties require the CSRs, ESRs and a Doctorate Degree in Systems Engineering. D-coded officers are authorized when they complete a Systems Engineering Doctorate Degree at NPS or another accredited institution.

Note 1a: C-coded billets are authorized when the billet's primary duties require expertise in Systems Engineering where a doctorate level of knowledge is essential for optimum performance; and professional experience and proven performance are required. A D-coded officer can be upgraded to a C-coded officer when they have completed at least 18 months in a D-coded billet. Officer must have a D code prior to C coded tour.

Enclosure (2)

Note 2: G-coded officers are authorized when:

(1) An officer has not completed all required ESR's (not completed a Thesis at NPS).

(2) An officer attends a civilian institution and completes two thirds or greater of the ESRs as determined by the Subject Matter Expert.

Note 2a: F-coded officers are justified when an officer has a G code and completes a tour in a Master's degree billet or higher.

Note 3: H-coded billets are authorized when a billet requires expertise in Systems Engineering where a master's level of knowledge is desirable but not essential for optimum performance.

Note 4: I-coded officers are authorized when an officer completes a Master's degree awarded through the Intermediate Graduate Education Program (IGEP) at an approved institution, and they do not fully meet P-code requirements. Officer will maintain I code even after tour in an S, R, P, Q, H coded billet.

Note 5: L-coded officers are authorized when they complete the SE certificate. N-coded and M-coded billets and officers are not authorized.

Note 6: P-coded billets are authorized when the billet's primary duties require expertise of the CSRs and ESRs. P-coded officers are authorized when the officer completes all of the Systems Engineering (580) curriculum ESRs, and is awarded an approved Master's degree associated with the curriculum. (NOTE: When thesis is completed, student must apply to the NPS registrar for a new transcript which should be forwarded to PERS-43 to update the Officer Master File.)

Note 6a: Q-coded billets are authorized when the billet requires all the requirements of the P-code, and professional experience and proven performance are required. Q-coded officers are authorized when they have a P-code and then complete at least 18-months in a master's degree coded billet or higher (P, Q, C, D). G-coded officers cannot obtain Q-codes.

Note 7: S-coded billets are authorized when two of the following conditions are met:

(1) The duties required detailed knowledge of, or experience in specific Systems Engineering systems, processes, design, acquisition, management or leadership.

(2) Appropriate training on specific systems, processes, design, acquisition, and management is available and accessible to qualified officers prior to assignment of billets.

S-coded officers are authorized when the officer has filled an B, H, S, R, Q, or P-coded billet for more than 18 months AND have no Subspecialty code in this field. Their FITREP must justify that they have accomplished tasks indicated above for more than 18 continuous months.

Enclosure (2)

Note 7a: R-coded billets are authorized when, in addition to the requirement for S-coded billets, the billet must be filled by officers having filled a previous 5800-coded billet. A requirement for familiarity or experience in the specific duties, as though service in a previous billet, should characterize these billets. R-coded officers are authorized when the officer has filled an R, Q, or P-coded billet for more than 18 months AND have no Subspecialty code in this field. Their FITREP must justify that they have accomplished tasks indicated above for more than 18 continuous months.

5. Major Area Sponsor and Subject Matter Experts:

Sponsor: VADM Benedict, Director, Strategic Systems Programs

Subject Matter Expert: VADM Benedict, Director, Strategic Systems Programs

APPROVED: VADM _____ 11/30/16
Major Area Sponsor [DATE]

APPROVED: _____ 4 JAN 2017
Director, OPNAV N12 [DATE]

Enclosure (2)

FY19-21 CORE SKILL REQUIREMENTS (CSRs)
SYSTEMS ENGINEERING
5801P, 5802P, 5803P, 5804P
Curriculum 580

Billet subspecialty coding is to be based on the minimum education/training/experience level required for optimum performance. Systems Engineering/5800P subspecialty coding is justified when, in addition to the general criteria stated in NAVPERS 15839 series (Manual of Navy Officer Manpower and Personnel Classification) Part B, the following specific criteria are satisfied:

1. Description of CSR Competencies. In order to achieve the goals for the SE masters programs, the outcomes are to produce graduates who:

a. **CSR-1:** Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.

b. **CSR-2:** Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including: systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.

c. **CSR-3:** Demonstrate proficiency in core skills of systems analysis. Core skills in this area include: design and performance of experiments; analysis and interpretation of data; understanding of optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This analysis should include familiarity with combat simulations and combat modeling.

d. **CSR-4:** Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.

e. **CSR-5:** Demonstrate an ability to communicate effectively through written and oral presentation of technical material.

Enclosure (3)

f. **CSR-6:** Demonstrate an understanding of professional and ethical responsibility.

g. **CSR-7:** Demonstrate recognition of, the need for, and an ability to engage in, life-long learning and knowledge of contemporary issues.

2. Applicable Officer Designators:
111X / 112X / 130X / 114X / 115X / 116X / 117X / 118X / 119X / 13XX / 14XX / 15XX

3. Applicable Billet Designator:

111X / 112X / 130X/ 114X / 13XX / 14XX

4. Educational and Significant Experience Criteria: Coded billets are authorized when the functions of the billet include the CSR competencies listed above (in paragraph 1). For additional clarification regarding definition of suffixes, refer to the NAVPERS 15839I, Vol 1.

a. Subspecialty Code Suffixes Authorized.

580X Subspecialty Code Suffixes Authorized				
Billet	**Officer**	**Suffix**	**Definition**	**Notes**
X	X	C	Proven Doctor of Philosophy	1a
X	X	D	Doctor of Philosophy	1
	X	F	Proven Master's Degree that does not meet all ESRs	2a
	X	G	Master's Degree that does not meet all ESRs	2
X		H	Master's Degree desired, not required	3
	X	I	Immediate Graduate Education Program (IGEP)	4
	X	L	Certificate degree at the Master's level	5
X	X	P	Master's Degree in approved Navy subspecialty	6
X	X	Q	Proven Master's Degree	6a
X	X	R	Proven Significant Experience	7a
X	X	S	Significant Experience obtained through OJT	7

Note 1: D-coded billets are authorized when the billet's primary duties require the CSRs, ESRs and a Doctorate Degree in Systems Engineering. D-coded officers are authorized when they complete a Systems Engineering Doctorate Degree at NPS or another accredited institution.

Note 1a: C-coded billets are authorized when the billet's primary duties require expertise in Systems Engineering where a doctorate level of knowledge is essential for optimum performance; and professional experience and proven performance are required. A D-coded officer can be upgraded to a C-coded officer when they have completed at least 18 months in a D-coded billet. Officer must have a D code prior to C coded tour.

Enclosure (3)

Note 2: G-coded officers are authorized when:

(1) An officer has not completed all required ESR's (i.e.: not completed a Thesis).

(2) An officer attends a civilian institution and completes two thirds or greater of the ESRs as determined by the Subject Matter Expert.

Note 2a: F-coded officers are justified when an officer has a G code and completes a tour in a Master's degree billet or higher.

Note 3: H-coded billets are authorized when a billet requires expertise in Systems Engineering where a master's level of knowledge is desirable but not essential for optimum performance.

Note 4: I-coded officers are authorized when an officer completes a Master's degree awarded through the Intermediate Graduate Education Program (IGEP) at an approved institution, and they do not fully meet P-code requirements. Officer will maintain I code even after tour in an S, R, P, Q, H coded billet.

Note 5: L-coded officers are authorized when they complete the SE certificate. N-coded and M-coded billets and officers are not authorized.

Note 6: P-coded billets are authorized when the billet's primary duties require expertise of the CSRs and ESRs. P-coded officers are authorized when the officer completes all of the Systems Engineering (580) curriculum ESRs, and is awarded an approved Master's degree associated with the curriculum. (NOTE: When thesis is completed, student must apply to the NPS registrar for a new transcript which should be forwarded to PERS-43 to update the Officer Master File.)

Note 6a: Q-coded billets are authorized when the billet requires all the requirements of the P-code, and professional experience and proven performance are required. Q-coded officers are authorized when they have a P-code and then complete at least 18-months in a master's degree coded billet or higher (P, Q, C, D). G-coded officers cannot obtain Q-codes.

Note 7: S-coded billets are authorized when two of the following conditions are met:

(1) The duties required detailed knowledge of, or experience in specific Systems Engineering systems, processes, design, acquisition, management or leadership.
(2) Appropriate training on specific systems, processes, design, acquisition, and management is available and accessible to qualified officers prior to assignment of billets.

S-coded officers are authorized when the officer has filled an B, H, S, R, Q, or P-coded billet for more than 18 months AND have no Subspecialty code in this field. Their FITREP must justify that they have accomplished tasks indicated above for more than 18 continuous months.

Enclosure (3)

Note 7a: R-coded billets are authorized when, in addition to the requirement for S-coded billets, the billet must be filled by officers having filled a previous 5800-coded billet. A requirement for familiarity or experience in the specific duties, as though service in a previous billet, should characterize these billets. R-coded officers are authorized when the officer has filled an R, Q, or P-coded billet for more than 18 months AND have no Subspecialty code in this field. Their FITREP must justify that they have accomplished tasks indicated above for more than 18 continuous months.

5. Curriculum Sponsor and Subject Matter Experts:

Sponsor: VADM Johnny Wolfe, Director, Strategic Systems Programs

Subject Matter Expert: CDR William (Bill) Harley, Strategic Systems Programs, William.Harley@ssp.navy.mil

APPROVED: _____ 27 NOV 18
Curriculum Sponsor [DATE]

APPROVED: _____ 4 FEB 2019
Director, OPNAV N12 [DATE]

Enclosure (3)

FY19-21 EDUCATIONAL SKILLS REQUIREMENTS (ESRs)
SYSTEMS ENGINEERING
5801P, 5802P, 5803P, 5804P
Curriculum 580

1. Curriculum Number: 580

2. Curriculum taught by NPS resident and non-resident. Resident and non-resident active duty Navy and Marine Corps students are fully funded.

3. Curriculum Length in Months: 21
   Month the program starts:

   September or March
   Refresher quarter: July or January

4. APC Required 323

5. Officers entering into the Systems Engineering curriculum will be offered the necessary preparatory level courses to enable them to satisfy the equivalent of a baccalaureate degree in Engineering. By the time they complete the curriculum, they shall meet, as a minimum, the requirements set forth by the Accreditation Board for Engineering and Technology (ABET). In the context of systems engineering, the term "systems" shall be used to include both systems and systems-of-systems (SoS). At the graduate level, the officer will acquire the competence to effectively contribute as a systems engineer to naval systems research, design, development, maintenance and acquisition. The officer will gain the ability to effectively integrate future technological, engineering, and acquisition approaches with existing practice through a combination of core systems engineering courses, specialization studies, and project/thesis research. An officer will meet the below-listed ESRs through the completion of a program of study determined by the officer, the program officer and the academic associate. Individual programs and how they support the officer's attainment of the ESRs will be specifically designed to meet the needs of the Navy and the officer's interests.

a. **ESR-1**: [UNDERGRADUATE MATHEMATICS AND BASIC SCIENCES] Understand and apply baccalaureate-equivalent coding, mathematics and physics. For mathematics, this includes single and multi-variable differential and integral calculus, ordinary differential equations, probability, and statistics. Coding includes the logic and application of programming languages. This ESR can be met by the appropriate undergraduate work.

b. **ESR-2**: [CAPABILITY ENGINEERING] Model and analyze military operations in order to identify capability needs and derive system requirements. Use modeling and simulation to analyze the operational effectiveness and performance of existing systems, emerging technological concepts, and planned systems. Consider the joint warfighter environment, technology readiness levels, effectiveness, cost, and risk in the analysis. Select the appropriate modeling tools to include back-of-the-envelope spreadsheet modeling, analytical modeling, discrete-event simulation, and continuous simulation modeling. Analyze cost and perform suitability analysis considering the entire life cycle.

Enclosure (4)

d. **ESR-3**: [SYSTEM ARCHITECTING] Perform system architecting, applying and integrating methods for both software and hardware applications. Construct feasible system functional and physical architectures that represent a balanced approach to meeting stakeholder needs and expectations; stated, implied, and derived system requirements; cyber-resiliency objectives; and suitability objectives such as being open, modular, extensible, maintainable, and reusable. Understand system architecture frameworks and their role in architecture development. Use model-based systems engineering techniques to create, define, and develop system architectures. Develop, analyze, and compare alternative architectures against appropriate, system-level evaluation criteria.

e. **ESR-4**: [ENGINEERING DESIGN ANALYSIS] Understand and apply core qualitative and quantitative methods to analyze and select hardware and software system designs. Methods should include problem formulation, alternatives development, alternatives modeling and evaluation, alternatives comparison, optimization, decision analysis, failure analysis, risk analysis, and futures analysis.

f. **ESR-5**: [SYSTEM INTEGRATION AND DEVELOPMENT] Apply the core skills of system integration and development to include integrating relevant technological disciplines that bear on the system effectiveness and cost. Understand system realization methods and processes necessary to transition from design to production, including prototyping, design for producibility, and production methods.

g. **ESR-6**: [SYSTEM VERIFICATION & VALIDATION] Apply the fundamental verification and validation principles of system test and evaluation to confirm if the capability needs and system requirements are met by the designed system. V&V principles are to include inferential statistics methods such as design of experiments (DOE) and analysis of variance (ANOVA), and testing methods such as functional simulation, analysis, examination, software in the loop, hardware in the loop, full system testing, and operational testing; in order to verify that the hardware matches the simulations in the earliest available environment and continuing during the entire life-cycle.

h. **ESR-7**: [HUMAN SYSTEMS INTEGRATION] Address human factors during requirements definition, as well as workload, safety, training, operability and ergonomics during design. Conduct functional analysis and allocation to human elements, performing cost-risk-effectiveness trade-offs among hardware, software, and human elements. Evaluate proposed designs for man-machine integration, human performance testing, and usability during development test and evaluation. Understand basic human biology as applied to human systems.

i. **ESR-8**: [SYSTEM DESIGN] Understand and demonstrate the system design process in a holistic context, applying and integrating methods for both software and hardware aspects of a design. The end-to-end design process should include: identifying capability need; defining requirements; conducting functional analysis and allocation to hardware, software, and human elements; creating a system functional design; designing a system; deriving and defining requirement specifications; allocating requirement specifications to sub-systems (for hardware,

software, and human elements); designing for suitability, including reliability, availability, maintainability, operability, and logistical supportability; performing a system assessment by conducting trade-off studies, evaluating system design alternatives against system capability need expressed as military effectiveness; estimating and analyzing the system cost and risk, including risk mitigation strategies; integrating human elements into the system design; and analyzing and planning for system testing and evaluation.

j. **ESR-9**: [PROJECT MANAGEMENT] Work as a team member or leader on a military systems engineering project. Demonstrate an understanding of project management principles. Demonstrate competence in the planning and management of complex projects. Understand the principles of and apply current industry approaches and technology to manage systems design, integration, test, and evaluation for large engineering projects.

k. **ESR-10**: [SPECIALIZATION] Demonstrate in-depth understanding of the principles, technologies, and systems used in at least one major specialty area. These areas can be specific warfare areas, such as combat systems, total ship systems, EW, IW, avionics, undersea warfare, or net-centric systems, a single traditional engineering specialty, such as mechanical, electrical, software, aerospace engineering, or naval architecture, or specialized disciplines such as human factors, availability, or safety. Demonstrate in-depth understanding of the scientific and engineering principles of the respective specialty, such as sensors, weapons, C4I systems, information systems, ship structures, hydrodynamics, power systems, and reliability. Demonstrate broad understanding of systems context of the specialization. Apply that understanding to the design of system components, sub-systems, and interfaces in the holistic context of the engineering of systems.

There will be four tracks of specialization resulting in differing P – Codes:

1. 5801 - Total Ship Systems Design Specialization
2. 5802 - Combat Systems specialization
3. 5803 - System of Systems Engineering and Integration
4. 5804 - Naval Air Systems Specialization

l. **ESR-11***: [CYBER] Understand and apply the fundamentals of the underlying principles of cyber infrastructure and systems; inherent vulnerabilities and threats, including industrial control systems; and defensive security procedures. (* ESR required for 14XX designators only)

m. **ESR-12**: [THESIS] Conduct independent analysis and research in the area of Systems Engineering, and show proficiency in presenting the results in writing and orally by means of a thesis and command-oriented briefing appropriate to this curriculum.

FY2019-2021 EDUCATIONAL SKILLS REQUIREMENTS
SYSTEMS ENGINEERING
5801P, 5802P, 5803P, 5804P

Approved:

VADM Johnny Wolfe,
Director, Strategic Systems Program

27 NOV 18
Date

VADM Ronald Route (Ret.), President,
Naval Postgraduate School

DEC 14 2018
Date

Director, TFMTER, (OPNAV N12)

4 FEB 2015
Date

Enclosure (4)

FY19-21 SAMPLE MATRIX
SYSTEMS ENGINEERING 580

SHIP SYSTEMS TRACK - 5801P

Start Dates: October (Fall Qtr) & March (Spring Qtr)

Refresher Winter 15-7	**SE1001** Math I for SEA (4-2)	**SE2003** Fundamentals of Mechanical Systems (4-2)	**SE1002** Math II for SEA (3-1)	**SE2101** Fundamentals of Electromagnetic Systems (4-2)	
QTR 1 Spring 16-7	**SE3100** Fundamentals of Systems Engineering (3-2)	**SE2440** Intro to Scientific Programming (3-2)	**OS3180** Probability and Statistics for SE (4-1)	**SE 3112** Combat Sys Engineering I (Sensor Fund.) (4-2)	**SE3811** Critical Thinking (2-0)
QTR 2 Summer 15-6	**SE3400** Engineering Project Management (3-2)	**SE 3250** Capabilities Engineering (3-2)	**SE 3011** Engineering Cost Estimation (3-0)	**SE 4112** Combat Sys Engineering III (Sensor Tech)s (4-2)	**SE3812** Engineering Ethics (2-0)
QTR 3 Fall 15-8	**SE3302** Systems Suitability (3-2)	**SE 4150** System Architecting and Design (3-2)	**TS3000** Electrical Power Engineering (3-2)	**SE 3113** Combat Sys Engineering II (Weapons) (4-2)	**SE3813** Technical Writing I (2-0)
QTR 4 Winter 16+?-4+?	**SE 4115** Combat Systems Integration (4-2)	**SE4354/OA4603** Test & Evaluation (4-0)	Track Elective (?-?)	**TS 3001** Fundamentals of Naval Architecture (3-2)	**SE3814** Technical Writing II (2-0)
QTR 5 Spring 11-10	**OS 4680** Naval Systems Analysis (4-0)	**SE 0811** Thesis Research (0-8)	**TS4001** Integration of Naval Systems Engineering (3-2)	**SE 3121** Introduction to C4ISR (3-0)	**SE3000** SE Colloquium (1-0)
QTR 6 Summer 7-22	**EO 2701** Introduction to Cyber Systems (4-2)	**SE 0811** Thesis Research (0-8)	**SE 0811** Thesis Research (0-8)	**TS4002** Ship Design Integration (2-4)	**SE3000** SE Colloquium (1-0)
QTR 7 Fall 9+?–12+?	SE Elective (?-?)	SE Elective (?-?)	**SE 0811** Thesis Research (0-8)	**TS4003** Total Ship Systems Engineering (2-4)	**SE3000** SE Colloquium (1-0)

Foundation Skills
SE Core
SE Electives
Track Courses
Thesis Slots
Project Sequence
Graduate Success/ Professional Development

Enclosure (5)

FY19-21 SAMPLE MATRIX
SYSTEMS ENGINEERING 580

COMBAT SYSTEMS TRACK - 5802P

Start Dates: October (Fall Qtr) & March (Spring Qtr)

Refresher Summer/Winter 15-7	**SE1001** **Math I for SEA** (4-2)	**SE2003** **Fundamentals of Mechanical Systems** (4-2)	**SE1002** **Math II for SEA** (3-1)	**SE2101** **Fundamentals of Electromagnetic Systems** (4-2)	
QTR 1 Fall/Spring 16-7	**SE3100** **Fundamentals of Systems Engineering** (3-2)	**SE2440** **Intro to Scientific Computing** (3-2)	**OS3180** **Probability and Statistics for SE** (4-1)	**SE 3112** **Combat Sys Engineering I (Sensor Fund.)** (4-2)	**SE3811** **Critical Thinking** (2-0)
QTR 2 Winter/Summer 15-6	**SE3400** **Engineering Project Management** (3-2)	**SE 3250** **Capabilities Engineering** (3-2)	**SE 3011** **Engineering Cost Estimation** (3-0)	**SE 4112** **Combat Sys Engineering II (Sensors Tech)** (4-2)	**SE3812** **Engineering Ethics** (2-0)
QTR 3 Spring/Fall 15-6	**SE3302** **Systems Suitability** (3-2)	**SE4150** **System Architecting and Design** (3-2)	**SE 3121** **Introduction to C4ISR** (3-0)	**SE 3113** **Combat Sys Engineering II (Weapons)** (4-2)	**SE3813** **Technical Writing I** (2-0)
QTR 4 Summer/Winter 15+?-6+?	**SE 4115** **Combat Systems Integration** (4-2)	**SE4354/OA4603** **Test & Evaluation** (4-0)	**Track Elective** (?-?)	**SE3201** **Engineering Systems Conceptualization** (2-4)	**SE3814** **Technical Writing II** (2-0)
QTR 5 Fall/Spring 10-14	**OS 4680** **Naval Systems Analysis** (4-0)	**SE 4113** **Unconventional Weapons (CBNRE)** (3-2)	**SE0811** **Thesis Research** (0-8)	**SE3202** **Engineering Systems Design** (2-4)	**SE3000** **SE Colloquium** (1-0)
QTR 6 Winter/Summer 7-22	**EO 2701** **Introduction to Cyber Systems** (4-2)	**SE0811** **Thesis Research** (0-8)	**SE0811** **Thesis Research** (0-8)	**SE3203** **Engineering Systems Implementation** (2-4)	**SE3000** **SE Colloquium** (1-0)
QTR 7 Spring/Fall 7+? – 16+?	**SE Elective** (?-?)	**SE Elective** (?-?)	**SE0811** **Thesis Research** (0-8)	**Track Elective** (?-?)	**SE3000** **SE Colloquium** (1-0)

Foundation Skills
SE Core
SE Electives
Track Courses
Thesis Slots
Project Sequence
Graduate Success/ Professional Development

Enclosure (5)

ESR TO COURSE CROSSWALK
SYSTEMS ENGINEERING 580

	Curriculum Number	580		
	Subspecialty Codes:	5801P - Total Ship System Design Specialization 5802P - Combat Systems Specialization		
	Degree Awarded	MS SE		
	ESR	**LEVEL**	**Course #**	**Course Name**
1	Mathematics and Basic Sciences	1000	SE1001	Math I
		2000	SE1002	Math II
			SE2003	Fundamentals of Mechanical Systems
			SE2101	Fundamentals of EM Systems
			SE2440	Intro to Scientific Computing
		3000	OS3180	Probability /Statistics
2	Capability Engineering	3000	SE3100	Fund of Systems Engineering
			SE3250	Capabilities Engineering
3	System Architecting	3000	SE3100	Fund of Systems Engineering
		4000	SE4150	Systems Architecting and Design
4	Engineering Design Analysis	3000	SE3202	Engineering System Design
			SE3302	Systems Suitability
		4000	SE4115	Combat Systems Integration
			OS4680	Naval Systems Analysis
5	System Integration and Development	3000	SE3100	Fund of Systems Engineering
		4000	SE4115	Combat Systems Integration
6	System Verification and Validation	3000	SE3100	Fund of Systems Engineering
			SE3250	Capabilities Engineering
		4000	SE4354	Test & Evaluation
7	Human System Integration	3000	OS3401	Human Factors in System Design
			SE3302	Systems Suitability
8	System Design	3000	SE3201	Engineering Systems Conceptualization
			SE3202	Engineering System Design
			SE3203	Engineering Systems Implementation
		4000	SE4150	Systems Architecting and Design
9	Project Management	3000	SI3400	Engineering Project Management
			SE3011	Engineering Cost Estimation
10	Specialization	3000	*SE3112*	CS Engineering I (Sensor Fund.)
			SE3113	CS Engineering III (Conv. Weapons)
			SE3121	Introduction to C4ISR
			SE4112	CS Engineering II (Sensor Tech)
			YYXXX	SE Elective #1 (indicate course)
			YYXXX	SE Elective #2 (different course)
			for Ship Systems Track (5801P) also include:	
			TS3000	Electrical Power Engineering
			TS3001	Naval Architecture
			for Combat Systems Track (5802P) also include:	
			SE4113	Unconventional Weapons (CRNRE)
			SEXXX	Track Elective
11	Cyber		EO2701	Introduction to Cyber Systems
12	Thesis		SE0811	Thesis Research (x4)

Enclosure (6)

COST ANALYSIS
SYSTEMS ENGINEERING 580

NPS Cost Analysis Form

CURRICULUM: Systems Engineering
CURRICULUM #: 580
SUBSPECIALTY: 580X
DEGREE: MS Systems Engineering/MS Engineering Systems

LENGTH: 8 quarters with refresher
DESIGN: Resident
COURSES: 24 courses with thesis
JPME: Yes for URL / No for EDO

NOTE: This table presents a standard cost of a curriculum for one cohort of students based principally on the number of courses contained. Implicit assumptions are that all curriculum courses are provided for the individual curriculum and their costs are attributed separately to it. In practice, courses may be shared by curricula, potentially reducing cost attributable per curriculum. Ongoing costs of curriculum administration and maintenance are included. Overhead costs are assigned using standard rates approximating experience. JPME costs are not reflected. Thesis/capstone project courses are not included in the total number of courses, but thesis/capstone project advising costs are implicit in other program costs.

NPS Cost Elements	Explanation	Examples	Type Cost		Calculation	Annual Cost ($K)	Program Cost ($K)	Comment
Refresher Delivery Costs								
Refresher Quarter	Program-level direct course delivery, by student	Faculty cost (faculty cost per student)	Direct	4	Assumes 25K/1 course and 4 refresher courses/quarter and 20 students per course. Calculation is 5K per student.	$20	$20	SE Refreshers are shared with program 308 (SEA program)
Program Delivery Costs								
Program Delivery / Faculty (shared courses)	Direct delivery of program, course sections	Faculty cost	Direct	13	Assumes $25K per course section (MOVES has 12 shared courses)	$163	$325	SE Combat Systems Track is shared with program 308. SE course courses of SE3201/2/3, SE3100, SI3400, SE3302, and SE4150 are shared with program 308, 311, and/or 312.
Program Delivery / Faculty (curriculum specific courses)	Direct delivery of program, course sections	Faculty cost	Direct	15	Assumes $25K per course section (MOVES has 22 curriculum specific courses)	$188	$375	
Program Administration	Program-level direct administration, by faculty	Faculty cost	Direct	2	Assumes 1/2 quarter FTE at $25K	$25	$50	
Prog. Development Costs								
New Course Development	Course research and preparation for first delivery	Faculty cost	Direct		Varies by circumstance. Stnd assumption of 1/2 quarter FTE ($25K) per course	$0	$0	
Program Support Costs								
Student Support	Special prog. support specific to the curriculum	e.g., TAD for student thesis travel. Experience tour.	Direct			$0	$0	
Thesis/Project Development	Administration & development of student theses in conjunction with Naval stakeholders, for deliverable output to those stakeholders.		Direct			$0	$0	
Technical Support - Lab	Ongoing maintenance of functionality, infrastructure & maintenance support, provided by technicians	e.g., Lab technician	Direct			$0	$0	
Prog. Maint/Recap Costs								
Academic Maintenance /Recapitalization	Recapitalization into faculty, discipline, programs	e.g., RIP, 3rd Q, Program development/ initiatives.	Direct		Assumes 1 quarter (4 courses) at $50K and 50% of courses are staffed by tenure track faculty (Total courses/4/2*50K)	$75	$150	
Research Program	For programs with a directly-associated research program element	e.g., Funding for research seeding.	Direct			$0	$0	
					Direct Costs	$470	$920	
Overhead Costs								
Academic Organization	Schools/Departments administrative & overhead	Deans, Chairs, Department staff, Academic Labs staff	Overhead		5% on Direct Costs	$24	$46	
Academic Infrastructure	OH related to NPS academic/education mission	Provost, Library, Acad Affairs, Registrar, Ed Technology, Admissions, Research Office, IT	Overhead		20% on Direct Costs	$94	$184	
Command Infrastructure	OH related to NPS as Navy command	President, Comptroller, Com Eval, Legal, IT, PAO	Overhead		15% on Direct Costs	$71	$138	
					OH Costs	$188	$368	
Total					**Total**	$658	$1,288	

NPS TUITION (FY15 per student)					Annual ($K)	Program ($K)
Non-Naval Military	Standard Resident				$20	$39
Govt Civilian	Standard Resident				$20	$39
International	Expected Intl average				$40	$79
Contractor	Standard Resident				$36	$72

NAVAL COST (FY15 per student)					Annual ($K)	Program ($K)
IA: Individuals Acct	(Assumes O-4)				$154	$308
Medical						
Other						

Enclosure (7)

SUBSPECIALITY FIT-FILL AND UTILIZATION DATA
SYSTEMS ENGINEERING 580X

Unclassified

Fit / Fill

Systems Engineering (5800P/5801P/5802P)

	Coded Billets		Officer Inventory		% Fill[1]	% Fit (Matrix)[2]
	P	Q	P	Q		
URL	0	0	22	0	NA	NA
RL	52	0	34	8	42/52 81%	26/42 62%
STAFF	1	0	0	0	1/1 100%	0/1 0%
1000 (Billets)	0	0	NA	NA	NA	NA
1050 (Billets)	0	0	NA	NA	NA	NA
TOTAL	53	0	56	8	43/53 81%	26/43 60%

[1] "%Fill" any officer in a coded billet
[2] "Matrix Fit" counted when any of an officer's subspecialties match the Matrix code.

Snapshot data "As of" Feb 2018

Unclassified

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Unclassified

Fit / Fill

Systems Engineering Aviation Systems (5804P)

	Coded Billets		Officer Inventory		% Fill[1]	% Fit (Matrix)[2]
	P	Q	P	Q		
URL	0	0	13	0	NA	NA
RL	29	0	6	0	27/29 93%	12/27 44%
STAFF	0	0	0	0	NA	NA
1000 (Billets)	0	0	0	0	NA	NA
1050 (Billets)	0	0	0	0	NA	NA
TOTAL	29	0	19	0	27/29 93%	12/27 44%

[1] "%Fill" any officer in a coded billet
[2] "Matrix Fit" counted when any of an officer's subspecialties match the Matrix code.

Snapshot data "As of" Feb 2018

Unclassified

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Enclosure (8)

SUBSPECIALITY FIT-FILL AND UTILIZATION DATA
SYSTEMS ENGINEERING 580X

Unclassified

Utilization

Curriculum 580 – Systems Engineering

	Utilization Rates[1]				
	5800 Sys Eng (SE)	5801 Ships SE	5802 Combat SE	5804 Aviation SE	Overall DoD Utilization Rates
URL	1/1	NA	1/1	3/3	5/5
RL	2/2	11/11	6/6	2/2	21/21
STAFF	NA	NA	NA	NA	NA
TOTAL	3/3 100%	11/11 100%	7/7 100%	5/5 100%	26/26 100%

[1] DOD Compliance = Utilization anytime during a Naval career

NPS maintains every tour after NPS is a payback tour

Snapshot data "As of" Oct 17 utilization report

Unclassified

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Enclosure (8)

SYSTEMS ENGINEERING 580
CURRICULUM REVIEW ACTION ITEMS

19-580-1 Incorporate the modifications to ESR and CSR language, as developed and reviewed by the SME. (CDR Greene), due 03 December 2018

19-580-2 Propose a Systems Engineering Leadership Curriculum (modeled after the Systems Engineering Management 522 curriculum) to Mr. William Bray, DASN (RDT&E), for potential sponsorship. (Dr. Giachetti), due 01 June 2019

SESG Working Group Offsite
Naval Post Graduate School, Monterey CA
27 February 2019
Meeting Minutes

Bob Steinbach kicked off and looked forward to briefings from education and safety committees. We agreed on exit criteria from the working session to be:

1. Preparation for the July meeting
2. Coming to agreement on what we will expect in Charters
3. Collection of inputs from the various members for NPS training needs.

Ron Giachetti briefed NPS activities:

1. Briefed the systems engineering activities education Program
2. Briefed education as related to MBSE, and helped to clarify what will be provided out of NPS education as compared to SYSCOM training for implementation of MBSE. They will address modeling language and modeling process as well as modeling tools. A lot of discussion over which tools will be taught. Not clear that they will be teaching with same tools NAVAIR is using. Need to influence NPS to include "no Magic Cameo " in their training. NPS is teaching a No Magic Cameo training on March 20, 2019.

Jennifer Glenn made a presentation on the progress of addressing hearing conservation and noise discussion:

1. BLUF the Navy has a significant problem of addressing hearing loss in its sailors while serving. DASN(RDT&E) working to make progress addressing the chronic problem.

There is no dedicated funding to address the problem, effort is dependent on programs funding. First effort will be to identify what the root cause is and then pursue funding to correct.

2. History of evaluating this issue and setting strategy has been long going back to early in the decade
3. The noise problem is complex and far from straight forward. Noise exposure alone is not the problem, most people can recover from noise exposure if they have quiet time and places to go to recover. This can be difficult when crew berthing spaces are in noisy compartments.
4. Target is to reduce noise by 3 DB for the service members suffering in the worst environments such as the flight deck.
5. Mike Doctor suggested the following actions

    a. Ask Chengs to provide POC to lead effort at each Command
    b. Looking for engineering recommendation on how to acquire reduced noise, how would you write the KSA (Key System Attribute) to solve the noise problem. Need to address multiple environments such as flight deck, machine spaces, berthing spaces etc.

c. Need recommendation on where this should fall in the SETR process to ensure we get solid engineering review and input.

d. Looking for four pilot programs to take on 3 DB reduction goal

In summary each SYSCOM to recommend how to approach these efforts and name a Champion to lead the way forward.

Bob Steinbach led a discussion on NPS curriculum development:

1. SE Curriculum development needs to include SESG governance
2. MBSE Tool choice needs to be addressed
3. Students should build their own reference model in MSSE
4. Is NPS to teach SysML? It is to be the near term baseline language for the NAVAIR. Systems Engineers need to be proficient in SYSML tool implemented in Cameo Systems Modeler.
5. Need to brief VADM Wolf to coordinate. There is an overlap of his concerns as they relate to training or EDOs as compared to training of Navy civilians generally trained in distance learning programs.
6. SESG needs to close on what we think is required from an NPS education.
7. As covered late in the meeting during the summary we will need to examine the roles of the SEEC and the SEOC and look at potential for overlap and how to address or even if these need to be combined into one activity or not. It may well just be a matter of determining how best to address the needs of the EDO vs the Civilian counterparts in the SYSCOMs . Both really need the same education.
8. CSM???? Is to be implemented at all SYSCOMs within one year. Funding already in place

SEEC Jose Velez:

1. Jose needs to find out who will be staying in the SEOC
2. Monday Mar 4 Jose was to meet with Mr. Bray to discuss how we are training the Acquisition workforce
3. Viviana Cordero Rivera to coordinate meeting with SSP VADM Wolfe to discuss adding an SSP working group to the SESG
4. Donna Carson-Jelley to take task to get SEEC charter signed

System Safety **Suzanne Bilodeau:**

1. Congratulated Susanne on her promotion to System Safety Director.
2. Susanne briefed ongoing system safety efforts including loss of hearing and noise.
3. DASN to assess middle tier Acquisition Safety Assessments
4. Discussed alignment of HIS working group and Reliability Working group.
5. Discussed how Cyber assessment has safety implications and need for both to collaborate.
6. Suzanne took action to get charter completed and signed.

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Exhibit 7. Department Policy on Course Coordinators

NAVAL POSTGRADUATE SCHOOL

Department of Systems Engineering
777 Dyer Road
Monterey, CA 93943

SUBJECT: Policy on Course Coordinators
DATE: 18 May 2010

1. Every course listed by the department shall have a faculty member assigned as its course coordinator. The course coordinators are appointed by the department chair. Preference is given to tenure track faculty of the department, although other faculty may be assigned. The period of appointment is for three years, with renewals possible.

2. The duties of the course coordinator are:

   a. Maintain the course syllabus. Make minor changes as necessary. Assure that the content required to support the outcomes and ESRS mapped to the course is current and sufficient.
   b. Maintain a reference set of instructional materials for the course and provide the set to faculty assigned to teach the course.
   c. Select the texts to be used in the course.
   d. Assist faculty assigned to teach the course as necessary. This includes, but is not limited to:
      i. Assisting in the design of assessment instruments for the course
      ii. Advising on grading issues
   e. Propose major changes to the course to the chairman as needed.
   f. Review all course journals submitted by faculty teaching the course.
   g. Enforce the course syllabus. In particular, assure that faculty members teaching the course comply with the texts, topics, and outline prescribed for the course.
   h. Prepare a report on the course each winter quarter, noting from the course journals any strengths and weaknesses of the course, and making any recommendations for improvement or change. In particular, discuss how well the course is supporting the outcomes and ESRs mapped to it.

Clifford A. Whitcomb
Department Chair, Systems Engineering

5/18/10
Date

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APPENDICES

Appendix A-1 – Course Syllabi for Master's Level Courses

Systems Engineering
Course Syllabi

Syllabi Index
Click "Course" to view syllabus,
Click "Return to Index" to return to this page
Click "Return to Main Document" when done reviewing this section

SE3011
SE3100
SE3250
SE3302
SE4003
SE4115
SE4150
SE4354
SI3400
OS3180

Number and Name: SE3011, Engineering Economics and Cost Estimation
Credits and Contact Hours: (3-0)
Course Coordinator's Name: Professor Ray Madachy
Textbook: None.

Catalog Description
An introduction to the cost aspects of systems engineering: exploring cost from a decision-making perspective. Examines how cost is used to select alternatives and how the cost of systems can be measured. Concepts covered include economic analysis, cost behavior, cost allocation, system cost, life cycle costs, cost over time, cost estimating techniques, cost uncertainty, and cost risk.

Prerequisites: OS3180 Probability and Statistics for Systems Engineers.
Required, Elective or Selected Elective Course: This is a required course.
Specific Learning Outcomes for the Course:

At the completion of the course students will be able to:

- Understand how cost is used in choosing between alternatives
- Understand basics of cost behavior and cost allocation
- Understand how costs change over the life-cycle of a system
- Choose between alternatives using economic reasoning
- Understand cost issues related to program management
- Develop life-cycle cost models
- Choose between alternatives using net present value analysis
- Apply cost estimating techniques to develop cost estimates
- Incorporate uncertainty into cost estimates
- Quantify and evaluate cost risk
- Allocate cost risk across time
- Develop budget from system cost estimate
- Develop and analyze system cost

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability	**X**

4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	
d. An ability to function on multi-disciplinary teams	
e. An ability to identify, formulate, and solve engineering problems	**X**
f. An understanding of professional and ethical responsibility	
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of engineering solutions in a global and societal context	**X**
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	**X**
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	**X**

Topics Covered

This course is a survey of cost topics focused on the use and analysis of cost information for defense management and decision making.

Concept	Topic	Hours
Cost Concepts	Introduction, Measuring Costs	4
	Cost for Decisions, Cost Behavior	
Economic Analysis	Economic Analysis	1
Cost of Outputs	Cost Allocation, ABC	2
Project Management	Cost/Schedule Relationships	1
	Earned Value Management	1
Cost over Time	Time Value of Money	1
	Comparison of Alternatives	1
	Comparison of Alternatives	1
Life Cycle Costs	Midterm Project	4
Cost Estimation	Introduction, Techniques, Regression	5
	Cost Estimating Relationships	
	Cost Quantity Relationships	
Uncertainty in Cost	Quantifying Uncertainty, System Cost	3
	Simulation Analysis	
Risk Management	Risk Concepts	1
	Risk Assessment	1
Budgeting	Cost Estimating and Budgeting	1
System Cost Analysis	Final Project	4

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Number and Name: SE3100, Fundamentals of Systems Engineering
Credits and Contact Hours: (3-2)
Course Coordinators Name: Senior Lecturer Gregory Miller

Textbook: The required course text is: *Systems Engineering and Analysis* by Blanchard & Fabrycky, 5th ed.
Catalog Description: This course is an introduction to systems thinking and the processes and methods of systems engineering. The course covers fundamentals of systems engineering: requirements analysis, functional analysis and allocation, preliminary system architecture, systems analysis, system design, life-cycle considerations, and the basics of test and evaluation. Various perspectives, from processes and standards, such as EIA 632, ISO 15288, IEEE 1220, and the International Council on Systems Engineering (INCOSE) models, are presented. Students also develop attributes enabling them to think and work as systems engineers like critical thinking, teamwork, communication, fair mindedness, tolerance for ambiguity, attention to details and systems thinking. The course includes the application of fundamental systems engineering processes and methods to an integrative project, as well as development of communication skills through oral presentations and written reports.
Prerequisites: None.
Required, Elective or Selected Elective Course: This is a required course.

Specific Learning Outcomes for the Course: At the completion of the course students will be able to:

- Apply basic systems engineering skills to develop technical details required for a systems engineering effort
  - Explain life-cycle issues regarding a product's design, production, support, use and retirement
  - Demonstrate the connections, iterations and recursions between key processes
- Define *the* problem to be solved, given an "I need" or "gap"
  - Identify stakeholders and document their needs
  - Establish system boundaries and identify peer system interactions.
- Document system requirements, having identified *the* problem
  - Establish operational objectives and document operational concept definitions
  - Elicit and elaborate requirements based on stakeholder needs
  - Complete system functional analysis
  - Develop a value hierarchy reflective of stakeholder goals
  - Define measures for system effectiveness and performance
- Develop and describe alternative system architectures
  - Allocate functions to system elements
  - Demonstrate informed trade-offs and decision-making with regard to variables and measures
  - Ensure traceability of requirements through mapping of components to functions, using decomposition as necessary
  - Synthesize system concept solutions
- Evaluate alternative solutions
  - Compare alternatives against each other based on stakeholder values
  - Recommend a preferred alternative, communicating its relative strengths and weaknesses
- Describe the strategy for system verification from design to requirements
  - Demonstrate evaluation during conception, design, implementation and delivery
  - Ensure technical performance measures map to operational characteristics
  - Communicate your efforts to stakeholders Prepare and deliver a presentation
  - Prepare and deliver a written report

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools	**X**

necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	
5. Demonstrate an ability to communicate effectively through written and oral presentation of tech. material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	**X**
d. An ability to function on multi-disciplinary teams	**X**
e. An ability to identify, formulate, and solve engineering problems	**X**
f. An understanding of professional and ethical responsibility	
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of engineering solutions in a global and societal	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	**X**

Topics Covered: This course introduces the student to the discipline of systems engineering in a DoD context. It begins with definitions of systems engineering and architecting. Different systems engineering process models are covered along with their benefits and limitations. Each step in the SE process is introduced, including needs analysis, requirements development, functional analysis & modeling, functional allocation, test and evaluation and considerations for operations and sustainment. Life-cycle cost as an independent variable to support trade studies and stakeholder value judgments is presented. As this is a fundamentals course, students are introduced to the basics in each area. It forms the foundation for other courses in the SE curriculum and provides the certificate students the basics of the SE discipline.

Overview	3	System analysis and alternatives	3
SE Processes & System Lifecycle	3	Life-cycle cost and CAIV	5
Needs analysis, stakeholder value system, operational	8	Test and evaluation basics	3
Functional analysis & allocation	5	Design Projects and briefings	10
Preliminary design and alternative generation	3		

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Number and Name: SE3250, Capability Engineering
Credits and Contact Hours: (3-2)
Course Coordinators Name: Senior Lecturer Matthew G. Boensel

Textbook: The required course text is: *Simulation Modeling and Analysis* by Law (fifth edition).
Other required references:

- *Naval Analytical Capabilities: Improving Capabilities-Based Planning*, Naval Studies Board, National Academy Press, 2005. Free copy at http://books.nap.edu/catalog.php?record_id=11455
- *CJCSI 3170.01I Joint Capabilities Integration and Development System*, May 2015. Free copy at https://dap.dau.mil/policy/Documents/2015/CJCSI_3170_01I.pdf
- *Portfolio Analysis Methods for Assessing Capability Options*, Paul K. Davis, Russell D. Shaver, Justin Beck, Santa Monica, CA: RAND, 2008. Free copy at http://www.rand.org/pubs/monographs/MG662/

Software. This course requires a modest proficiency in *Excel*. A discrete-event simulation language called *ExtendSim* is also introduced. *ExtendSim* is accessed through remote login to a server farm, via the NPS Cloud Lab, or from the lab computers in Bullard 212C. *Excel* can be used for batch input and analysis of output. We will also use *Minitab* software for statistical analysis (or *Excel*) which also may be accessed via remote login or from the lab computers in BU 212C. Both *ExtendSim* and *Minitab* are available for local installation with nominally priced limited license versions

Catalog Description: This course presents a systems engineering approach to determining military capabilities required to execute a mission set. **It introduces and relies upon simulation as a method for assessing performance of a capabilities portfolio**. Topics covered include current DoD and Naval practices for capabilities engineering, design and assessment of capability portfolios, and the use of custom simulations to analyze capability portfolio performance.
Prerequisites: OS3180 Probability and Statistics for Systems Engineers and SE3100 Fundamentals of Systems Engineering.

Co-requisite: SE3011 Engineering Economics and Cost Estimation.

Required, Elective, or Selective Elective Course: This is a required course.

Specific Learning Outcomes for the Course: At the completion of the course students will be able to:

- Describe the DoD and Navy processes for determining required capabilities.
- Describe the existing Navy taxonomy of capabilities.
- Construct a capabilities portfolio against a given set of missions
- Model the effectiveness and cost of a capability portfolio
- Construct a low-resolution model representing a capability portfolio
- Describe the requirements for a high-resolution model representing a capability portfolio.
- Create the requirements for a high-resolution model representing a capability portfolio.
- Interpret the results of a high-resolution model representing a capability portfolio.

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**

2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	**X**
c. An ability to design a system, component, or process to meet desired ends	**X**
d. An ability to function on multi-disciplinary teams	
e. An ability to identify, formulate, and solve engineering problems	
f. An understanding of professional and ethical responsibility	
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of engineering solutions in a global and societal	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	**X**
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	

Topics Covered: This course examines the top level of systems engineering in the Navy mapping missions to capabilities. It begins with a brief overview of the Joint Capabilities Integration and Development Systems (JCIDS) and Program Planning and Budgeting Execution (PPBE) processes and Navy participation in them. It then models and analyzes military operations in order to identify capability needs and derive system requirements. Modeling and simulation tare used to analyze the operational effectiveness and performance of existing systems, emerging technological concepts, and planned systems. Appropriate modeling tools include back-of-the-envelope spreadsheet modeling, analytical modeling, discrete-event simulation, and continuous simulation modeling.

Overview	4 hours	Closed form solutions	2 hours
Capabilities	4 hours	Design of Experiments	5 hours
Continuous models	10 hours	Bounding with approximations	3 hours
Discrete models	5 hours	Integration with Cost Data	2 hours
Output Analysis	5 hours	Applied Portfolio Selection Projects and briefings	10 hours

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Number and Name: SE3302, Systems Suitability

Credits and Contact Hours: (3-2)

Course Coordinators Name: Senior Lecturer Mark Rhoades

Textbook: The required course text is:

- *Systems Engineering and Analysis* by Blanchard and Fabrycky (fifth edition).
- **The Art of Systems Architecting**, Maier and Rechtin, 3rd Ed. CRC Press, 2009.
- Other required references:
- International Council on Systems Engineering (INCOSE) SE Handbook, Version 4, 2015, INCOSE

Software. This course requires a modest proficiency in *Excel* and *Word*. Students can also use *Minitab* software or *Excel* for statistical analysis. *Minitab* is accessed through the VPN using remote login to the NPS Cloudlab or the lab computers in Bullard 212C.

Catalog Description

This course presents basic techniques of system design for operational suitability and feasibility, including reliability, maintainability, usability (including human factors and human performance), supportability, producibility, human systems integration, software integration, and logistics. It covers application of discipline-based engineering for detailed configurations in a systems context, as well as internal and external system integration. Software integration and management from a systems perspective is also presented. It covers the application of fundamental disciplinary engineering processes and methods to an integrative systems project. Development of communication skills is accomplished through discussion boards, oral presentations and written reports.

Prerequisites: SE3100 Fundamentals of Systems Engineering.

Required, Elective, or Selective Elective Course: This is a required course.

Specific Learning Outcomes for the Course: At the completion of the course students will be able to:

- Define reliability requirements for a system
- Allocate reliability requirements to sub-systems
- Define maintainability requirements for a system and components
- Define availability requirements for a system
- Estimate system availability from component data
- Define usability requirements for a system
- Make a preliminary assessment of a system for usability
- Define supportability requirements for a system
- Make a preliminary assessment of a system for supportability
- Define requirements for system survivability
- Define requirements for system inter-operability
- Define requirements for system software suitability
- Manage trades between suitability requirements
- Apply design principles for each of the suitability factors in the course

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**

2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	**X**
d. An ability to function on multi-disciplinary teams	
e. An ability to identify, formulate, and solve engineering problems	**X**
f. An understanding of professional and ethical responsibility	**X**
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of engineering solutions in a global and societal	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	**X**

Topics Covered: This course examines the Systems Engineering Process required to frame an assessment of alternatives for cost, effectiveness and system trades. Techniques are presented for assessing and selecting among alternative systems using the subjects listed below.

Reliability	6 hours	Usability (Introduction to Human Systems	3 hours
Maintainability	3 hours	Software Suitability	3 hours
Availability	3 hours	System Survivability	3 hours
Supportability	3 hours	Interoperability Collaborative Systems	3 hours
Producibility	3 hours	Labs/Project	20 hours

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Number and Name: SE4003, Systems Software Engineering

Credits and Contact Hours: (3-2)

Course Coordinators Name: Professor Raymond Madachy

Textbook: The required course text is:

- *Software Engineering: A Practitioner's Approach*, Roger S. Pressman, 7th Ed., 2010, McGraw-Hill.

Catalog Description

The course is designed to teach students the basic concepts of software engineering and methods for requirements definition, design and testing of software. Specific topics include introduction to the software life cycle, basic concepts and principles of software engineering, methods for requirements analysis, software design and development. Special emphasis is placed on the integration of software with other components of a larger system.

Prerequisites: SE3100 Fundamentals of Systems Engineering; SE3302 Systems Suitability; SE3303 Systems Assessment; SI3400 Fundamentals of Engineering Project Management**.**

Required, Elective, or Selective Elective Course: This is a required course.

Specific Learning Outcomes for the Course:

SE4003 is intended to present software engineering from the perspective of an overarching systems engineering process framework. The course strategy to accomplish this is three-fold:

- Provide a broad understanding of software engineering through reading and discussion of material drawn from the textbook and from additional written material and instructor notes.
- Through short papers and discussions, enable the students to better understand the issues that they will face in the systems engineering and acquisition workplace.
- Augment the classroom instruction and discussion with two individual student projects and a final exam.

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	**X**

5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	
d. An ability to function on multi-disciplinary teams	**X**
e. An ability to identify, formulate, and solve engineering problems	**X**
f. An understanding of professional and ethical responsibility	
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of engineering solutions in a global and societal context	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	**X**
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	**X**

Topics Covered

This course is divided into three main segments of five modules each. Segment 1 presents the big picture and includes the following topics:

- Software Viewed in a Systems Context
- Overview of Software and Software Engineering
- Software Engineering as a Process
- Agile Development and Speeding Up the Process
- Software Engineering as a Principled Process

Segment 2 - Software Systems Acquisition - includes:

- Software Requirements Modeling
- System and Software Architecture
- Software Design Concepts
- Strategies for Software Testing
- Software Evolution

Segment 3 - Software for the Long Term: Special Topics – includes:

- System and Software Quality
- System-wide Impacts of COTS and Reuse
- System and Software Safety
- Measuring the Software Development Process
- Measuring Software Development Progress

Overview	3 hrs.	Software Systems Acquisition: Lifecycle Activities	9 hrs.
The Big Picture: Systems Software Engineering	9 hrs.	Software for the Long Term: Special Topics	9 hrs.

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Number and Name: SE4115, Combat Systems Integration
Credits and Contact Hours: (4-2)
Course Coordinators Name: Associate Professor Robert C. Harney

Textbook: The required course text is:

- *Combat Systems Engineering. Volume 6. Systems Engineering and Integration* by Robert C. Harney

Readings. No supplemental readings are required.
Software. No software is required. Proficiency in *MATLAB*, *Excel*, or other mathematical computation tool is useful, but not required, for course work.

Catalog Description
This course presents systems engineering techniques for integrating combat systems into a common system, including technology development, system development and integration, network integration, and system of systems integration. Lectures and projects exploring engineering design tools and analysis methods to meet specified systems requirements are used. Topics include engineering analysis of interfaces for power, data, mechanical, and other attributes; engineering change management; advanced collaboration environments; technology readiness levels; and integration risk mitigation.

Prerequisites: SE3113 Combat Systems Engineering II, SE4112 Combat Systems Engineering III or consent of instructor.

Required, Elective, or Selective Elective Course: This is an elective course – part of the Combat Systems Engineering track.

Specific Learning Outcomes for the Course:

- Describe the systems engineering process as it applies to combat system design
- Select a combat systems suite that satisfies mission and program requirements
- Arrange the elements of that combat systems suite on the platform of interest while satisfying critical design constraints and without unnecessarily sacrificing performance
- Verify that the combat systems design satisfies key performance requirements including survivability
- Trade different strategies to optimize survivability versus cost and performance
- Address electromagnetic compatibility issues in the design of the combat system
- Determine which approaches to multisensor integration will work in a specific operational setting.
- Assess the operational availability of the combat system.
- Integrate safety considerations into the design of the combat system
- Work as a team to design a combat system that satisfies specified mission requirements

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis	**X**

and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	**X**
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	**X**
d. An ability to function on multi-disciplinary teams	**X**
e. An ability to identify, formulate, and solve engineering problems	**X**
f. An understanding of professional and ethical responsibility	
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of eng. solutions in a global and societal context	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	

Topics Covered

This course applies the systems engineering process to the development of integrated combat systems. Combat systems elements necessary for integration, design approaches, and assessment approaches are described including the subjects listed below.

Systems engineering in the integration process	7 hours
Combat system design – process, element location, and integration architecture determination	5 hours
Survivability (conventional weapons)	5 hours
Reduced observables design	5 hours
Survivability (WMD)	3 hours
Electromagnetic interference and mitigation approaches	4 hours
Multi-sensor integration considerations and data fusion	2 hours
Combat system-specific safety, human factors, & supportability considerations	7 hours
Combat system test and evaluation	2 hours
Combat system integration project	20 hours

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Number and Name: SE4150, Systems Architecture and Design

Credits and Contact Hours: (3-2)

Course Coordinators Name: Professor Ronald Giachetti

Textbook: The required course texts are:

- Mark W. Maier and Eberhardt Rechtin, *The Art of Systems Architecting*, 3rd Edition, CRC Press, 2009. ISBN 978-1-4200-7913-5.
- Edward Crawley, Bruce Cameron and Daniel Selva. *System Architecture: Strategy and Product Development for Complex Systems*. Pearson Higher Education, Inc., 2016. ISBN 978-0-13-397534-5.

Other required references: weekly handouts provided on the course Sakai site

Software. This course requires Vitech's CORE University Edition systems engineering software (www.vitechcorp.com). This course will include the use of CORESim, which is an embedded discrete event simulator within the Vitech CORE software. Other similar products to support MBSE can be used.

Catalog Description

This course builds on the fundamentals of systems engineering by providing a foundation in system architecting and design principles and practices and enabling students to develop skills in identifying system elements with their capabilities, designing the relationships between those elements, and predicting system behavior through those relationships. Specifically, this course provides students the language, terminology, concepts, methods, and tools of system architecting, modeling and design through a study of various types of architectures, architecting and design. Topics covered include functional and physical architecture modeling and analysis, architecture frameworks, and architecting heuristics.

Prerequisites: SE3100 Fundamentals of Systems Engineering and SE3250 Capability Engineering.

Required, Elective, or Selective Elective Course: This is a required course.

Specific Learning Outcomes for the Course:

At the completion of the course students will be able to:

- Create system architecture descriptions responsive to capability needs with models.
- Construct alternative system architectures for balanced system solutions, applying design heuristics and divergent thinking. Demonstrate their feasibility through simulation.
- Conduct architectural trades, analyze and compare alternative architectures, and justify architecture recommendations with appropriate analyses.
- Apply system architecture frameworks appropriately in their role in architecture description and development. Determine and create the artifacts (e.g., diagrams, tables, etc.) specified by a framework in a given situation (we use DoDAF mostly).

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis	**X**

and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	**X**
d. An ability to function on multi-disciplinary teams	
e. An ability to identify, formulate, and solve engineering problems	**X**
f. An understanding of professional and ethical responsibility	**X**
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of eng. solutions in a global and societal context	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	**X**

Topics Covered

This course approaches a range of topics applicable to system architecting and design through a combination of lectures, discussion, and lab work. Lectures present conceptual material, and labs put the concepts into practice. Lecture and lab topics are coordinated and woven together to introduce students to system architecture and design principles and practices in a stepwise but iterative fashion over the duration of the course.

Introduction to Systems Architecture/*Lab: Capability Need Statement*	3 hours/*2*
Architecture Foundations/*Lab: Design Reference Mission*	3 hours/*2*
Models for Architecting/*Lab: System Context (Architecture Scoping) & Top Level*	3 hours/*2*
Architecture Frameworks/*Lab: Sequence Diagrams of External System Interactions*	3 hours/*2*
DoDAF/*Lab: Architecture Partitioning / Decomposition (Internal View of System's*	6 hours/*2*
Concept Modeling/*Lab: Operational Activity / OPM Modeling*	3 hours/*2*
Executable Architectures and Functional Behavior Simulation/*Lab: Functional Behavior*	3 hours/*2*
Concept Generation and Selection/*Lab: Concept Generation / Selection and Physical*	3 hours/*2*
System V&V and Certification, Architecture Complexity, and Open Architecture *Lab: System*	3 hours/*2*

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Number and Name: SE4354, Systems Test & Evaluation
Credits and Contact Hours: (4-0)
Course Coordinators Name: CDR Kathleen Giles, USN, PhD

Textbook: There is no required textbook for this course.
Most course materials are government policy documents. The design of experiments content in the second half of the course will refer to *Statistics for Experimenters*, by Box, Box and Hunter, though the homework and test content are all in the course slides. The presentations and materials selected for the course were originally drawn from OA4603, which was taught for many years by Tom Hoivik of the NPS Operations Research Department. These materials were adapted for SE4354, previously taught by David Hart, and updated to reflect current documentation. Reading material and other references for the course are posted on Sakai.

Software. A working knowledge and proficiency with basic computing and office automation is required. This includes the use of tools like internet browsers, Microsoft Word, Excel, PowerPoint, and Adobe Reader. Additionally, some basic knowledge of Excel, Minitab, MATLAB or another statistical tool of your choice is necessary.

Catalog Description: This course is designed to cover principles of test and evaluation (T&E) and the roles, purposes, functions, and techniques of T&E within the systems engineering process. The course will cover all aspects of T&E throughout the life cycle of a system to include test planning, test resources, development of test requirements, selection of critical test parameters, development of measures of effectiveness and performance, test conduct, analysis of test results, and determination of corrective action in the event of discrepancies. The course will emphasize the application of T&E through all phases of system development to include modeling and simulation (M&S) activities for enhancing the T&E process, developmental test and evaluation (DT&E), live fire test and evaluation (LFT&E), and operational test and evaluation (OT&E). Principles of experiment design and statistical analysis of test results will be reviewed. The course content will be consistent with Congressional and DoD requirements and guidelines and will include case studies and lessons learned from actual defense system tests. This course also offered as OA4603.
Prerequisites: OS3180 Probability and Statistics for Systems Engineering or equivalent and SE3100 Fundamentals of Systems Engineering.

Required, Elective, or Selective Elective Course: This is an elective course.

Specific Learning Outcomes for the Course: Upon successful completion of this course, you will be able to:

- Describe the role of T&E within systems engineering and throughout the acquisition process.
- Characterize and distinguish the key characteristics of developmental and operational T&E, as conducted by DoD.
- Demonstrate familiarity with the DoD Handbooks governing T&E.
- Formulate traceable requirements for testing complex systems using the dendritic approach.
- Prepare a draft Operational Test input to the Test and Evaluation Master Plan (TEMP) using the Integrated Evaluation Framework (IEF).
- Demonstrate familiarity with principles and statistical tools of design of experiments (DOE).
- Develop test scenarios and identify the required resources for tests.
- Apply statistical tools for evaluating specification compliance and designing experiments.

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**

2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	**X**
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	**X**
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	X
b. An ability to design and conduct experiments, as well as to analyze and interpret data	X
c. An ability to design a system, component, or process to meet desired ends	X
d. An ability to function on multi-disciplinary teams	X
e. An ability to identify, formulate, and solve engineering problems	X
f. An understanding of professional and ethical responsibility	X
g. An ability to communicate effectively	X
h. The broad education necessary to understand the impact of eng. solutions in a global and societal context	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	X

Topics Covered: This course is designed to cover principles of test and evaluation (T&E) and the roles, purposes, functions, and techniques of T&E within the systems engineering process. The course will cover all aspects of T&E throughout the life cycle of a system to include test planning, test resources, development of test requirements, selection of critical test parameters, development of measures of effectiveness and performance, critical operational issues, test design, test conduct, analysis of test results, and determination of corrective action in the event of discrepancies.

Course Introduction; Role of T&E, DoD directives, policy and guidance	3 hrs.	Suitability, human systems integration	3 hrs.
Requirements analysis, technical performance measures, and test planning	3 hrs	Single factor test design (ANOVA), two-factor test design	3 hrs.
Operational T&E planning principles	3 hrs	Multi-factor factorial design, variable selection, fractional test design	3 hrs.
Application of OT&E planning and review of current OT&E work	3 hrs	Live fire T&E, T&E lessons learned	3 hrs.
Statistics review, confidence limits for binomial proportions, performance guarantee testing	3 hrs	Student project presentations	3 hrs.

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Number and Name: SI3400, Fundamentals of Engineering Project Management
Credits and Contact Hours: (3-2)
Course Coordinators Name: Lecturer Brigitte Kwinn

Textbook: The required course text is: *Project Management (A Systems Approach to Planning, Scheduling, and Controlling* by Harold Kerzner (twelfth edition).

Other required references: None

Other textbooks: *Visualizing Project Management, 3rd Edition* by Kevin Forsberg, Hal Mooz and Howard Cotterman. New Jersey: John Wiley & Sons, 2005

Software. This course requires a modest proficiency in *Microsoft Excel* and *Microsoft Word.* The students can use *Microsoft Project* if they would like. *(Microsoft, Microsoft Excel, Microsoft Word and Microsoft Project are trademarked by Microsoft Corporation).*

Catalog Description: This course examines modern techniques of engineering project management from a systems perspective, including project planning, organization, and control. Specific topics include discussion of the systems engineering management process, risk management, scheduling methodologies, the DoD acquisition environment, management of design activities, PERT, CPM, and project control mechanisms. Case studies are used to examine application of principles. Large scale system management, mitigation of technical risk, integrated product and process development, quality management, contracting, and the international environment are discussed. Large-scale systems management problems are examined using commercial software suites. Covers application of fundamental systems project management processes and methods to an integrative system project. Development of communication skills is accomplished through oral presentations and written reports.

Corequisites: SE3100 Fundamentals of Systems Engineering.

Required, Elective, or Selective Elective Course: This is a required course.

Specific Learning Outcomes for the Course:

Upon successful completion of the course students will be able to:

- Define the processes and concepts of project management (e.g., initiate, plan, execute/launch, monitor, control, and close)
- Define concepts of project management (e.g. communicate and team build)
- Design a project organization tailored to a project by applying different kinds of organizational design approaches
- Construct a project Work Breakdown Structure that translates scope and requirements into an organized list of deliverables and tasks
- Identify key technical and programmatic reviews, milestones, interim deliverables and audits as part of a project plan. Create a project schedule by applying the techniques of PERT (Program, Evaluation and Review Technique, a network analysis tool) and CPM (Critical Path Method), including all project control gates.
- Estimate project costs and present a cost breakdown structure; justify labor and material cost estimates.
- Synthesize a time-phased budget, combining project schedule and cost estimates.
- Plan for the following elements as an integrated part of engineering project management:
  - Risk
  - Configuration control (baseline control)
  - Earned Value (EV)
  - Contracts and procurements
  - Quality
- Write a Systems Engineering plan (SEP) that demonstrates knowledge and proficiencies in the fundamentals of engineering project management.

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	

1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	**X**
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	**X**
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**
4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	**X**
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	**X**
6. Demonstrate an understanding of professional and ethical responsibility.	**X**
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	
d. An ability to function on multi-disciplinary teams	**X**
e. An ability to identify, formulate, and solve engineering problems	
f. An understanding of professional and ethical responsibility	**X**
g. An ability to communicate effectively	**X**
h. The broad education necessary to understand the impact of eng. solutions in a global and societal context	**X**
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	**X**
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	

Topics Covered: This course examines engineering project management using the systems engineering technical management processes and a broad view to project management. It supports the students' ability to (1) enable them to practice the fundamentals of engineering project management, (2) know when and how to apply engineering project management methods across the project life-cycle, and (3) demonstrate proficiency in communicating engineering project tools and methods using critical thinking.

PM Overview, Project Manager's Role	3 hours	Risk and Opportunities	3 hours
Project Planning	3 hours	Pricing and Estimating	3 hours
Project Scheduling	3 hours	Contracts, Procurements and Proposals	3 hours
Organizational Structures and Staffing	3 hours	Quality Management	1.5 hours
Time Phased Budget and Cost Control	3 hours	Configuration Management	1.5 hours

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Taught by Department of Operations Research
Number and Name: OS3180, Probability and Statistics for Systems Engineering
Credits and Contact Hours: (4-1)
Course Coordinators Name: Professor Tom Lucas

Textbook: The required course text is:

- *Probability and Statistics for Engineers and Scientists* by Anthony Hayter (4th edition).

Software. JMP is the required software for data analysis. It is available for free download on the NPS intranet at https://www.nps.edu/Technology/SoftwareLib/index.htm.

Catalog Description
The course covers the basic tools and concepts of probability and statistics. Topics include probability laws and calculation methods, conditional probability, common probability distributions, discrete and continuous random variables, expectation, variance, covariance, confidence intervals, hypothesis testing, regression, time series, experimental design, and nonparametric statistics.

Prerequisites: SE1001 Mathematics for SE I or equivalent.

Required, Elective, or Selective Elective Course: This is a required course.

Specific Learning Outcomes for the Course:
At the completion of the course students will be able to:

- Apply basic probability to model military phenomena.
- Analyze discreet data sets.
- Analyze continuous data sets.
- Apply principles of design of experiments.
- Construct statistical estimates.
- Perform hypothesis tests.
- Conduct regression analysis.
- Effectively present statistical results in written and oral formats.

Student Outcomes Addressed by the Course:

MSSE MASTERS PROGRAM OUTCOMES	
1. Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This includes the ability to apply knowledge of mathematics, science, and engineering to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and modern engineering tools necessary for engineering practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of systems and processes for military applications.	
2. Demonstrate an ability to design a system, component, or process to meet desired needs incorporating appropriate engineering standards within multiple realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and lifecycle sustainability. Demonstrate proficiency in the application of systems engineering methods and processes, including systems thinking, stakeholder needs analysis, concept of operations, requirements definition and analysis, functional analysis and allocation, human systems integration, design, architecture, lifecycle support, lifecycle cost, systems assessment, trade-off, selection, and test and evaluation.	
3. Demonstrate proficiency in core skills of systems analysis, to include an ability to design and conduct experiments, as well as to analyze and interpret data and to perform deterministic and stochastic modeling of systems, optimization, decision analysis, risk analysis, economic modeling, and lifecycle supportability analysis. This includes familiarity with combat simulations and combat modeling.	**X**

4. Demonstrate an ability to function on multidisciplinary teams working as a team member or leader in an authentic systems engineering project through both individual and team level contributions. Demonstrate proficiency in interpersonal skills and communications. Demonstrate competence in the planning and management of authentic systems engineering projects.	
5. Demonstrate an ability to communicate effectively through written and oral presentation of technical material.	
6. Demonstrate an understanding of professional and ethical responsibility.	
7. Demonstrate a recognition of, the need for, and an ability to engage in, life-long learning and a knowledge of contemporary issues.	
ABET CRITERION 3 STUDENT OUTCOMES	
a. An ability to apply knowledge of mathematics, science, and engineering	**X**
b. An ability to design and conduct experiments, as well as to analyze and interpret data	
c. An ability to design a system, component, or process to meet desired ends	
d. An ability to function on multi-disciplinary teams	
e. An ability to identify, formulate, and solve engineering problems	
f. An understanding of professional and ethical responsibility	
g. An ability to communicate effectively	
h. The broad education necessary to understand the impact of engineering solutions in a global and societal	
i. A recognition of the need for, and an ability to engage in life-long learning	
j. A knowledge of contemporary issues	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	

Topics Covered

Basic Probability	5 hours
Discrete Random Variables	5 hours
Continuous Random Variables	5 hours
Normal Probability Distributions	5 hours
Joint Probability Distributions	5 hours
Descriptive Statistics and Point Estimation	5 hours
Confidence Intervals	5 hours
Hypothesis Testing	5 hours
Simple Linear and Multiple Regression	10 hours
Projects /Exams	5 hours

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Appendix A-2 – Theses and Directed Research Projects

Please describe any requisite or optional requirements for a master's level theses and/or directed research project.

The general requirements for a masters degree from NPS are described, as well as any specific requirements for the masters degree.

The award of a masters degree has requirements related to a thesis at the NPS level, namely that "a thesis or its equivalent is required" as documented in the catalog. From the NPS catalog:

The master's degree may be awarded for successful completion of a curriculum, which has the approval of the Academic Council as meriting the degree. Such curricula shall conform to current practice in accredited institutions and shall contain a well-defined major.

General Naval Postgraduate School minimum requirements for the master's degree are as follows:

- 32 quarter-hours of graduate level credits of which at least 24 quarter-credits must be earned from NPS*.
- A thesis or its equivalent is required.

*NPS generally allows a maximum of 12 graduate-level, quarter-credits to be transferred for purposes of earning a graduate degree. However, an additional 12 quarter-credits may be transferred from the Air Force Institute of Technology (AFIT) in Dayton, Ohio. This is in addition to the normal transfer allowed (12), bringing the total to a maximum of 24 quarter-credits transferable from AFIT to NPS. Permission to transfer a specific course to serve as a substitute for a degree requirement will be determined by the Department Chairman or equivalent person responsible for nominating candidates for degrees at NPS and must be pre-approved in a coherent plan of study for the student. Regardless of transfer credits allowed, all NPS master's degrees still require at least 24 quarter-credits be earned directly from NPS.

Further, specific requirements for formatting and procedural compliance for a masters thesis or capstone project report are described in the NPS catalog. The SE department graduate theses and capstone project reports must conform to these thesis requirements. From the NPS catalog:

The Thesis/Dissertation/MBA Project Report and Joint Applied Project Preparation Manual provides formatting and procedural guidance for preparing and processing electronic thesis/dissertation/reports at the Naval Postgraduate School. It covers both unclassified and classified theses/reports. All references to "theses" also refer to Dissertations, MBA Professional Reports and Joint Applied Projects. The document is on the web at http://www.nps.edu/research/research1.html.

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Appendix B – Faculty Vitae (*)

Name: **Timothy P. Anderson**
Lecturer (14 years NPS service)

Education

Degree	Discipline	Institution	Year
BS	Industrial and Operations Engineering	University of Michigan	1987
MS	Operations Research	Naval Postgraduate School	1994

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Lecturer (MILFAC), Operations Research	1997 - 2001	PT
George Mason University	Adjunct Professor	2007 - 2008	PT
Naval Postgraduate School	Adjunct Professor, Systems Engineering (DL)	2008 - 2011	PT
Naval Postgraduate School	Adjunct Professor, Operations Research	2009 - 2011	PT
Naval Postgraduate School	Lecturer, Operations Research	2011 - present	PT
Naval Postgraduate School	Lecturer, Systems Engineering (DL)	2011 - present	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
The Aerospace Corporation	Department Director	Director of the Integrated Cost and Schedule Analysis Department	October 1, 2000 - Present	FT

Certifications or Professional Registrations

Certified Cost Estimator/Analyst, ICEAA, June 15, 2007 - Present

Current Membership in Professional Organizations

Chapter VP, ICEAA, January 1, 1994 - Present

Honors and awards

2010 National Estimator/Analyst of the Year for Technical Achievement, Society of Cost Estimating and Analysis, June 15, 2010

The Wayne E. Meyer Award for Excellence in Systems Engineering, Naval Postgraduate School, September 15, 2010

2017 Service to the Society Award, International Cost Estimating and Analysis Association (ICEAA), June 16, 2017

Service activities

Program Organizer, International Cost Estimating and Analysis Association, Washington, DC Chapter, October 1, 2007 - September 30, 2015

Officer, Vice President, International Cost Estimating and Analysis Association, Washington, DC Chapter, October 1, 2015 – Present

Principal Publications and Presentations in the Last Five Years

None

Recent Professional Development Activities

None

Name: **Paul T. Beery**
Assistant Professor (3 years NPS service)

Education

Degree	Discipline	Institution	Year
BA	Statistics	Rutgers University	2009
MS	Systems Engineering Analysis	Naval Postgraduate School	2011
PhD	Systems Engineering	Naval Postgraduate School	2016

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Assistant Professor, Systems Engineering	2018 - present	FT

Non-academic Experience
None

Certifications or Professional Registrations
None

Current Membership in Professional Organizations
None

Honors and Awards
Selected Presenter: SERC Doctoral Students Forum, Systems Engineering Research Center (SERC), December 2, 2015

Outstanding Paper Award: SERC Doctoral Students Forum, Systems Engineering Research Center (SERC), December 3, 2015

Service Activities
Academic Associate - 722 Program, 2018

Principal Publications and Presentations in the Last Five Years
Whitcomb, C. A., Abdelhamid, T. K., Porter, N. W., Beery, P. T., Wolfgeher, C. A., Parker, G. W., Szczerbinski, M., Robertson, C. (2015). *NPS Technical Report NPS-SE-15-001: A systems approach to modeling drivers of conflict and convergence in*

the Asia-Pacific region in the next 5-25 years. Monterey CA: Naval Postgraduate School. http://hdl.handle.net/10945/45531

Whitcomb, C. A., Beery, P. T., Parker, G. W., Wolfgeher, C. A. (in press). *A System Dynamics Model of Factors Affecting U.S. and Russian Interactions in Europe*.

MacCalman, A. D., Beery, P. T., Paulo, E. P. (2016). A Systems Design Exploration Approach that Illuminates Tradespaces Using Statistical Experimental Designs. *Systems Engineering, 19*, 409-421.

Whitcomb, C. A., Beery, P. T. (2016). Chapter 12 Exploring the Design Space. *Parnell, G. S., Editor, Trade-off Analytics: Creating and Evaluating the Tradespace, Wiley Series in Systems Engineering and Management, Wiley & Sons, 2017*. http://www.wiley.com/WileyCDA/WileyTitle/productCd-111923753X.html

Gillespie, S. E., Giachetti, R. E., Hernandez, A. D.S., Beery, P. T., Paulo, E. P. (2017). *System of Systems Architecture Feasibility Analysis to Support Tradespace Exploration*. IEEE. http://ieeexplore.ieee.org/document/7994944/

Casola, K. J., Beery, P. T., Paulo, E. P. (in press). System Architecting and Analysis of Medium Displacement Unmanned Surface Vehicle “Sea Hunter. *Naval Engineers Journal*.

Beery, P. T., Paulo, E. P., Twelfth International Mine Warfare Technology Symposium, "Comparing Legacy and Future MCM Capabilities," Monterey, CA, United States. (May 23, 2016).

Paulo, E. P. (Author & Presenter), Beery, P. T. (Author), Williams, R. D. (Author), Undersea Warfare Conference, "NPS Studies Addressing Future of Mine Warfare," Groton, CT, United States. (September 19, 2017).

Paulo, E. P. (Author & Presenter), Beery, P. T. (Author & Presenter), Technologies for Information Operations, "MBSE: The Integration of Systems Engineering and Modeling and Simulation for Better Decision Making," Center for Joint Services Electronic Warfare, Naval Postgraduate School, Monterey, CA, United States. (October 24, 2017).

Beery, P. T., Thirteenth International Mine Warfare Symposium, "Next Generation Mine Warfare UUVs," Monterey, CA, United States. (May 23, 2018).

Recent Professional Development Activities

None

Name: **Barbara J. Berlitz**
Senior Lecturer (9 years NPS service)

Education

Degree	Discipline	Institution	Year
BA	English	Arizona State University	1977
JD		Monterey College of Law	1985

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
NPS Writing Center		January 2011 - January 2016	PT
Naval Postgraduate School	Senior Lecturer	2012 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Northern California Attorney Mediators	full time practicing attorney member	While practicing law in my sole practice business in Pacific Grove, I attended and participated in regular meetings with this organization	January 1985 - December 1991	FT
Barbara J. Berlitz, Esq.	Researcher	Legal Research and appellate projects for local attorneys; in private practice as sole practitioner for eight years with staff of two	November 1985 - December 1992	FT
various	Real Estate Broker	Real Estate Broker handling negotiations in commercial and residential properties	January 1992 - December 2008	N/A

Certifications or Professional Registrations
None

Current Membership in Professional Organizations
None

Honors and Awards
None

Service Activities

Attendee, Meeting, SE Dept. representative for ABET, April 2015 - January 2018

Faculty reviewer, Thesis Review, September 2012 - Present

Attendee, SE Dept. Meeting, Recording Secretary, January 2014 - Present

Attendee, Meeting, SE Dept Rep on Faculty Council, February 2015 - Present

Volunteer English as a Second Language tutor

Volunteer equestrian trail assistance-first aid/CPR

Volunteer mediator

Principal Publications and Presentations in the Last Five Years

Berlitz, B. J. (2015). Ethics in Engineering. *chapter in BKCASE blog revised for 2015-2016*.

Recent Professional Development Activities

Workshop, Design for Student Success Workshop, NPS, November 2015 - March 2016

Name: **Matthew G. Boensel**
Senior Lecturer (20 years NPS service)

Education

Degree	Discipline	Institution	Year
BS		United States Naval Academy	1980
MS	Operations Research	Naval Postgraduate School	1988

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	MILFAC	June 1999 - June 2003	FT
Naval Postgraduate School	Program Officer Operations Research and Applied Math	June 2000 - June 2003	PT
Naval Postgraduate School	Lecturer, Systems Engineering	July 2003 - June 2007	FT
Naval Postgraduate School	Course Coordinator, OS4680	June 1999 - June 2009	PT
Naval Postgraduate School	Associate Chair of Operations, Systems Engineering	June 2003 - Present	PT
Naval Postgraduate School	Senior Lecturer, Systems Engineering	July 2007 - Present	FT
Naval Postgraduate School	Course Coordinator, SE3250	September 2009 - Present	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Patrol Wing Ten	Current Operations Officer	Plan and coordinate operational and exercise flight operations for seven P-3 squadrons.	1990 - 1992	FT
Patrol Squadron Forty-Seven (1992-1993)	Operations Officer	Plan and execute operations and training for twelve combat aircrews utilizing nine P-3 aircraft.	1992 - 1994	FT
Patrol Wing Ten (1993-1994)	Operations Officer	Coordinate and guide Wing level operations for multiple operational squadrons.	1992 - 1994	FT
Office of the Chief of Naval Operations, Assessment Division (N81)		Primary aviation readiness analyst (N814). Reviewed Navy program decisions and made recommendations to Navy leadership regarding funding and readiness for all US Navy aviation programs.	1994 - 1996	FT
HQ, US Army Europe, Office of		Assistant Division Chief for Movements and Deployment under the	1996 - 1999	FT

the Deputy Chief of Staff Logistics		Deputy Chief of Staff, Logistics. Analyzed and developed plans for logistic movement from the European central region to various deployed sites.		

Certifications or Professional Registrations

Associate Systems Engineering Professional, INCOSE, December 14, 2015 - December 13, 2020

Current Membership in Professional Organizations

Military Operations Research Society (MORS), 1996 – present

International Council on Systems Engineering (INCOSE), 2007 - present

Honors and Awards

Top 5% - Rear Admiral John Jay Schieffelin Award for Teaching Excellence, NPS, May 27, 2015

Service Activities

Associate Chair for Operations, Department Administration, October 1, 2014 - September 30, 2015

Associate Chair for Operations, Department Administration, October 1, 2015 - September 30, 2016

Associate Chair for Operations, Department Administration, October 1, 2016 - September 30, 2017

Associate Chair for Operations, Department Administration, October 1, 2017 - September 30, 2018

Principal Publications and Presentations in the Last Five Years

None

Recent Professional Development Activities

None

Name: **Ronald R. Carlson**
Professor of Practice (10 years NPS service)

Education

Degree	Discipline	Institution	Year
BS	Nuclear Engineering	University of Michigan	1979
MBA		Embry Riddle Aeronautical University	1991
MS	National Security and Strategic Studies	Naval War College	1997
Master of Philosophy	Systems Engineering	Stevens Institute of Technology	2018

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Lead Systems Integrator (DL) Program Officer (232)	2012 - present	PT
Naval Postgraduate School	Aviation Systems Engineering (DL) Program Officer (312)	2015 - present	PT
Postgraduate School	sor of Practice, Systems Engineering (DL)	present	
Postgraduate School	ns engineering Non-Resident (DL)Master's Degree Program Officer (311)	present	

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
U.S. Navy		various squadron and staff tours	1983 - 1999	FT
SEA CONTROL SQUADRON THREE TWO	Commanding Officer		1999 - 2002	FT
Systems Engineering (APMSE)	S-3B Assistant Program Manager		2002 - 2003	FT
S-3B Aircraft	PMA-290 Deputy Program Manager		2003 - 2005	FT
Systems Engineering Department (AIR 4.1)	Military Director		2005 - 2009	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

International Council on Systems Engineering (INCOSE), 2009 - Present

Honors and Awards

Incentive Pay awards; October 2015, September 2016, October 2017, October 2018

Time off award, October 3, 2015

Wayne E Meyer Excellence in Teaching Award; September 2012, March 2013, March 2014, March 2017

Service Activities

Course Coordinator, SE 3303 Systems Assessment, March 31, 2010 - March 31, 2016

Committee Member, SE Department Curriculum Committee, August 24, 2015 - Present

Principal Publications and Presentations in the Last Five Years

Carlson, R. R., Montgomery, P. R., 12th Annual Acquisition Research Symposium, "The Making of a Government LSI- from warfare capability to operational system." (May 13, 2015).

Montgomery, P. R., Carlson, R. R., NAVAIR Senior Leadership Presentation, "An Enterprise Lead Systems Integration (LSI) Framework," NAVAIR, Naval Air Station, Patuxent River, MD, United States. (October 2, 2015).

Vaneman, W. K., Carlson, R. R. (2017). *Defining an Enterprise Lead Systems Integration (LSI) Framework*. Waikoloa, HI: IEEE.

Carlson, R. R., Vaneman, W. K., SOSE 2017, "Defining an Enterprise Lead Systems Integration (LSI) Framework." (June 2017).

Vaneman, W. K., Carlson, R. R., Acquisition Research Symposium, "Managing Complex System Engineering and Acquisition through Lead Systems Integration," Naval Postgraduate School, Monterey, CA, United States. (May 9, 2018).

Vaneman, W. K., Carlson, R. R., 28th Annual INCOSE International Symposium, "Engineering Complex Mission Capabilities through Lead Systems Integration," INCOSE, 28th Annual INCOSE International Symposium, Washington, DC, United States. (July 10, 2018).

Vaneman, W. K., Carlson, R. R., 21st Annual NDIA Systems Conference, "Lead Systems Integration: An Engineering and Management Strategy for System of Systems," NDIA, Tampa, FL, United States. (October 23, 2018).

Vaneman, W. K., Carlson, R. R. (2018). *Managing Complex Systems Engineering and Acquisition through Lead Systems Integration*. Monterey, CA: Naval Postgraduate School. www.researchsymposium.org

Vaneman, W. K., Carlson, R. R., 21st Annual NDIA Systems Conference, "Organizational Considerations for Effective Model-Based Systems Engineering Implementation," NDIA, Tampa, FL, United States. (October 23, 2018).

Recent Professional Development Activities

None

Name: **John T. Dillard**
Senior Lecturer (20 years NPS service)

Education

Degree	Discipline	Institution	Year
BA		University of Tennessee-Chattanooga	1974
MS	Systems Management	University of Southern California	1985

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Senior Lecturer, Systems Acquisition Management	1994-1996 and 2000 - present	FT
University of California, Santa Cruz	Adjunct Professor	2001 - 2010	PT
Naval Postgraduate School	Senior Lecturer, Systems Engineering	2018 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Defense Systems Management College (Resident), Ft Belvoir, VA	Program Manager Course		1988	FT
U.S. Army Command and General Staff College (Resident), Fort Leavenworth, KS			1988 - 1989	FT
U.S. Army War College (Resident), Carlisle, PA			1996 - 1997	FT
Army Tactical Missile System (Lieutenant Colonel)	Assistant Project Manager			FT
Javelin Anti-Tank Missile System (Lieutenant Colonel)	Assistant Project Manager			FT
Defense Contract Management Agency, Long Island, NY (Colonel)	Commander			FT
Joint Advanced Special Operations Radio System (Lieutenant Colonel)	Product Manager			FT

Certifications or Professional Registrations

Level 3 Certified in Program Management

Current Membership in Professional Organizations

NPS Foundation Life Member

Project Management Institute Author and Member

International Council on Systems Engineering (INCOSE)

Honors and Awards

Navy Meritorious Civilian Service Award

Service Activities

Program Manager, Advanced Acquisition Program, 2004 - 2005

Alternate Member, NPS Faculty Advisory Board, 2005 - 2006

Provost's Systems Engineering Enterprise Design Committee, 2006 - 2007

Faculty Research Committee Member, 2008 - 2009

Program Coordinator, Defense Acquisition University Coordinator/Representative, November 3, 2000 - September 30, 2017

Chairperson, NPS Faculty Retirement and Special Functions Committee

Principal Publications and Presentations in the Last Five Years

Dillard, J. T., Ford, D., Angelis, D. (2014). Valuation of Real Options as Competitive Prototyping in System Development. *Defense Acquisition Research Journal, 21*(3), 667-692.

Angelis, D. I., Ford, D. N., Dillard, J. T. (2015). *Real Options in Military System Acquisition: The Case Study of Technology Development for the Kingfish Unmanned Underwater Vehicle*. Monterey, CA: Naval Postgraduate School.

Dillard, J. T. (2016). *Costs of Commonality*. Monterey, CA: NPS Acquisition Research Program.

Ford, D. N., Dillard, J. T. (2018). *Crossing the Technology Valley of Death: The Case of the MDUSV*.

Angelis, D. I. (Author & Presenter), Ford, D. N. (Author), Dillard, J. T. (Author), WEAI, "Real Options in Military System Acquisition: An Application to Unmanned Underwater Vehicles," Honolulu, HI, United States. (July 1, 2015).

Dillard, J. T., Western Economics Association International, "Costs of Commonality," WEAI, Portland, OR, United States. (June 30, 2016).

Recent Professional Development Activities

None

Name: **Larrie D. Ferreiro**
Lecturer (1 year NPS service)

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Defense Acquisition University (DAU)	Professor of Systems Engineering Management	2005 - 2010	FT
Catholic University of America, Washington DC	Adjunct Professor of Systems Engineering	2008 - 2015	PT
Defense Acquisition University (DAU)	Professor of Systems Engineering Management	2010 - Present	PT
George Mason University	Adjunct Professor of Systems Engineering	2011 - Present	PT
Stevens Institute of Technology	Adjunct Professor of Systems Engineering and Ocean Engineering	2012 - Present	PT
Georgetown University	Adjunct Professor of Systems Engineering Management	2015 - Present	PT
Naval Postgraduate School	External Lecturer/Adjunct	2017 - Present	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Office of Naval Research (ONR) Global	Liaison Scientist/Assoc Dir. for International Programs		June 2001 - September 2004	FT
Noesis, Inc.	Senior Engineer		September 2004 - December 2005	FT
Defense Acquisition University (DAU)	Professor of Systems Engineering, Science, and Tech Management		December 2005 - December 2009	FT
RAND Corporation	Visiting Fellow		January 2013 - May 2013	FT
Defense Acquisition University (DAU)	Director of Research		2009 - Present	FT

Certifications or Professional Registrations

Chartered Engineer, Engineering Council of Great Britain, 1987 - Present

Professional Engineer, State of Virginia, 1989 - Present

European Engineer, European Federation of National Engineering Associations, 1990 - Present

DAWIA Level III in Systems Planning, R&D, Engineering, DoD Acquisition Professional Community, 1993 - Present

DAWIA Level III in Science and Technology, DoD Acquisition Professional Community, 2006 - Present

Current Membership in Professional Organizations

Society of Naval Architects and Marine Engineers (SNAME), 1977 - Present

The Royal Institution of Naval Architects (RINA), 1985 - Present

American Society of Mechanical Engineers (ASNE), 1986 - Present

International Council on Systems Engineering (INCOSE), 2005 - Present

Honors and awards

U.S. Coast Guard Parthenon, U.S. Coast Guard, 1998

U.S. Navy Superior and Outstanding Performance Award, U.S. Navy, 2004

Award for Excellence in Systems Engineering, Defense Acquisition University (DAU), 2007

Award for Excellence in Systems Engineering, Office of Secretary of Defense Acquisition, Technology and Logistics, 2007

Service activities

Grant Evaluation Committee Member, NPS Broad Agency Announcement on Acquisition Research Program, 2010 - Present

Assistant Project Officer for Data Exchange Agreements, Naval Sea Systems Command, Preliminary Design Division (NAVSEA 03D), July 1982 - September 1993

Course Developer and Manager, Defense Acquisition University (DAU), December 2005 - September 2009

Peer Review and Evaluation of RAND Research in Systems Acquisition and Management, RAND National Defense Research Institute (NDRI, 2005 - Present

Executive Editor, Defense Acquisition Research Journal, Defense Acquisition University (DAU), October 2009 - Present

Steering Committee, RAND National Defense Research Institute (NDRI), 2010 - Present

Peer Review and Evaluation of MITRE Research in Acquisition Systems, MITRE Corp, 2011 - Present

Principal Publications and Presentations in the Last Five Years

None

Recent Professional Development Activities

None

Name: **Rama D. Gehris**
Professor of Practice (7 years NPS service)

Education

Degree	Discipline	Institution	Year
BS	Mathematics	New Mexico Institute of Mining and Technology	1987
MS	Mathematics	New Mexico Institute of Mining and Technology	1990
PhD	Systems Engineering	George Washington University	2008

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
New Mexico Institute of Mining and Technology	Teaching Assistant/Lecturer, Department of Mathematics	1986 - 1989	PT
Cerro Coso Community College	Lecturer, Department of Mathematics	1992 - 1993	PT
St Mary's College of Maryland	Adjunct Professor, Department of Mathematics	1997	PT
Naval Postgraduate School	Prof of Practice, Department of Systems Engineering	2011 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
US Navy, China Lake CA	Researcher: Civilian	Numerical modeling and simulation of Trident D5 Stage three rocket motor in FORTRAN. Research and mathematical modeling in the areas of computational fluid dynamics and combustion.	1989 - 1995	FT
US Navy, Patuxent River MD	Software Team Lead: Civilian	Software design and development for E2C Aircraft. Software cost estimation, scheduling and coordination. Software architecture design.	1995 - 1999	FT
US Navy, Patuxent River MD	Software Contract Monitoring: Civilian	Software requirements and specifications documents review, software design/architecture review and contractor oversight for AH-1 Helicopter upgrades program.	1999 - 2000	FT
US Navy, Patuxent River MD	Senior Software	Software maintenance and development for E2C Aircraft in C++/C. Software architecture	2003 - 2010	FT

	Developer: Civilian	design, review and execution. Requirements generation, and review. Software testing.		
US Navy, Patuxent River MD	Acquisition and Maintenance Program Support: Civilian	Competitive source selection technical support.	2010 - 2011	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

None

Honors and Awards

None

Service Activities

None

Principal Publications and Presentations in the Last Five Years

Giammarco, K. M., Carlson, R. R., Blackburn, M., Auguston, M., Gehris, R. D., Jones, M. J., Quartuccio, J., Giles, K. B., Wolfgeher, C. A., Parker, G. W. (2017). *Verification and Validation (V&V) of System Behavior Specifications: Interim Technical Report*.

Recent Professional Development Activities

Continuing Education Program, Collaborate Tips, NPS Sakai Help Desk, Monterey, CA, United States, 2018

Name: **Ronald E. Giachetti**
Professor and Chair (8 years NPS service)

Education

Degree	Discipline	Institution	Year
BS	Mechanical Engineering	Rensselaer Polytechnic Institute	1990
MS	Manufacturing Engineering	Polytechnic University	1993
PhD	Industrial Engineering	North Carolina State University	1996

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
North Carolina State University, Raleigh, NC	Research Assistant	1993 - 1996	FT
National Institute of Standards and Technology, Gaithersburg, MD	National Research Council Postdoctoral Research Associate, Manufacturing Systems Integration Division	1996 - 1997	FT
Florida International University, Miami, FL	Associate Professor, Industrial and Systems Engineering	1997 - 2011	FT
Naval Postgraduate School	Professor and Chair, Systems Engineering	2011- present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Materials Research Laboratory, Sikorsky Aircraft, Stratford, CT	Engineering Intern		1988	FT
Airborne Instrumentation Laboratory (AIL) Systems, Deer Park, NY	Engineer		1990 - 1993	FT
Laboratory for Production Engineering and Machine Tools, Rheinland-Westphalen Technisher Hochschule (RWTH), Aachen, Germany	Research Assistant		1995	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

Journal of Enterprise Transformation, Associate Editor, May 2010 - Present

International Council on Systems Engineering (INCOSE)

Honors and Awards

None

Service Activities

Program Coordinator, Academic Associate of 311 Program, January 2015 - June 2015

Chairperson, Manage Department, July 1, 2015 - Present

Task Force Member, Systems Engineering Working Group, January 1, 2016 - Present

Member, Navy's Systems Engineering Work Group, January 1, 2015 - December 31, 2018

Editorial Review Board Member, Journal of Enterprise Transformation, January 1, 2013 - Present

Vice Commodore of Training, Naval Postgraduate School Sailing Association, January 1, 2015 - December 31, 2018

Principal Publications and Presentations in the Last Five Years

Badiru, A. B., Racz, L., Giachetti, R. E. (2015). Measurement and control of imprecision in engineering design. *Handbook of Measurements: Benchmarks for Systems Accuracy and Precision* (pp. 491–510). CRC Press.

Giachetti, R. E. (2015). Evaluation of the DoDAF Meta-model's Support of Systems Engineering. *Procedia Computer Science, 61*, 254–260.

Giachetti, R. E. (2015). System of Systems Capability Needs Analysis via a Stochastic Network Model. *NAVAL ENGINEERS JOURNAL, 127*(4), 67–79.

Giachetti, R. E. (2017). *Making the case for quality metrics for conceptual models in systems engineering*. System of Systems Engineering Conference (SoSE).

Gillespie, S. E., Giachetti, R. E., Hernandez, A. D.S., Beery, P. T., Paulo, E. P. (2017). *System of Systems Architecture Feasibility Analysis to Support Tradespace Exploration*. IEEE. http://ieeexplore.ieee.org/document/7994944/

Giachetti, R. E., Fernando, H., Pollman, A. G. (2018). *Enterprise Wireless Communications Architecture Power Analysis*. Springer (for INCOSE).

Giachetti, R., Holness, K., McGuire, M. (2018). *The Ability of Engineers to Extract Requirements from Models* (pp. 394-399).

Kim, S., Giachetti, R., Park, S. (2018). Real Options Analysis for Acquisition of New Technology: A Case Study of Korea K2 Tank's Powerpack. *Sustainability, 10*(11), 3866.

Recent Professional Development Activities

Workshop, Human Capital Management Skills for Supervisors and Managers, NPS, Monterey, CA, September 22, 2015 - September 24, 2015

Conference Attendance, ABET Conference, ABET, Hollywood, FL, United States, April 1, 2016 - April 2, 2016

Name: **Kristin M. Giammarco**
Associate Professor (10 years NPS service)

Education

Degree	Discipline	Institution	Year
BE	Electrical Engineering	Stevens Institute of Technology-New Jersey	1999
MS	Systems Engineering Management	Naval Postgraduate School	2007
PhD	Software Engineering	Naval Postgraduate School	2012

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Stevens Institute of Technology	Adjunct Professor, Systems Engineering and Architecture	2009-2012	PT
Naval Postgraduate School	Lecturer, Systems Engineering	2009-2012	FT
Naval Postgraduate School	Associate Professor, Systems Engineering	2012-present	
Naval Postgraduate School	Academic Associate, Systems Engineering Management (SEM)-PD21 Program	2014-present	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
The MITRE Corporation, Eatontown, NJ	Communications Engineer		2000 - 2001	FT
CERDEC, Ft. Monmouth, NJ	Systems Engineer		2001 - 2008	FT
CERDEC S&TCD, Ft. Monmouth, NJ	Chief Engineer, SEAMS Division		2008 - 2009	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

International Council on Systems Engineering (INCOSE), 2005 - Present

International Society for Systems Pathology (ISSP) Board of Directors, January 2017 - Present

Honors and Awards

Outstanding Academic Achievement, Naval Postgraduate School, September 2007

Systems Analysis Award, Army Materiel Command (AMC), 2007

Wayne E. Meyer Award for Excellence in Systems Engineering, Naval Postgraduate School; September 2007, June 2011, September 2011, June 2014, September 2014

Special Act Award; October 2015, September 2016, September 2017

Best Transition in Systems Engineering Research, The MITRE Corp., March 2017

In top 5% of NPS faculty considered for the 2017 Rear Admiral John Jay Schieffelin Award for Teaching Excellence, NPS, May 17, 2018

Service Activities

Committee Chair, PhD Advising: CDR Katy Giles, January 25, 2016 - March 30, 2018; John Quartuccio, December 22, 2015 - Present

Committee Member, PhD Committee Service: Gary Parker, April 14, 2016 - Present; Chris Wolfgeher, April 29, 2016 - Present

Member, Systems Engineering Research Center (SERC), November 2015 - Present

High School Student Mentor, Science and Math Academy; September 2015 - June 2016, September 2017 - June 2018

Committee Member, Lifecycle Modeling Language Steering Committee, July 2013 - September 2017

Principal Publications and Presentations in the Last Five Years

Giammarco, K. M., Auguston, M. (2018). Behavior modeling approach for the early verification and validation of system of systems emergent behaviors. *Engineering Emergence: A Modeling and Simulation Approach*. Boca Raton, FL: CRC Press Taylor & Francis Group.

Holland, T., Turnista, C., Giammarco, K. M., Rainey, L. (2018). *CSEEP: The Consortium for the Study and Exploration of Emergent Phenomena*. Orlando, FL: Simulation Interoperability Standards Organization (SISO) Simulation Innovation Workshop (SIW).

Giles, K. B., Giammarco, K. M. (in press). A Mission-based Architecture for Swarm Unmanned Systems. *Journal of Systems Engineering*.

Giammarco, K. M., System of Systems Engineering Collaborators Information Exchange (SoSECIE), "Practical Modeling Concepts for Engineering Emergence in Systems of Systems," United States. (March 20, 2018).

Giammarco, K. M., Military Operations Research Society Symposium (MORSS), "Monterey Phoenix Approach and Tool for Behavior Modeling: A Tutorial," MORS, Monterey, CA, United States. (June 18, 2018).

Giammarco, K. M., Military Operations Research Society Symposium (MORSS), "The Monterey Phoenix Approach and Tool for Behavior Modeling," Monterey, CA, United States. (June 20, 2018).

Giammarco, K. M., Consortium for the Study and Exploitation of Emergent Phenomena, "Examining Emergence with Monterey Phoenix," Georgia Technical Research Institute (GTRI), Web conference. (July 16, 2018).

Recent Professional Development Activities

Workshop, MIT SEARi Workshop on Model Centric Decision Making, MIT, Cambridge, MA, United States, January 2015

Industry Trip, PD21 Industry Trip, NPS, Monterey, CA, United States, June 18, 2018 - June 23, 2018

Industry Trip, PD21 Industry Trip, NPS, San Jose, CA, United States, September 14, 2018

Industry Trip, PD21 Industry Trip, NPS, San Jose, CA, United States, September 14, 2018

Name: **Kathleen B. Giles**
Military Faculty (MILFAC), 1 year NPS service

Education

Degree	Discipline	Institution	Year
BS	Oceanography	United States Naval Academy	1998
MS	Technical Management	Johns Hopkins University	2006
PhD	Systems Engineering	Naval Postgraduate School	2018

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Military Faculty, Systems Engineering	2018	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
VP-26	Naval Flight Officer		June 1, 2000 - May 31, 2003	FT
US Naval Test Pilot School	Student		June 1, 2003 - May 31, 2004	FT
VX-20	P-3C / S-3B Mission Systems Flight Test		June 1, 2004 - May 31, 2006	FT
Fleet Readiness Center Southeast	P-3C Production Officer		June 1, 2006 - May 31, 2009	FT
VX-20	P-8A Mission Systems Development Tester		June 1, 2009 - May 31, 2011	FT
PMA-209 Common Avionics Program Office	Deputy Integrated Product Team Lead		June 1, 2011 - August 31, 2013	FT
VX-1	Fixed-wing Operational Test Department Head		September 1, 2013 - May 15, 2014	FT

Certifications or Professional Registrations
None

Current Membership in Professional Organizations
International Council on Systems Engineering (INCOSE), January 1, 2018 - Present

Honors and Awards
Best Transition in Systems Engineering Research, MITRE, March 23, 2017

Principal publications and presentations in the Last Five Years
Giammarco, K. M., Giles, K. B., Whitcomb, C. A. (2017). Comprehensive use case scenario generation: An approach for modeling system of systems behaviors. *2017 12th System of Systems Engineering Conference (SoSE)*. IEEE. http://dx.doi.org/10.1109/sysose.2017.7994950

Giammarco, K. M., Carlson, R. R., Blackburn, M., Auguston, M., Gehris, R. D., Jones, M. J., Quartuccio, J., Giles, K. B., Wolfgeher, C. A., Parker, G. W. (2017). *Verification and Validation (V&V) of System Behavior Specifications: Interim Technical Report*.

Giammarco, K. M., Giles, K. B. (2017). Verification and Validation of Behavior Models Using Lightweight Formal Methods. *Disciplinary Convergence in Systems Engineering Research* (pp. 431-447). Springer International Publishing. http://dx.doi.org/10.1007/978-3-319-62217-0_31

Giles, K. B., Giammarco, K. M. (2017). Mission-based Architecture for Swarm Composability (MASC). *Procedia Computer Science* (vol. 114, pp. 57-64).

Giles, K. B., Giammarco, K. M. (in press). A Mission-based Architecture for Swarm Unmanned Systems. *Journal of Systems Engineering*.

Giles, K. B., Specialist's Meeting SET-222 on Swarm Centric Solutions for Intelligent Sensor Networks, "A Framework for Integrating the Development of Swarm Unmanned Aerial System Doctrine and Design," NATO Science and Technology Organization, Rome, Italy. (June 7, 2016).

Giles, K. B., CRUSER TechCon, "Monterey Phoenix Behavior Modeling of Robotics and Unmanned Systems," CRUSER, NPS Ingersoll Quad, Monterey, CA, United States. (July 13, 2016).

Giammarco, K. M., Giles, K. B., 15th Annual Conference on Systems Engineering Research, "Verification and validation of behavior models using lightweight formal methods," Redondo Beach, CA, United States. (March 23, 2017).

Giammarco, K. M., Giles, K. B., Whitcomb, C. A., 12th Annual Conference on System of Systems Engineering, "Comprehensive Use Case Scenario Generation:An Approach for Modeling System of Systems Behaviors," IEEE, Waikoloa, HI, United States. (June 20, 2017).

Giles, K. B., Complex Adaptive Systems, "Mission-based Architecture for Swarm Composability," Missouri S&T University, Courtyard Marriott, Chicago, IL, United States. (October 30, 2017).

Giles, K. B., Systems Engineering Research Council Doctoral Students Forum, "Mission-based Architecture for Swarm Composability," SERC, FHI 360 Conference Center, Washington, DC, United States. (November 7, 2017).

Giles, K. B., CRUSER TechCon, "A Mission-based Architecture for Swarm Composability," NPS CRUSER, NPS Mechanical Engineering Auditorium, Monterey, CA, United States. (April 17, 2018).

Recent Professional Development Activities

Faculty Fellowship, Teaching Fellowship Program, Naval Postgraduate School, Monterey, CA, October 1, 2017 - September 30, 2018

Name: **John M. Green**
Senior Lecturer, 16 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Physics	Saginaw Valley State University	1972
	College of Command and Staff	Naval War College	1982
MA	International Relations	Salve Regina College	1984
MS	Computer Science	University of New Haven	1986
MBA	Management Science	University of New Haven	1998

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Senior Lecturer, Systems Engineering	2002-present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
General Dynamics, Electric Boat Division Submarine Advanced Technology Program	Engineering Specialist		July 1984 - December 1989	FT
Lockheed Martin Librascope Advanced Systems Group	Staff Engineer		January 1990 - December 1990	FT
Lockheed Martin Government Electronics Systems Advanced Weapons Systems Group	Principal Member of the Engineering Staff		March 1991 - September 1998	FT
ITT Gilfillan	Manager of Advanced Systems		October 1998 - January 2000	FT
Raytheon Naval & Maritime Integrated Systems Group	Senior Principal Systems Engineer		January 2000 - March 2002	FT

Certifications or Professional Registrations

First Class Broadcast License with Radar Endorsement, Federal Communications Commission, October 1969 - Present

Current Membership in Professional Organizations

Institute of Electrical and Electronics Engineers (IEEE), Senior Member

American Institute of Aeronautics and Astronautics (AIAA), Senior Member

Honors and Awards

Government Electronics Systems Engineering Department Team award, Lockheed Martin, October 1994

Government Electronics Systems Naval Systems Department Vice President's Award, Lockheed Martin, November 1997

Raytheon Authors Award, June 2001

Service Activities

Committee Member, Undersea Warfare Academic Group, May 2002 - Present

Principal Publications and Presentations in the Last Five Years

Green, J. M., Stracener, J., Tolentino, G. (2017). *System Effectiveness Analysis Framework* (4th ed., vol. 21, pp. 1-4). RMS Partnership. https://nebula.wsimg.com/5a9924bd38788e3790af6dafe884d334?AccessKeyId=AA1944B48599DC2798EB&disposition=0&alloworigin=1

Green, J. M. (2017). *Hitchins' Five Layer Model as an Evaluation Framework for Regulations*. San Diego: INCOSE San Diego Chapter Miniconference.

Green, J. M., Tolentino, G., Stracener, J. (2017). Measures of Effectiveness through Transfer Characteristics of Black Boxes. *The Journal of Reliability, Maintainability, and Supportability in Systems Engineering* (Winter 2018), 5-12.

Green, J. M., Bones, M., Bunch, L., Fisher, K., Mara, S., Stone, A. (2018). *Data Fusion in the Kill Chain*. 2018 National Fire Control Conference.

Green, J. M. (2018). *The Kill Chain and Lusser's Product Law*. 2018 National Fire Control Conference.

Green, J. M. (2018). *Measures of Effectiveness through Transfer Characteristics of Black Boxes*. 86th MORS.

Green, J. M., Stracener, J., t, G. (2018). *System Effectiveness Analysis Framework*. 86th MORS.

Green, J. M. (2018). Hitchin's Five Layer Model as an Evaluation Framwework for Regulations. *The Science of Laws Journal*, *4*(1), 29-33. www.scienceoflaws.org

Recent Professional Development Activities

None

Name: **Robert C. Harney**
Associate Professor, 23 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Chemistry and Physics	Harvey Mudd College	1971
MS	Engineering of Applied Science	University of California-Davis	1972
PhD	Engineering of Applied Science	University of California-Davis	1976

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Senior Lecturer, Systems Engineering	2002-present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Martin Marietta Corp.	Sr. Professional Staff	Managed laser systems research in Research & Tech Organization; managed Laser Systems Department; developed sensor technologies for Strategic Defense Initiative Mission Area	May 1982 - May 1993	FT
Robert C. Harney	Consultant	Systems engineering for laser radar and countermeasures programs at National Laboratories	May 1993 - September 1995	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

American Chemical Society (ACS), January 1970 - Present

American Association of Physics Teachers (AAPT), January 1971 - Present

Optical Society of America (OSA), January 1972 - Present

Astronomical Society of the Pacific (ASP), January 1975 - Present

Society of Photo-Optical Instrumentation Engineers (SPIE), May 1980 - Present

National Defense Industrial Association (NDIA), May 1984 - Present

Association of Old Crows (AOC), January 1985 - Present

American Society of Naval Engineers (ASNE), July 1999 - Present

Honors and Awards

Award for Excellence in Systems Engineering and Integration, Northrop Grumman; 2000, 2001

Outstanding Research Achievement in Systems Engineering, Naval Postgraduate School, 2002

Wayne E. Meyer Excellence in Systems Engineering Award, Naval Postgraduate School, 2006

Merit Award for Academic Service, Graduate School of Engineering and Applied Science (GSEAS), Naval Postgraduate School, 2008

Certificate of Recognition of 20 Years of Service, US Government, January 25, 2016

Service Activities

Chairperson, Associate Chair for Research, 2003 - Present

Committee Member, NPS Research Board, October 2003 - Present

Committee Member, Academic Council, October 2004 - Present

Committee Chair, Course Review Committee of the Academic Council, October 2006 - Present

Committee Chair, SE Department Doctoral Committee, 2010 - Present

Committee Member, NPS Laser Safety Committee, December 2011 - Present

Principal Publications and Presentations in the Last Five Years

Nelson, D. H. (Author & Presenter), Harney, R. C. (Author), Stevens, M. R. (Author), Seventeenth Annual Directed Energy Symposium, "Combat Systems Engineering of High Energy Laser Weapons Systems," Directed Energy Professional Society/NAVSEA, Anaheim, CA, United States. (March 5, 2015).

Nelson, D. H. (Author & Presenter), Harney, R. C. (Author), Stevens, M. R. (Author), Directed Energy Systems Symposium/Employment of DE Weapons Conference, "Implications of Combat Systems Engineering for High Energy Laser Weapons System Development," Directed Energy Professional Society, Norfolk, VA, United States. (September 16, 2015).

Harney, R. C. (Author), Nelson, D. H. (Author & Presenter), Stevens, M. R. (Author), Eighteenth Annual Directed Energy Symposium, "Combat Systems Engineering of High Energy Laser Weapon Systems," Directed Energy Professionals Society, Albuquerque, NM, United States. (March 7, 2016).

Recent Professional Development Activities

Self-Study Video Course:

- Everyday Engineering, Teaching Company, Chantilly, VA, April 2017
- The Theory of Everything: The Quest to Explain All Reality, Teaching Company, Chantilly, VA, July 2017
- Anthropology and the Study of Humanity, Teaching Company, Chantilly, VA, July 2018
- Philosophy of Science, Teaching Company, Chantilly, VA, September 2018
- Big History, Teaching Company, Chantilly, VA, October 2018

Name: **Alejandro D.S. Hernandez**
Associate Professor, 13 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Civil Engineering	United States Military Academy-West Point	1985
MS	Operations Research	Naval Postgraduate School	1994
MA	Strategic Studies	Army War College	2007
PhD	Operations Research	Naval Postgraduate School	2008

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
School of Professional & Graduate Studies, Baker University, KS	Adjunct Lecturer	2000-2002	FT
California State University Monterey Bay, Executive MBA Program, School of Business	Adjunct Professor	2011-present	FT
Naval Postgraduate School	Associate Professor, Systems Engineering	2011-present	FT
Naval Postgraduate School	Academic Associate, Systems Engineering Management	2018-present	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Defense Evaluation Support Activity, Albuquerque, NM	Systems Analyst		1994 - 1997	FT
Joint Warfighting Center, Suffolk, VA	Program Manager		1997 - 2000	FT
Fort Leavenworth, KS	Senior Analyst		2000 - 2002	FT
Senior Operations Research/Systems Analyst, NPS	Director of Wargaming		2005 - 2009	FT
United States Forces - Iraq, Iraq, Analysis & Assessments, J-9	Chief		2009 - 2010	FT
Deputy Chief of Staff, G-8, D.C., Warfighting Analysis Division	Chief		2010 - 2011	FT
NPS Naval Research Program	Program Manager		2013 - 2014	FT
NPS Simulation Experiments and Efficient Design Center	Deputy Director		2013 - Present	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

Institute for Operations Research and Management Sciences (INFORMS), October 1, 2014 - Present

International Test and Evaluation Association ITEA, February 7, 2016 - Present

Institute of Industrial & Systems Engineers (IISE), January 24, 2017 - Present

International Council on Systems Engineering (INCOSE)

Military Operations Research Society (MORS)

Society of American Military Engineers (SAME)

Honors and Awards

Navy Meritorious Civilian Service Medal, June 2013

Navy Meritorious Civilian Service Medal 2nd Award, October 2014

Service Activities

Deputy Director, Simulation Experiments and Efficient Design Center, June 2012 - Present

SE Department Representative, Energy Academic Group, October 2013 - Present

SE Department Alternate Representative, Faculty Council, October 2014 - Present

Develop, administer, grade PhD level statistics examination, PhD Statistics Exam Developer, January 2016 - Present

Co-Chair Energy Working Group, 86th Military Operations Research Society Symposium, October 2017 - June 2018

Principal Publications and Presentations in the Last Five Years

Hernandez, A. D.S. (2017). Guiding Construction of Better Test Designs by Modeling Random Latin Hypercube Correlation Values with the Gumbel Distribution. *Journal of Test and Evaluation*.

Hernandez, A. D.S. (in press). Engineering a Management Structure for Energy Research. *Journal of Strategic Planning for Energy and the Environment*.

Hernandez, A. D.S. (2018). Development of a New Course in Research Methods Based on Engineering Reasoning. *Innovations in the Teaching of Research Methodology Excellence Awards: An Anthology of Case Histories 2018*. Reading: Academic Conferences and Publishing International Limited.

Hernandez, A. D.S. (2018). *An Engineering Reasoning-Based Course on Research Methodologies for Systems Engineers*.

Hernandez, A. D.S., 86th Military Operations Research Society (MORS) Symposium, "An Analytical Framework for Operational Energy Research." (June 2018).

Recent Professional Development Activities

Teaching Executive MBA course at CSUMB, Strategic Management of Innovation and Technology, CSUMB, October 2014 - December 2014

Name: **Karen S. Holness**
Professor of Practice, 4 years NPS Service

Education

Degree	Discipline	Institution	Year
BA	American Studies	University of Notre Dame	1994
BS	Industrial Engineering	State University of New York-Buffalo	1998
MS	Industrial Engineering	State University of New York-Buffalo	2004
PhD	Industrial and Systems Engineering	State University of New York-Buffalo	2008

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Assistant Professor, Systems Engineering	2015-2018	FT
Naval Postgraduate School	Professor of Practice, Systems Engineering	2018-present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Corning Incorporated, Corning, NY	Industrial Engineer		1998 - 2001	FT
Naval Surface Warfare Center Dahlgren Division, Dahlgren, VA	Industrial Engineer		2007 - 2009	FT
Naval Air Warfare Center Training Systems Division, Orlando, FL	Systems Engineer		2009 - 2015	FT

Certifications or Professional Registrations
None

Current Membership in Professional Organizations
Human Factors and Ergonomics Society (HFES)

International Council on Systems Engineering (INCOSE)

National Society of Black Engineers (NSBE)

Honors and Awards
Employee Development Peer Recognition Award, November 2007

Quarterly Team Excellence Award, Program Executive Office Integrated Warfare Systems (PEO IWS), 2011

Service Activities

OR/HSI Program Hiring Committee, May 2016

Committee Member, SE Department Hiring Committee, March 2016 - September 2016

Committee Member, SE Department Hiring Committee, November 1, 2016 - November 30, 2016

IRB Vice Chair, Institutional Review Board, October 1, 2017 - March 9, 2018

SE 4151 Course Coordinator, July 2017 - Present

Principal Publications and Presentations in the Last Five Years

Holness, K. S. (2016). *Content Analysis in Systems Engineering Acquisition Activities*.

Holness, K. S. (2016). *Key Factors in Human Systems Integration Design Tradeoff Decisions*.

Holness, K. S., Khan, R. H., Parker, G. W. (2017). *An Empirical Study on Content Analysis Use in Test and Evaluation Deficiency Report Analysis*.

Holness, K. S., Khan, R. H., Parker, G. W. (2018). *An Empirical Study on Content Analysis Use in Test and Evaluation Deficiency Report Analysis*.

Giachetti, R., Holness, K., McGuire, M. (2018). *The Ability of Engineers to Extract Requirements from Models* (pp. 394-399).

Holness, K. S., 13th Annual Acquisition Research Symposium, "Content Analysis in Systems Engineering Acquisition Activities." (May 2016).

Holness, K. S., IIE Industrial and Systems Engineering Research Conference, "Key Factors in Human Systems Integration Design Tradeoff Decisions." (May 2016).

Holness, K. S., 15th Annual Acquisition Research Symposium, "An Empirical Study on Content Analysis Use in Test and Evaluation Deficiency Report Analysis.," NPS. (May 2018).

Name: **Bonnie W. Johnson**
Lecturer, 13 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Physics	Virginia Polytechnic Institute and State University	1992
MS	Systems Engineering	Johns Hopkins University	2002

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Lecturer	2011-present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Nichols Research Corporation, Missile Defense Programs	Engineer		1995 - 1997	FT
Digital Systems International Corporation, Nuclear Treaty Programs	Lead Systems Engineer		1997 - 1998	FT
Science Applications International Corporation, Nuclear Treaty Programs	Lead Systems Engineer		1998 - 1999	FT
Systems Planning and Analysis Corporation, Navy PEO TSC Programs	Senior Systems Engineer		1999 - 2000	FT
Digital Systems Resources, Navy Common Command and Decision System	Senior Systems Engineer		2000 - 2002	FT
Science Applications International Corporation, Missile Defense programs	Senior Systems Engineer		2002 - 2003	FT
Northrop Grumman, Joint SIAP Program	Senior Systems Engineer		2003 - 2006	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

Women in Defense (WID), June 2017 - June 2018

Institute of Electrical and Electronics Engineers (IEEE), January 2015 - Present

Directed Energy Professional Society (DEPS), September 2016 - Present

Complex Systems Society (CCS), September 2017 - Present

Association for the Advancement of Artificial Intelligence (AAAI), November 2017 - Present

Honors and Awards

Wayne E. Meyer Award, NPS Systems Engineering Department, June 20, 2014

Service Activities

Developed SE4117 - Directed Energy Systems Engineering Course materials, Course development, September 1, 2016 - September 30, 2016

Committee Member, National Fire Control Symposium, October 2014 - February 2018

Committee Member, Association for the Advancement of Artificial Intelligence, June 2017 - June 2018

Girl Scouts, September 2008 - September 2018

Principal Publications and Presentations in the Last Five Years

Johnson, B. W. (Author & Presenter), International Conference on Complex Systems, "Engineering Complex Systems Using Automated Decision Aids," Cancun, Mexico. (September 2017).

Johnson, B. W. (Author & Presenter), Association for the Advancement of Artificial Intelligence, "A Systems Approach to Battle Management Aids," AAAI, Arlington, VA, United States. (November 2017).

Johnson, B. W. (Author & Presenter), National Fire Control Symposium, "A Systems Approach to Battle Management Aids," Oahu, HI, United States. (February 2018).

Michnewich, D. (Author & Presenter), Blau, J. A. (Author), Johnson, B. W. (Author), Directed Energy Systems Symposium, "Modeling High Energy Laser System to Determine Energy Storage on Navy Ships," Directed Energy Professional Society, Portsmouth, VA, United States. (September 27, 2018).

Recent Professional Development Activities

Conference Attendance, National Fire Control Symposium, Tri-Services, Orlando, FL, United States, February 3, 2017 - February 8, 2017

Conference Attendance, Conference on Complex Systems, CSS, Cancun, Mexico, September 18, 2017 - September 21, 2017

Conference Attendance, Directed Energy Professional Society, DEPS, Monterey, CA, United States, September 2017

Conference Attendance, Artificial Intelligence for Military Applications, AAAI, Arlington, VA, United States, November 8, 2017 - November 9, 2017

Conference Attendance, National Fire Control Symposium, Oahu, HI, February 4, 2018 - February 9, 2018

Conference Attendance, Directed Energy Professional Society, DEPS, Oxnard, CA, United States, February 27, 2018 - March 2, 2018

Name: **Joseph T. Klamo**
Assistant Professor, 3 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Mechanical Engineering	University of Michigan	2001
MS	Mechanical Engineering	California Institute of Technology	2002
PhD	Fluid Mechanics / Mechanical Engineering	California Institute of Technology	2007

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
California Institute of Technology	Graduate Research Assistant	October 1, 2001 - December 5, 2006	FT
Naval Postgraduate School	Assistant Professor	2015 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Ford Motor Company	Summer Intern; Climate Control Systems Engineering		May 1999 - September 2001	FT
Naval Surface Warfare Center, Carderock Division	Marine Systems Engineer		December 2006 - December 2011	FT
Naval Surface Warfare Center, Carderock Division	Group Leader, Captive Model Testing		January 1, 2012 - August 9, 2015	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

American Society of Mechanical Engineers (ASME), July 11, 2016 - Present

Honors and Awards

Unit Meritorious Award, Naval Sea System Command, Department of the Navy, June 2015

Invited Speaker, Ocean Engineering Seminar Series, Mechanical Engineering Dept, University of California - Berkeley, February 3, 2017

Invited Speaker, 2018 AVIATION Forum & Exposition, American Institute of Aeronautics and Astronautics, June 25, 2018

Invited Speaker, AOE Seminar Series, Aerospace and Ocean Engineering Dept, Virginia Polytechnic Institute and State University, November 5, 2018

Service Activities

Committee Member, Curriculum Committee, October 1, 2015 - Present

Committee Member, Faculty Council, December 1, 2017 - Present

Reviewer, Journal Article, Journal of Fluids and Structures, August 2014

Reviewer, Grant Proposal, US Army Research Office, Mechanical Sciences Division, September 2016

Reviewer, Conference Paper, SNAME 30th American Towing Tank Conference, August 2017

Reviewer, Journal Article, Journal of Fluids and Structures, September 2017, March 2018

Reviewer, Conference Paper, AIAA Region VI Student Conference, March 2018

Faculty Mentor, Science and Engineering Apprenticeship Program (SEAP), June 4, 2018 - July 27, 2018

Faculty Mentor, Naval Research Enterprise Internship Program (NREIP), June 4, 2018 - August 10, 2018

Principal Publications and Presentations in the Last Five Years

Klamo, J. T. (2018). Multidisciplinary experiment using steep regular waves to determine ship operating conditions that avoid capsize. *Multiscale and Multidisciplinary Modeling, Experiments and Design, 1*(2), 119-132. http://dx.doi.org/10.1007/s41939-018-0012-1

Jones, L. M., Klamo, J. T., Kwon, Y. W. (Presenter), Didoszak, J. M., 37th International Conference on Ocean, Offshore, & Arctic Engineering (OMAE 2018), "Numerical and experimental study of wave-induced load effects on a submerged body near the surface," American Society of Mechanical Engineers, Madrid, Spain. (June 20, 2018).

Klamo, J. T., AVIATION Forum & Exposition, "A different perspective on vortex-induced vibrations, shaped by Anatol," American Institute of Aeronautics and Astronautics, Atlanta, GA, United States. (June 25, 2018).

Klamo, J. T., AOE Seminar, "Exploring the hdyrodynamic-driven performance of surface and underwater vehicles," Virginia Polytechnic Institute and State University, AOE Department, Blacksburgh, VA, United States. (November 5, 2018).

Recent Professional Development Activities

Conference Attendance, 31st Symposium on Naval Hydrodynamics, Office of Naval Research, Monterey, CA, United States, September 12, 2016 - September 16, 2016

Conference Attendance, Oceans'16, MTS/IEEE, Monterey, CA, United States, September 20, 2016 - September 22, 2016

Conference Attendance, 30th American Towing Tank Conference, SNAME, West Bethesda, MD, United States, October 3, 2017 - October 5, 2017

Conference Attendance, 37th International Conference on Ocean, Offshore, & Arctic Engineering (OMAE 2018), ASME, Madrid, Spain, June 17, 2018 - June 22, 2018

Name: **Brigitte T. Kwinn**
Lecturer, 10 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Math Science and Engineering	United States Military Academy-West Point	1984
MS	Systems Engineering	University of Arizona	1994

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Department of Systems Engineering, United States Military Academy, West Point, NY	Instructor and Assistant Professor	1994 - 1997	FT
Operations Research Center of Excellence, United States Military Academy, West Point, NY	Operations Research/Systems Analyst	2002	FT
Department of Systems Engineering, United States Military Academy, West Point, NY	Assistant Professor and Program Director	2003 - 2006	FT
Naval Postgraduate School	Lecturer, Systems Engineering	2008 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
US Army Operational Test Command, Fort Hood, Texas	Operations Research/Systems Analyst		2000 - 2001	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

International Council on Systems Engineering (INCOSE), July 2015 - Present

Honors and Awards

Department of Systems Engineering Outstanding Faculty Award, United States Military Academy, West Point, June 1997

Rear Admiral John Jay Schieffelin Teaching Excellence Award finalist, NPS Schieffelin Award Committee, May 25, 2017

Wayne E. Meyer Award for Excellence in Systems Engineering for Teaching Excellence 2017, Department of Systems Engineering, September 22, 2017

Rear Admiral John Jay Schieffelin Teaching Excellence Award finalist, Naval Postgraduate School, May 17, 2018

Wayne E. Meyer Award for Excellence in Systems Engineering for Teaching Excellence 2018, Department of Systems Engineering, September 21, 2018

Service Activities

Committee Member, 311 Curriculum Program Officer, June 1, 2012 - Present

SI3400 Fundamentals of Engineering Project Management, Course Coordinator, July 2015 - Present

Officer, Secretary, The Friends4Michael Foundation, May 31, 2002 - Present

Principal Publications and Presentations in the Last Five Years

None

Recent Professional Development Activities

Webinar Series, System of Systems Engineering Collaborators Information Exchange (SoSCIE), Office of the Deputy Assistant Secretary of Defense for Systems Engineering (ODA SD(SE)) Systems Engineering, May 1, 2017 - September 30, 2018

Name: **Raymond J. Madachy**
Professor, 10 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Mechanical Engineering	University of Dayton	1981
MS	Systems Science	University of California-San Diego	1983
PhD	Industrial and Systems Engineering	University of Southern California	1994

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
USC Center for Systems and Software Engineering, University of Southern California	Research Assistant Professor, Department of Industrial and Systems Engineering, Interim Director of Systems Architecting and Engineering Program, and Principal	2005 - 2008	FT
Naval Postgraduate School	Associate Professor, Systems Engineering	2008 – 7 July 2018	FT
Naval Postgraduate School	Professor, Systems Engineering	8 July 2018 - present	FT
Naval Postgraduate School	Course Coordinator, SE4003: Systems Software Engineering	January 2009 - present	PT
Naval Postgraduate School	Academic Associate, SE (DL) Curriculum 311	July 2015 - present	PT
Naval Postgraduate School	Course Coordinator, SE3011: Engineering Economics and Cost Estimation	October 2016 - present	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Software Engineering Process Group and Senior Engineering Specialist, Litton Systems	Manager		1992 - 2000	FT
C-Bridge Institute	Chief Scientist		2000 - 2001	FT
Cost Xpert Group	Chief Science Officer		2001 - 2005	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

Senior Member, Institute of Electrical and Electronics Engineers (IEEE), 1992 - Present

President, San Diego Chapter, International Council on Systems Engineering (INCOSE), 1998 - Present

Honors and Awards

Best Paper: Software Estimating Track, International Cost Estimating and Analysis Association, June 2015

Academic Tenure, July 1, 2015

USC CSSE Lifetime Achievement Award, University of Southern California Center for Systems and Software Engineering, October 19, 2016

Best Paper, IEEE Empirical Software Engineering and Measurement (ESEM) conference, November 8, 2017

Service Activities

Chairperson, Faculty Council Scholarship Committee, January - December 2017

Academic Associate, SE (DL) Curriculum 311 Academic Associate, July 1, 2015 - Present

Committee Member, Faculty Council, January 1, 2016 - Present

Course Coordinator, SE3011: Engineering Economics and Cost Estimation Course Coordinator, October 1, 2016 - Present

President-Elect, INCOSE San Diego Chapter, January 2015 - January 2016

President, INCOSE San Diego Chapter, January 2016 - January 2017

Past President, INCOSE San Diego Chapter, January 2017 - January 2018

Vice President of Chapter Development, INCOSE San Diego Chapter, January 2018 - January 2019

Editor, Journal Editor, Journal of Cost Analysis and Parametrics, 2014 - Present

Principal Publications and Presentations in the Last Five Years

Madachy, R. J., Brazilian Function Point Users Group, "Software Process Dynamics," Sao Paulo, Brazil. (August 8, 2016).

Madachy, R. J., International Software Engineering Research Network Annual Meeting, "Software Maintainability Metrics Workshop," International Software Engineering Research Network, La Ciudad, Spain. (September 5, 2016).

Madachy, R. J., 8th Annual SERC Sponsor Research Review, "Model-Driven UAS ISR Tradespace Analysis.," Systems Engineering Research Center, Washington, DC. (November 3, 2016).

Madachy, R. J., Jacques, D., INCOSE San Diego Chapter Meeting, "System Cost Modeling and SysML Integration in Model-Based Systems Engineering," International Council on Systems Engineering, San Diego, DC. (January 18, 2017).

Recent Professional Development Activities

None

Name: **Gregory A. Miller**
Senior Lecturer, 15 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Electrical Engineering	United States Naval Academy	1987
MS	Electrical Engineering	Naval Postgraduate School	1992

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Senior Lecturer, Systems Engineering	2004 - present	FT
Naval Postgraduate School	Course Coordinator, SE3100: Fundamentals of Systems Engineering	2010 - present	PT
Naval Postgraduate School	Course Coordinator, SE4150: Systems Architecting and Design	2010-2013	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
USS Samuel Gompers (AD-37)	Quality Assurance Officer		June 1987 - October 1989	FT
Pearl Harbor Naval Shipyard	Assistant Project Superintendent and Surface Ship Business Operations Officer		May 1992 - October 1995	FT
Electronic Support Measures In-Service Engineering Agent at Space and Naval Warfare Systems Center, San Diego	Project Manager and Systems Engineer		October 1995 - April 1999	FT
Ashore Networks in the Naval Integrated Networks program office, PEO (C4I & Space)	Assistant Program Manager		April 1999 - June 2004	FT

Certifications or Professional Registrations

Certified Systems Engineering Professional, International Council on Systems Engineering, May 1, 2016 - May 1, 2019

Certified DAWIA Level I in Production, Quality and Manufacturing, Defense Acquisition Workforce Improvement Act (DAWIA)

Certified DAWIA Level I in Test & Evaluation, Defense Acquisition Workforce Improvement Act (DAWIA)

Certified DAWIA Level III in Program Management, Defense Acquisition Workforce Improvement Act (DAWIA)

Certified DAWIA Level III in Systems Planning, Research, Development and Engineering, Defense Acquisition Workforce Improvement Act (DAWIA)

Current Membership in Professional Organizations

International Council on Systems Engineering (INCOSE), May 28, 2007 - Present

American Society of Naval Engineers (ASNE), July 10, 2008 - Present

Honors and Awards

Wayne E. Myer Award for Excellence in Systems Engineering Teaching, Naval Postgraduate School; December 2006, September 2007, September 2008, September 2009, March 2010, December 2015, December 2016

Special Act Award, NPS, September 28, 2015

Service Activities

Committee Member, NPS Institutional Review Board, July 16, 2015 - Present

Principal Publications and Presentations in the Last Five Years

Miller, G. A., Giachetti, R. E. (2014). *Enterprises as Inquiring Systems with Implications for InformationWarfare*.

Miller, G. A., Rebecca, B., Brandi, C., Richard, C., Ashleonte, D., Steven, G., Stephen, H., Ivan, L., Jesse, M., Aamir, Q., Anthony, S. (2015). *Systems Engineering Approach to Improving the Littoral Combat Ship Maintenance Concept* (vol. 1, pp. 139-157). Alexandria, VA: American Society of Naval Engineers. http://www.navalengineers.org/Resources/Product-Info/productcd/FMMS2015

Middleton, W., Miller, G. A., Pollman, A. G. (2018). *Architecture Models for Coordination of Unmanned Air and Ground Vehicles Conducting Humanitarian Assistance and Disaster Relief*. Springer (for INCOSE).

Middleton, W., Miller, G. A., Pollman, A. G. (2018). *Collaborative Air-Ground Unmanned Vehicles for Search & Rescue Exercise*. MORS.

Miller, G. A., 19th Annual Systems Engineering Conference, "Philosophy of Engineering: Initial Explorations," National Defense Industrial Association, Waterford Springfield, Springfield, VA, United States. (October 24, 2016).

Recent Professional Development Activities

None

Name: **Donald S. Muehlbach Jr.**
Professor of Practice, 10 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Electronics	Chapman University	1979
MS	Systems Engineering	University of Southern California	1981
PhD	Postsecondary and Adult Education	Capella University	2008

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
UCSD	Technology Academic Director	2003 - 2009	
Naval Postgraduate School	Professor of Practice	2009 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
SAIC	Senior System Engineer	Senior System Engineer for DoD systems through entire life cycle.	1984 - 2003	FT
U.S. Navy, Reserve Component	Captain/O6	Engineering Duty Officer (EDO).	1982 - 2011	FT

Certifications or Professional Registrations

Professional Certificate in Systems Engineering, UC San Diego, May 1998 - Present

Current Membership in Professional Organizations

American Society of Naval Engineers (ASNE)

International Council on Systems Engineering (INCOSE)

US Naval Institute (USNI)

Honors and Awards

Wayne E. Meyer Award for Excellence in Systems Engineering, Naval Postgraduate School, December 2010, March 2011, September 2011, December 2011, June 2012, September 2012, June 2013, September 2014, March 2015, December 2015, March 2016, December 2016, September 2017 (2), December 2017, September 2018

GSEAS Faculty Award for Extraordinary Merit in Teaching, GSEAS, Naval Postgraduate School, 2011

Legion of Merit Medal in the USN, 2011

Rear Admiral John Jay Schieffelin Award for Teaching Excellence, Naval Postgraduate School, 2013

Allen Griffin Award for Excellence in Post-Secondary Teaching, 2015

Service Activities

None

Principal Publications and Presentations in the Last Five Years

None

Recent Professional Development Activities

None

Name: **Bryan M. O'Halloran**
Assistant Professor, 2 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Engineering Physics	Oregon State University	2009
MS	Mechanical Engineering	Oregon State University	2011
PhD	Mechanical Engineering	Oregon State University	2013

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Oregon State University	Graduate Research Assistant, Complex Engineered Systems Design Lab & Design Engineering Lab	September 2010 – August 2013	FT
University of Arizona	Adjunct Professor, Reliability Engineering	January 2016 – March 2017	PT
Naval Postgraduate School	Assistant Professor	August 2016 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
ATI Wah Chang	Engineering Intern		June 2006 – April 2009	PT
Robert Lloyd Sheet Metal	HVAC Controls Engineer		July 2009 – September 2009	FT
Raytheon Missile Systems	Senior Reliability and Safety Engineer		August 2013 – August 2016	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

American Society of Naval Engineers (ASNE)

International Council on Systems Engineering (INCOSE)

US Naval Institute (USNI)

Honors and Awards

None

Service Activities

Academic Council Member NPS, 2017 - Present

Faculty Advisor NPS, New command media for student theses, June 1, 2017 - Present

Session Chair, 2017 ASME International Conference on Nuclear Engineering (ICONE), 2017

Track Organizer, 2017 ASME International Design Engineering Technical Conferences (IDETC), 2017

Track Organizer, ASME International Design Engineering Technical Conferences (IDETC), 2017 and 2018

Session Chair, 2017 ASME International Mechanical Engineering Congress and Exposition (IMECE), 2017

Session Chair, 2017 Reliability and Maintainability Symposium, 2017

Session Chair, System of Systems Engineering (SoSE) conference, 2017 and 2018

Officer, Secretary, 2018 ASME International Design Engineering Technical Conferences (IDETC), 2017 - 2018

Session Chair, 2018 ASME International Design Engineering Technical Conferences (IDETC), 2018

Session Chair, International Conference on Emerging Technologies and Factory Automation (ETFA), 2018

Officer, Vice President, 2018 ASME International Design Engineering Technical Conferences (IDETC), 2018 - 2019

Principal Publications and Presentations in the Last Five Years

O'Halloran, B. M., System of Systems Engineering (SoSE), "Systems Architecture in Failure Analysis." (June 2017).

O'Halloran, B. M., International Council on Systems Engineering (INCOSE), "A Graph Theory Approach to Functional Failure Propagation in Early Complex Cyber-Physical Systems (CCPSs)." (July 2017).

O'Halloran, B. M., International Design Engineering Technical Conferences (IDETC) and Computers and Information in Engineering Conference (CIE), "A model-driven approach for early assessment of defense in depth (DiD) capabilities of complex sociotechnical systems." (August 2017).

O'Halloran, B. M., Emerging Technologies and Factory Automation, "A dynamic failure propagation methodology supporting the risk assessment of multidisciplinary systems." (September 2017).

Van Bossuyt, D., O'Halloran, B. M., Singapore University of Technology and Design SUTD-MIT International Design Centre, "Driving System Architecture Decisions Using Reliability and Failure Analysis Information in Conceptual System Design," Singapore. (April 2018).

Van Bossuyt, D., O'Halloran, B. M., IEEE 13th Annual System of Systems Engineering Conference, "Irrational System Behavior in a System of Systems," IEEE. (July 2018).

Recent Professional Development Activities

None

Name: **Walter E. Owen**
Associate Chairman for Distributed Programs & Outreach
Senior Lecturer, 26 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Naval Engineering	United States Naval Academy	1979
MS	Management	Naval Postgraduate School	1992
DPA	Public Administration	Golden Gate University	2003

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
U. S. Naval Academy	Faculty Member	1997 - 2006	

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Fighter Squadron One-Five-Four (VF-154)	Naval Flight Officer		1982 - 1985	FT
Navy Recruiting District St. Louis (NRD-STL)	Officer Programs Officer	Executive position responsible for the attainment of all Navy Officer programs in greater St. Louis bi-state region.	1985 - 1988	FT
USS Enterprise (CVN-65)	Air Operations Officer	Executive position responsible for all ship Air Traffic Control functions during around-the-world cruise.	1988 - 1990	FT

Certifications or Professional Registrations

Certified DAU ACQ201 Intermediate Program Management Course Instructor., 1996 - 1997

Certified DAU SYS201 Intermediate Systems Engineering Course Instructor., 1994 - 1998

Current Membership in Professional Organizations

American Society for Public Administration (ASPA)

American Society of Military Comptrollers (ASMC)

International Council on Systems Engineering (INCOSE)

Project Management Institute (PMI)

Honors and Awards

Recognition Award, Director of the Office of Continuous Learning and the Dean of GSBPP, Naval Postgraduate School, September 2006

Inductee to Hall of Fame, Graduate School of Engineering & Applied Sciences, Naval Postgraduate School, September 2009

Special Act Award, Chairman, Department of Systems Engineering, Naval Postgraduate School, July 2010

Special Act Award, GSEAS, September 10, 2014, October 5, 2015

Special Act Award, NPS/SE, September 30, 2017

Service Activities

Joint Executive Systems Engineering Management- Product Development, 721- Program Officer, January 2000 - Present

PM and PI, (721), Joint Executive Systems Engineering Management Program offered through the PD21 partnership with MIT, RIT and UDM. Academic Associate from July 1999 through July 2005., July 2000 - Present

PM and PI, (311 and 312), Systems Engineering Non-Resident Program, July 2001 - Present

Associate Chair for Distributed Programs & Outreach, Department of Systems Engineering., November 2007 - Present

PM and PI, (581), PhD in Systems Engineering handling business, marketing and tuition for the resident-hybrid program., July 2009 - Present

PM/PI, Systems Engineering Certificates, April 2013 - Present

Reliability & Maintainability Engineering Certificate, 242- Program Officer, June 2015 - Present

Aviation Systems Engineering, 312 Curriculum- Academic Associate, June 2015 - Present

Program Coordinator, SE iTech Outreach Seminar Series, November 2017 - Present

SEM- Systems & Program Management degree program, 722- Program Officer, February 2018 - Present

Principal Publications and Presentations in the Last Five Years

Roberts, B. J., Owen, W. E. (2014). Managing Conflict Through Onboarding Efforts. *No*. West-East Institute International Academic Conference.

Roberts, B. J., Owen, W. E., 2014 West-East Institute International Academic Conference, "Managing Conflict through Onboarding Efforts.," New Orleans, LA, United States. (October 15, 2014).

Roberts, B. J., Owen, W. E., E-Learn 2015, "From Orientation to Onboarding: An Elaboration of a Redesigned Orientation for Virtual and resident Graduate systems Engineering Programs.," Kona, HI, United States. (October 20, 2015).

Roberts, R. J. (Author), Owen, W. E. (Author), Hawaii International Conference on Education, "Increasing Learner Metacognition and Self-Regulatory Behavior In Graduate Distance Education," Oahu, HI, United States. (January 2017).

Recent Professional Development Activities

None

Name: **Fotis A. Papoulias**
Associate Professor, 29 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Mechanical Engineering	National Technical University of Athens-Greece	1983
MS	Naval Architecture and Marine Engineering; Aerospace Engineering	University of Michigan	1986
PhD	Naval Architecture and Marine Engineering	University of Michigan	1987

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
University of Michigan	Postdoctoral Research Associate, Naval Architecture and Marine Engineering	1987	FT
Naval Postgraduate School	Assistant Professor, Mechanical Engineering	1989 - 1994	FT
Naval Postgraduate School	Associate Professor, Mechanical Engineering	1995 – 2015	FT
Naval Postgraduate School	Associate Professor, Mechanical Engineering	2015 - present	PT
Naval Postgraduate School	Associate Professor, Systems Engineering	2015 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Various: University of Michigan, CISCO Systems, US Army Defense Language Institute (DLI)	Consulting		1992 - 2002	PT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

None

Honors and Awards

None

Service Activities

Committee Chair, NPS Curriculum Committee, October 1, 2015 - September 30, 2016

Committee Chair, NPS TDSI Coordinator, October 1, 2015 - September 30, 2016

Principal Publications and Presentations in the Last Five Years

Papoulias, F. A., Yakimenko, O. A., others (2013). Payload and survivability tradeoffs in the presence of risk. *Monterey, California: Naval Postgraduate School*.

Didoszak, J. M., Papoulias, F. A. (in press). *Operational Seakeeping Considerations in LCU Deployment*. Acquisition Research Program.

Didoszak, J. M., Papoulias, F. A., 2015 TSSE Design Team Project Outbrief, "Samar Class Littoral Escort Vessel," NAVSEA O5, NPS MAE Auditorium. (December 2015).

Didoszak, J. M., Papoulias, F. A., 2016 TSSE Design Team Project, "Minutemen Project IPR," COMNAVSURFOR. (November 2016).

Didoszak, J. M., Papoulias, F. A., 2016 TSSE Design Team Project Outbrief, "Minutemen Project," NAVSEA O5, NPS MAE Auditorium. (December 2016).

Didoszak, J. M., Papoulias, F. A., 2016 TSSE Design Team Project, "Minutemen Project Outbrief," COMNAVSURFOR. (March 2017).

Didoszak, J. M., Papoulias, F. A., Acquisition Research Results, "Stability Criteria for LCU." (April 24, 2017).

Didoszak, J. M. (Author & Presenter), Papoulias, F. A. (Author & Presenter), PEO Ships-NPS Coordination Meeting, "LCU Transverse Stability Study IPR," PEO-S. (April 2017).

Didoszak, J. M. (Author), Papoulias, F. A. (Author), Bouwense, M. (Author & Presenter), Future Warfare Studies Institute (Naval War College), "Minutemen Project Brief." (May 2017).

Papoulias, F. A., Didoszak, J. M., Acquisition Research Results, "LCU Seakeeping Results." (July 21, 2017).

Recent Professional Development Activities

None

Name: **Gary W. Parker**
Research Associate, 8 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Aerospace Engineering	University of Colorado	1976
MS	Business Administration	Boston University	1983
MS	Physics	Naval Postgraduate School	1986
MS	Systems Engineering	Naval Postgraduate School	1986

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Faculty Associate - Research	November 20, 2010 - Present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
United States Army	Lieutenant Colonel (Ret), Military Intelligence		December 20, 1976 - February 28, 1997	FT
Northrop Grumman Corporation	Systems Engineer and Program Manager	Principle/lead systems engineer during acquisition, development, deployment, and support of ground and airborne ISR systems.	March 1, 1997 - November 19, 2010	FT

Certifications or Professional Registrations
None

Current Membership in Professional Organizations
International Council on Systems Engineering (INCOSE), May 20, 2015 - Present

Honors and Awards
Special Act Award, Systems Engineering/NPS, September 29, 2015

Individual Cash Award NRB, Systems Engineering Department, September 20, 2017

Service Activities
Faculty Mentor, STEM Internship Program, June 2015 - August 2015

Head Instructor, NPS Judo Club, October 1, 2012 - July 1, 2017

Principal Publications and Presentations in the Last Five Years

Giammarco, K. M., Carlson, R. R., Blackburn, M., Auguston, M., Gehris, R. D., Jones, M. J., Quartuccio, J., Giles, K. B., Wolfgeher, C. A., Parker, G. W. (2017). *Verification and Validation (V&V) of System Behavior Specifications: Interim Technical Report*.

Holness, K. S., Khan, R. H., Parker, G. W. (2018). *An Empirical Study on Content Analysis Use in Test and Evaluation Deficiency Report Analysis*.

Giammarco, K. M. (Presenter), Giles, K. B. (Presenter), Parker, G. W. (Presenter), Robots in the Roses, "Monterey Phoenix Modeling Tent," CRUSER, NPS, Monterey, CA, United States. (April 2016).

Whitcomb, C. A. (Author & Presenter), Khan, R. H. (Author), Parker, G. W. (Author), Wolfgeher, C. A. (Author), Industrial & Systems Engineering Research Conference (ISERC), "Building Competent Systems Engineering Leaders." (May 2016).

Johnson, B. W. (Author), Parker, G. (Author), Nelson, D. (Author), Armentrout, A. (Author), Behre, C. (Author), Ngo, T. (Author), Rowney, D. (Author), Schroeder, E. (Author), Stopper, M. (Author), National Fire Control Symposium, "Objective Architecture for Tactical Energy Management of Directed Energy Weapons," Orlando, FL. (February 7, 2017).

Recent Professional Development Activities

Seminar, Data Analysis and Machine Learning Using MATLAB, NPS, Monterey, CA, United States, August 30, 2017

Seminar, Improving Operational Resilience of Critical Energy Infrastructure Systems, NPS Center for Infrastructure Defense, Monterey, CA, United States, September 29, 2017

Seminar, Critical Structures Formulations for Graph Interdiction Problems, Operations Research Department, NPS, Monterey, CA, United States, April 19, 2018

Conference Attendance, Acquisition Research Symposium, GSBPP Acquisition Research Program, Monterey, CA, United States, May 9, 2018 - May 10, 2018

Non-credit short course, “My Glory Never Dies”: The Military in Literature, Film, and Onstage, Graduate Writing Center, NPS, Monterey, CA, United States, July 12, 2018 - August 9, 2018

Research Training, Human Research - Investigators and Key Research Personnel, Collaborative Institutional Training Initiative, NA, October 2, 2018 - October 13, 2018

Research Training, Responsible Conduct of Research for Engineers, Collaborative Institutional Training Initiative, NA, October 13, 2018 - October 18, 2018

Name: **Eugene P. Paulo**
Associate Professor, 18 years NPS service

Education

Degree	Discipline	Institution	Year
BS		United States Military Academy-West Point	1981
MS	Operations Research	Naval Postgraduate School	1991
PhD	Industrial Engineering	University of Central Florida	1998

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
United States Military Academy	Assistant Professor, Department of Systems Engineering	1998 - 2000	FT
Naval Postgraduate School	Director, TRADOC Analysis Center	2001-2002	FT
Naval Postgraduate School	Assistant Professor (MILFAC), Operations Research	2000-2004	FT
Naval Postgraduate School	Senior Lecturer, Systems Engineering	2005-2007	FT
Naval Postgraduate School	Associate Professor, Systems Engineering	2008 – present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
N/A				

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

None

Honors and Awards

Northrop Grumman Award for Excellence in Systems Engineering, Jun 2005, Dec 2006

Wayne Meyer Award for Excellence in Systems Engineering, Dec 2007, June 2008, Dec 2008, June 2011

Service Activities

Associate Chair for Instruction, Department of Systems Engineering, 2006-Present

Chairman, Systems Engineering Hiring Committee, 2010-2011

Academic Associate, PhD in Systems Engineering Program, 2010 – present

Member, Systems Engineering Department Doctoral Program, 2010-Present

Principal Publications and Presentations in the Last Five Years

MacCalman, A. D., Beery, P. T., Paulo, E. P. (2016). A Systems Design Exploration Approach that Illuminates Tradespaces Using Statistical Experimental Designs. *Systems Engineering, 19*, 409-421.

Gillespie, S. E., Giachetti, R. E., Hernandez, A. D.S., Beery, P. T., Paulo, E. P. (2017). *System of Systems Architecture Feasibility Analysis to Support Tradespace Exploration*. IEEE. http://ieeexplore.ieee.org/document/7994944/

Casola, K. J., Beery, P. T., Paulo, E. P. (in press). System Architecting and Analysis of Medium Displacement Unmanned Surface Vehicle “Sea Hunter. *Naval Engineers Journal*.

Beery, P. T., Paulo, E. P., Twelfth International Mine Warfare Technology Symposium, "Comparing Legacy and Future MCM Capabilities," Monterey, CA, United States. (May 23, 2016).

Cohn, K. R. (Author), Lionis, A. (Author & Presenter), Paulo, E. P. (Author), Advanced High-Power Lasers and Beam Control Conference, "Experimental Design of a UCAV-BASED HEL Weapon," Directed Energy Professional Society, Colorado Springs. (July 29, 2016).

Paulo, E. P. (Author & Presenter), Beery, P. T. (Author), Williams, R. D. (Author), Undersea Warfare Conference, "NPS Studies Addressing Future of Mine Warfare," Groton, CT, United States. (September 19, 2017).

Paulo, E. P. (Author & Presenter), Beery, P. T. (Author & Presenter), Technologies for Information Operations, "MBSE: The Integration of Systems Engineering and Modeling and Simulation for Better Decision Making," Center for Joint Services Electronic Warfare, Naval Postgraduate School, Monterey, CA, United States. (October 24, 2017).

Recent Professional Development Activities

None

Name: **Anthony G. Pollman**
Assistant Professor, 2 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Nuclear Engineering	Purdue University	2004
MS	Nuclear Engineering	Purdue University	2004
PhD	Mechanical Engineering	University of Maryland	2011
MBA		Naval Postgraduate School	2015

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
U.S. Naval Academy	Master Instructor (Military)	April 2009 - April 2012	FT
Naval Postgraduate School	Deputy Marine for Research & TRWG Director	April 2012 - June 2015	FT
Naval Postgraduate School	Contracted Instructor	October 2016 - December 2016	PT
Naval Postgraduate School	Assistant Professor	February 2017 - Present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
U.S. Marine Corps	Data Chief		June 1994 - December 2004	FT
U.S. Marine Corps	Communications Officer		December 2004 - June 2015	FT
Republic Services	General Manager		July 2015 - June 2016	FT
Captain's Properties, LLC	Member (Owner)		August 2014 - Present	PT

Certifications or Professional Registrations

DAWIA II, Department of Defense, 2015 - Present

Current Membership in Professional Organizations

American Nuclear Society (ANS), 2004 - Present

Marine Corps Association (MCA), 2009 - Present

American Society of Mechanical Engineers (ASME), 2011 - Present

Order of the Engineer, 2014 - Present

American Society for Engineering Education (ASEE), 2017 - Present

International Council on Systems Engineering (INCOSE), 2017 - Present

Honors and Awards

Superior Service Award, Naval Postgraduate School (Marine Corps Association & Foundation), March 2015

Outstanding Volunteer Service Medal, Naval Postgraduate School, June 2015

Meritorious Paper, Hardened Electronics & Radiation Technology Society, March 2017

NPS Foundation/U.S. Naval Institute Annual Essay Contest Winner, NPS Foundation & U.S. Naval Institute, June 2018

Certificate of Appreciation, 1st Airborne, October 2018

Service Activities

Co-chair, Global Maritime Forum, February 2017 - July 2017

Deputy Director, Littoral Operations Center, February 2017 - Present

Faculty Representative-at-Large, Faculty Council, January 2018 - Present

Associate Chair, Inclusion and Diversity Council, November 2018 - Present

Session Chair, Office of Naval Research - Global, April 19, 2017 - April 21, 2017

Responsible-Engineer-in-Charge (REIC) - Rwanda Project(s), Engineers Without Borders - USA (UCSB Chapter), 2014 - 2017

Reviewer, Conference Paper, American Institute of Aeronautics and Astronautics (AIAA), March 2018 - April 2018

Principal Publications and Presentations in the Last Five Years

Miller, K., O'Halloran, B. M., Pollman, A. G., Freeley, M. (in press). *Securing the Internet of Battlefield Things While Maintaining Value to the Warfighter*. Stellenbosch: National Defense University.

Pollman, A. G., Science and Technology Division Colloquim, "Simplified, Integral, Rapid-condensation Transient Experiment & Modeling," Institute for Defense Analysis, Alexandria, VA, United States. (June 2015).

Pollman, A. (Author & Presenter), Littoral OPTECH-South, "Command & Control of a Cross-domain Drone Amphibious Assault," Office of Naval Research - Global, Naval Club, Cartagena, Colombia. (April 2017).

Pollman, A. G., Gannon, A. J., UC Davis - Mechanical & Aerospace Engineering Colloquim, "Mitigating Intermittency on a Renewable-Powered Micro-Grid." (November 2017).

Pollman, A. G., Enabling STRIKE Culture, "Organizational Culture," 101st Airborne Leadership Development Program, Fort Campbell, KY. (October 22, 2018).

Recent Professional Development Activities

Seminar, COMPASS New Faculty Training, Naval Postgraduate School, Monterey, CA, United States, 2017

Tutorial, Joint Theater-level Simulation Training, Naval Research Program, Monterey, CA, United States, January 8, 2018 - January 12, 2018

Name: **Mark M. Rhoades**
Senior Lecturer, 17 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Aeronautical Engineering	University of Michigan	1983
MS	Aeronautical Engineering	Naval Postgraduate School	1990
MS	Systems Engineering Management	Naval Postgraduate School	2006

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
U.S. Naval Academy	Master Instructor (Military)	April 2009 - April 2012	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
U.S. Navy	Naval Pilot		1983 - 1988	FT
Naval Aviation Depot North Island	Field Service Officer		1990 - 1993	FT
AIRPAC Staff	Adversary Class Desk Officer		1993 - 1995	FT
Naval Air Systems Command	Systems Engineer		1995 - 1998	FT
GPS Joint Program Office, Los Angeles AFB	Navy Deputy Program Manager		1998 - 2001	FT
Real Options Valuation, Inc	Vice President for Training and Risk Modeling		May 2008 - Present	FT

Certifications or Professional Registrations

Certified Quantitative Risk Management, International Institute of Professional Education and Research (IIPER), April 2008 - Present

Current Membership in Professional Organizations

Tau Beta Pi, September 1, 1981 - Present

Military Officers Association of America (MOAA), October 1, 1983 - Present

International Council on Systems Engineering (INCOSE), October 1, 2007 - Present

Honors and Awards

Meyer Award for Teaching Excellence in Systems Engineering, SE Department, September 30, 2010

Meyer Award for Teaching Excellence in Systems Engineering, SE Department, September 30, 2016

Meyer Award for Teaching Excellence in Systems Engineering, SE Department, September 30, 2017

Service Activities

Faculty Mentor; Mentored junior faculty on remote computing capabilities and distance learning systems., October 1, 2017 - September 30, 2018

Faculty Mentor, SE3302 Course Coordinator, October 1, 2010 - Present

Faculty Mentor, SE4353 Course Coordinator, October 1, 2012 - Present

Principal Publications and Presentations in the Last Five Years

Rhoades, M. M. (2015). Risk-based Schedule Planning with Simulation. *Modeling Risk, 3rd Edition*.

Rhoades, M. M., Rhatigan, J. L., Tackett, S. H., Worden-Buckner, K. K. (2018). *REDUCING HUMAN RADIATION RISKS ON DEEP SPACE MISSIONS*. Monterey: IEEE.

Recent Professional Development Activities

Workshop, Design for Student Success, NPS, Monterey, CA, November 1, 2015 - November 30, 2015

Tutorial, MBSE with Innoslate, SPEC Innovations, Manassas, VA, Bahrain, March 16, 2018

Tutorial, Verification and Validation with Innoslate, SPEC Innovations, Manassas, VA, United States, June 13, 2018

Seminar, Welcome to Innoslate 4.0, SPEC Innovations, Manassas, VA, United States, June 28, 2018

Tutorial, Overview of DoDAF with Innoslate, SPEC Innovations, Manassas, VA, United States, August 24, 2018

Seminar, Exercising your Behavior Model, Vitech Corporation, April 23, 2015 - Present

Seminar, Mastering the CORE Schema, Vitech Corporation, October 30, 2015 - Present

Tutorial, Cost Estimation and Risk Registers using @RISK, Palisades, December 8, 2015 - Present

Name: **Robert Semmens**
Assistant Professor, <1 year of NPS service

Education

Degree	Discipline	Institution	Year
BS		United States Military Academy	1998
PhD		Stanford University	2017

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Stanford University	Teaching Assistant, Topics in Cognition and Learning: Visualization	2011	PT
Stanford University	Instructor, An Introduction to Wilderness Skills	2011 - 2013	PT
Stanford University	Teaching Assistant, Cognition and Learning	2013	PT
Stanford University	Teaching Assistant, Spatial Approaches to Social Science	2014	PT
San Jose State University	Lecturer, Research Methods	2015	PT
Stanford University	Teaching Assistant, Introduction to Data Analysis and Interpretation	2015	PT
Stanford University	Teaching Assistant, Human-Computer Interatction Research	2016	PT
Stanford University	Postdoctoral Scholar	September 2017 - September 2018	FT
Naval Postgraduate School	Assistant Professor	September 2018 - Present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Imprimis, Incorporated	Systems Engineering		February 2004 – Se ptember 2010	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

Institute of Electrical and Electronics Engineers (IEEE)

Honors and Awards

None

Service Activities

Conference Paper Reviewer, ACM SIGCHI, September 2018 - Present

Conference Paper Reviewer, Human Robot Interaction, September 2018 - Present

Principal Publications and Presentations in the Last Five Years

Semmens, R. (2013). You Can Go Your Own Way... But You Won't: Exploring Road Utilization in the Bay Area. *Computing for Geospatial Research and Application (COM. Geo), 2013 Fourth International Conference on* (pp. 146--147).

Semmens, R. (2014). In GPS We (Sometimes) Trust. *6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*.

Semmens, R., Piech, C., Friend, M. (2015). Who Are You? We Really Wanna Know... Especially If You Think You're Like a Computer Scientist. *Proceedings of the Third Conference on GenderIT* (pp. 40--43).

Semmens, R. (2017). *Drawn Together: Using Visualization Using Visualization as a Problem-Solving Strategy in Project Management*. Stanford University.

Recent Professional Development Activities

None

Name: **William A. Solitario**
Professor of Practice, 12 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Chemical Engineering	City College of New York	1962

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Professor of Practice, Systems Engineering	2007 - Present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Northrop Grumman Ship Systems (Ingalls Shipbuilding)	Director of Technology Development, Director of Research and Development, Director of International Marketing, Director of Design Engineering, Director of Engineering Test and Trials	Starting with the first major application of Systems Engineering to military ship design through principal responsibility for the entire Detail Design required to construct, and logistics to maintain the CG 47 Ticonderoga Class Cruiser, and finally as Director of Research and Development.	1968 - 2009	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

None

Honors and Awards

None

Service Activities

Northrop Grumman Ship Systems Chair, Meyer Institute, 2003-2009

Principal Publications and Presentations in the Last Five Years

Solitario,W.A., “Integrated Ship Topside System”, SMI Signature Management: The Pursuit of Stealth, London, March 2004

Solitario, William, Shebalin, Paul, Bean, John, “Systems Engineering a Naval Railgun,” 13th Annual EML Symposium, Potsdam (Berlin) Germany, May 2006

Recent Professional Development Activities

None

Name: **Mark R. Stevens**
Senior Lecturer, 15 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Nuclear Engineering; Physics	United States Military Academy-West Point	1980
MS	Physics	Rensselaer Polytechnic Institute	1988

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Department of Physics, United States Military Academy, West Point NY	Assistant and Associate Professor	1988 - 1991	FT
University of California at Berkeley	Professor of Military Science	2001 - 2003	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
94th Engineer Battalion (Combat)(Heavy)	Executive Officer		1995 - 1996	FT
130th Engineer Brigade	Brigade Operations Officer		1996 - 1997	FT
130th Engineer Brigade	Deputy Commander		1997 - 1998	FT
Transatlantic Programs Center, U.S. Army Corps of Engineers	Deputy Director		1998 - 2001	FT

Certifications or Professional Registrations

Associate Systems Engineering Professional, International Council of Systems Engineering (INCOSE), December 13, 2015 - December 13, 2020

Registered Professional Engineer, Civil Engineering, State of Virginia

Current Membership in Professional Organizations

Charter Member. West Point Chapter, Phi Kappa Phi, May 1980 - Present

President, Blue Ridge Post, Society of American Military Engineers (SAME), March 1982 - Present

Founding Member, West Point Post, Sigma Pi Sigma, March 1990 - Present

Member, International Council on Systems Engineering (INCOSE), 2006 - Present

Honors and Awards

Distinguished Honor Graduate, US Army Engineer Officer Advanced Course, June 1986

Letter of Commendation for Teaching Excellence (top 5% of teachers for the Schieffelin Award), Naval Postgraduate School; 2005, 2006, 2008

Award for Excellence in Systems Engineering Analysis, Northrop-Grumman, 2006

Award for Excellence in Systems Engineering Analysis, Northrop-Grumman, 2007

Wayne E. Meyer Award for Teaching Excellence in Systems Engineering, Naval Postgraduate School, December 2008, June 2018

Award for Excellence in Systems Engineering Analysis, Northrop-Grumman, 2009

Merit Award for Teaching, GSEAS, Naval Postgraduate School, 2009

Service Activities

Attendee, Meeting, Academic Council Representative, Systems Engineering and Analysis Curriculum, June 2004 - Present

Faculty Advisor, Academic Associate, Systems Engineering Analysis (SEA) (308) Curriculum, June 2008 - Present

Faculty Advisor, Academic Associate, SE (580) Curriculum, June 2011 - Present

Committee Chair, Curricula, Certificate, and Degree Requirements Committee (CCDRC) of the Academic Council, September 2011 - Present

Committee Member, Departmental Curriculum Committee, August 2015 - Present

Session Chair, Directed Energy Professional Society 2017 Directed Energy Systems Symposium, September 27, 2017; Attendee, Meeting for Symposium, September 25, 2017 - September 29, 2017

Attendee, Meeting, NDIA Warheads & Ballistics Classified Symposium, July 31, 2018 - August 2, 2018

Judge, Monterey County Science Fair, March of each year 2012 – 2016 and 2018

Officer, Treasurer, I Cantori di Carmel, July 2006 - June 2012

Officer, Treasurer, Camerata Singers, February 2013 - Present

Principal Publications and Presentations in the Last Five Years

Nelson, D. H. (Author & Presenter), Harney, R. C. (Author), Stevens, M. R. (Author), Seventeenth Annual Directed Energy Symposium, "Combat Systems Engineering of High Energy Laser Weapons Systems," Directed Energy Professional Society/NAVSEA, Anaheim, CA, United States. (March 5, 2015).

Nelson, D. H. (Author & Presenter), Harney, R. C. (Author), Stevens, M. R. (Author), Directed Energy Systems Symposium/Employment of DE Weapons Conference, "Implications of Combat Systems Engineering for High Energy Laser Weapons System Development," Directed Energy Professional Society, Norfolk, VA, United States. (September 16, 2015).

Harney, R. C. (Author), Nelson, D. H. (Author & Presenter), Stevens, M. R. (Author), Eighteenth Annual Directed Energy Symposium, "Combat Systems Engineering of High Energy Laser Weapon Systems," Directed Energy Professionals Society, Albuquerque, NM, United States. (March 7, 2016).

Recent Professional Development Activities

None

Name: **Joseph W. Sweeney III**
Lecturer, 12 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Electrical Engineering	United States Naval Academy	1975
MS	Aeronautical Engineering	Naval Postgraduate School	1987
MS	Systems Engineering	Southern Methodist University	2018

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Naval Postgraduate School	Military Lecturer, Aeronautical Engineering	1991-1994	FT
Naval Postgraduate School	Lecturer, Systems Engineering	2010 - present	FT
Naval Postgraduate School	Program Officer, Systems Engineering (DL) Curric 311	2010 - present	PT
Naval Postgraduate School	Program Officer, Systems Engineering Management (DL) Curric 721	2010 - 2012	PT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Department of the Navy	Active Duty Naval Officer		1975-1994	FT

Certifications or Professional Registrations

None

Current Membership in Professional Organizations

International Council on Systems Engineering (INCOSE), August 22, 2010 - Present

Volunteer in local chapter, Project Management Institute (PMI), September 29, 2010 - Present

Institute of Electrical and Electronics Engineers (IEEE), January 1, 2012 - Present

American Institute of Aeronautics and Astronautics (AIAA), January 10, 2013 - Present

Association for Unmanned Vehicle Systems International (AUVSI), February 1, 2017 - Present

Honors and Awards

Volunteer of the Year, PMI-MBAY Chapter, March 2016

Service Activities

Guest Speaker, New student orientation, November 30, 2017

Guest Speaker, New student orientation, June 8, 2018

Program Coordinator, Deputy for SSP Systems Engineering Chair, July 2010 - Present

Attendee, Meeting, Bi-weekly NPS Program Officer meetings, August 2010 - Present

Attendee, Meeting, Bi-weekly GSEAS Program Officer meetings, January 2018 - Present

Attendee, Meeting, NDIA Warheads & Ballistics Classified Symposium, July 31, 2018 - August 2, 2018

Principal Publications and Presentations in the Last Five Years

Green, J. M., Sweeney, J. W., Stracener, J. (2014). *The Application of Black Box Theory to System Development*. Washington DC: SEDC 2014.

Sweeney, J. W., PMI Mbay Branch meeting, "BSIM Organization," PMI-MBAY, Dinner meeting, Monterey, CA, United States. (August 20, 2015).

Recent Professional Development Activities

Conference Attendance, International Council on Systems Engineering (INCOSE) International Workshop, Torrance, CA, January 23, 2014 - January 27, 2014

Conference Attendance, International Council on Systems Engineering (INCOSE) International Symposium (IS), Seattle, WA, July 12, 2015 - July 17, 2015

Conference Attendance, International Council on Systems Engineering (INCOSE) International Workshop, Torrance, CA, January 30, 2016 - February 2, 2016

Conference Attendance, INCOSE International Symposium (IS), INCOSE, Edinburgh, Scotland, July 18, 2016 - July 21, 2016

Conference Attendance, INCOSE International Workshop, INCOSE, Torrance, CA, United States, January 28, 2017 - January 31, 2017

Name: **Douglas Van Bossuyt**
Assistant Professor, 1-year NPS service

Education

Degree	Discipline	Institution	Year
BA	International Studies	Oregon State University	2007
BS	Mechanical Engineering	Oregon State University	2007
MS	Mechanical Engineering	Oregon State University	2009
PhD	Mechanical Engineering	Oregon State University	2012

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
National Center for Accessible Transportation, Oregon State University	Graduate Research Assistant	September 2007 - January 2009	FT
Faculty of Architecture, Design, and Planning, University of Sydney	Visiting Scholar	June 2010 - August 2010	FT
Complex Engineered Systems Design Laboratory, Oregon State University	Courtesy Faculty, Graduate Research Assistant	January 2009 - July 2016	PT
Colorado School of Mines	Assistant Professor	August 2013 - December 2016	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
Jet Propulsion Laboratory	Space Grant Intern		June 2009 - August 2009	PT
NuScale Power	Probabilistic Risk Assessment Engineer		August 2012 - August 2013	FT
KTM Research	Partner and Automation Engineer		January 2017 - December 2017	FT

Certifications or Professional Registrations

Divemaster, Professional Association of Diving Instructors, April 15, 2008 - Present

Certified Nuclear Risk Professional, Electric Power Research Institute, November 2013 - Present

Current Membership in Professional Organizations

Professional Association of Diving Instructors, 2008 - Present

American Society of Mechanical Engineers (ASME), 2009 - Present

Order of the Engineer, 2012 - Present

Prognostics and Health Management Society (PHM), October 2013 - Present

International Council on Systems Engineering (INCOSE), July 2018 - Present

Honors and Awards

ASME Computer Aided Product and Process Development (CAPPD) Student Travel Grant Recipient, ASME, 2011

International Conference on Engineering Design Reviewers' Favourite Recognition, International Conference on Engineering Design, 2015

Shultz Family Humanitarian Engineering Faculty Fellow, Colorado School of Mines, 2015

Service Activities

Leading effort to develop new PhD program guidelines, PhD Program Committee, 2018 - Present

Session Chair, Track Organizer, Reviewer, ASME International Design Engineering Technical Conference & Computers and Information in Engineering (IDETC/CIE2018) - 2018

Reviewer, Grant Proposal, Department of Energy: CINR Reviewer, 2018; SBIR PIR 1, 2018

Session Chair, IEEE 13th System of Systems Engineering Conference (SoSE2018) - Reliability in System of Systems Engineering Special Session, 2018

Track Organizer, Prognostics and Health Management Society 2018 Conference, 2018

Principal Publications and Presentations in the Last Five Years

Van Bossuyt, D., O'Halloran, B. M., Arlitt, R. (2018). *Irrational System Behavior in a System of Systems*. IEEE.

Dempere, J., Papakonstantinou, N., O'Halloran, B. M., Van Bossuyt, D. (2018). Risk Modeling of Variable Probability External Initiating Events in a Functional Modeling Paradigm. *The Journal of Reliability, Maintainability, and Supportability in Systems Engineering*. https://www.rmspartnership.org/journal.html

Van Bossuyt, D., O'Halloran, B. M., Singapore University of Technology and Design SUTD-MIT International Design Centre, "Driving System Architecture Decisions Using Reliability and Failure Analysis Information in Conceptual System Design," Singapore. (April 2018).

Van Bossuyt, D., SE Dept PD-21 Fall 2018 cohort orientation session, "Emergent System Behaviors and Critical Function Failures and Risk Analysis, Oh My!." (September 14, 2018).

Van Bossuyt, D., 10th Annual Conference of the Prognostics and Health Management Society, "A Method for Automated Cavitation Detection with Adaptive Thresholds." (September 2018).

Recent Professional Development Activities

Workshop, 2018 NSF Design Circle Workshop – Designing and Developing Global Engineering Systems, National Science Foundation, March 22, 2018 - March 24, 2018

Conference Attendance, INCOSE International Symposium, INCOSE, July 7, 2018 - July 12, 2018

Conference Attendance, 10th Annual Conference of the Prognostics and Health Management Society, PHM Society, September 24, 2018 - September 27, 2018

Name: **Warren K. Vaneman**
Professor of Practice, 7 years NPS service

Education

Degree	Discipline	Institution	Year
AS	Science	Camden County College	1985
BS	Meteorology and Oceanography	State University of New York-Maritime College	1986
MS	Systems Engineering	Virginia Polytechnic Institute and State University	1997
PhD	Industrial and Systems Engineering	Virginia Polytechnic Institute and State University	2002

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Virginia Tech	Adjunct Professor	January 18, 2007 - Present	PT
Naval Postgraduate School	Professor of Practice, Systems Engineering (DL)	2012 - present	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
National Geospatial-Intelligence Agency	Senior Systems Engineer		1992 - 2004	FT
Architecture Analysis Division, National Reconnaissance Office	Chief		2004 - 2007	FT
National Reconnaissance Office Ground Enterprise Directorate	Chief Architect		2007 - 2010	FT
U.S. Navy Surface Warfare and Space Cadre Officer (Reserve Component)			1987 - September 1, 2017	FT

Certifications or Professional Registrations

Certified Systems Engineering Professional, International Council on Systems Engineering, August 15, 2016 - August 15, 2019

Joint Professional Military Education (Phase 1), Naval War College, May 1, 2008 - Present

Current Membership in Professional Organizations

International Council on Systems Engineering (INCOSE), Member, 1998 - Present

Lifecycle Modeling Language Steering Committee (LML), Chair, 2013 - Present

Navy Leagues for the United States, STEM Committee Member, September 2017 - Present

Honors and Awards

Wayne E. Meyer Award, Naval Postgraduate School, December 19, 2014

Legion of Merit, U.S. Navy, November 8, 2015

30 Year Civilian Service Award, Naval Postgraduate School, October 2016

Legion of Merit (Second Award), U.S. Navy, September 2017

Wayne E. Meyer Award, Naval Postgraduate School, June 15, 2018

Service Activities

Attendee, Graduation, NAVAIR Graduation for Distant Learning Students, April 12, 2018

Program Organizer, NUWC Newport Graduation for Distance Learning, June 15, 2018 - September 18, 2018

Committee Member, Navy League of the United States, October 1, 2017 - October 31, 2018

Chairperson, Lifecycle Modeling Language Steering Committee, May 10, 2013 - September 30, 2019

Principal Publications and Presentations in the Last Five Years

Vaneman, W. K., Systems Engineering Innovation and Technology Seminar Series, "Model-Based Systems Engineering De-Mystified," Naval Sea Systems Command, Washington, DC. (April 5, 2018).

Vaneman, W. K., Carlson, R. R., Acquisition Research Symposium, "Managing Complex System Engineering and Acquisition through Lead Systems Integration," Naval Postgraduate School, Monterey, CA, United States. (May 9, 2018).

Vaneman, W. K., Carlson, R. R., PM Training Systems, "Managing Complex System Engineering and Acquisition through Lead Systems Integration," Marine Corps, Orlando, FL. (May 17, 2018).

Vaneman, W. K., 86th Military Operations Research Society Symposium, "Bridging the Divide Between Operations Research and Systems Engineering with Model-Based Systems Engineering," Military Operations Research Society, Naval Postgraduate School, Monterey. (June 20, 2018).

Vaneman, W. K., Carlson, R. R., 28th Annual INCOSE International Symposium, "Engineering Complex Mission Capabilities through Lead Systems Integration," INCOSE, 28th Annual INCOSE International Symposium, Washington, DC, United States. (July 10, 2018).

Vaneman, W. K., Marine Corps Systems Command MBSE Day, "Model-Based Systems Engineering De-Mystified," Marine Corps Systems Command, Quantico, VA. (July 31, 2018).

Recent Professional Development Activities

None

Name: **Clifford A. Whitcomb PhD**
Professor, 14 years NPS service

Education

Degree	Discipline	Institution	Year
BSE	Nuclear Engineering	University of Washington-Seattle	1984
SM	Electrical Engineering and Computer Science	Massachusetts Institute of Technology	1992
SM	Naval Engineering	Massachusetts Institute of Technology	1992
PhD	Mechanical Engineering	University of Maryland College Park	1998

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Massachusetts Institute of Technology, Cambridge, MA	Associate Professor of Naval Construction and Engineering	July 1998 - February 2001	FT
System Design and Management (SDM) Program, Massachusetts Institute of Technology, Cambridge, MA	Director, MIT-UTC Systems Engineering Program, Senior Lecturer, and Senior Research Scientist	February 2001 - June 2003	FT
University of New Orleans, New Orleans, LA	Northrop Grumman Ship Systems Endowed Chair in Shipbuilding and Engineering, Professor of Engineering Management	August 2003 - July 2005	FT

Non-academic Experience

Organization	Title	Duties	Dates	FT/PT
USS Scamp (SSN-588)	Communications Officer		April 1985 - October 1986	FT
Supervisor of Shipbuilding, Groton, CT	Shipwork Coordinator		October 1986 - May 1989	FT
Naval Surface Warfare Center, Bethesda, MD	Ship Design Research Engineer		June 1992 - September 1995	FT
Office of Naval Research (ONR), Arlington VA	Program Officer		October 1995 - July 1998	FT
Naval Sea Systems Command, Philadelphia, PA	Eminent Scientist		April 2003 - July 2005	FT

Certifications or Professional Registrations

Certified Systems Engineering Professional, INCOSE, 2004 - 2014

Lean Six Sigma Master Black Belt, NGSS, 2004

Current Membership in Professional Organizations

Society of Naval Architects and Marine Engineers (SNAME), Member

International Council on Systems Engineering (INCOSE), Member

Honors and Awards

Fellow, International Council on Systems Engineering (INCOSE), International Council on Systems Engineering, January 1, 2015

Wayne E. Meyer Award for Teaching Excellence, Naval Postgraduate School, June 16, 2017

Fellow, Society of Naval Architects and Marine Engineers (SNAME), January 1, 2018

Distinguished Professor, Naval Postgraduate School, September 1, 2018

Service Activities

Member, Promotion and Tenure Committee, December 1, 2018 - March 31, 2019

Faculty Advisor, 282 Academic Associate, October 1, 2016 - Present

Faculty Advisor, 581 Program Officer, October 1, 2016 - Present

Committee Chair, SE Department ABET and WSCUC Accreditation Coordinator, October 1, 2017 - Present

Editor-in-Chief, Journal Editor, Journal Systems Engineering, July 1, 2018 - Present

Principal Publications and Presentations in the Last Five Years

Whitcomb, C. A., Beery, P. T. (2016). Chapter 12 Exploring the Design Space. *Parnell, G. S., Editor, Trade-off Analytics: Creating and Evaluating the Tradespace, Wiley Series in Systems Engineering and Management, Wiley & Sons, 2017*. http://www.wiley.com/WileyCDA/WileyTitle/productCd-111923753X.html

Giammarco, K. M., Whitcomb, C. A. Using the Design Reference Mission for Framing Naval Ship Design Problems. *Naval Engineers Journal, 130*(1), 101-111.

Doerry, N., Singer, D., Strickland, J., Tom, M., Whitcomb, C. A. (2017). *Set-Based Design*. Society of Naval Architects and Marine Engineers.

Whitcomb, C. A., Hernandez, A., Vizzini, M. (2019). *Engineering Reasoning in Set-Based Design*. *Naval Engineers Journal, 131(1).*

Recent Professional Development Activities

Workshop, Design Thinking and the Art of Innovation, Stanford University, June 17, 2015 - June 19, 2015

Workshop, Human Centered Design Fundamentals Workshop, Office of Personnel Management, Washington, DC, United States, April 4, 2016 - April 7, 2016

Workshop, Set-Based Design, American Society of Naval Engineers (ASNE), Alexandria, VA, United States, September 26, 2017 - September 27, 2017

Name: **Oleg A. Yakimenko**
Professor, 20 years NPS service

Education

Degree	Discipline	Institution	Year
BS	Computer Science	Moscow Institute of Physics and Technology-Moscow	1983
MS	Aeronautical Engineering	Moscow Institute of Physics and Technology-Moscow	1986
MS	Operations Research	Zhukovsky Air Force Engineering Academy-Moscow	1988
PhD	Aeronautical Engineering	Zhukovsky Air Force Engineering Academy-Moscow	1991
MBA	Financial Management	Russian American Humanitarian University-Moscow	1995
PhD	Operations Research	Russian Academy of Sciences-Russia	1996

Academic Experience

Institution	Title/Rank/Position	Dates Held	FT/PT
Zhukovskiy Air Force Engineering Academy, Moscow, Russia	Senior Engineer	1986 - 1988	FT
Zhukovskiy Air Force Engineering Academy, Moscow, Russia	Lecturer	1988 - 1991	FT
Zhukovskiy Air Force Engineering Academy, Moscow, Russia	Assistant Professor	1991 - 1993	FT
Zhukovskiy Air Force Engineering Academy, Moscow, Russia	Associate Professor	1993 - 1996	FT
Zhukovskiy Air Force Engineering Academy, Moscow, Russia	Professor	1996 - 1998	FT

Non-academic experience

Organization	Title	Duties	Dates	FT/PT
Russian Air Force	Active Duty Officer (Colonel)		1986 - 1998	FT

Certifications or Professional Registrations

Commercial Pilot License, FAA, 2002 - Present

Current Membership in Professional Organizations

Russian and International Engineering Academy, Scientific Advisor, 1996 - Present

Russian Academy of Sciences of Aviation and Aeronautics, Fellow, 1998 - Present

American Institute of Aeronautics and Astronautics (AIAA), Associate Fellow, 1999 - Present

Aerodynamic Decelerator Systems Technical Committee of the American Institute of Aeronautics and Astronautics, Member, 2005 - Present

Editorial Board of the Progress in Astronautics and Aeronautics Book Series of the American Institute of Aeronautics and Astronautics, Member, 2006 - Present

Editorial Board of the International Journal of Advanced Robotic Systems, Editor, 2009 - Present

Western Region of the American Institute of Aeronautics and Astronautics, Deputy Director of Education, 2011 - Present

Editorial Board of the Unmanned Systems Journal, Editor, 2012 - Present

Honors and Awards

Outstanding Leadership and Service Citation, AIAA, 2008

Service Activities

Committee Member, DEC Committee, August 2017 - January 2018

Committee Member, Chair Reappointment Committee, December 2017 - February 2018

Committee Member, Controls&UAVs Technical Committee, October 7, 2015 - Present

Committee Member, Explosive Ordnance Qualification/Certification Board, April 2016 - Present

Committee Member, American Institute of Aeronautics and Astronautics, 2002 - Present

Editorial Review Board Member, American Institute of Aeronautics and Astronautics, 2003 - Present

Board of Directors, American Institute of Aeronautics and Astronautics, 2008 - Present

Editor, Associate Editor, International Journal of Advanced Robotic Systems, 2011 - Present

Editor, Associate Editor, Unmanned Systems, 2012 - Present

Principal Publications and Presentations in the Last Five Years

Yakimenko, O. A., Engebraten, S., Moen (2018). Evolving a Repertoire of Controllers for a Multi-Function Swarm. *Evostar*. Parma, Italy.

Yakimenko, O. A., Williams, A. (2018). Persistent Mobile Aerial Surveillance Platform using Intelligent Battery Health Management and Drone Swapping. *4th International Conference on Control, Automation and Robotics*. Auckland, New Zealand.

Yakimenko, O. A., Anderson, W. (2018). Challenges in Modeling Wind Power Generation Based on Available Weather Data. *3rd IEEE International Conference on Smart and Sustainable Technologies*. Split, Croatia: IEEE.

Yakimenko, O. A., Engebraten, S., Glette, K. (2018). Field-Testing of High-Level Decentralized Controllers for a Multi-Function Drone Swarm. *14th IEEE International Conference on Control and Automation*. Anchorage, AK: IEEE.

Yakimenko, O. A., Fields, T. (2018). Development of a Steerable Single Actuator Cruciform Parachute. *Journal of Aircraft, 55*(3).

Recent Professional Development Activities

None

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Appendix C – Equipment

Please list the major pieces of equipment used by the master's level program in support of instruction and attainment of educational goals.

A. Systems Computation Laboratory

The Systems Computation Laboratory was described in detail in FACILITIES, Section II. Laboratories. It has 50 interconnected processors with remote access and workstations for 24 students and multiple projectors and screens for interactive display of all processors. The processors and workstations were last replaced in 2018. The lab is supplemented by another 30 servers that have the same software load and are available for remote login via a Citrix server. The servers were replaced in 2016. The Computation Lab provides exceptionally substantial computational support for large-scale simulation, modeling, and systems engineering projects.

B. SEA/CDIO Projects Laboratory

The SEA/CDIO Projects Laboratory has three large dedicated spaces that are used for team-based projects. These spaces are furnished to accommodate team meetings as well as project documentation and hardware assembly. Each space has a number of computers to facilitate project completion and documentation.

C. Advanced Fabrication Laboratory

The Advanced Fabrication Laboratory contains multiple 3D printers capable of printing plastic (PLA), reinforced (carbon fiber, Kevlar) plastic, nylon, and 17-4 stainless steel. The lab provides capabilities for micro and electronic manufacturing. The lab also provides the facility for the department's virtual and augmented reality systems.

D. Autonomous Systems Engineering and Integration Laboratory (ASEIL)

The ASEIL contains the department's autonomous system fleets. The department operates a fleet of 13 Adept Pioneer 3-AT ground robots, 3 Clearpath robotics Husky ground vehicles, a 20-drone swarm of 3DR solos, and many other air, ground, surface and undersurface platforms.

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Appendix D – Institutional Summary (*)

The Institutional Summary is presented as a separate appended document beginning on the next page.

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NAVAL
POSTGRADUATE
SCHOOL

Appendix D
Institutional Summary

Graduate School of Engineering and Applied Sciences

Suite 537, Spanagel Hall

Naval Postgraduate School

Monterey, CA 93943-5117

June 20, 2019

for

Engineering Accreditation Commission
ABET
415 N. Charles Street
Baltimore, Maryland 21201

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1. The Institution

1.1 Name and address of the institution:
Naval Postgraduate School, 1 University Circle, Monterey, CA 93943

1.2 Name and title of the chief executive officer of the institution:
VADM Ann Rondeau, USN (Ret.) President

1.3 Name and title of the person submitting the self-study report:
VADM Ann Rondeau, USN (Ret.) President

1.4 Name the organizations by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations.

NPS is currently accredited by one regional organization and three programmatic organizations. The list of organizations and initial/renewal dates are as follows:

Accreditor	Initial Accreditation	Most Recent Renewal	Next Review
WSCUC	1955	2010	Review Fall 2020
ABET			
Astronautical Engineering	1996	2014	2019
Electrical Engineering	1973	2014	2019
Mechanical Engineering	1973	2014	2019
Systems Engineering	2010	2014	2019
Systems Engineering (DL)	2010	2014	2019
AACSB	2000	2015	2020
NASPAA	1980	2015	2022

2. Type of Control

NPS Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc.

NPS is a federally funded institution within the Department of the Navy. The President of the Naval Postgraduate School is the academic coordinator for all graduate education programs in the Navy. The President administers fully-funded graduate educational programs at NPS, other service graduate schools and civilian universities.

NPS is assisted and advised by a Board of Advisors, a federal advisory committee, composed of not more than ten members who are eminent authorities in the field of academia, business, national defense and the defense industry, management, leadership,

and research and analysis. All Board members are appointed by the Secretary of Defense, and are appointed to provide advice on behalf of the government on the basis of their best judgment without representing any particular point of view and in a manner that is free from conflict of interest. Those members who are not full-time or permanent part-time federal employees are appointed as experts and consultants under the authority of 5 U.S.C. § 3109, and these individuals serve as special government employees.

The purpose of the Board, under the provisions of the Federal Advisory Committee Act (FACA) of 1972, as amended, shall provide the Secretary of the Navy, through the Chief of Naval Operations and the Presidents of the Naval Postgraduate School (NPS) and the Naval War College (NWC) independent advice and recommendations on matters pertaining to the educational, doctrinal, and research policies and activities of the NPS and the NWC. The Secretary of the Navy or designated representative, on behalf of the Secretary of Defense, may act upon the Board's advice and recommendations.

The board meets at least once a year (fall) in the Washington, DC metro area. The board presents a written report with its advice and recommendations to the Secretary of the Navy, via the Chief of Naval Operations and the Presidents of the NPS and NWC. The Committee Chairperson may present its report in person to the Secretary of the Navy. Website for the Board is at https://my.nps.edu/web/board-of-advisors .

One of the Board's two subcommittees focusses on matters concerning the Naval Postgraduate School and is comprised of no more than 15 members. This subcommittee meets a minimum of twice annually. The spring meeting shall be held at the campus of the NPS and the fall meeting shall be held in the Washington, DC metro area concurrent with the main committee meeting.

The Chief of Naval Operations ensures that NPS is provided the appropriate resources and policy guidance to accomplish its mission.

3. Educational Unit

Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included.

The President of the Naval Postgraduate School is the academic coordinator for all graduate education programs in the Navy. The President administers fully-funded graduate educational programs at the Naval Postgraduate School, other service graduate schools and civilian universities.

Reporting to the President on the academic side is the Provost and Academic Dean, who is in turn the supervisor for all four school deans (Graduate School of Engineering and Applied Science, Graduate School of Operational and Information Sciences, School of International Graduate Studies, and the Graduate School of Business and Public Policy) as well as the Vice Provost of Academic Affairs, the Dean of Research, the Dean of Students,

and the University Librarian. Among the administrative staff are: Associate Provost for Faculty Management and Administration, Associate Provost for Graduate Education, Associate Provost for Educational Effectiveness, Director of Academic Administration and Registrar, Director the Center for Educational Design, Development, and Distribution. An organization chart for upper level administration within the school is shown below in Figure 1.

3.1 Overview

The engineering educational unit at NPS is the Graduate School of Engineering and Applied Sciences (GSEAS). GSEAS consists of seven academic departments (Applied Mathematics, Electrical and Computer Engineering, Mechanical and Aerospace Engineering, Meteorology, Oceanography, Physics and Systems Engineering) and three Academic Groups (Space Systems Academic Group, Undersea Warfare Academic Group, and the Energy Academic Group). The chart showing the internal organization of the engineering educational unit (GSEAS) is shown in Figure 2 below.

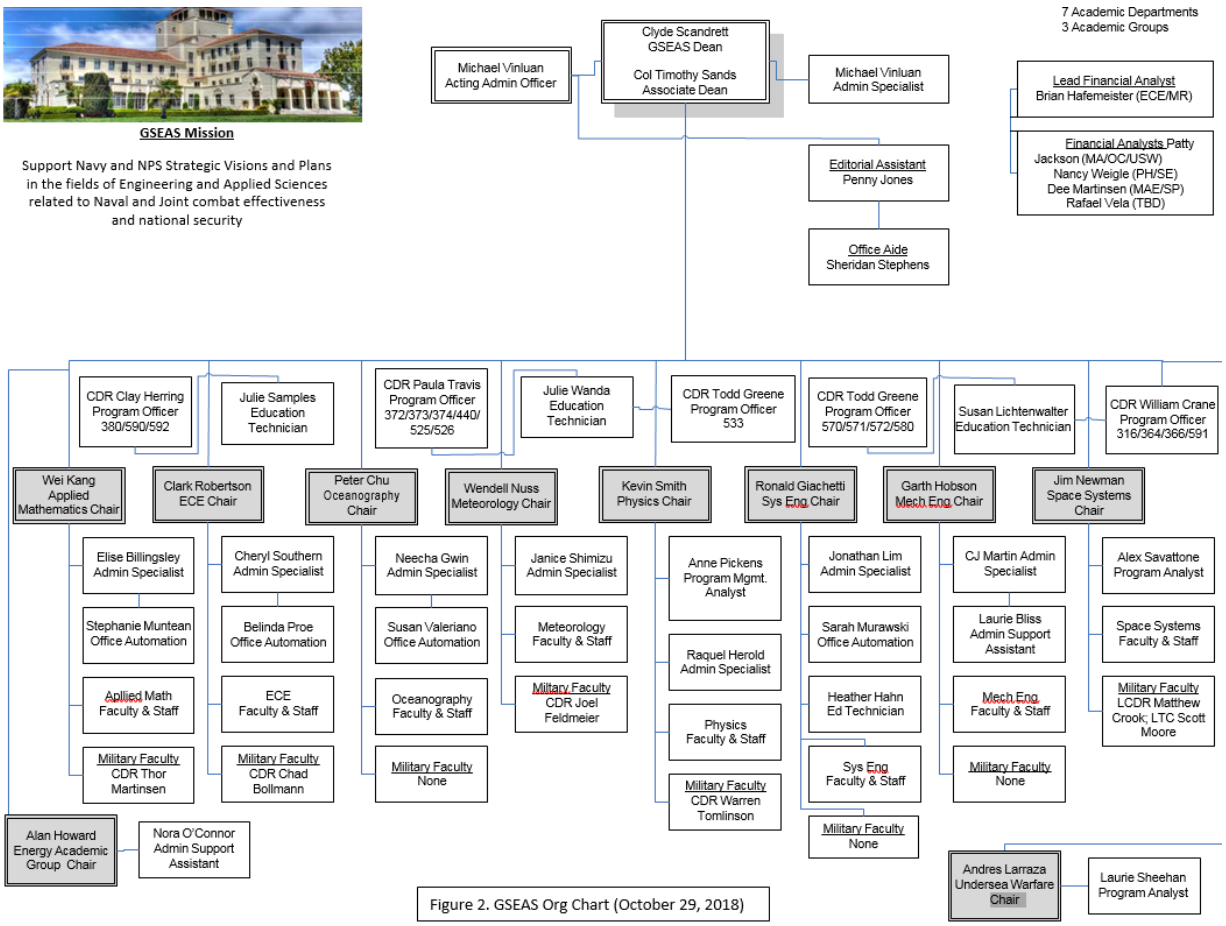


Figure 2. GSEAS Org Chart (October 29, 2018)

Within the Naval Postgraduate School, GSEAS supports the Navy and DoD by educating future leaders to lead, innovate and manage in a rapidly changing, highly technological world, and by conducting research recognized internationally for its relevance to national defense and academic quality. More specifically, and in support of the mission of NPS and the strategic needs of the Department of the Navy, GSEAS provides advanced technical and scientific knowledge and understanding so graduates:

- understand the capabilities and limitations of current and future technologies in battle space environments;
- understand and apply emerging and advanced technologies to enhanced war fighting capabilities;
- are able to learn, anticipate, respond and lead in future**,** complex and rapidly changing technological environments;
- are able to represent their organization's technical needs and interests with and within myriad constituencies, to include DoD, the Joint Staff, and industry.

3.2 Traditional Academic Degrees

GSEAS accomplishes the above by offering high quality, traditional academic degrees that include:

- Science and engineering curricula tailored to the needs of naval communities and other DoD constituents;
- Research programs funded by the defense community, aligned to future capabilities--integrated into curricula and courses;
- Education linked to real-world experiences in laboratories, experiments, testing--frequently classified;
- Blending current operational experience of students, emerging technologies, and cutting-edge faculty in both joint and international cultures;
- Life changing education--transforming officers into circumspect technical generalists, sub-specialists and war fighters.

Sustaining cutting edge faculty supported by laboratories aligned to future naval capabilities and enabling technologies that result in up-to-date curricula and programs is essential to assure that graduates are capable of leading and managing future assignments in support of enhanced war fighting and national security.

The Department of Applied Mathematics and the Department of Physics teach mathematics and physics courses in support of engineering programs and perform considerable basic and applied research. The Department of Electrical and Computer Engineering, the Department of Mechanical and Aerospace Engineering, the Department of Systems Engineering, and the Space Systems Engineering Academic Group teach engineering subjects and conduct engineering research.

Clyde Scandrett, Professor and Dean, is the administrative head of the principal education unit for engineering education, GSEAS. There are no additional administrative units

within GSEAS.

3.3 Additional Engineering Programs

Within GSEAS there are several engineering programs that are not ABET accredited:

- Master of Engineering (Computer Engineering) and MS in Computer Engineering offered by the Electrical & Computer Engineering Department.
- MS in Electronic Warfare Systems Engineering offered by the Electrical & Computer Engineering Department.
- MS in Engineering Acoustics offered by the Physics Department.
- MS in Systems Engineering Management offered by the Systems Engineering Department.
- MS in Engineering Systems offered by the Systems Engineering Department.
- MS in Space Systems Engineering offered by the Space Systems Academic Group.
- MS in Engineering Science offered by many departments.

Other engineering programs at NPS not offered within GSEAS that have also not been reviewed by ABET are:

- MS Information Warfare Systems Engineering offered by the Department of Information Sciences, Graduate School of Operational and Information Sciences.
- MS Electronic Warfare Systems Engineering offered by the Department of Information Sciences, Graduate School of Operational and Information Sciences.
- MS Software Engineering offered by the Department of Computer Science, Graduate School of Operational and Information Sciences.
- MS in Systems Engineering Analysis offered in collaboration between the Operations Research and Systems Engineering Departments.

3.4 Engineering Enrollment and Degree Data

Enrollment and degree statistics for the engineering educational unit as a whole and for each program being evaluated for the current and preceding five (5) academic years are shown in Table D-1 (Parts 1-6).

3.5 Engineering Personnel

The number of personnel, both full-time and part-time, for the Departments of Electrical and Computer Engineering, Mechanical and Aerospace Engineering, and the Systems Engineering Program is shown in Table D-2 (Parts 1-3).

3.6 Admission of Students

The general criteria and procedures for admitting students to engineering programs:

i. The NPS Admissions Office evaluates applicants based on three criteria. The result is the assignment of an Academic Profile Code (APC). This is a three-digit code, which summarizes pertinent portions of a student's prior college performance. The three independent digits reflect an individual's cumulative

Grade-point Average (GPA), referred to as Quality Point Rating (QPR); exposure to and performance in calculus-related mathematics courses; and exposure to and performance in selected science/engineering areas.

First Digit:

The first digit indicates overall academic performance based on a recalculated* GPA from all previous college transcripts. The first digit is derived from the following table:

Code	QPR Range
0	3.60-4.00
1	3.20-3.59
2	2.60-3.19
3	2.20-2.59
4	1.90-2.19
5	0.00 -1.89

*Failures and repeated courses are included in the QPA calculation.

Second Digit:

The second digit represents mathematical background according to the following criteria and is described in the table below:

Code	Meaning
0	Math Major/Minor, Quantitative Economics Degree with B or better average; math taken less than or equal to 7 years ago.*
1	Lower Level, Upper level, Linear Algebra with a GPA of at least a 3.5; math taken less than or equal to 5 years ago.
2	Lower Level, Upper Level with average between C+ and B+ ; math taken less than or equal to 5 years ago. No Linear Algebra
3	Lower Level Calculus Sequence with a C or better; or if math taken greater than 5 years ago.
4	Calculus for Business/Social Sciences with a C or better. 1 Lower Level Calculus Course with at least a C-. Two Pre-Calculus with a B or better.
5	One pre-Calculus with C- or better grade.
6	No pertinent college-level math with C- or better grade.

*All math courses from calculus through post-calculus are considered when evaluating the transcripts for the second digit. A minimum calculus sequence is Calculus I and II.

Third Digit:

The third digit represents previous course coverage in science and technical fields

according to the following criteria:

Code	Eng/Tech GPA	Meaning
0	3.00 - 4.00	ABET EAC accredited, BS Eng Degree (regardless of time passed)
1	> = 2.30	Non-ABET EAC accredited, Eng Degree (regardless of time passed)
2	> = 2.30	Any BS Tech degree (regardless of time passed)
3	> = 3.00	Completed calculus-based physics sequence with a B average or above
4	> = 2.00	One calculus-based physics course with at least a C
5	< = 1.99	No pertinent technical courses.

Engineering Degrees include: Aero/Astro, Computer/Electrical, Mechanical, Materials, Marine, Naval, Ocean, Systems, Industrial, Chemical, and Bioengineering and Naval Architecture. **This list is not exhaustive.**

Technical degree to include: Applied Physics, Engineering Physics, Physics

Engineering/Technical GPA is based upon a 4.0 scale.

General Engineering and EE/ME Technology degrees are not counted as engineering degrees/technical degrees for purposes of calculating an APC.

When calculating the APC, if the record cannot meet all the requirements to obtain Code 0 (i.e., GPA is 2.75 but all other requirements are met) the Code drops to a 1 automatically but no further.

A first digit code of 0, 1, 2 or 3 (as appropriate) will be assigned only if transcripts provided exhibit at least 75 semester-hours or 112 quarter-hours of actual graded classroom instruction. Grades of Pass/Fail, Credit/No Credit will not count toward the 75/112 hour requirement.

A technical code of 1 or 0 ordinarily is assigned only to an Officer whose undergraduate major was Physics, Aeronautical, Electrical, Mechanical or Naval Engineering, or whose undergraduate technical major is consistent with the Officer's designated occupational specialty. General Engineering degrees and Engineering Technology degrees are specifically excluded from this list of engineering degrees.

If a waiver of the APC is requested, the appropriate Academic Department makes the acceptance decision through the Program Officer and Academic Associate, and the Dean if ultimately required.

ii. There is no history of admission standards for freshmen -- NPS does not enroll students directly from high school.

iii. Advanced placement credits are not utilized by Admissions for evaluating undergraduate transcripts. If there is an inordinate amount of AP credits, the Director of Admissions annotates such on the academic record evaluation.

iv. There are no special admission requirements for entry into the upper division or professional programs in the engineering educational unit, since all NPS students are admitted into Master's programs.

v. Policies regarding admission of transfer students from other institutions to the engineering programs are as follows:

The admissions process for all transfer students to NPS, to include engineering programs, is the same process used for all students. An Academic Profile Code is established and the Department reviews the applicant's package for acceptance or denial. Since the process is the same for both transfer students and all others, the fact that a student is transferring into NPS is transparent to the Admissions Office.

Upon entry to the Naval Postgraduate School, each student's academic record will be evaluated for possible transfer of credit or for exemption from portions of the curricular program by validation of course work previously completed. Twelve hours of graduate-level courses previously completed may be accepted for transfer credit. These include graduate-level courses taken after completion of the baccalaureate degree and those taken in the last term before award of the baccalaureate and certified to be in excess of degree requirements.

NPS generally allows a maximum of 12 graduate-level quarter-credits to be transferred for purposes of earning a graduate degree. However, an additional 12 quarter-credits may be transferred from the Air Force Institute of Technology (AFIT) in Dayton, Ohio. This is in addition to the normal transfer allowed (12), bringing the total to a maximum of 24 quarter-credits transferable from AFIT to NPS.

Permission to transfer a specific course to serve as a substitute for a degree requirement will be determined by the Department Chairman or equivalent person responsible for nominating candidates for degrees at NPS and must be pre-approved in a coherent plan of study for the student. Regardless of transfer credits allowed, all NPS master's degrees still require at least 20 quarter-credits be earned directly from NPS.

vi. There is no history of transfer engineering student statistics -- NPS does not generally categorize students as transfer students. All students are admitted into graduate degree programs. Some credits may be transferred as described above.

3.7 Programs Offered for Accreditation and Degrees Granted

The five programs to be evaluated and the focus of this accreditation process are the following:

1. MS in Astronautical Engineering
2. MS in Electrical Engineering
3. MS in Mechanical Engineering
4. MS in Systems Engineering
5. MS in Systems Engineering, DL

3.8 Requirements for Graduation

The processes used to certify that graduation requirements complying with Engineering

Accreditation Commission (EAC) criteria have been met by each graduate are within the engineering departments, not at the college and/or university level. Samples of work sheets or check-off sheets used for this purpose are available in each engineering department. Meeting EAC criteria is beyond scope of the general Registrar processes at NPS.

3.9 Information Regarding Administrators

Current summary *curriculum vitae* for the administrative head of the engineering educational unit and associates or assistants who have faculty status or are in responsible charge of a major service unit are provided below.

President Ann E. Rondeau, Ed. D.
Vice Admiral, U. S. Navy, Retired
Naval Postgraduate School
Monterey, California

Retired Vice Adm. Ann E. Rondeau will be appointed as President, Naval Postgraduate School on January 29, 2019. She brings to the assignment an unparalleled record of leadership and achievement within the military and academia in the areas of education, training, research, executive development, change management, and strategic planning. Prior to her appointment, Adm. Rondeau served as the sixth president of the College of DuPage. Her most recent military position was as the President of the National Defense University, a consortium of five colleges and nine research centers in Washington, DC.

Rondeau has extensive leadership experience in significant military and educational roles. In 1985, she was selected and served as a White House Fellow in the Reagan Administration and went on to serve as the Deputy Commander of the U.S. Transportation Command in Illinois, Pentagon Director/Chief of Staff for the U.S. Navy Staff, Commander of the Navy Personnel Development Command in Virginia, Commander of the Naval Service Training Command at Great Lakes, Ill., Pacific Fleet Staff Chief of Staff in Hawaii, Commanding Officer of Naval Support Activity in Tennessee and other staff and commanding responsibilities with policy, support and student service. Rondeau retired from the U.S. Navy as a three-star admiral in 2012 and was the second woman to have achieved that rank in the Navy**.** She then served as a partner and later an independent consultant with the IBM Watson group.

Rondeau holds a B.A. from Eisenhower College (NY), an M.A. from Georgetown University (DC) and an Ed.D. from the College of Education at Northern Illinois University in DeKalb. She also holds an honorary Doctorate in Public Service from Carthage College (Kenosha, WI) and an honorary Doctorate in Humane Letters from Rosalind Franklin University of Medicine and Science (Chicago, IL).

She is proud member of the Arizona State University Flag Officer Advisory Council, the National Museum of the American Sailor Foundation Board of Directors, the Military Advisory Board (under the aegis of Center for Naval Analysis), the Dwight D. Eisenhower Memorial Commission, the Chicago Regional Growth Corporation Board, Choose DuPage Board of Directors, and the Council for Higher Education Accreditation. Additionally, Dr. Rondeau serves on the Executive Board of the U.S. Navy “Education for Seapower Study” —a clean-sheet review of naval learning.

Dr. Steven R. Lerman
Provost, Naval Postgraduate School
Naval Postgraduate School
Monterey, California

Dr. Steven R. Lerman assumed the position of Provost and Academic Dean of the Naval Postgraduate School on August 29, 2016.

Dr. Lerman comes to the Naval Postgraduate School following more than 40 years of experience in higher education, most recently serving as Provost and Executive Vice President of Academic Affairs at The George Washington (GW) University (2010-2015) and A. James Clark Professor of Civil and Environmental Engineering (2010-2016). As Provost, Dr. Lerman was responsible for GW's 10 schools and colleges, athletics (24 Division I varsity sports, club sports and intramurals), the Division of Student Affairs and the University Library. Approximately 4,900 full and part-time faculty and staff report up through these units with a combined budget of $580 million. Dr. Lerman was also responsible for all academic and student life aspects for three GW campuses (Foggy Bottom, Mt. Vernon and the Virginia Science and Technology Campus) as well as at the university's three learning centers.

Prior to GW, Dr. Lerman served as Dean for Graduate Education (2007-2010) and Vice Chancellor (2008-2010), at his alma mater, the Massachusetts Institute of Technology (MIT). In this capacity, Dr. served as the chief deputy to the Chancellor who has responsibility for student affairs, undergraduate education and graduate education.

Dr. Lerman has served as Director of the Center for Educational Computing Initiatives, the research unit of an MIT-wide research center devoted to studying the application of computational and communication technologies on education. He held the Class of 1922 Professorship at MIT, chaired the Faculty Advisory Boards of the MIT OpenCourseWare initiative and Academic Media Production Services, and was Deputy Director of the Singapore-MIT Alliance, MIT's largest distance education program. He served as the Chair of the MIT faculty from 1998 to 2001 and as Associate Chair of the Faculty from 1996 to 1998.

Dr. Lerman is a past Lilly Teaching Fellow, and the recipient of several teaching awards during his time at MIT, including the Maseeh Teaching Award, as well as the Advisor of the Year award through the National Association of Graduate and Professional Students. He has both chaired and served as a member of countless academic, industry and government advisory boards, and has broadly published in his field of transportation systems analysis.

Dr. Lerman received his Bachelor of Science and Master of Science degrees in Civil Engineering, and his Doctorate in Transportation Systems Analysis, from the Massachusetts Institute of Technology.

Dr. Clyde L. Scandrett
Dean, Graduate School of Engineering and Applied Sciences
Naval Postgraduate School
Monterey, CA

Dr. Clyde Scandrett was appointed Dean of the Graduate School of Engineering and Applied Science in December 2014. He is a former chair of the Department of Applied Mathematics (2002-2008) and twice Chair of the Undersea Warfare Academic Group (2000-2002 and 2011-2014).

Dr. Scandrett received his undergraduate degree from the California Institute of Technology in 1976, and received his doctorate in Engineering Sciences and Applied Mathematics from Northwestern University in 1985. His research interests are primarily in the field of wave propagation having several publications in the Journal of the Acoustical Society of America, Wave Motion, and the Journal of Computational Physics. Dr. Scandrett continues his support of the Mine Warfare Community in his involvement with biennial symposia focused on the Mine problem and in editing past proceedings. Prior to his arrival at the Naval Postgraduate School in 1987, Dr. Scandrett also worked for two years as an assistant research scientist at the Supercomputer Computations Research Center at Florida State University.

COLONEL Timothy A. Sands, USAF
Associate Dean, Graduate School of Engineering and Applied Science
Naval Postgraduate School
Monterey, CA

Colonel Timothy Sands is the Associate Dean of the Graduate School of Engineering and Applied Sciences with a faculty appointment at the rank of Associate Professor. The Associate Dean serves the graduate education of more than nine-hundred students in resident & distance-learning programs; managing daily operations of more than two-hundred fifty faculty and staff in seven academic departments; and ensuring safe operations of ninety scientific laboratories including planning and execution of the school's $20M+ annual mission-budget, overseeing externally funded research programs exceeding $35M; and furthermore serving as the senior Air Force officer & liaison on the Navy installation, advising the university President on air force collaboration and students.

Colonel Sands entered active military service in 1993 as program manager for the acquisition of space systems. He later became a career electronic warfare officer and flew combat missions in the B-52 heavy bomber in Serbia, Kosovo, Afghanistan, and Iraq. Dr. Sands served as a weapons officer, an instructor, an evaluator, a professor and researcher, and research center director, associate provost, chief academic officer, and dean. He earned the bachelors, masters, and professional degrees in mechanical engineering from NC State University, Stanford University, and Columbia University respectfully, and the doctorate in astronautical engineering from the Naval Postgraduate School.

Garth V. Hobson
Professor and Chairman
Department of Mechanical and Aerospace Engineering
Naval Postgraduate School
Monterey, CA

Dr. Hobson is a professor and chair in the Department of Mechanical and Aerospace Engineering specializing in experimental and computational turbomachinery problems. He has more than 60 journal and refereed conference publications in this field. His current research interests are in transonic fan and compressor aerodynamics, stall precursors, inlet distortion, cross flow fan propulsion, mini gas turbines for UAV propulsion, transitional flows in compressor cascades, erosion of compressor blades due to sand ingestion, high cycle fatigue and signature suppression. He has been the director of the Turbopropulsion Laboratory since 2005 and had managed a yearly budget of more than $1.0M. He joined the Naval Postgraduate School in 1990 as an associate professor in the Department of Aeronautical and Astronautical Engineering. This after received his PhD in Aerospace Engineering at the Pennsylvania State University in 1989. His thesis was on the Fully Elliptic Calculation of Turbomachinery Flows. Prior to that he worked at the National Institute for Aeronautics and Systems Technology as head of the Aerothermodynamics Group. He oversaw the design of the turbine, or hot section, of a small gas turbine. Prior to that he worked on modification of aircraft exhaust systems for passive countermeasures against heat-seeking missiles. His design using transpiration cooling earned him the Directors award for Innovative Engineering. He received his MSc in Mechanical Engineering (1983) and BSc in Aeronautical Engineering (1979) both from the University of the Witwatersrand, Johannesburg. His Masters thesis was on transpiration cooled boundary layers. Dr Hobson has been a consultant to DENA (Duke Energy).

Ronald E. Giachetti
Professor and Chairman
Department of Systems Engineering
Naval Postgraduate School
Monterey, CA

Dr. Ronald E. Giachetti, is the Chair and Professor of Systems Engineering at the Naval Postgraduate School (NPS) in Monterey, California. He teaches and conducts research in the design of enterprise systems, systems modeling, and system architecture. He has published over 50 technical articles on these topics including a textbook on the *Design of Enterprise Systems: Theory, Methods, and Architecture*.

At the Naval Postgraduate School he leads the systems engineering department consisting of 45 faculty and staff serving 450 students in resident and distance learning programs. In addition to managing the department, he teaches courses in system of systems engineering and system architecture.

He is internationally known for his work in enterprise systems, having lectured in Colombia, Peru, Mexico and other countries, participating in the National Research Foundation of Chile, and as a member of IFAC's technical committee on enterprise integration. Prior to joining NPS, he was an Associate Professor of Industrial and Systems Engineering at Florida International University in Miami, FL. At FIU he developed and led the MS in Information Systems program and actively taught in external programs in Jamaica, Mexico, Colombia, and Peru. He has conducted $1M in externally funded research for the Navy, NSF, US Army, US Air Force, Royal Caribbean Cruise Lines, Carnival Cruise Lines, and other Florida companies. He was a National Research Council postdoctoral researcher in the Manufacturing Systems Integration Division at the National Institute of Standards and Technology (NIST) in Gaithersburg, MD. He earned a Ph.D. in Industrial Engineering from North Carolina State University in Raleigh, NC in 1996; a MS in Manufacturing Engineering from Polytechnic University in Brooklyn, NY in 1993; and a BS in Mechanical Engineering from Rensselaer Polytechnic Institute in Troy, NY in 1990.

Douglas J. Fouts
Professor and Chairman
Department of Electrical and Computer Engineering Naval Postgraduate School
Monterey, CA

Douglas J. Fouts has been the Chair of the Department of Electrical and Computer Engineering since April 1, 2019. Prior to that he served the ECE department as the Associate Chair for Research from September 2017 until April 2019 and as the Associate Chair for Instruction from July 2015 until September 2017. He has been a Professor in the department since 2003, was an Associate Professor from 1996 until 2003, an Assistant Professor from 1990 until 1996, and he has held a secondary appointment in the Space Systems Academic Group since 1991. He has also served as the Naval Postgraduate School Interim Vice President and Dean of Research from January 2012 until Jul 2012 and as the Associate Dean of Research from July 2006 until January 2012. He also worked in industry as a design engineer at Burroughs Corporation (now Unisys) from 1980 to 1983 and at The Aerospace Corporation in 1979. Prof. Fouts received his PhD and MS in Electrical and Computer Engineering from the University of California at Santa Barbara in 1990 and 1984, respectively, and his bachelor's degree in Computer Science from the University of California at Berkeley in 1980. The primary area of teaching and research for Prof. Fouts is Computer Engineering, although he also teaches courses in electronics. Over the years he has been successful at keeping the Computer Engineering courses offered by the department current with rapidly-developing new technology by developing courses in Fault Tolerant Computing (EC4810), VLSI Design (EC4870), Advanced Computer Architecture (EC4820), FPGA Design (EC4830), Embedded Computer Systems (EC3800), and Spacecraft Computing (SS3035). Prof. Fouts has had a very active research program over the years that includes both unclassified and classified work. His current research interests include reconfigurable computing, FPGA design, embedded computer systems, and reverse engineering. His unclassified research has resulted in the publication of over 45 papers in scholarly journals and refereed conferences and he holds 6 US patents. He has advised or co-advised over 100 MSEE theses and PhD dissertations at the NPS. Prof. Fouts received the Menneken Award for Excellence in Scientific Research in 2002, the Outstanding Research Achievement Award for the Department of Electrical and Computer Engineering in 1997, the Outstanding Instructional Performance Award for the Space Systems Academic Group in 1996, and the Outstanding Research Achievement Award for the Space Systems Academic Group in 1993. He is a member of the Institute of Electrical and Electronics Engineers, the American Radio Relay League, and he is a registered professional Electrical Engineer in the state of California. He is also an accomplished trombonist and the Scoutmaster for Boy Scout troop 93.

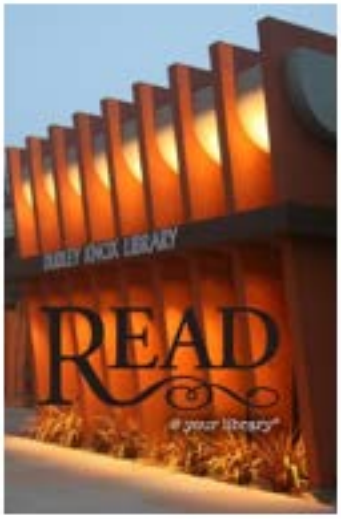
4. Academic Supporting Units

Supporting academic departments that provide required portions of the instruction for engineering students in the programs being evaluated are the Department of Operations Research in the Graduate School of Operational & Information Sciences, the Space Systems Academic Group, the Department of Physics, and the Department of Applied Mathematics, the latter three in GSEAS.

5. Non-Academic Support Units

There are no non-academic support units at NPS that support only the engineering academic programs. All non-academic support units that support academic programs at NPS are consolidated at NPS level.

5.1 Dudley Knox Library (DKL)



5.1.1 Mission:

Dudley Knox Library contributes to learning, research and teaching—anytime, anywhere—through relevant and evolving collections, tools, services, and spaces designed for NPS patrons of today and tomorrow.

5.1.2 Vision:

The Dudley Knox Library is a dynamic and collaborative partner with members of the NPS community that is dedicated to advancing knowledge through integrated resources, responsive services, library instruction, and research assistance. We work together to promote NPS's position as a top-tier graduate-level teaching and research institution that fosters lifelong learning. DKL is a flexible, agile organization that measures and continually assesses our quality, relevance and effectiveness as we support the NPS strategic plan.

5.1.3 Leadership:

Edward M. Corrado is the chief administrative officer and Director of the Dudley Knox Library. His responsibilities include providing vision and leadership for the Library and campus in accordance with and in support of the NPS mission and strategic plan, managing a budget of approximately $5.5 million. Mr. Corrado joined NPS in 2017. Prior to joining the Naval Postgraduate School he was the Associate Dean of Library Technology Planning and Policy and Interim Dean of Special Collections at the University of Alabama. He was also the Director of Library Technology at Binghamton University. His research interests include digital preservation, data management, cloud computing, and reproducibility of library and information science

research. He is the co-author of Digital Preservation for Libraries, Archives, and Museums, which is now in its second edition. He has a Masters of Library Service from Rutgers University and a Bachelor of Arts in Mathematics from Caldwell University.

5.1.4 Scholarly Content:

The Library provides access to a robust suite of eBooks, eJournals and databases plus a core print collection that supports NPS graduate instruction and research needs. DKL provides access to ~86% of the top-ranked engineering and applied science journals based upon *InCites Journal Citation Reports dataset* (updated September 9, 2017). We also provide access to thousands of additional scientific journals covering many disciplines (search here: https://nps.primo.exlibrisgroup.com).

Like other academic libraries, DKL continues to experience high annual subscription price increases for our scholarly content (11.3% annual price increase over 2015-2017 alone). Such increases, coupled with similar increases in databases, software, and personnel costs, makes it increasingly difficult for us to maintain current levels of subscription spending to as many resources as our faculty and students require. In this environment of escalating costs we regularly engage our stakeholders and monitor usage statistics to best leverage our limited resources to support the NPS mission.

We facilitate discovery of engineering and applied science information through subscriptions to a range of specialized and interdisciplinary databases (with and without full-text) including: *Aerospace Research Central (AIAA), American Society of Mechanical Engineers (ASME), IEEE Explore*, INSPEC, *Janes', JSTOR, Meteorological and Geoastrophysical Abstracts, ProQuest, Web of Knowledge*, and many more.

Because no library is an island we routinely provide "just in time" document delivery and interlibrary loan services that rapidly obtain materials for our students and faculty from other academic and federal libraries.

5.1.5 Seamless Access:

The library website (https://library.nps.edu) provides the portal to our information resources as well as a wide range of student- and faculty-academic support services. Over recent years library staff reviewed web analytics, conducted usability studies, and created "personas" of our three key users – resident students, distributed learning (DL) students, and faculty to help us understand our patrons. Armed with this information we comprehensively redesigned our website with a focus on making it "user-centric." The resulting site emphasizes patrons' top activities to simplify their access to information and associated services. We continue to gather feedback and make continuous improvements to the site. Other libraries as well as the team behind the redesign of the NPS institutional website have adapted many of our process and best practices.

In 2017 we launched a cutting-edge, cloud-based, access and discovery system that gives our patrons a more "Google/Google Scholar-like" search experience. A single search box on the library homepage enables users to quickly search across both resources and disciplines to retrieve results from print, online and data sources at the journal or book title level down to the journal article or book chapter level. Putting more resources into the hands of our patrons through this consolidated search helps users rapidly locate appropriate resources and know

which sources are available for more advanced search protocols.

A team of four reference librarians provide the primary reference assistance and instruction services to campus. An additional four librarians also support individual departments and disciplines. We offer drop-in research-related workshops: *Research Quick Start I & II* and *Thesis Quick Start*, as well as visits to classrooms to provide discipline-specific information modules.

5.1.6 Institutional Memory:

Named for NPS's first faculty member, Calhoun, the NPS institutional archive (https://calhoun.nps.edu) is a highly searched and centralized archive of NPS-authored works. Built on open-source software, Calhoun provides worldwide access to more than 55K items including theses and dissertations (dating from the early 1920's); faculty-authored journal articles, book chapters, and technical reports; and institutional publications. Resources have permanent handle-style URLs that are discoverable from Google, Google Scholar and other locations and used for many purposes at and beyond NPS.

FY17 Library Quick Facts

Number	Description
25.5	Library staff FTE
78	Average weekly hours (Sun-Sat); extended hours during finals weeks
695,144	Titles in Library catalog
32,438	Titles in Restricted catalog
589,387	eResources available in Library catalog (books, journals, reports & more)
55,158	NPS-authored eResources in NPS Archive: Calhoun
1,701	NPS-authored eResources in Restricted Collection
12,885	Physical volumes circulated
1,491	Physical course reserves circulated
4,300	Interlibrary loans borrowed from other libraries for NPS users
984	Document delivery from physical collection to NPS users
1,082	Daily visits average to the library building
1,466	Daily visits average for the website
1,642	Daily visits average for NPS Archive: Calhoun
606	Daily visits average for our research guides
22	Daily visits average for Ask a Librarian
807	Daily visits average for our library search*
24,052	Hours students used collaborative study rooms (includes 10,900 hours in technology-equipped rooms)
1,297	Students taking advantage of extended hours during finals
138	Library instruction sessions offered (face-to-face and virtual)
2,881	Students receiving library instruction
176	Hours of library instruction
2,545	Reference questions (from all service points)
23	New resident student library web orientation and tours
960	Students receiving web orientation and tours
260	Student technology help requests
356	Staff technology help requests

In a parallel effort to promote and provide access to NPS-authored works that are "restricted through classified," we created an internal online portal to provide access to NPS restricted theses, dissertations and technical reports from 2001 to present. We also created and continue to curate NPS' presence on classified networks to raise awareness of NPS research efforts.

Both Calhoun and our restricted resources have proven to be extremely well utilized centralized repositories for public access to NPS-authored and institutional content. Ongoing collaborations with the Defense Technical Information Center (DTIC) (http://www.dtic.mil) enriches their databases and provides broader access to NPS-authored scholarly works and associated data.

5.1.7 Peer Comparisons:

Dudley Knox Library provides annual statistical inputs to the Integrated Postsecondary Data System (IPEDS) and the Association of College and Research Libraries (ACRL). This enables us to benchmark our staffing and spending against two groups of peer academic libraries (peer groups defined by NPS: NPS Research Peer Institutions and NPS Peer Institutions). While our library is currently understaffed as compared to peer libraries, our total spending (labor, content and operations) is comparable. Despite our staff vacancies (exacerbated by hiring freezes, recent retirements, and the climbing cost of serials pressuring our relatively level budget), DKL has excellent service to our community as demonstrated through faculty feedback and graduating student surveys.

5.2 Graduate Writing Center (GWC)

5.2.1 Mission:

To develop the writing and critical thinking skills of NPS students for success in graduate school and as military and civilian leaders.

5.2.2 Leadership:

Dr. Sandra Leavitt has been the Director of the Graduate Writing Center and Thesis Processing Office at the Naval Postgraduate School since 2012. With a budget of approximately $1.5 million, she supervises writing coaches and language instructors while providing tutorials and hands-on workshops for resident and distance learning masters and doctoral degree thesis students. She holds the title of research assistant professor with a 2007 doctorate in Comparative Politics and International Relations from Georgetown University.

The GWC provides all new students with an overview of expectations for graduate-level research and writing through its *Foundations of Academic Writing* seminar.

The Graduate Writing Center offers individualized, one-to-one coaching to help NPS students develop the critical thinking, writing, and communication skills necessary for success at NPS and in their future assignments.

Additional GWC services include a rich variety of hands-on workshops, tutorials, online resources, and learning tools to help students advance their critical thinking and develop their academic communication, research, and writing skills.

Workshops are offered in person and many are recorded to provide just-in-time refreshers.

5.3 Thesis Processing Office (TPO)

5.3.1 Mission:

Publish high-quality theses, dissertations, and capstone reports that reflect NPS's commitment to quality, service, academic integrity, and expansion of knowledge.

Thesis processors provide tutorials for using NPS-specific Word and LaTeX templates for the preparation and publication of theses and dissertations. TPO staff work closely with students and their advisors on applying DoD distribution markings, proper attribution, and copy editing to their capstone reports. International students have free editing available to them. Thesis processors

prepare for publication public release as well as restricted through Top Secret theses and dissertations. Thesis Processing also produces *Compilations of Abstracts (COAs)* covering all of NPS and specific academic groups, such as undersea warfare, cybersecurity, and energy. Public release theses and COAs are accessible via the Library's Calhoun repository as well as the Defense Technical Information Center (DTIC), while access to restricted through classified publications is provided through other avenues (including DTIC) for access by authorized individuals.

5.4 Information Technology and Communications Services (ITACS)

5.4.1 Mission:

The Information Technology and Communications Services (ITACS) department provides technological and communications support for the entire voice, video and data infrastructure of NPS. This support encompasses national and international students enrolled in both residential and Distance Learning (DL) programs, all requiring robust and flexible educational delivery systems and research capabilities.

5.4.2 Leadership and organization:

The ITACS department is led by Mr. Joe LoPiccolo, Director, Information Technology and Communications Services and Chief Information Officer, and is comprised of 52 civilian staff, organized as below.

5.4.3 Operations:

5.4.3.1 Client Services: Client Services is made up of Educational Technologies, the Technology Assistance Center, and Classified Computing Programs.

a. The ***Educational Technologies*** team provides campus-wide support of the technology in all NPS' shared learning spaces and audio-visual (AV) systems used in teaching both resident and non-resident students. This includes oversight of 12 computer labs, 8 VTC/Video Tele-Education (VTE) systems, 86 smart classrooms, 21 technology smart conference facilities, 135 software packages and several virtual environments with over 300 virtual machines. Educational Technologies also maintains the Sakai Collaborative Learning Environment (CLE), web-based collaboration, streaming and on-demand video systems, on-campus podcasting, and the robust video tele-education infrastructure including a 60-port Video Bridge.
b. The ***Technology Assistance Center (TAC)*** is the primary means of IT support for students and faculty. The TAC handles the level one, two and three support calls, including hardware support for faculty, staff, resident students, and DL students. In a typical month the TAC will respond to approximately 1,400 phone calls, 300 walk-ins, and 1,000 emails.
c. The ***Classified Computing Program (CCP)*** provides staff and infrastructure to support the operations of the University's three classified networks. Leveraging the expertise found in ITACS' other functional areas, CCP supports classrooms, computer labs, secure video teleconferencing, distance learning, conferences, and seminars in the Sensitive Compartmented Information Facility (SCIF), Systems

Technology Battle Lab (STBL), the Dudley Knox Library, Watkins Hall, and in various auditoria and lecture halls around campus, as needed.

5.4.3.2 Research Computing: Research Computing provides support for High Performance Computing (or HPC, also known as Supercomputing), Linux computing, Machine Learning/Artificial Intelligence, and Big Data/Data Analytics (Hadoop). The HPC Data Center was established in 2009, and currently hosts approximately 400 users (students, faculty, staff, and their collaborators) that are using the computers for teaching and research. As of May 2018, the systems in the HPC datacenter have approximately 5,570 CPU "cores" across 124 servers, and over 3 Petabytes of disk storage. The users of the systems typically are running models and codes that require immense amounts of computing power and storage that would otherwise require them to obtain resources on systems outside of NPS. Several new faculty members have come to NPS in part because of the availability of the NPS Research Computing resources.

5.4.3.3 Resources Management**:** This includes IT Asset Management; Contract Administration; Financial Management; Facilities Management; and Human Resources.

The Development Operations (DevOps) team consists of three primary groups including Application Development, Cyberinfrastructure and Unified Communications:

a. The ***Application Development*** team provides integrated, comprehensive technology solutions that enable NPS to streamline and improve its business processes and practices. This includes the technical implementation of the NPS public web site (www.nps.edu), the NPS Intranet web site, maintenance and administration of over 50 locally developed and commercial web applications, development of new web applications, administration of approximately 310 relational databases on more than 30 instances of database servers (Microsoft SQL Server, Oracle, and MySQL), implementation and maintenance of an academic information data warehouse, implementation and maintenance of a web-based issue tracking and project management system, and implementation and maintenance of web-based collaboration tools, such as an Enterprise Wiki and SharePoint. Examples of major applications that the team supports include the NPS student management system (known as “Python”) and an open source financial management system, Kuali Financial System (KFS). Additionally, the team provides assistance to researchers in the areas of database administration, application administration, and application development.
b. ***Cyberinfrastructure (CI)*** operates five distinct physical networks connecting more than 7,500 wired and wireless edge devices. The largest is the EDU network with a 100 Gigabit per second (Gb/s) connection to the Corporation for Education Network Initiative in California’s (CENIC) Digital California (DC) network backbone for commercial Internet and the High-Performance Research (HPR) networks for Internet2, U.S. Department of Energy’s Energy Sciences Network (ESnet), National Lambdarail (NLR) and other research capabilities. The datacenter houses 335 physical and virtual servers. CI manages the enterprise backup system and is also responsible for the infrastructure for telephone and

network cabling and the physical plant, including construction/remodeling projects across campus.

c. The ***Unified Communications*** team supports all of the e-mail, telephone, VoIP, cell phone, Blackberry and video tele-conferencing communications at NPS.

5.4.3.4 Cybersecurity: The Cybersecurity (CS) team is responsible for securing the networks and data on campus including computer network defense and monitoring, anti-virus and vulnerability management, operating system and application patch management, certification and accreditation of networks and applications, and provides the tools and technologies to find, protect, and react to the unauthorized disclosure of sensitive privacy data on NPS networks. CS provides measures that protect and defend information and information systems by ensuring their confidentiality, integrity, availability, non-repudiation and authentication. This includes Computer Network Defense for intrusion detection, network monitoring, and restoration of information systems.

The team liaises with third parties throughout DoD, DON, the greater academic community, as well as state and local government organizations to maintain currency with the latest cybersecurity and privacy policies, guidelines, threats, and vulnerabilities. Additionally, the team delivers relevant and timely Cybersecurity and Privacy training to the campus user population as well as collaborates with faculty and students on Cybersecurity-relevant Research topics. Recently, the team established an EDU Cybersecurity Operations Center (CSOC) that provides around the clock CS support to the campus and other DoD educational partners including the US Naval Academy, the US Naval War College, and the Defense Language Institute-Foreign Language Center.

5.4.4 Communications Services, Partnerships and Outreach

The IT Strategic Plan, *Enabling the Mission*, informs planning and policy decisions for the department. The Information Technology Council, comprised of representatives from every major academic area as well as a number of administrative departments, acts as the advisory group for planning and implementation of initiatives while under the strategic direction of the IT Executive Council led by the NPS Provost.

Information Technology and Communications Services provides the following campus-wide services, which also support all areas of engineering at NPS:

1 Accounts: 6,054
2 Active Phone Lines: 989 digital; 728 VoIP; 2,059 analog
3 Audio-Conferencing Ports: 24
4 ISDN Video-Conferencing Circuits: 60
5 Video-Conferencing Facilities: 49
6 Video Tele-Education Systems: 8
7 Sixty Port Multipoint Control Unit (MCU)/Video Bridge: 1
8 Multimedia Presentation Systems: 130
9 Backup Data combined: 442.8 terabytes
10 E-Mail Stored: 29.6 terabytes
11 Client E-Mail Quotas—unlimited

12 Client Storage Quotas--unlimited
13 External E-Mail Received: 29,503,038 per year
14 Internet Traffic: 3.1 terabytes per day
15 Network Attached Systems: 5,451
16 Campus Wireless bandwidth—1gigabytes
17 Campus Wireless traffic—2.6 terabytes per day
18 Campus Wired Network—Software Defined Network (1st in DoD)
19 Campus Internet Connection—100 Gigabits—(1st in DoD)
20 Networks: 5
21 User Data: 595.2 terabytes
22 Web Services:

Extranet: page views: 6,850,655 per year

Intranet: page views 1,641,144 per year

Additionally, the Monterey Peninsula Department of Defense Net (DoDNet) provides fiber-optic connectivity from NPS to local DoD assets including the Defense Language Institute-Foreign Language Center and Presidio of Monterey, the Defense Manpower Data Center, Fleet Numerical Meteorology and Oceanography Center, the Naval Research Laboratory Monterey detachment, and the National Weather Service, enabling these properties to abandon commercial leased services and save resultant costs.

5.4.5 Facilities

The following facilities offer support to engineering programs:

- Twenty-nine classrooms, equipped with multimedia projection systems and instructor computers
- Eight video-tele-education classrooms augmented with videoconferencing technology, specialized video display systems, instructor computer, document camera, live streaming and capture technology, microphones, speakers and digital audio-visual routing consoles.
- Fifteen Learning Resource Centers (some specifically used by engineering), which includes secure labs that maintain circuit layout and design software, programming and simulation software; and some with thirty-four computer workstations, a multi-function device, and multi-media system used for classroom-level instruction.

5.4.6 High-Performance computing (HPC)

HPC includes supercomputer systems, storage and archiving systems, Linux-based scientific workstations, visualization systems, high-speed networks, special purpose and experimental systems, and application and systems software needed to make these systems useful. The HPC resources at NPS include the following:

5.4.6.1 HAMMING

Hamming is a general-purpose heterogeneous supercomputer. First installed in 2009 and refreshed several times since, the cluster's name commemorates the internationally renowned mathematician Richard Hamming, who was a Professor of Mathematics at NPS from 1976 until his passing in 1998. With 4270 cores and over 18 Terabytes of available

memory, the Hamming supercomputer is a formidable resource for research needs and classroom use alike. Ten of Hamming's 81 compute nodes also feature GPUs for appropriate applications, and a large curated collection of proprietary and open-source software is available.

5.4.6.2 GRACE

Grace is a cluster for "big data" research using the Hadoop distributed filesystem and Spark in-memory processing system. First installed in 2015, this subsystem is named after RDML Grace Hopper, a pioneer in computer science and information theory whose significance to the US Navy and her field will be remembered for generations. Whereas Hamming is suited for simulations, where code on multiple machines can "pull in" data as needed, Grace's model is the opposite: the code is deployed to the data, which is stored across multiple compute nodes, for processing "in place." These intermediate results can then be combined incrementally to give research insights. This model makes Grace suited for real-world data sets that are too large for processing directly.

5.4.6.3 MASERATI

Maserati is a fast data transfer point, connected directly to the CENIC research network. Maserati is a data transfer node (DTN) connected via a 100Gb/s link, and participates in the Pacific Research Platform. This network is especially useful for researchers who want to share data with colleagues at other institutions along the west coast, including California universities, Department of Defense research laboratories, and Department of Energy computing facilities.

5.4.6.4 BOWDITCH

Bowditch is a platform for "cloud-native" computing applications. The system is named after the mathematician Nathaniel Bowditch, whose work in navigation is still important to navies and sailors today over 200 years after his death. Bowditch is a generic "container" platform, using some of the same tools that power the likes of Google and Amazon. Resources already developed on Hamming or Grace can be accessed from Bowditch using the unified high-speed cluster network or deployed to cloud services such as Amazon Web Services (AWS) when more scalability is needed. Still under development, Bowditch will be used for applications such as neural network training, artificial intelligence, and machine learning.

5.4.6.5 EXISTING USE

The current user base consists of over 400 users from over a dozen departments, institutes and academic groups, and includes NPS faculty, students, distance learning students, and partner institutions (e.g. Naval Academy, NRL, AFRL). Workloads include weather forecasting, arctic ice prediction, turbo-propulsion modeling, digital forensics, image recognition, and many other topics related to the DoD mission.

5.4.6.6 Classified HPC

Although this is currently outside the scope of the current use of HPC resources, our users have expressed a strong desire to have similar HPC resources available on the classified side. This is an important area for further investigation and consideration.

6. Credit Unit

NPS courses are listed with two numbers in parentheses separated by a hyphen, which indicate the hours of instruction per week in the classroom and in the laboratory respectively. When calculating quarter-hours for the credit value of the course, laboratory hours are assigned half the value shown. Thus, a (3-2) course, having three hours of lecture and two hours of laboratory, will be assigned a credit of four quarter hours.

NPS operates year round, with four twelve-week quarters. Included in each quarter are final examinations and an enrichment week.

6.1 Course Credit for Master's Thesis Work

Credit hours of 0 lectures, 8 laboratories (0-8) will be granted for each thesis slot registered for provided it is on the student's course matrix. Thesis credit shall be graded pass/fail, thus it is not used in computation of the student's QPRs.

6.2 Credit Hour Policy

A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that reasonably approximates not less than:

6.2.1 One hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or

6.2.2 At least an equivalent amount of work as required in paragraph (1) of this definition for other academic activities as established by NPS, including laboratory work, internships, practica, and other academic work leading to the award of credit hours.

7. Tables

Table D-1 (Part 1). Program Enrollment and Degree Data

Engineering Education Unit as a Whole (GSEAS- w/ SEA 308 program)

Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
		1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
2019	FT							425		0		
	PT							392		0		
2018	FT							369		0	177	8
	PT							430		0	228	1
2017	FT							403		0	167	12
	PT							529		0	237	0
2016	FT							441		0	174	11
	PT							563		0	247	0
2015	FT							402		0	187	7
	PT							517		0	200	0
2014	FT							457		0	202	13
	PT							530		0	244	2

Note:

Shaded areas are not applicable.

All enrollment data is from the fall term of each academic year.

(Return to Educational Unit Overview)

Table D-1 (Part 2). Program Enrollment and Degree Data

Astronautical Engineering

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
2019		FT							17		0		
		PT							2		0		
2018		FT							0		0	2	0
		PT							8		0	6	0
2017		FT							0		0	0	0
		PT							0		0	0	0
2016		FT							0		0	0	0
		PT							10		0	10	0
2015		FT							0		0	0	0
		PT							17		0	11	0
2014		FT							0		0	0	0
		PT							17		0	12	0

Shaded areas are not applicable.
All enrollment data is from the fall term of each academic year.

Table D-1 (Part 3). Program Enrollment and Degree Data

Electrical Engineering

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
2019		FT							71		0		
		PT							78		0		
2018		FT							60		0	28	0
		PT							63		0	30	0
2017		FT							56		0	28	0
		PT							100		0	48	0
2016		FT							57		0	25	0
		PT							123		0	42	0
2015		FT							66		0	28	2
		PT							74		0	20	0
2014		FT							79		0	39	4
		PT							61		0	27	0

Note:

Shaded areas are not applicable.
All enrollment data is from the fall term of each academic year.

Table D-1 (Part 4). Program Enrollment and Degree Data

Mechanical Engineering

Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
		1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
2019	FT							50		0		
	PT							55		0		
2018	FT							55		0	28	1
	PT							65		0	9	0
2017	FT							63		0	34	1
	PT							67		0	8	0
2016	FT							64		0	27	1
	PT							65		0	13	0
2015	FT							50		0	29	0
	PT							70		0	12	0
2014	FT							68		0	35	2
	PT							101		0	10	0

Note:

Shaded areas are not applicable.
All enrollment data is from the fall term of each academic year.

Table D-1 (Part 5). Program Enrollment and Degree Data

Systems Engineering (Resident)

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
2019		FT							87		0		
		PT											
2018		FT							75		0	37	2
		PT											
2017		FT							85		0	36	0
		PT											
2016		FT							91		0	35	4
		PT											
2015		FT							93		0	43	0
		PT											
2014		FT							108		0	43	0
		PT											

Note:

Shaded areas are not applicable.
All enrollment data is from the fall term of each academic year.

Table D-1 (Part 6). Program Enrollment and Degree Data

Systems Engineering (DL)

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
2019		FT											
		PT							254		0		
2018		FT											
		PT							271		0	164	0
2017		FT											
		PT							335		0	163	0
2016		FT											
		PT							353		0	159	0
2015		FT											
		PT							326		0	138	0
2014		FT											
		PT							323		0	162	0

Shaded areas are not applicable.
All enrollment data is from the fall term of each academic year.

(Return to Education Unit d. Program Enrollment and Degree Data)

Table D-2 (Part 1). Personnel

Department of Electrical and Computer Engineering

Year: 2019

	HEAD COUNT		FTE
	FT	PT	
Administrative[1]	1	.75	1.75
Faculty (tenure-track)[2]	18	2.25	20.25
Research Assistant/Associate/Full Professors	2	0	2
Lecturers, Sr. Lecturers, & Prof. of Practice	2	0	2
Technicians/Specialists	5	0	5
Office/Clerical Employees	2	0	2
Faculty Associates – Research	4	0	4

[1]Department Chair, 0.25 FTE for Associate Chair Fargues, 0.25 FTE for Associate Chair Kragh, and 0.25 for Associate Chair (Fouts)
[2]Excludes Department Chair and 0.75 FTE each for tenured Professor Fargues, Kragh, and Fouts

Table D-2 (Part 2). Personnel

Department of Mechanical and Aerospace Engineering

Year: 2019

	HEAD COUNT		FTE
	FT	PT	
Administrative[1]	1	0	1
Faculty (tenure-track)[2]	13	0	13
Research Assistant/Associate/Full Professors	12	0	12
Lecturers, Sr. Lecturers, & Prof. of Practice	4	1	5
Technicians/Specialists	5	0	5
Office/Clerical Employees	2	0	2
Faculty Associates – Research or LSS[3]	4	0	4

[1]Department Chair
[2]Excludes Department Chair
[3]Learning Support Systems

Table D-2 (Part 3). Personnel

Department of Systems Engineering

Year: 2019

	HEAD COUNT		FTE
	FT	PT	
Administrative[1]	2	0	2
Faculty (tenure-track)[2]	13	0	13
Research Assistant/Associate/Full Professors	0	0	0
Lecturers, Sr. Lecturers, & Prof. of Practice[3]	17	0	17
Technicians/Specialists	2	0	2
Office/Clerical Employees	3	0	3
Faculty Associates – Research or Education	6	0	6

[1]Includes Department Chair & Associate Chair for Distributed Programs & Outreach - Owen.
[2]Excludes Department Chair
[3]Excludes Associate Chair for Distributed Programs & Outreach - Owen.

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