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# Theory Applied—Experience Tours at the Naval Postgraduate School

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The Operations Research Department at the Naval Postgraduate School (NPS) in Monterey, California educates analysts who are fully capable of conducting independent analytical studies of military problems. Significant to this education is an opportunity to apply theory from the classroom to a problem from the real world. Halfway through the two year program, each student is encouraged to participate in a three to six week experience tour at a Department of Defense (DoD) analytical organization. During this tour students obtain hands-on experience working military operations research problems alongside experienced analysts. They also identify a thesis topic for follow-on research when they return to the NPS. Faculty members supervise the students' thesis research during the remainder of their time in Monterey. The theses are more than just a graduation requirement, some result in publications in refereed journals and most solve pressing problems for the DoD. We recognize that the unique set of circumstances here at NPS makes this all possible but hold strongly to the idea that applied experience is essential to our graduates and that aspects of our program are exportable to civilian universities.

*Key words:* experience tour; thesis; developing analytical skills; teaching with projects

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## Introduction

The Operations Research (OR) Department at the Naval Postgraduate School (NPS) in Monterey, California provides its students with an opportunity to apply theory from the classroom to a problem from the real world. After completing core coursework, each student has the opportunity to participate in an experience tour at a Department of Defense (DoD) analytical organization. The students then spend the remainder of their time at NPS in advanced coursework and thesis research under the direct supervision of a faculty member. This combination of an experience tour with a thesis helps the student understand how to conduct independent analytical studies of military problems, provides low-cost support to the analytical organizations, and enhances faculty ties to the military analytical community. It also reveals how much OR the student has learned—a morale booster after more than a year in the classroom.

## OR at NPS

The NPS provides graduate level education to military officers from the nation's four uniformed services, international partner countries, and government civilians. The school was founded in Annapolis,

Maryland in 1909 as a postgraduate department of the United States Naval Academy. NPS moved to its current home in Monterey at the end of 1951. The OR program was established after the move to California with an initial class of nine students. Today the OR department has some 120 students enrolled in programs that lead to a Masters' of Science in Operations Research. Distinguished alumni include the former Chairman of the Joint Chiefs of Staff, Admiral Mike Mullen, Lieutenant General Ricardo Sanchez, former Secretary of the Air Force Secretary James Roche, and Singapore's Chief Defence Scientist Pao Chuen Lui.

The curriculum in the OR department consists of eight quarters of course work, four courses per quarter. A student must complete the core course requirements in the first five quarters. The experience tour follows the completion of the core and starts the thesis. Each student completes a masters' thesis and advanced coursework in the remaining three quarters. It is essential that our graduates depart NPS not only with a strong theoretical grounding in OR, but also with experience in solving real problems. Many of our graduates will move directly into positions of responsibility in which they will be viewed as the subject matter experts in analysis. They will not have time for on the job training.

## Core Coursework

The majority of students in the OR department are U.S. military officers in the operations analysis (OA) curriculum, so we restrict the discussion to this major. Each student arrives at NPS some three to fifteen years after undergraduate education. Each brings a wide range of experiences; many have served in combat, some have commanded units, all have an understanding of their services' missions. Because of the long break from academia, most will undergo a refresher quarter, reviewing discrete mathematics, calculus, and matrix algebra. The next five quarters provide the core courses of the program. The core includes a broad range of traditional OR courses: probability, statistics, stochastic processes, optimization, computational methods, simulation, and decision theory. Unique to NPS, the core also includes military OR courses in combat modeling, joint campaign analysis, and search theory. Each student also participates in a twice monthly held seminar, during which faculty and visiting speakers present their research efforts, potential thesis topics, and experience tour options. Attendance is required for all students until they have obtained a thesis advisor with an approved topic.

## Experience Tour and Thesis

The fifth quarter in the OR department is unique at NPS; OA students take two accelerated courses for the first half of the quarter and then spend the next three to six weeks at their experience tour. During the experience tour, the student works with senior decision makers, analysts, and engineers from the host organization on a wide range of projects, isolates a problem appropriate for a thesis topic, and obtains other information necessary to solve the problem back at NPS. A wide variety of experience tours are available to the students but broadly fall into four categories. First, some students arrange for the experience tour themselves. Students arrive at NPS with extensive operational experience and frequently identify a potential thesis topic based on these experiences during their core coursework. These students then use their military contacts, and sometimes those of faculty, to arrange an appropriate tour. Second, some experience tours are based on long-standing relationships between the department and various analytical agencies. One such relationship is with the Johns Hopkins University Applied Physics Lab (JHU APL) in Baltimore, Maryland. The NPS has sent students to JHU APL for several decades. Third, some tours are based on the students' anticipated future assignment. Many DoD analytical agencies will receive NPS graduates in their follow-on assignment and these agencies "audition" students during their experience tour.

The experience is not entirely one-sided; the students also have the opportunity to determine if they want to pursue an assignment to the agency after graduation. Many students that do will continue to work on thesis related projects post graduation. Fourth, some tours are based on faculty members' research efforts. Tenured faculty at NPS are required, at a minimum, to obtain one quarter of funding from external sponsors. NPS faculty conduct DoD sponsored research for a wide range of organizations and frequently send students they advise to these organizations in order to develop a thesis topic that supports their broader research efforts. A wise student remains in contact with their advisor throughout the tour, discussing the feasibility of potential thesis topics, data requirements, and other issues necessary to ensure that the student returns to NPS with a well-defined, scoped thesis topic that can be completed in the student's remaining two quarters. After returning to NPS, each student splits their time between upper level OR courses (with electives in direct support of their thesis) and thesis research. When possible, students will return to the analytical agency that supported their tour to brief the results of their thesis.

Funding for the experience tour comes from several sources. The Navy and Marine Corps provide experience tour funding for many of their officers in the OR department. The analytical organizations that host students often fund the students directly. Faculty members also fund students whose theses directly support some aspect of their own research. The department will, as a measure of last resort, provide money for students who have not obtained funding for their experience tour.

## Faculty Involvement

The fifty faculty in the OR department play a significant role in a student's experience tour and thesis. Every student must complete a thesis to graduate, so, on average, each faculty member needs to support two–three students per year. There is no written requirement for faculty to support a minimum number of students, but several factors encourage the faculty to take on students. First, the culture in the department places significant value on the thesis experience—it is part of what makes the NPS OR experience unique and the faculty believes it is a critical element in the education of our students. Second, advising military officers on military OR theses broadens the understanding of a predominantly civilian faculty. A twenty-six year old assistant professor fresh out of his Ph.D. program advising a forty-year old Navy Commander offers a win–win opportunity for both. The officer, with years of military experience, but far removed from his undergraduate studies, benefits from the current knowledge of the assistant

professor, and the assistant professor, with little to no past interaction with the military, gains a better understanding of some aspect of the Navy. Third, the quality and number of advised theses are considered in promotion and tenure decisions. Fourth, strong students can and do contribute to a faculty member's research, resulting in journal articles and additional research funding. Some former students, years after graduation and in senior positions for the military, have turned to their former professors with funding for research. Distinguished Professor Jerry Brown is known to advise new faculty, "Take good care of your students, they deserve it, and eventually you'll be working for one of them." Dr. Brown speaks from experience—he taught then Commander Mullen linear programming in 1984.

### Exportability

The experience tour and thesis process in the OR department is possible only because of the unique nature of our students and our school. Nonetheless, aspects of the process could be applied in civilian universities to provide students, both graduate and undergraduate, with invaluable applied experience before leaving academia and entering industry. Several reproducible conditions exist at NPS that make our students' experience possible. First, the faculty recognizes and embraces the value of applied work. This appreciation for the applied permeates the entire school and has created a culture that makes

the experience tour and thesis our main effort in the department. Our current chairman reads and evaluates every thesis! Without this culture, the process would not work. Second, we have established over the years strong working relationships with our "industry," i.e., the DoD analytical community. These efforts have taken time and effort, and continue to require our attention but provide invaluable access for both our students and faculty. Third, we provide students the time necessary to experience the "real world" and solve their problem. This comes at a significant cost. The students miss the opportunity to take additional courses because of the time away at the experience tour and the thesis research hours at NPS. We consider the benefits to greatly exceed the costs.

### Conclusions

The experience tour and thesis process in the OR department at NPS provides our students with an opportunity to apply their knowledge to a real-world military problem, provides low-cost support to various DoD organizations, provides our civilian faculty with valuable military experience, generates funding streams for research, and occasionally lands one of our graduates a plum assignment. We recognize that the unique set of circumstances here at NPS makes this all possible but hold strongly to the idea that applied experience is essential to our graduates and that aspects of our process are exportable to civilian universities.