



NAVAL  
POSTGRADUATE  
SCHOOL

# **Educating Military Operations Research Practitioners**

*Real decisions, real outcomes, global impact*

Professors Ron Fricker & Rob Dell  
IFORS  
17 July 2014

The Nation's Premiere Defense Research University

Monterey, California  
[WWW.NPS.EDU](http://WWW.NPS.EDU)



# UPS George D. Smith Prize

- Created to strengthen ties between industry and schools of higher education
- Prize awarded for effective and innovative preparation of students to be good OR practitioners
- Also intended to encourage sharing of best practices among academic programs
- NPS awarded Smith Prize in 2013





# Naval Postgraduate School (NPS)



- 81 master's and 16 doctoral degree programs
- \$294 million revenue (29% direct Navy funds) in 2013
- 719 faculty
- 1,633 resident students includes 250 international from 49 countries
- 1,271 distributed learning degree (and certificate) students

*“The best and the brightest military officers from the United States and around the world come to the Naval Postgraduate School in Monterey, California to work with world-class faculty on real military and defense problems.”*

President George H.W. Bush



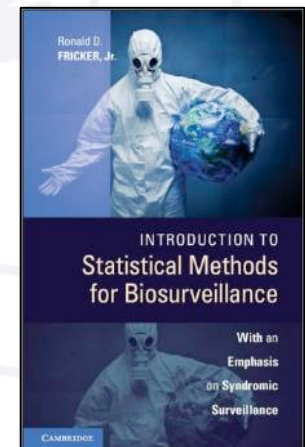
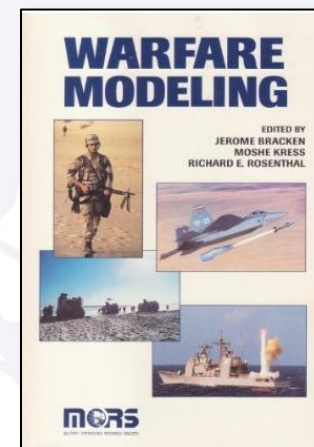
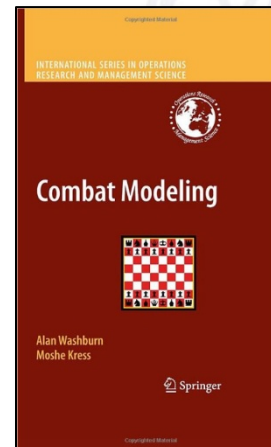
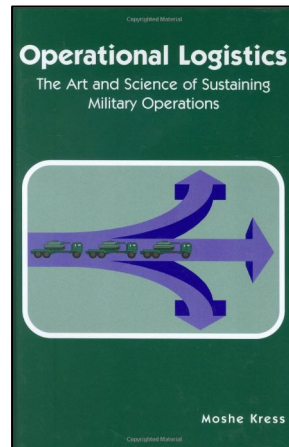
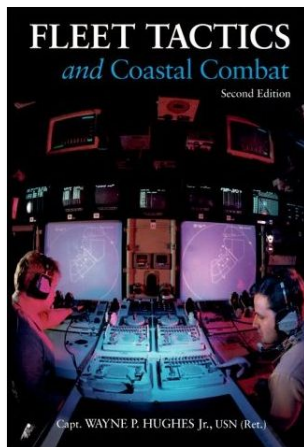


- Oldest OR instructional program in the US (started in 1951)
- One of the largest with 50 faculty:
  - 22 tenured / tenure track professors
    - 7 full, 10 associate, 5 assistant
    - 3 National Academy of Engineering members
  - 19 non-tenure track
  - 9 military faculty: USN, USA, USMC
- 120 resident graduate students
  - US Navy, Marines, Army and 15 international officers



- Faculty deeply involved in and committed to solving urgent defense problems
  - Work synergistically with operationally-current thesis students
  - Sustained reimbursable research relationships with defense sponsors (~\$10M in FY13)
- Selected research sponsors
  - Office of Naval Research
  - Air Force Office of Scientific Research
  - Army Research Office
  - Navy, Air Force, Army, Marines, Coast Guard
  - Military Sealift Command
  - Defense Threat Reduction Agency

- Wargaming and campaign analysis
- Logistics & inventory management
- Force structure planning, evaluation, and analysis
- Cost estimation and human systems integration
- Human capital modeling and analysis
- Test and evaluation; simulation
- Data science & data analytics





- The Tenth Rothkopf Rankings of Universities' Contributions to the 'INFORMS Practice' Literature
  - 2013 article in OR journal *Interfaces*
  - Measures contributions to the practice of OR
- NPS OR in first place in last two rankings
  - Consistent performance:
    - “...for US universities the Naval Postgraduate School takes the top ranking for visibility and second for yield...”
    - “...among all US universities, only the Naval Postgraduate School has ranked in the top-six for all of the rankings since 2002.”



# NPS Officer-Students







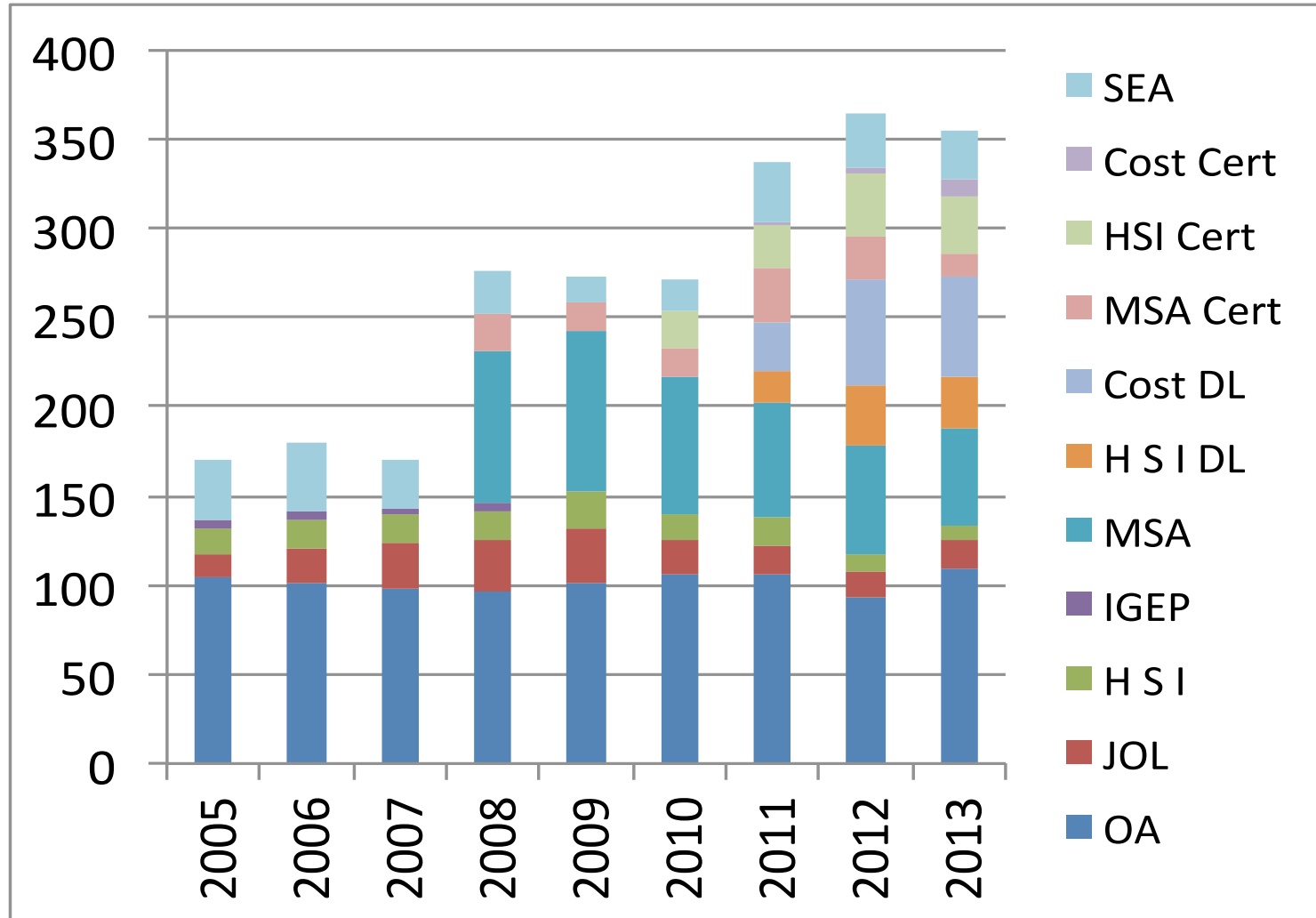
# Military Career with NPS MSOR

- Age 18-21
  - Decision to join the military
- Age 21-28
  - Two or three tours flying aircraft, driving ships, commanding troops
  - > \$3 Million dollar investment
- Age 28-30
  - NPS MSOR student
- Age 30-retirement
  - Tours as OR analyst mixed with more tours flying aircraft, driving ships, commanding troops

U.S. NAVY OFFICER RANKS					
GRADE	RANK	ABBREVIATION	COLLAR INSIGNIA	DESCRIPTION	SLEEVE / SHOULDER BOARD INSIGNIA
O-1	ENSIGN	ENS		1 GOLD BAR	
O-2	LIEUTENANT JUNIOR GRADE	LTJG		1 SILVER BAR	
O-3	LIEUTENANT	LT		2 SILVER BARS	
O-4	LIEUTENANT COMMANDER	LCDR		1 GOLD OAK LEAF	
O-5	COMMANDER	CDR		1 SILVER OAK LEAF	
O-6	CAPTAIN	CAPT		1 SILVER SPREAD EAGLE	
O-7	REAR ADMIRAL LOWER HALF	RDML		1 SILVER STAR	
O-8	REAR ADMIRAL UPPER HALF	RADM		2 SILVER STARS	
O-9	VICE ADMIRAL	VADM		3 SILVER STARS	
O-10	ADMIRAL	ADM		4 SILVER STARS	
O-11	FLEET ADMIRAL	FADM		5 SILVER STARS	

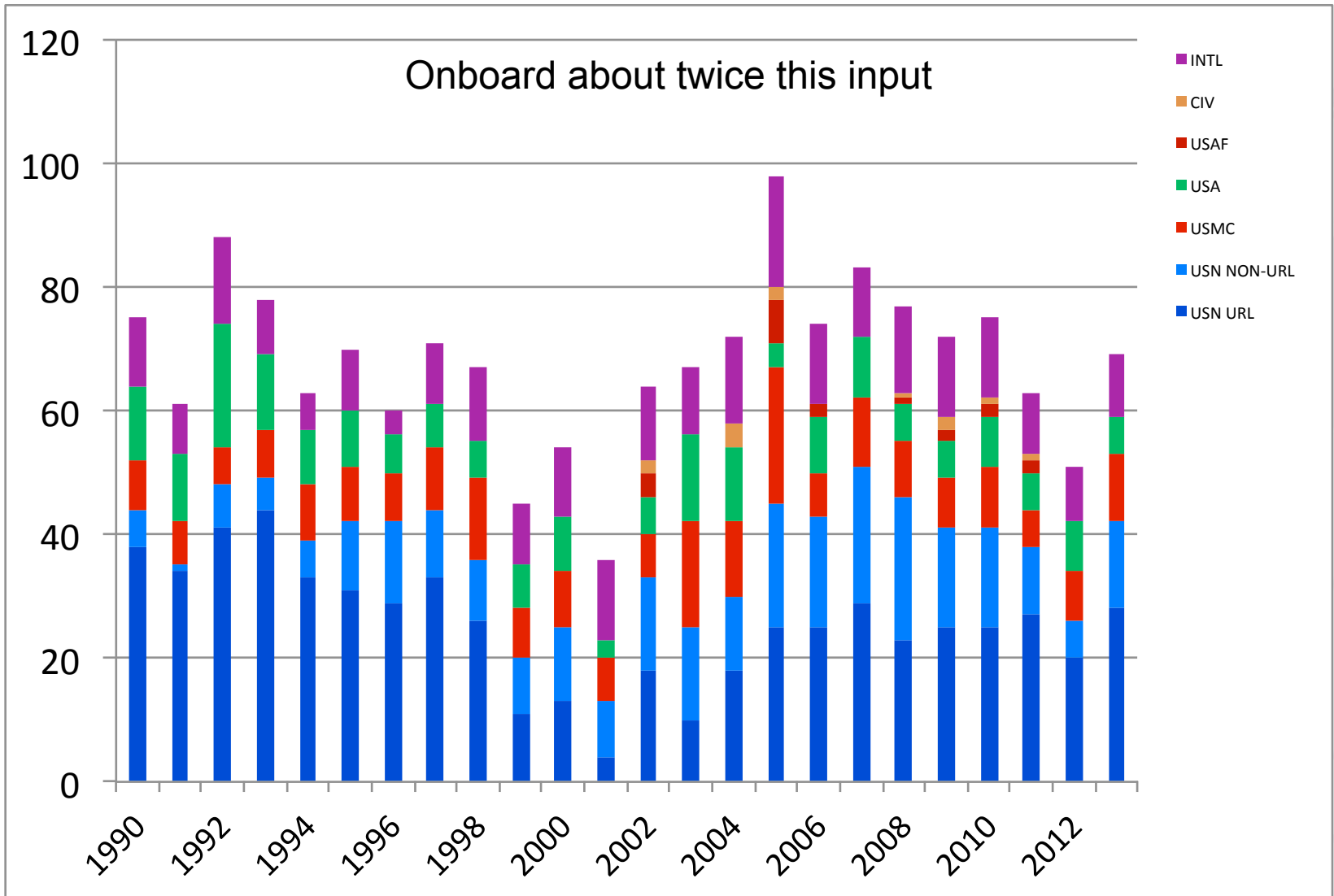


# OR Department Total Students





# OR Resident Student Input by Service



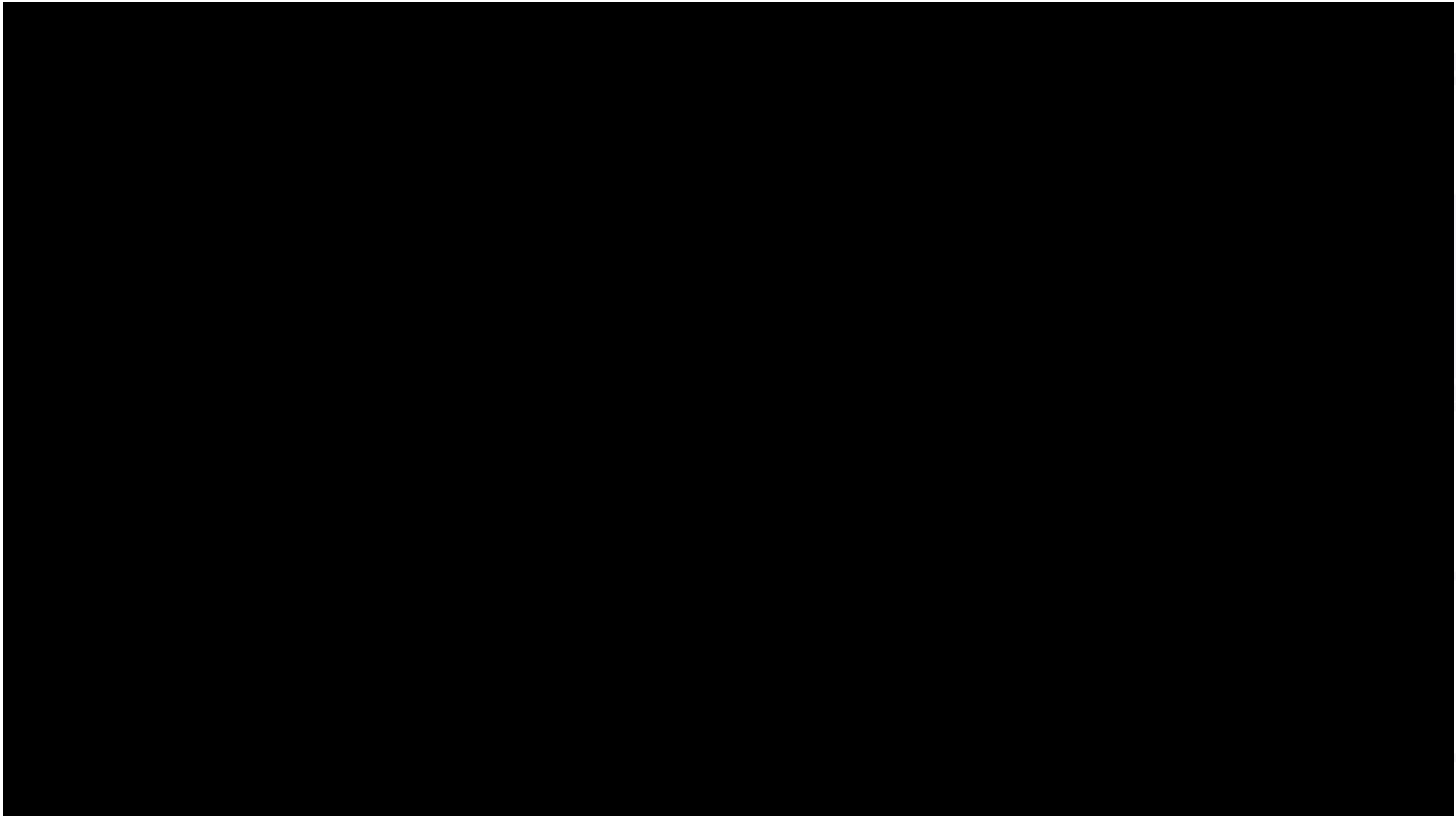


# Officer-Students & Research





# Officer-Students & Research





# NPS MSOR Degree Program

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Q1	MA 3042 (4-0) Linear Algebra	MA 1118 (4-0) Multivariable Calculus	OA 3101 (4-1) Probability	OA 2801 (4-1) Computational Methods for OR	OA 2900 (1-0) Workshop
Q2	OA 3201 (4-0) Linear Programming	OA 3102 (4-2) Statistics	OA 3301 (4-0) Stochastic Models I	OA3304 (4-0) Decision Theory	OA 2900 (1-0) Workshop
Q3	OA 4202 (4-0) Network Flows and Graphs	OA 3103 (4-1) Data Analysis	OA 4301 (4-0) Stochastic Models II	OA 3302 (4-0) Simulation Modeling	OA 2900 (1-0) Workshop
Q4	OA 4201 (4-0) Nonlinear Programming	OA 4106 (3-1) Advanced Data Analysis	OA 4702 (4-0) Cost Estimation	OA 4333 (4-0) Simulation Analysis	OA 2900 (1-0) Workshop
Q5a	OA 4655 (4-0) Joint Combat Modeling	OA 4801 (3-2) Spreadsheet Modeling for MOR	OA 3602 (4-0) Search Theory and Detection		
Q5b	OA 3900 (5-0) Experience Tour				
Q6	OA 0810 (0-8) Thesis Research	OA 4656 (4-0) Studies in Defense and Military OR	OA 4602 (4-0) Joint Campaign Analysis	NW 3230 (4-2) Strategy and Policy	
Q7	OA 0810 (0-8) Thesis Research	OA 4XXX Elective (4-0)	OA 4910 (4-0) HF case studies in OR	NW 3275 (4-0) Joint Maritime Operations I	
Q8	OA 0810 (0-8) Thesis Research	OA 4XXX Elective (4-0)	NW 3285 (4-0) National Security	NW 3276 (4-0) Joint Maritime Operations II	



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**OA 3201 (4-0) Linear Programming**

**OA 4202 (4-0) Network Flows and Graphs**

**OA 4201 (4-0) Nonlinear Programming**

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**OA 3102 (4-2)  
Statistics**

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**OA 3103 (4-1) Data  
Analysis**

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**OA 4106 (3-1)  
Advanced Data  
Analysis**

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# Stochastic Models

**OA 3301 (4-0)  
Stochastic Models I**

**OA 4301 (4-0)  
Stochastic Models II**

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**OA 3302 (4-0)  
Simulation Modeling**

**OA 4333 (4-0)  
Simulation Analysis**

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		<b>OA 4655 (4-0) Joint Combat Modeling</b>
<b>OA 4702 (4-0) Cost Estimation</b>	<b>OA 4801 (3-2) Spreadsheet Modeling for MOR</b>	<b>OA 3602 (4-0) Search Theory and Detection</b>

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<b>NW 3230 (4-2) Strategy and Policy</b>	<b>OA 4656 (4-0) Studies in Defense and Military OR</b>
<b>OA 4910 (4-0) HF case studies in OR</b>	<b>NW 3275 (4-0) Joint Maritime Operations</b>
<b>NW 3285 (4-0) National Security</b>	<b>OA 4602 (4-0) Joint Campaign Analysis</b>
	<b>NW 3276 (2-2) Joint Maritime Operations</b>



Jeff Kline – 2011 INFORMS Prize for teaching of OR/MS Practice

“I found the course not only academically relevant, but also applicable to the current joint operational environment.”

Major Christopher Bachl

“Specifically, he teaches how to bridge the gap between what is analytically interesting and what matters to military decision makers.”

Commander Harrison Schramm

“The JCA class was first and foremost about practical application. Captain Kline used case studies to illustrate the usefulness of nearly all of the tools that we had learned in our previous coursework.”

Commander Daniel Pfeiff



# Individual Thesis

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## OA 2900 – Thesis Preparation

- Introduce students to potential thesis topics
  - ✓ Outside organizations
  - ✓ Graduating students
  - ✓ Faculty
- Introduce writing and communication rubrics

### *Thesis Preparation*

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## OA 3900 – Experience Tour & Research

Selected locations:

- US Marine Corps, Quantico, VA
- US Pacific Command, Honolulu, HI
- US Africa Command, Stuttgart, Germany
- Naval Air Station Fallon, Fallon, NV
- Naval Support Activity, Panama City, FL
- San Diego Naval Medical Center
- US Navy Air Systems Command, Pax River, MD
- Commander Naval Forces, San Diego, CA
- Naval Supply System Command, Mechanicsburg, PA
- Pentagon, Washington DC
- USS JASON DUNHAM, Dubai, UAE
- Naval War College, Newport, RI
- Center for Army Analysis, Ft. Belvoir, VA

### *Thesis Research*

Ref	MA 1113 (4.0) Single Variable Calculus	MA 1114 (4.0) Single Variable Calculus II	MA 1025(4.0) Finite Math	OA 1600 (2-2) Introduction to Operations Research	
01	MA 3042 (4.0) Linear Algebra	MA 1118 (4.0) Multivariable Calculus	OA 3101 (4-1) Probability	OA 2801 (4-1) Computational Methods for OR	OA 2900 (1.0) Workshop
02	OA 3201 (4.0) Linear Programming	OA 3102 (4-2) Statistics	OA 3301 (4.0) Stochastic Models I	OA3304 (4.0) Decision Theory	OA 2900 (1.0) Workshop
03	OA 4202 (4.0) Network Flows and Graphs	OA 3103 (4-1) Data Analysis	OA 4301 (4.0) Stochastic Models II	OA 3302 (4.0) Simulation Modeling	OA 2900 (1.0) Workshop
04	OA 4201 (4.0) Nonlinear Programming	OA 4106 (3-1) Advanced Data Analysis	OA 4702 (4.0) Cost Estimation	OA 4333 (4.0) Simulation Analysis	OA 2900 (1.0) Workshop
05a	OA 4655 (4.0) Joint Combat Modeling	OA 4801 (3-2) Spreadsheet Modeling for MOR	OA 3602 (4.0) Search Theory and Detection		
05b	OA 3900 (5.0) Experience Tour				
06	OA 0810 (0-8) Thesis Research	OA 4656 (4.0) Studies in Defense and Military OR	OA 4602 (4.0) Joint Campaign Analysis	NW 3230 (4-2) Strategy and Policy	
07	OA 0810 (0-8) Thesis Research	OA 4XXX Elective (4.0)	OA 4910 (4.0) HF case studies in OR	NW 3275 (4.0) Joint Maritime Operations I	
08	OA 0810 (0-8) Thesis Research	OA 4XXX Elective (4.0)	NW 3285 (4.0) National Security	NW 3276 (4.0) Joint Maritime Operations II	



# A Few Recent Theses

**LCDR J. Ryan McLaughlin, USN:** *“Optimizing Adversary Training and the Structure of the Navy Adversary Fleet”*

- demonstrates how to provide better training and save hundreds of millions of dollars over 20 years

**LT Robert Floyd, USN:** *“Scheduling USCG Atlantic Area Cutters”*

- improves use of area cutters and saves time developing schedules

**MAJ Peter Nesbitt, USA:** *“Delaying a Nuclear Proliferator: Interdicting Combined Social Network and Project Management Models”*

- new theory motivated by classified research

**LCDR Walter Kulzy, USN:** *“Modeling and Evaluating Indigenous Populations’ Support for their Government and Life Satisfaction”*

- assists U.S. Africa Command make investment decisions

**Maj Michael K. Chankij, USMC:** *“Assessing Resiliency of the JP-8 Distribution System on Guam (U)”*

- classified thesis used to guide investment

**LT Leslie A. Sloodmaker, USN:** *“Countering Piracy with the Next Generation Piracy Performance Surface Model”*

- generated improvements to an existing model

**Cpt Maro D. Enoka, USMC:** *“Optimizing Marine Security Guard Assignments”*

- improves use of USMC guards and saves time developing assignments



- NPS OR degree programs reviewed every two years by military sponsors
  - Two day on-site session that evaluates and assesses all facets of the program
    - Assessment and validation of sponsor and other Navy stakeholder requirements
    - Review of current educational goals and degree requirements
    - Evaluation of the design and execution of the existing curriculum
  - Intended to ensure rigor, applicability, and most especially program relevancy
  - Informed by surveys of graduates and surveys of their supervisors



## Over 4,300 graduates including:

**"I think that the operations research curriculum that I went through is one that's very relevant to what we do in the Navy. ...I've used it in three significant tours in the Pentagon. I've also used it at sea and war fighting. What the curriculum taught me to do was to properly frame a problem, ask the right questions, to assess risk and to move on from there."**

--Admiral Michael G. Mullen, USN  
17th Chairman, Joint Chiefs of Staff  
NPS OR M.S. '85



**"Humanitarian assistance, disaster relief, communications, asymmetric warfare – whatever challenge you are facing can be successfully approached and analyzed using OR methods."**

--Rear Admiral Sinclair Harris, USN  
Vice Director for Operations  
Joint Chiefs of Staff  
NPS OR M.S. '89





Naval Postgraduate School Operations Research Department Alumni  
Serving Together in Kabul, Afghanistan October 21, 2012



Spanish Navy LCDR Pablo Alvarez

Turkish Army Captain Faith Cesur

US Army LTC Jeff House

German Army LTC Jens Hartmann

US Army COL Bob Bradford

Turkish Army Major Hakan Kabalar

“I hope you and the other professors find it encouraging that your daily efforts build US and allied Analysis capacity and make a difference sometimes years later and halfway around the world.”

LTC Jeff House



# Admiral Michael G. Mullen, USN





# Admiral Michael G. Mullen, USN





- **Program Evaluations**

- ✓ Invite reps from key industries to campus to discuss industry needs and requirements

- **Military Faculty**

- ✓ Bring industry practitioners into the faculty, perhaps under some sort of extended sabbatical or industry fellow program

- **Faculty Research**

- ✓ Ensure faculty stay at the forefront of industry problems and practices, and bring that research back into the classroom

- **Student Theses**

- ✓ Triple benefit: theses contribute to faculty research, students bring critical industry-specific knowledge to the research, and students get to work on industry-relevant research problems

- **Reachback Support**

- ✓ Be there for your alumni

➤ For more detail, see: <http://faculty.nps.edu/rdfricke/frickerpa.htm>



