

Naval Postgraduate School  
Monterey, California 93943-5138



NPS-09-09-003

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# Compilation of Thesis Abstracts

June 2009



Office of the Vice President and Dean of Research  
Naval Postgraduate School



## PREFACE

This publication contains abstracts of unrestricted or unclassified theses submitted for the degrees doctor of philosophy, master of business administration, master of science, and master of arts for the June 2009 graduation. Classified and restricted distribution abstracts are listed on the NPS SIPRnet.

This compilation of abstracts of theses is published in order that those interested in the fields represented may have an opportunity to become acquainted with the nature and substance of the student research that has been undertaken. Copies of theses are available for those wishing more detailed information. The procedure for obtaining copies is outlined on the last page of this volume.

For additional information on programs, or for a catalog, from the Naval Postgraduate School, contact the director of admissions.

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The *Compilation of Theses Abstracts* (unrestricted) can be found online at  
<http://www.nps.edu/Research/MoreThesisAbst.html>.

Summary of Research, an annual compilation of research projects and publications, is also available online,  
at <http://www.nps.edu/Research/SummaryRes.html>.



# INTRODUCTION

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## Mission

The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

Increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the United States of America through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense-related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.

The research program at NPS exists to support the primary mission of graduate education. Research at NPS:

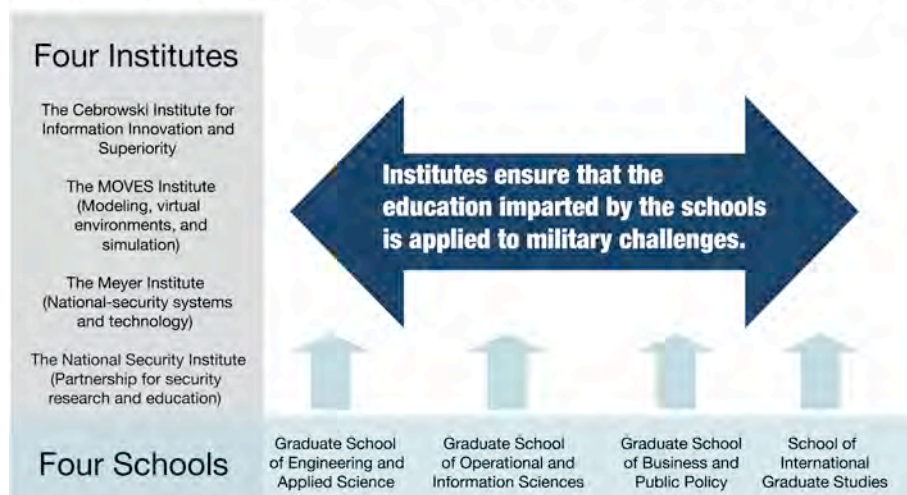
- maintains upper-division course content and programs at cutting edge;
- challenges students with creative problem solving experiences on DoD-relevant issues;
- advances DoN/DoD technology;
- solves warfare problems; and
- attracts and retains quality faculty.

## Academic Programs

To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization tying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has aligned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer's career.

***Integrated • Systems Oriented • Flexible • Partnered for Strength***



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# INTRODUCTION

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Programs of graduate studies at NPS are grouped as follows:

## **Graduate School of Operational and Information Sciences**

- Computer Science
- Computing Technology
- Electronic Warfare
- Human Systems Integration
- Information Sciences
- Information Systems and Operations
- Information Systems Technology
- Information Warfare
- Joint C4I Systems
- Joint Information Operations
- Modeling, Virtual Environments, and Simulation
- Operations Analysis
- Operational Logistics, Joint
- Software Engineering
- Special Operations
- Systems Analysis

## **Graduate School of Engineering and Applied Sciences**

- Applied Mathematics
- Combat Systems Science and Technology
- Electronic Systems Engineering
- Meteorology
- Meteorology and Oceanography
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors/Mechanical Engineering
- Space Systems Engineering
- Space Systems Operations
- Systems Engineering
- Systems Engineering and Analysis
- Systems Engineering Management
- Undersea Warfare
- Underwater Acoustic Systems

## **Graduate School of Business and Public Policy**

- Acquisition and Contract Management
- Contract Management
- Defense Business Management
- Defense Systems Analysis
- Defense Systems Management
- Executive Management
- Executive Master of Business Administration
- Financial Management
- Information Systems Management
- Material Logistics Support
- Manpower Systems Analysis
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Systems Engineering Management
- Transportation Management

## **School of International Graduate Studies**

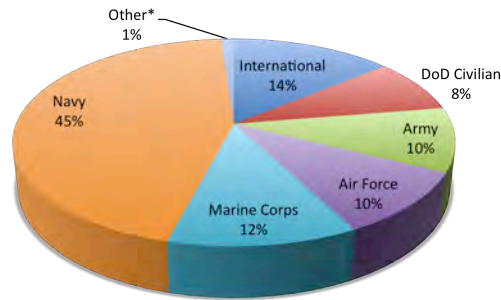
- Civil–Military Relations
- Combating Terrorism: Policy, Strategy
- Defense Decision Making and Planning
- Homeland Security and Defense
- Security Studies
- Stabilization and Reconstruction
- National Security and Intelligence:
  - Middle East, South Asia, Sub-Saharan Africa
  - Far East, Southeast Asia, Pacific
  - Europe and Eurasia
  - Western Hemisphere

## **Students**

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government, and military officers and government civilian employees of other countries. The resident degree/subspecialty student population for June 2009 is shown in Figure 1 on the following page.

# INTRODUCTION

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\*Army Reserve, Army Reserve National Guard, Coast Guard, National Oceanographic and Aeronautics Administration

**Figure 1: Resident Degrees/Subspecialty Student Population for June 2009**

## Academic Degrees

Curricula meet defense requirements within the traditional degree framework. All curricula lead to a master's; additional study may yield an engineer's or doctoral degree. Below is a listing of the degrees offered at NPS:

### Master of Arts Degrees

National Security Affairs  
Security Studies

### Master of Business Administration

### Master of Science Degrees

Applied Mathematics  
Applied Physics  
Applied Science  
Astronautical Engineering  
Combat Systems Technology  
Computer Science  
Computing Technology  
Contract Management  
Defense Analysis  
Electrical Engineering  
Electronic Warfare Systems Engineering  
Engineering Acoustics  
Engineering Science  
Engineering Systems  
Engineering Systems Management  
Human Systems Integration  
Information Operations  
Information Systems and Operations  
Information Technology Management  
Information Warfare Systems Engineering  
Management  
Materials Science and Engineering  
Mechanical Engineering  
Meteorology  
Meteorology and Physical Oceanography  
Modeling, Virtual Environments, and Simulation  
Operations Research  
Physical Oceanography

Physics  
Product Development  
Program Management  
Remote Sensing Intelligence  
Security Studies  
Software Engineering  
Space Systems Operations  
Systems Analysis  
Systems Engineering  
Systems Engineering Analysis  
Systems Engineering Management  
Systems Technology

### Engineer Degrees

Astronautical Engineer  
Electrical Engineer  
Mechanical Engineer

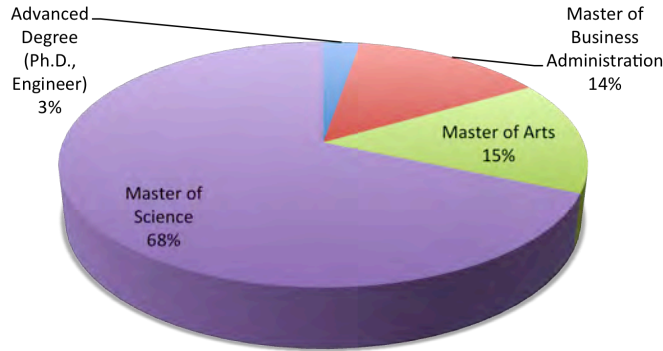
### Doctor of Philosophy

Applied Mathematics  
Applied Physics  
Astronautical Engineering  
Computer Science  
Electrical Engineering  
Engineering Acoustics  
Information Sciences  
Mechanical Engineering  
Meteorology  
Modeling, Virtual Environments, and Simulation  
Operations Research  
Physical Oceanography  
Physics  
Security Studies  
Software Engineering

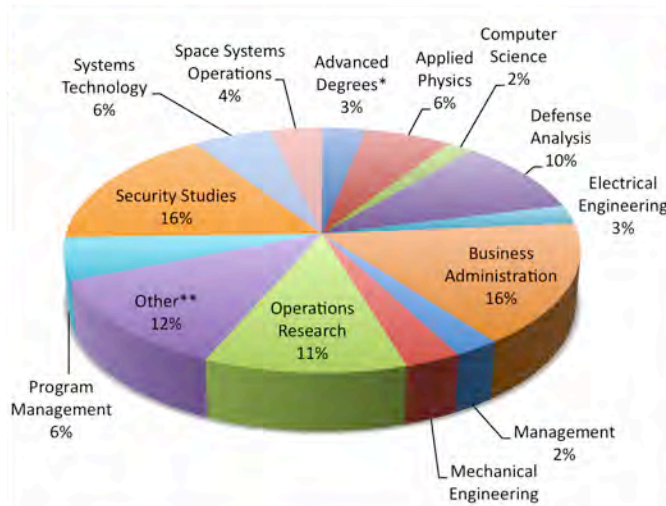
# INTRODUCTION

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In June 2009, 187 degrees were conferred. Figure 2 indicates distribution by type, Figure 3 by degree area.



**Figure 2. Distribution by Degree Type (187 Degrees Conferred)**



**Figure 3. Degrees Conferred in June 2009 (187 Degrees Conferred)**

\*Advanced degrees (doctorate): computer science (2), modeling virtual environments, and simulation (2), physics (1)

\*\*Other master's degrees: applied mathematics (1), engineering acoustics (2), engineering science (1), human-systems integration (3), information operations (4), information technology management (3), meteorology (2), meteorology and physical oceanography (1), modeling, virtual environments, and simulation (1), physical oceanography (1), physics (2), software engineering (1), systems engineering (2)

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# INTRODUCTION

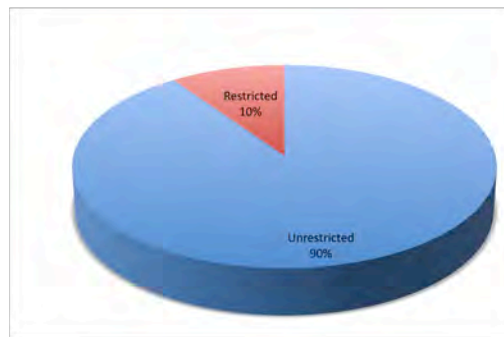
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## Theses

The thesis is the capstone of the student's academic endeavor at NPS. Thesis topics address issues ranging from the current needs of the fleet and joint forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Aided by their faculty advisors, NPS students represent a vital resource within the DoD for addressing warfighting problems, one especially important at present, when technology in general, and information operations in particular, is changing rapidly. Our officers think innovatively and possess the knowledge and skill to apply nascent technologies in the commercial and military sectors. Their first-hand grasp of operations, when combined with a challenging thesis project that requires them to apply their focused graduate education, is one of the most effective elements in solving fleet/joint-force problems. NPS graduate education encourages a lifelong capacity for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.



**Figure 4. Classification of Theses  
(187 Degrees Conferred)**



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**ADVANCED DEGREES**

**Doctor of Philosophy**



# DOCTOR OF PHILOSOPHY

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## **CROSS-DOMAIN NETWORK FAULT LOCALIZATION**

**William D. Fischer—Lieutenant Colonel, United States Army**

**B.S., College of William and Mary, 1989**

**M.S., Naval Postgraduate School, 2001**

**Doctor of Philosophy in Computer Science—June 2009**

**Advisor: Geoffrey G. Xie, Department of Computer Science**

Prior research has focused on intra-domain fault localization, leaving the cross-domain problem largely unaddressed. Faults often have widespread effects, which if correlated, could significantly improve fault localization. For both competitive and security reasons, domain managers hesitate to share fault observations even when doing so may significantly ease fault localization. This dissertation presents a characterization of the problem space in terms of inference accuracy, privacy, and scalability, and provides a framework to evaluate any design in the design spectrum. This framework explicitly models the inference accuracy and privacy requirements for discussing and reasoning over cross-domain problems, addresses scalability impacts, and facilitates the re-use of existing fault-localization algorithms while enforcing domain privacy policies. This dissertation provides a graph-digest-based approach with which participating network domains can exchange abstracted graphs that represent network fault-propagation models. The research explores the feasibility of this approach via the implementation of an inference-graph-based design in a cross-domain network setting. The results show a substantial improvement in cross-domain fault-localization accuracy and inference speed by using the inference-graph-digest-based approach.

**KEYWORDS:** Networking, Fault Localization, Cross-Domain, Bayesian

## **TERAHERTZ QUANTUM CASCADE STRUCTURES USING STEP WELLS AND LONGITUDINAL OPTICAL-PHONON SCATTERING**

**Will Freeman—DoD Civilian**

**B.S., California State University-Northridge, 1996**

**M.S., Naval Postgraduate School, 2004**

**Doctor of Philosophy in Physics—June 2009**

**Advisor: Gamani Karunasiri, Department of Physics**

Electron transport properties of terahertz (THz) longitudinal optical (LO)-phonon quantum cascade (QC) structures are modeled in order to investigate high-gain quantum cascade laser (QCL) structures. A new structure, a step well QC structure, is proposed. Under such an arrangement, there are three main energy levels within the step well, where the transition from the upper state to the middle state is at the THz radiative spacing and the transition from the middle state to the lower state is at or near the LO-phonon energy ( $\sim 36$  meV in GaAs). Because of the inherent difficulties in using rate equations for this type of transport analysis, a Monte Carlo simulation is developed. Step well injectors are modeled and shown to be capable of high injection efficiencies ( $\sim 90\%$ ), higher than previously obtained. Comparisons to conventional square well LO-phonon structures are made, including a Monte Carlo analysis of a high-power THz QCL. Interface roughness scattering is shown to be significant only for roughness greater than approximately one monolayer. It is found that step well structures are capable of high gains and injection efficiencies, with comparable characteristics to other square well designs, but do have increased scattering from the upper state to the lower states.

**KEYWORDS:** Terahertz, THz, Quantum Cascade Structure, QC Structure, Quantum Cascade Laser, QCL, Step Well, Longitudinal Optical-Phonon, LO-Phonon, Electron-Phonon Scattering, Electron-Electron Scattering,

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# DOCTOR OF PHILOSOPHY

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Impurity Scattering, Interface Roughness Scattering, Optical Transition, Electron Transport, Monte Carlo Method, Metal-Metal Waveguide, Surface Plasmon Waveguide

## MODELING HUMAN VISUAL PERCEPTION FOR TARGET DETECTION IN MILITARY SIMULATIONS

**Patrick W. Jungkunz–Kapitänleutnant, German Navy  
Dipl.-Inform., Universität der Bundeswehr München, 2000  
Doctor of Philosophy in Modeling, Virtual Environments, and Simulation–June 2009  
Advisor: Christian Darken, Department of Computer Science**

The search and target acquisition models used in current military simulations for visual detection of ground Soldiers are empirical. Although taking into account human performance data collected in field trials, they do not attempt to realistically model human search behavior. This, however, is necessary to achieve realistic target detection performance, including such phenomena as false-positive detections at realistic locations. Working towards this goal, this research creates a model of human visual perception for the search of a human target. The contributions of bottom-up and top-down information on human visual perception are examined in a visual search experiment, which includes eye movement recording of the participants. The results show that semantically relevant scene information is used to guide the search process, influencing eye movements. Consequently, a predictive model of eye fixations is created; this model takes semantically relevant scene locations into account. These meaningful locations are extracted from ground-truth simulation data and fused into a relevance map. The relevance map is compared with eye fixations of participants searching for human targets in realistic scenes. This comparison shows that the relevance map predicts fixation locations very well. A combination of the relevance map with a salience map achieves even better prediction of eye fixations.

**KEYWORDS:** Human Visual Perception, Eye Movements, Eye Tracking, Human Behavior Modeling, Target Detection, Visual Search, Semantic Relevance, Relevance Map

## STRESS EFFECTS ON THE TRANSFER FROM VIRTUAL-ENVIRONMENT FLIGHT TRAINING TO STRESSFUL FLIGHT ENVIRONMENTS

**Christopher K. McClernon–Major, United States Air Force  
B.S., United States Air Force Academy, 1999  
M.S., North Carolina State University, 2003  
Doctor of Philosophy in Modeling, Virtual Environments, and Simulation–June 2009  
Advisor: Michael E. McCauley, Department of Operations Research and the MOVES Institute  
Second Readers: William J. Becker, MOVES Institute  
Anthony J. Ciavarelli, MOVES Institute  
Rudolph P. Darken, Department of Computer Science and the MOVES Institute  
Nita L. Miller, Department of Operations Research and the MOVES Institute  
LCDR Paul E. O'Connor, USN, Department of Operations Research**

The purpose of this research is to investigate the effects of stress training on stressful flight operations in order to mitigate the human-factors preconditions to aircraft accidents. In addition, stress-training implementation strategies are investigated in order to develop pedagogy pertinent to stress training. A series of three empirical experiments are performed to test the transfer of both human emotional states and task skills from a virtual environment to subsequent test scenarios. Results indicate that stress training improves performance, decreases physiological responses to stress, and decreases subjective appraisals of stress in a simulator criterion session. A second experiment tests the generalization of these results to a novel, real-world stressor. In this study, stress training in a flight simulator is found to enhance performance and moderate the adverse effects of stress when piloting an aircraft in a stressful flight environment. A third empirical study tests the transfer of flight simulator skills to a real-world flying task. Flight simulator training improves the performance of a training group when compared to a no-training, control group. This line of research demonstrates that stress training is a viable approach for preparing trainees for stressful flight environments and stress in general.

**KEYWORDS:** Stress, Training, Transfer of Training, Flight Simulator, Virtual Environment, Human Physiology, Human Performance, Strain, Stress Coping, Stress Exposure Training

# DOCTOR OF PHILOSOPHY

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## AN ACTIVITY-DRIVEN MODEL FOR AN INTERACTIONAL NOTION OF CONTEXT

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**M.Eng., Imperial College-London, 1997**

**M.S., Naval Postgraduate School, 2006**

**Doctor of Philosophy in Computer Science–June 2009**

**Advisor: Gurminder Singh, Department of Computer Science**

Prior research in context-awareness has largely been dominated by a positivist notion of context. While this notion of context is sufficient for well-defined and focused applications, it suffers from two main shortcomings. First, it fails to consider context as a dynamic construct that arises from a user's interactions. Second, it lacks enough consideration for the role of the human actor in context-awareness. As a result, it is inadequate for dealing with the kind of high-level activities that people naturally engage in as part of their everyday lives. This dissertation proposes an activity-driven model for an interactional notion of context that addresses these shortcomings. In this model, context is defined as a relation between activities. The model is validated using a prototype implementation running on the Google Android mobile phone emulator. Results show that this model improves the computing experience of the user and provides unique benefits that were not previously available, such as situation awareness, memory and mental aid, and an associative mode of information access. A rule-based method for discovering parent-child relationships between activities is also validated. These findings demonstrate that the activity-driven model of context warrants further research as a viable basis for context-aware mobile computing.

**KEYWORDS:** Mobile Computing, Context Awareness, Activities



**MASTER  
OF  
BUSINESS ADMINISTRATION**



# **MASTER OF BUSINESS ADMINISTRATION**

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## **U.S. BUDGETING FOR THE UNITED NATIONS: PROCESS, POLICY, AND PROBLEMS**

**John M. Armstrong—Lieutenant Commander, United States Navy**

**Master of Business Administration—June 2009**

**Advisor: Richard Doyle, Graduate School of Business and Public Policy**

**Second Reader: Elda Pema, Graduate School of Business and Public Policy**

The U.S. is the largest single contributor to the UN budget. U.S. funding consists of assessed contributions (approximately 70 percent) and voluntary contributions (the remaining 30 percent). The U.S. share of the regular UN budget, part of assessed contributions, has been lowered on three occasions; from 39 percent in 1946 to 32 percent in 1954, to 25 percent in 1973, and to 22 percent in 2001. As of 1992, the U.S. contributed more money to UN peacekeeping than in regular dues. In 1973 the UN instituted separate assessments for peacekeeping missions. The U.S. was assessed between 30 and 31 percent for peacekeeping dues until 2001, when the assessment was lowered to 28 percent, and then lowered again in 2009 to just below 26 percent. The Senate Foreign Relations Committee, the House International Relations Committee, and the Senate and House Appropriations Committees play critical roles in determining U.S. funding for the UN. UN procurement and internal management reform, abortion, the Human Rights Council, and the degree of U.S. influence in the UN have been significant factors affecting congressional funding decisions. Attempts to withhold funding to influence UN policy have produced mixed results.

**KEYWORDS:** Budgeting, United Nations, Funding

## **THE STRYKER MOBILE GUN SYSTEM: A CASE STUDY ON MANAGING COMPLEXITY**

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**Master of Business Administration—June 2009**

**Advisor: John Dillard, Graduate School of Business and Public Policy**

**Second Reader: Keith Snider, Graduate School of Business and Public Policy**

This case study analyzes how the Stryker Mobile Gun System (MGS) Program managed complexity. The MGS is one of the ten variants of the Stryker series of vehicles that equip the Army's Stryker Brigade Combat Teams. These brigades were created by the Army Chief of Staff from 1999–2003, General Eric Shinseki, to provide the Army with a highly deployable, medium-force capability. Initially intended as a variant that required limited development, the MGS experienced a number of significant challenges during systems development.

This case study uses one of the program's primary issues, reliability shortfalls with the ammunition handling system, to describe how the program self-organized to manage complexity. The case study identifies the elements of complexity that existed in the Defense Acquisition System and how they interacted to create a challenging situation for the MGS Program.

After a crisis period from 2004–2005, the MGS Program changed its acquisition approach through the revitalization of systems engineering and risk management. This case study examines the self-organizing methods that the MGS Program used to improve system performance; it concludes with a description of how acquisition programs can better align their acquisition strategy to achieve programmatic resilience.

**KEYWORDS:** Stryker Brigade Combat Team, Interim Force, Mobile Gun System, Complexity, Uncertainty, Systems Engineering, Reliability, Risk Management, Acquisition Strategy

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# MASTER OF BUSINESS ADMINISTRATION

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## AN ANALYSIS OF CONTRACT MANAGEMENT PROCESSES AT FLEET AND INDUSTRIAL SUPPLY CENTERS WORLDWIDE

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Master of Business Administration—June 2009**

**Carl R. Ward—Lieutenant Commander, United States Navy  
Master of Business Administration—June 2009**

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**Cory Yoder, Graduate School of Business and Public Policy**

The purpose of this project is to assess the contracting processes capabilities at Commander, Fleet and Industrial Supply Centers (COMFISCS), which includes all seven Fleet and Industrial Supply Center (FISC) locations: Jacksonville, Florida; Norfolk, Virginia; Pearl Harbor, Hawaii; Puget Sound, Washington; San Diego, California; Sigonella, Italy; and Yokosuka, Japan. This analysis is conducted using the Contract Management Maturity Model (CMMM). The primary purpose of this study is to analyze FISC's contracting processes to identify key process area strengths and weaknesses and to provide a roadmap for possible improvement if needed. This study also focuses on the specific metrics currently used by COMFISCS to measure the performance of their contracting management processes. The results provide COMFISCS and the individual FISC commanders with a snapshot of the maturity level of their contracting processes, both individually and as a whole. This will allow COMFISCS to identify the unique challenges that each individual FISC is facing and provide an assessment tool on how to effectively engage and overcome these challenges and improve the organization's contracting process.

**KEYWORDS:** Contract Management Maturity Model, COMFISCS, FISC, NAVSUP, Contracting Process Management, Contracting Processes

## THE POSSIBLE EFFECTS OF THE DEPARTMENT OF DEFENSE ACTING AS A BUYER ON THE DERIVATIVES FUTURES MARKET

**Thomas R. Bowman—Lieutenant, United States Navy  
Master of Business Administration—September 2009**

**Evan P. Wright—Lieutenant, United States Navy  
Master of Business Administration—June 2009**

**Advisors: Douglas A. Brook, Graduate School of Business and Public Policy**

**Nayantara Hensel, Graduate School of Business and Public Policy**

**Donald Summers, Graduate School of Business and Public Policy**

The purpose of this project is to research the possible effects of the Department of Defense's (DoD) participation as a buyer in the commercial futures market for derivatives.

The idea that the DoD should participate in derivatives trading has been proposed and published by others in the past; however, the recommendations reviewed for this research failed to provide empirical evidence to highlight likely outcomes if their recommendations were put into practice. With this project, the authors research the likely effects that DoD purchases of oil on the commercial futures market would have on the market price. Additionally, the authors conduct research to determine how substantial DoD savings or losses could be from practicing a hedging program. The authors take a mostly quantitative approach to investigate these questions, then integrate qualitative analysis to support the final conclusions and recommendations.

The goal of this project is to achieve federal government recognition and consideration of the findings. The authors believe that hedging against the rising costs of fossil fuels in the commercial futures market is a terrific, low-risk action that the DoD could practice in fuel procurement.

**KEYWORDS:** Oil, Price Elasticity of Demand, Hedging, Department of Defense, DoD, Fuel Purchases

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# MASTER OF BUSINESS ADMINISTRATION

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## **ANALYZING C2 GREYHOUND CAPACITY AT FLEET READINESS CENTER SOUTHWEST**

**Althea C. Dewar—Lieutenant Commander, United States Navy**

**Master of Business Administration—June 2009**

**Bobby B. Savanh—Lieutenant Commander, United States Navy**

**Master of Business Administration—June 2009**

**Advisors: Kenneth J. Euske, Graduate School of Business and Public Policy**

**Susan Heath, Graduate School of Business and Public Policy**

In an effort to foster process improvement and ensure cost-wise support of ongoing military operations throughout the world, Fleet Readiness Center Southwest (FRCSW) created the Continuous Process Improvement (CPI) program as a vehicle to establish cost-wise readiness throughout the organization. The goal of this project is to determine a reasonable range of production at FRCSW while maximizing flexibility to support the fleet. The success of this project depends on conducting capacity measurement analysis to support findings and recommendations in assisting FRCSW. Several modeling tools are used to assess capacity, which assist in locating some of the constraints on the C2 production line at FRCSW. It is found that the scope of the C2 production line requires further capacity analysis using tools beyond this project. The project concludes with recommendations for future research using modeling and simulation.

**KEYWORDS:** C2 Greyhound, Capacity Analysis, AirSpeed Toolset, Process Flow, Precedence Diagram, Work Breakdown Structure, WBS, PMI3, Single Flow Process

## **A FEASIBILITY STUDY AND COST BENEFIT ANALYSIS OF CONFERENCE COORDINATING AT THE NAVAL POSTGRADUATE SCHOOL**

**Angela S. Dotson—Captain, United States Marine Corps**

**Master of Business Administration—June 2009**

**Martin C. Oliver—Lieutenant, United States Navy**

**Master of Business Administration—June 2009**

**Advisors: Becky D. Jones, Graduate School of Business and Public Policy**

**Kenneth J. Euske, Graduate School of Business and Public Policy**

This project is a feasibility study and cost benefit analysis of conference coordinating at the Naval Postgraduate School (NPS). The objective is to determine an effective conference-coordinating model based on current event-planning techniques within commercial businesses and other universities. Four possible solutions are proposed and compared.

Through conversations and observations with NPS faculty and staff that possess conference-coordinating experience, four main challenge areas are identified: facility scheduling, MWR, personnel continuity, and funding. Remedying these challenges is the metric used to evaluate four possible solutions. The solutions consist of creating a website, creating an internal conference coordinator position(s), MWR conducting conference coordinating, and conducting conferences off-site.

Results indicate that the most viable option for NPS is to incorporate conference-coordinating responsibilities within MWR. Although MWR is the most feasible option presented due to an established administrative and operational infrastructure, the research includes cautions to assist with refocusing on existing core competencies.

**KEYWORDS:** Conference Coordinating

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# MASTER OF BUSINESS ADMINISTRATION

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## AN ANALYSIS OF THE ARLIEGH BURKE DESTROYER CLASS DAMAGE CONTROL SHIPBOARD PHASED-REPLACEMENT PROCESS

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Master of Business Administration—June 2009

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The primary objective of this project is to provide recommendations for process changes in order to implement an effective phased-replacement program for damage control gear on Arliegh Burke Destroyer Class ships. This research focuses on damage control equipment in Repair Locker Two. The authors analyze the shipboard phased-replacement process to assess whether it is effective and adequately supporting the readiness of Repair Locker Two.

The analysis is limited in scope to FY07 and FY08. A data analysis, oriented toward process improvement, is conducted based on STARS Federal Supply Group (FSG) data, shipboard interviews, Repair Locker inventories, and ATG subject-matter-expert opinion. The analysis is conducted on ten ships: five from the West Coast and five from the East Coast.

The analysis reveals that phased-replacement support from a standardized process in Repair Locker Two is lacking on multiple ships in the study. Recommendations are provided for a suggested phased-replacement support plan and for process improvement.

**KEYWORDS:** Phased Replacement, Arliegh Burke Class Destroyer, Damage Control, Process Improvement, DDGRON, CNSF, COMNAVSURFOR, AFMP, CLASSRON, DC

## KNOWLEDGE OF THE MILITARY RETIREMENT SYSTEM AMONG NAVAL POSTGRADUATE SCHOOL OFFICERS AND AN ANALYSIS OF ASSOCIATED RETIREMENT INFORMATION SOURCES

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Master of Business Administration—June 2009

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Master of Business Administration—June 2009

Advisors: David R. Henderson, Graduate School of Business and Public Policy  
Mark J. Eitelberg, Graduate School of Business and Public Policy

This project assesses the level of knowledge about the military retirement system among U.S. military officers attending the Naval Postgraduate School. The level of knowledge is correlated to the effectiveness of the underlying communication sources used by the population. A web-based survey site is used for primary data collection and preliminary survey results analysis.

The project determines the areas of the retirement system that are unfamiliar to the sample population; determines the various modes of retirement system communication used by the population; correlates levels of knowledge to basic demographics and communication modes; and finds the root causes in knowledge deficiencies recommended.

The project concludes that there is a significant military-retirement-knowledge deficiency in the sample population at the Naval Postgraduate School. The military-retirement information system is assessed as the root cause of this deficiency. Recommendations include improvements in the consolidation, periodicity, and policy of the military-retirement information systems.

**KEYWORDS:** Military Retirement, Retirement Information Sources, Retirement Information Systems, General Military Training, Military Compensation, Defined Benefit Plan, Defined Contribution Plan, Military Pension, Military Retirement Fund, Military Retirement Communication Modes

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# MASTER OF BUSINESS ADMINISTRATION

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## THE ECONOMICS OF LANDMINES AND DEMINING

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**Master of Business Administration—June 2009**

**Etsay Gebrehiwot—Director General, Ethiopian Mine Action Office**

**Master of Business Administration—June 2009**

**Advisors: David R. Henderson, Graduate School of Business and Public Policy**

**Francois Melese, Defense Resources Management Institute**

Landmines threaten human lives and the welfare of mine-affected countries. They cause an economic burden both by destroying lives and by limiting the valuable use of land. Landmines remain dangerous for decades after they are deployed, killing or injuring civilians and rendering land impassable and unusable.

Historically, studies of the impact of landmines focused mostly on safety issues and the risk of injuries and deaths. More recently it has become obvious that landmines can interfere with the overall economic development of mine-affected nations. In reaction to the problems posed by landmines, the world community has responded with attempts to tackle the problem of landmines. A newly formed “mine action” industry has grown rapidly in the last decade. Mine-affected countries, international organizations, non-governmental organizations (NGOs), and donor countries are among those supporting mine action programs to alleviate suffering and assist in the reconstruction of mine-affected nations.

There are many ways to reduce the impact of landmines, but the most common practice is demining. Demining is dangerous, expensive to implement, and involves many complex challenges. It utilizes scarce resources, including time, manpower, and money. Furthermore, in many countries landmines are so widespread that completely demining affected areas would create an enormous economic burden. This study attempts to identify and evaluate alternative approaches to demining in order to provide recommendations on the most cost-effective options for a country to make the best use of its scarce resources to guarantee civilian safety and promote economic development.

**KEYWORDS:** Economics of Landmines, Demining, Economic Impact of Landmines, Solutions to Landmine Problem, Alternatives to Demining, Cost-Benefit Analysis of Demining, Finance of Demining, Structure of Demining Organizations

## COMBAT SUPPORT FORCES (1C6C) NAVAL SURFACE FORCES REQUIREMENTS-BASED BUDGET DETERMINATION FOR ASSAULT CRAFT UNIT ONE

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**Master of Business Administration—June 2009**

**Michael D. Ruminski—Lieutenant, United States Navy**

**Master of Business Administration—June 2009**

**L. Scott Wallace—Lieutenant, United States Navy**

**Master of Business Administration—June 2009**

**Advisors: Kenneth J. Euske, Graduate School of Business and Public Policy**

**John Mutty, Graduate School of Business and Public Policy**

The purpose of this project is to analyze the operational and maintenance requirements of Landing Craft Utility (LCU) vessels assigned to Assault Craft Unit One (ACU-1) in order to create a methodology to develop a requirements-based financial model. This research analyzes the number of LCUs required to perform assigned tasks based upon maintenance schedules, deployment cycles, and training evolutions. In addition, this research compares expenditures made to the maintenance fund code, operating hours, and the number of craft deployed in order to explain past expenditures. From this, a model is developed that takes into consideration the operational requirements of LCUs to forecast the resources needed to support the craft.

**KEYWORDS:** Budget, Model, Requirements-Based, LCU, ACU-1, 1C6C, NBG-1, OPTAR, Operational Availability

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# MASTER OF BUSINESS ADMINISTRATION

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## MARKET PERCEPTION OF CONSOLIDATIONS IN THE EUROPEAN DEFENSE INDUSTRY FROM 2001 TO 2009: A CASE OF EVENT STUDIES

**Panagiotis Panagiotakopoulos**–Lieutenant Commander, Hellenic Navy  
**Master of Business Administration–June 2009**

**Konstantinos Tourkantonis**–Lieutenant Commander, Hellenic Navy  
**Master of Business Administration–June 2009**

**Advisors: Nayantara Hensel, Graduate School of Business and Public Policy**  
**Donald Summers, Graduate School of Business and Public Policy**

The purpose of this research is to examine and analyze whether there is a statistically significant reaction in financial markets to the announcements of European defense manufacturers' consolidations for the time period from 2001 to 2009. The research focuses on the top four European contractors: BAE Systems, EADS, THALES, and Finmeccanica. The analysis is accomplished with the use of a series of event studies, using the arithmetic stock returns of the companies' against the index of the intimate stock exchange market.

The project also examines whether the financial markets responded in the same manner in different consolidations and in different stock markets.

**KEYWORDS:** European Defense Industry, Event Study, Merger, Acquisition, Consolidation, Abnormal Return

## AN EXTERNAL, STRATEGIC ANALYSIS OF THE AVIATION MAINTENANCE, REPAIR, AND OVERHAUL INDUSTRY AND POTENTIAL MARKET OPPORTUNITIES FOR FLEET READINESS CENTER SOUTHWEST

**Lester O. Patterson, Jr.**–Lieutenant, United States Navy  
**Master of Business Administration–June 2009**

**Bradford C. Tonder**–Lieutenant, United States Navy  
**Master of Business Administration–June 2009**

**Advisors: Becky D'Addea Jones, Graduate School of Business and Public Policy**  
**Kenneth J. Euske, Graduate School of Business and Public Policy**

The purpose of this research is to supplement the long- and short-range strategic development efforts of Fleet Readiness Center Southwest (FRCSW) by providing command leadership with an analysis of the current aviation maintenance, repair, and overhaul (MRO) industry: the goal is to identify potential expansion opportunities for FRCSW.

Strategy development is dependent upon a solid, current, and complete industrial analysis. An industrial analysis includes: 1) a definition of the industry, 2) a description of external forces acting upon the industry, 3) a description of the industry structure, and 4) an examination of the key success factors that benchmark the requirements for a firm to stay competitive in the industry. These analyses provide FRCSW with the information required to leverage their core competencies to identify and capitalize on potential opportunities in the industry.

This study identifies emerging trends, presents projected forecasts, identifies external forces on both the military aviation MRO industry and FRCSW, and discusses those factors that are key to long-term success in the military aviation MRO industry. The conclusions present a number of opportunities for FRCSW to explore in their effort to remain the Navy's premier aviation depot.

**KEYWORDS:** Fleet Readiness Center, Aviation Maintenance Repair and Overhaul, MRO, Aviation Enterprise, Military Depots, Aviation Maintenance, FRCSW, NADEP

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# MASTER OF BUSINESS ADMINISTRATION

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## MANAGEMENT AND OVERSIGHT OF SERVICES ACQUISITION WITHIN THE UNITED STATES ARMY

**Charles A. Rau—DoD Civilian**

**Master of Business Administration—June 2009**

**Peter J. Stammersky—Captain, United States Army**

**Master of Business Administration—June 2009**

**Advisors: Rene G. Rendon, Graduate School of Business and Public Policy**

**Aruna U. Apte, Graduate School of Business and Public Policy**

**Uday M. Apte, Graduate School of Business and Public Policy**

The purpose of this project is to determine how the United States Army manages and oversees the acquisition of services. To accomplish this objective, the authors deployed a survey to 81 contracting centers to collect empirical data. The survey, created by Meinshausen and Compton as part of a prior Naval Postgraduate School MBA project, was designed to collect data on contract characteristics, life-cycle approach, project management, organization structure, and training provided to acquisition personnel. The survey was available for two full weeks in early March 2009. During this period, 61 respondents completed the survey, representing a 75% response rate. The results show that the vast majority of contracting centers are using competitively-bid, fixed-price contracts without any type of incentive. This research also shows that a project-team approach is often utilized; however, the contracting officer routinely leads the acquisition effort. Additionally, the respondents indicate that there are not enough acquisition workforce billets, the current billets are not adequately filled, and training resources are lacking. The results of this project will be used for further research in a Department of Defense-wide analysis of lifecycle management of service acquisitions.

**KEYWORDS:** Service Contracting, Life-Cycle Management, Contract Management, Project Management, Program Management

## COMMANDER'S (EXECUTIVE OFFICER'S) GUIDE FOR DETECTING AND DETERRING PROCUREMENT FRAUDS IN MILITARY UNITS (ORGANIZATIONS) OF THE ARMED FORCES OF THE UKRAINE

**Vadym Voloshenko—Colonel, Ukrainian Ministry of Defense**

**Master of Business Administration—June 2009**

**Advisors: Juanita M. Rendon, Graduate School of Business and Public Policy**

**James Suchan, Graduate School of Business and Public Policy**

The objective of this project is to review the best practices of American organizations in the areas of internal control and fraud prevention and to provide guidelines for fraud detection and fraud deterrence for commanders in the Ukrainian Armed Forces. The financial control system in the Ukrainian Armed Forces is historically based on a professional audit. Decentralization of management and control is a current trend in the military organization. The Cabinet of Minister of Ukraine developed a long-term strategy to establish an internal control system throughout the Ukrainian government, including the uniformed services. Conceptually, this system will be based on the U.S. Committee of Sponsoring Organizations of the Treadway Commission (COSO) Internal Control—Integrated Framework, which is becoming a de-facto global standard. Under current transformational conditions, the suggested project can work as an internal-control outpost and increase general awareness of commanders or top-level managers about internal control effectiveness and fraud prevention.

**KEYWORDS:** Internal Control, Fraud Management, Ukraine

# **MASTER OF BUSINESS ADMINISTRATION**

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## **THE IMPACT OF SOFTWARE REUSE ON THE COST OF NAVY SONAR AND FIRE CONTROL SYSTEMS**

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Master of Business Administration—June 2009**

**Advisors: Joseph G. San Miguel, Graduate School of Business and Public Policy  
Michael W. Boudreau, Graduate School of Business and Public Policy**

One of the critical aspects in the design and sustainment of new and replacement Navy combat systems is the development of software to run the systems in a manner that maximizes their benefit to national security. This research examines the Navy's acquisition of anti-submarine warfare sonar- and fire-control software to determine if software reuse has been effective in lowering costs. The potential for cost avoidance exists due to the commonality of the anti-submarine warfare mission across the surface, air, surveillance, and submarine communities. The three categories of costs chosen for analysis are maintenance; training; and research, development, test, and evaluation. This analysis focuses on the identification of trends associated with each of the costs for selected systems and programs. Identifying trends in funding could provide evidence of the cost-effectiveness of software reuse efforts within and across the surface, air, surveillance, and submarine communities.

**KEYWORDS:** Software Reuse, Reuse, ASW Software, Sonar, Fire Control, APB, ARCI

# **MASTER OF SCIENCE**

**Applied Mathematics**  
**Applied Physics**  
**Computer Science**  
**Defense Analysis**  
**Electrical Engineering**  
**Engineering Science**  
**Human Systems Integration**  
**Information Operations**  
**Information Systems and Operations**  
**Information Technology Management**  
**Management**  
**Mechanical Engineering**  
**Meteorology**  
**Meteorology and Physical Oceanography**  
**Modeling, Virtual Environments, and Simulation**  
**Operations Research**  
**Physical Oceanography**  
**Physics**  
**Program Management**  
**Software Engineering**  
**Space Systems Operations**  
**Systems Engineering**  
**Systems Technology**



# **MASTER OF SCIENCE IN APPLIED MATHEMATICS**

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## **A GAME THEORETIC APPROACH TO CONVOY ROUTING**

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**Master of Science in Applied Mathematics—June 2009**

**Advisors: Guillermo Owen, Department of Applied Mathematics**

**Carlos Borges, Department of Applied Mathematics**

A two-person search/ambush game is considered, where each player wants to maximize his survival time while minimizing the survival time of his adversary. This is done in the context of convoy routing, where each player can choose which route they take. Their estimated survival times depend upon a) whether their adversary is directly searching on that route, b) the indirect probability of detection or hazard if their adversary is not along that route, and c) the risk involved with moving from route to route. It is possible for a player to be interdicted even if his adversary is not on that route. Each player has a payoff matrix that maximizes their expected time-to-capture. It is shown that both payoff matrices can be evaluated as a bi-matrix game that yields optimal mixed Nash Equilibria through the use of non-linear programming. The results of this evaluation can be used to optimally conduct route clearing and convoy routing.

**KEYWORDS:** Game Theory, Bimatrix, Modeling, Convoy Routing, Nash Equilibrium, Search, Ambush



# MASTER OF SCIENCE IN APPLIED PHYSICS

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## **OPTIMIZING SCR DESIGN FOR OPTICAL DETECTION**

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**Master of Science in Applied Physics—June 2009**

**Advisors: Gamani Karunasiri, Department of Physics**

**Douglas Fouts, Department of Electrical and Computer Engineering**

Though traditionally used as switching devices, thyristors are capable of facilitating the conversion of light intensity to frequency. However, off-the-shelf thyristors are designed to handle relatively large current ( $> 1$  mA) and are therefore not suitable for low-power light detection. In this work, low-current ( $< 1$  nA) thyristors are fabricated using the AMI ABN process via MOSIS based on a previous design which is slightly modified. The fabricated thyristors and the transistors that were included for verification purposes are characterized with an Agilent 4155B Semiconductor Parameter Analyzer. The fabricated thyristors exhibit the expected switching behavior and operate with current levels in tens of pA. Measured I-V characteristics of the transistors reveal that the exclusion of an active mask even within the pbase layer when using the AMI ABN process results in sub-optimal performance. An analysis of the thyristors corroborates this finding and confirms simulation results in previous work which indicates that the thyristor switching voltage decreases in direct proportion to the width of the first n doped layer. Incident light is also found to cause a decrease in switching voltage. From these findings, the optimal width of the first n doped layer is determined to be equal to or greater than  $5.2 \mu\text{m}$ , and the active mask is recognized as an essential augmentation to all metal contacts in devices fabricated using CMOS technology.

**KEYWORDS:** Thyristor, Silicon Controlled Rectifier, MOSIS, AMI ABN Process, CMOS Design, Optical Detection, Active Layer

## **TRANSPORT IMAGING: DEVELOPING AN OPTICAL TECHNIQUE TO CHARACTERIZE BULK SEMICONDUCTOR MATERIALS FOR NEXT-GENERATION RADIATION DETECTORS**

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**Master of Science in Applied Physics—June 2009**

**Advisor: Nancy M. Haegel, Department of Physics**

**Second Reader: Craig F. Smith, Department of Physics**

Characterization of the mobility-lifetime product is critical to the development of new materials for semiconductor radiation detectors. An optical technique has been developed that allows for the direct determination of the minority carrier diffusion length, drift length, and mobility-lifetime product from a single image of the recombination luminescence in semiconductor materials. Excess carriers are generated using the electron beam in a scanning electron microscope. The charge is then drifted by applying an electric field, and the subsequent recombination luminescence is imaged by an optical microscope on a high-sensitivity CCD camera. The challenge in applying this technique to new materials for nuclear radiation detectors is the requirement for thick samples and the resultant need to characterize transport in three dimensions. In this work, initial research is performed on the simulations and analysis of experimental data required to characterize thick layers of high-purity GaAs for nuclear radiation detectors. The first models are applied to extract values for surface recombination velocity, which plays a key role in determining the excess carrier distribution in bulk materials. Cathodoluminescence of one promising high Z material, BiFeO<sub>3</sub>, is performed.

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## APPLIED PHYSICS

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**KEYWORDS:** Cathodoluminescence, Diffusion, Drift, Mobility, Lifetime, Bismuth Ferrite, BiFeO<sub>3</sub>, Semiconductor, Transport Imaging

### POINT-DENSITY EFFECTS ON DIGITAL ELEVATION MODELS GENERATED FROM LIDAR DATA

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Master of Science in Applied Physics—June 2009

Advisor: Richard C. Olsen, Department of Physics

Second Reader: David Trask, Measurement and Signal Intelligence Chair Professor

The use of airborne LiDAR systems (ALS) to obtain topographical information of the earth's surface and generate digital elevation models (DEMs) has grown extensively in the field of remote sensing. Selected areas of point-cloud LiDAR data collected from Honduras in 2008 are used to produce DEMs with varying densities to show the effects of lower-resolution LiDAR data. An IDL code is utilized to reduce the selected LiDAR point-cloud data to 90%, 66%, 50%, 30%, 10%, 5%, 3%, 1%, 0.5%, 0.3%, 0.1%, 0.05%, 0.03%, and 0.01% of its original density to obtain lower-resolution datasets. The software Quick Terrain Modeler (QTM) and its ILAP Bare Earth Extractor Plug-In are used to generate DEMs from the varying point-cloud density datasets and the software ENVI is used to perform DEM analysis. It is found that a LiDAR point-cloud density dataset of at least 0.6 points per square meter is necessary to generate an accurate DEM for the test environment.

**KEYWORDS:** DEM, Digital Elevation Model, Point Density, LiDAR, QTM, Quick Terrain Modeler, ILAP Bare Earth Extractor, ENVI

### POLARIMETRIC IMAGING FOR THE DETECTION OF DISTURBED SURFACES

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Master of Science in Applied Physics—June 2009

Advisor: Richard C. Olsen, Department of Physics

Second Reader: Richard M. Harkins, Department of Physics

This work tests the ability of the fast time-division SALSA polarimetric camera of Bossa Nova Technologies, Ltd. to distinguish disturbed from undisturbed surfaces. Earth and asphalt are imaged, and the data is processed using standard ENVI™ software. The polarization signature of the disturbed earth is not strong, even when processing is employed. The camera is better able to distinguish between the polarization characteristics of patched or disturbed asphalt and the surrounding pavement, particularly when maximum likelihood classification is applied. The current results indicate that the camera needs to be systematically tested for sensitivity to roughness scale and soil type and that the asphalt results need to be further verified.

**KEYWORDS:** Polarimetric Imaging, Polarimetric Camera, Improvised Explosive Devices

### VISIBLE-TO-SWIR DOWN-CONVERSION AND ITS APPLICATION TO INDIVIDUAL IDENTIFICATION, FRIEND OR FOE

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Master of Science in Applied Physics—June 2009

Advisor: Nancy M. Haegel, Department of Physics

Second Reader: Peter P. Crooker, Department of Physics

The objective of this research is to extend the current design of the individual identification friend or foe (IIFF) patch to provide a response in the shortwave infrared (SWIR) region of the electromagnetic spectrum. The purpose of the IIFF patch is to mitigate fratricide during ground engagements by emitting an NIR signal when the wearer is illuminated by a targeting laser attached to the shooter's weapon. Due to the proliferation of NIR night vision

devices (NVDs), it is desirable to produce a version of the patch that emits in the SWIR spectrum, making its response visible to operators with next-generation NVDs while being invisible to conventional NVDs. This enhances the “covert” nature of the IFF patch.

To produce SWIR output, a visible-light emitter is used in conjunction with a downconverting phosphor filter. This thesis develops and evaluates candidates for visible-light emitters and downconverting phosphor filters in order to determine the most suitable candidate for use in the IFF patch.

Three potential candidate materials are evaluated using photoluminescence excitation spectroscopy. A quantitative comparison of the combined efficiency is performed to select an initial optimized combination. SWIR emission is observed through an InGaAs imaging array.

**KEYWORDS:** SWIR, Visible Light, Fratricide, Phosphor Downconversion, IFF, Photoluminescence Excitation, Spectroscopy

## **CHARACTERIZATION OF ROBOTIC TAIL ORIENTATION AS A FUNCTION OF PLATFORM POSITION FOR SURF-ZONE ROBOTS**

**Courtney L. Holland–Lieutenant, United States Navy  
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**Master of Science in Applied Physics–June 2009**

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**Second Reader: Peter P. Crooker, Department of Physics**

The Naval Postgraduate School Small Robot Initiative is an ongoing effort to develop autonomous robotic platforms for military applications. The latest design in this series, a quadruped robot with a tail for stability and obstacle climbing, is currently under development in collaboration with Case Western Reserve University. Tail orientation as a function of robot platform attitude is tested for angle of bank climbs at 10 and 15 degrees. Data indicate that although the platform induced noise is significant, tail orientation can be successfully managed with proper PID feedback mechanisms, including tail position as a function of platform attitude. Gross control of the tail used as an assist for climbing is validated in this experiment. More sophisticated filter algorithms are indicated for fine tuned tail control, including but not limited to the Kalman filter.

## **CHARACTERIZATION OF MEMS, A DIRECTIONAL MICROPHONE WITH SOLID AND PERFORATED WINGS**

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**Master of Science in Applied Physics–June 2009**

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**Second Reader: Bruce Denardo, Department of Physics**

This goal of this research is to characterize two micro-electro-mechanical system (MEMS)-based directional sound sensors with solid and perforated wings. The design of the sensors is based on the structure of the *Ormia ochracea* fly’s hearing system, which has highly directional hearing through mechanical coupling of the eardrums. The sensors are made of a 10-micron thick, single-crystal, silicon layer with dimensions of 1 x 2 mm<sup>2</sup>. The sensors are fabricated using a SOIMUMPs process available through the MEMSCAP foundry service. The characteristics of the two sensors are simulated in COMSOL finite element software, and responses to incident sound at different angles are measured using a laser vibrometer. Both sensors show good sound coupling, and measured and simulated frequency responses are in good agreement. The sensor with perforated wings is found to have a faster response compared with that of the solid wings, primarily due to lower mass and higher damping. The measurements show good sensitivity to the direction of sound as predicted from the modeling.

**KEYWORDS:** SOIMUMPs, MEMS, *Ormia Ochracea*, Biomimetic, Directional Microphone, Sensor, Microphone, Fly Hearing, Undersea Warfare

## ULTRAVIOLET RESONANCE RAMAN ENHANCEMENTS IN THE DETECTION OF EXPLOSIVES

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Master of Science in Applied Physics–June 2009**

**Advisor: Craig F. Smith, Lawrence Livermore National Laboratory Chair Professor**

**Second Reader: J. Chance Carter, Lawrence Livermore National Laboratory**

Raman-based spectroscopy has potential military use for standoff detection of high explosives. Normal (non-resonance) and resonance Raman spectroscopies are both light scattering techniques that use a laser to measure the vibrational spectrum of a sample. In resonance Raman, the laser is tuned to match the wavelength of a strong electronic absorbance in the molecule of interest; in normal Raman, the laser is not tuned to any strong electronic absorbance bands. The selection of appropriate excitation wavelengths in resonance Raman can result in a dramatic increase in the Raman scattering efficiency of select band(s) associated with the electronic transition. Other than the excitation wavelength, resonance Raman is performed experimentally the same as normal Raman. In these studies, normal and resonance Raman spectral signatures of select, solid high-explosive (HE) samples and explosive precursors are collected at 785 nm, 244 nm, and 229 nm. Solutions of PETN, TNT, and explosive precursors (DNT and PNT) in acetonitrile solvent as an internal Raman standard are quantitatively evaluated using ultraviolet resonance Raman (UVRR) microscopy and normal Raman spectroscopy as a function of power and select excitation wavelengths. Use of an internal standard allows resonance enhancements to be estimated at 229 nm and 244 nm. Investigations demonstrate that UVRR provides ~2000-fold enhancement at 244 nm and ~800-fold improvement at 229 nm, while PETN shows a maximum of ~25-fold at 244 nm and ~190-fold enhancement at 229 nm solely from resonance effects when compared to normal Raman measurements. In addition to the observed resonance enhancements, additional Raman signal enhancements are obtained with ultraviolet excitation (i.e., Raman scattering scales as  $\nu^4$  for measurements based on scattered photons). A model, based partly on the resonance Raman enhancement results for HE solutions, is presented for estimating Raman enhancements for solid HE samples.

**KEYWORDS:** Raman Spectroscopy, Standoff Detection, High Explosives, Explosive Detection, Inelastic Scattering, Resonance Raman

## ELECTRICAL AND THERMAL ANALYSIS OF GALLIUM NITRIDE HEMTS

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**Master of Science in Applied Physics–June 2009**

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**Second Reader: Gamani Karunasiri, Department of Physics**

The purpose of this thesis is to build a transient model and to study the electrical and thermal characteristics of the AlGaIn/GaN HEMT. The authors first use Method 3104 of MIL-STD 750D to determine the location of HEMT structure that gate voltage measurement relates to. Second, the authors investigate the performance of single pulse and multiple pulses. Third, the authors study and compare the performance between the DC model and the Transient model (multiple pulses) with the same power. Finally, the authors compare the self-heating effect between various substrates and discuss the observation of unique transistor heating. Based on the analysis of these simulation results, the performance of the AlGaIn/GaN HEMT could be predicted.

**KEYWORDS:** Gallium Nitride, HEMT, High Electron Mobility Transistor, Silvaco, ATLAS, Modeling, Transient, Self-Heating, Pulse

## **RADAR IMAGING FOR MOVING TARGETS**

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Interest in radar imaging has been growing for the last several decades because of its long-range sensing capabilities. The continued utility of radar imaging and its applications in wide-ranging areas are fundamentally dependent on the ability to produce high-quality artifact-free imagery. The use of radar to identify and image moving targets remains of great interest for both commercial and military use. However, when imaging a moving target there will be issues of incorrect positioning or streaking as the unknown target velocity gives rise to image artifacts. Many techniques have been developed to handle moving objects, however, these techniques make use of the so-called start-stop approximation, in which target motion is assumed to be momentarily stationary while it is being interrogated by a radar pulse.

A new, linearized, imaging theory that combines spatial, temporal, and spectral aspects of scattered waves has been developed. This thesis considers the performance of these techniques and compares them to existing imaging schemes. It is shown that the new imaging scheme provides better localization and is translation invariant in phase-space. It is also shown that the imaging scheme is dependent on the aperture geometry.

**KEYWORDS:** Radar Imaging, Moving Targets, Point Spread Function, Ambiguity Function



# MASTER OF SCIENCE IN COMPUTER SCIENCE

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## AN EXAMINATION OF THE MH-60S COMMON COCKPIT FROM A DESIGN METHODOLOGY AND ACQUISITIONS STANDPOINT

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**Master of Science in Computer Science—June 2009**

**Advisors: Rudolph P. Darken, Department of Computer Science and the MOVES Institute  
Anthony J. Ciavarelli, MOVES Institute**

Over the last two decades, cockpits have migrated from the traditional analog gauges of moving dials to computer displays representing an assortment of flight data. In keeping with this modernization trend, the U.S. Navy determined that the newest rotary-wing fleet aircraft, the MH-60S and MH-60R, would incorporate these advanced cockpit designs. This program is named Common Cockpit. Using structured interviews with current Navy MH-60S pilots and analysis of system design models, it is determined that the MH-60 glass cockpit has fundamental flaws in cockpit design and usability. One major issue identified is the omission of a fully integrated moving map. The lack of a moving map is a serious issue because many of the MH-60 missions require precise navigation. The Navy pilots interviewed indicate that the lack of a moving map makes mission-task performance difficult and could threaten safety. It is argued that a user-centered design methodology would have given ample consideration to including the moving map and would have produced a more effective and usable cockpit design. Recommendations are made to improve design methodology by using crew-centered design methods. Recommendations are also made regarding modification of existing Common Cockpit acquisitions procedures needed to produce a better product for the fleet.

**KEYWORDS:** Common Cockpit, MH-60S Knighthawk, Crew-Centered Design Philosophy, Systems Engineering Cockpit Design Methodology, Human Computer Interface Design Methodology

## VISUALIZATION OF CLIENT-SIDE WEB BROWSING AND EMAIL ACTIVITY

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**Master of Science in Computer Science—June 2009**

**Advisor: Cynthia E. Irvine, Department of Computer Science  
Second Reader: Chris S. Eagle, Department of Computer Science**

Both web browsers and email clients provide records of user activity, the former as part of the history mechanism for revisitation purposes, and the latter as part of each message. Both are highly valuable from a forensic perspective, with elements such as visited site, mail contact, and event timestamp revealing a wealth of information about the user's browsing and communication behavior. The ability of the forensic analyst to quickly and efficiently explore and understand this volume of information and reconstruct the user's online activity is important, and can contribute to the progress of the investigation. The objective of this thesis is the design and construction of a set of tools to transform this textual history into a visual format, thus facilitating the analysis, interpretation, and identification of trends and relationships that may exist. The result of transforming textual histories into visual images and presenting them in a single summary report is the effective distillation of large amounts of information into minimal space, thereby enabling the analyst to form a high-level profile of the user who generated the data. This allows the analyst to better understand the user's online activity in the context of the specific investigation, and effectively prioritize his/her limited time and attention.

**KEYWORDS:** Forensic, Browsing, Email, Automation, Visualization

## PROBABILITY DISTRIBUTIONS OVER CRYPTOGRAPHIC PROTOCOLS

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Master of Science in Computer Science–June 2009

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Second Reader: George Dinolt, Department of Computer Science

This study examines the problem of assuring correct functionality of cryptographic protocol verifiers. As a replacement for manual input of well-known protocols, the authors propose the creation of a random protocol generator capable of producing protocols of varying degrees of correctness. This generator would be verifier-independent, and the protocols translated into verifier languages as required. This would automate the creation of protocols and eliminate the variability in both translation quality and the resulting body of tests. To this end, the authors propose a common definition for cryptographic protocols, develop multiple probability distributions over this definition, and implement a generator that uses these distributions. As a proof of concept, the authors translate protocols created by the generator into a suitable format for the Cryptographic Protocol Shapes Analyzer.

**KEYWORDS:** Automatic Protocol Generation, Protocol Analysis, Security Protocols, Cryptographic Protocols, Key-Exchange Protocols, Authentication Protocols, Protocol Verification

# **MASTER OF SCIENCE IN DEFENSE ANALYSIS**

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## **THE FUTURE OF RAIDING: LESSONS IN RAIDING TACTICS FROM THE INDIAN WARS AND LAW ENFORCEMENT**

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**Master of Science in Defense Analysis—June 2009**

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**Second Reader: Robert L. O’Connell, Department of Defense Analysis**

The War on Terror is a fight between states and non-state actors. In this struggle, raiding has emerged as an important tactic used to deny the enemy safe haven, to kill and capture known terrorists, and to gain vital intelligence to relentlessly pursue terrorists worldwide. Conducting raids is one method that coalition partners must utilize in order to defeat terrorist networks. This thesis specifically explores how, when, and where raids prove strategically useful; how different forces conduct raids; and which techniques achieve strategic gains via raids. To pre-empt, prevent, and disrupt terrorist organizations from successfully waging their brand of warfare, it is likely that the United States and coalition partners must continue to pursue raiding operations under certain situations and utilizing modern techniques. This thesis argues, through the study of the Indian Wars from 1800–1890 and law enforcement raiding techniques used against gangs in the United States, that utilizing the appropriate raiding technique at the correct time and place under the appropriate circumstance can significantly disrupt or destroy networked terrorist organizations.

**KEYWORDS:** Commando Raids, Terrorism, Street Gangs, Law Enforcement Tactics, Indian Wars

## **ALIGNED INCENTIVES: COULD THE ARMY’S AWARD SYSTEM INADVERTENTLY BE HINDERING COUNTERINSURGENCY OPERATIONS?**

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**Erik Jansen, Department of Defense Analysis**

The United States Army has struggled to institutionalize counterinsurgency operations in the Global War on Terror. The Army’s reward system, which drives individual motivation and reflects corporate values, plays a much-overlooked role in this struggle. Within the Army (indeed, within most organizations), pay, promotion, and awards form the tripod of extrinsic motivation and represent tools the organization can use to reward specific behavior. Today and for the foreseeable future, both pay and promotion will have limited effects in promoting counterinsurgency behavior. The Army’s award system, which proudly traces its history to George Washington, was not developed as a complete system until World War I and, in many respects, ceased development after World War II. The current “Pyramid of Honor,” which focuses on valorous acts, is deeply engrained in Army culture. At the same time, significant work and thought have gone into revising the Army’s “capstone” manuals, FM-1 and FM-3.0. These documents, along with a separate manual on counterinsurgency, all revised or created since 9/11, attempt to move the Army in a new direction.

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This thesis explains the paradox that results. The Army has reached a point where it is telling its Soldiers to do one type of action: work by, with, and through the host nation. Yet it disproportionately delivers awards to those who conduct a separate type of action: engaging and killing the enemy.

**KEYWORDS:** Awards, Counterinsurgency, Reward Systems, Department of Defense Hall of Heroes, Army Stories of Valor, Army Silver Star Recipients

### **SMALL NATION, BIG DIFFERENCE: HOW THE NORWEGIAN ARMED FORCES SHOULD CONDUCT COUNTERINSURGENCY OPERATIONS**

**Trond Gimmingsrud–Lieutenant, Royal Norwegian Navy**

**Master of Science in Defense Analysis–June 2009**

**Master of Science in Information Operations–June 2009**

**Hans-Marius Pedersen–Captain, Royal Norwegian Army**

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**Advisor: David Tucker, Department of Defense Analysis**

**Second Reader: Hy S. Rothstein, Department of Defense Analysis**

This thesis postulates the need for the Norwegian Armed Forces to conduct counterinsurgency operations into the future and attempts to answer the question of how such operations should be conducted.

First, the fundamental dynamics of an insurgency and a counterinsurgency are described using a generic model. The role and importance of information operations in such conflicts is discussed. The process of nation-building is considered, with the aim of extracting implications for military forces. After establishing a theoretical foundation through discussing insurgencies, information operations, and nation-building, the thesis turns to a discussion of the relevant capabilities under the control of the Norwegian government in order to elicit important possibilities and limitations. Finally, the thesis suggests both missions and important priorities for the Norwegian Armed Forces in a counterinsurgency operation based upon theoretical foundation and the means available. The thesis concludes that while the Norwegian Armed Forces should be considered suitable for counterinsurgency operations, there is a significant need for education about and understanding of such conflicts.

**KEYWORDS:** Insurgency, Counterinsurgency, Information Operations, Nation-Building, Norwegian Armed Forces

### **BURMA: ASSESSING OPTIONS FOR U.S. ENGAGEMENT**

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**Second Reader: Col Brian H. Greenshields, USAF, Department of Defense Analysis**

This thesis considers Burma's recent history, from World War II to present day, to examine how the current state of affairs evolved. Burma's diverse ethnic groups and the nearly continuous insurgencies since World War II are analyzed relative to a short period of democracy (following British colonial rule) from 1948 to 1962, to repressive military rule from 1962 to today.

This thesis examines how Burma's military juntas have retained internal control in the face of insurgent and pro-democracy movements. Burma's geographic location, between the rising powers of India and China, its abundant natural resources, its drug trade, and the government's human rights abuses all make the country important to United States' foreign relations in Asia. This thesis evaluates current U.S. policies toward Burma and explores possible Burmese policy options for the U.S. in the future. Recommendations are provided for future U.S. policy towards Burma.

**KEYWORDS:** Burma, Counterinsurgency, Ethnic Minorities, Pro-Democracy Movement, Natural Resources, Western Sanctions, Regional Partners, Human Rights Abuses, Drug Trade, U.S. Engagement

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## DEFENSE ANALYSIS

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### IN THE SHADOW OF THE DURAND LINE: SECURITY, STABILITY, AND THE FUTURE OF PAKISTAN AND AFGHANISTAN

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**Advisor: Marcos Berger, Department of Defense Analysis**

**Second Reader: Douglas A. Borer, Department of Defense Analysis**

The Durand Line (Pak-Afghan border) gained international attention during the Soviet invasion of Afghanistan. The government of Afghanistan's refusal to acknowledge the Durand Line as the official border with Pakistan has serious implications in relation to the Global War on Terror (GWOT), especially in Pakistan's Federally Administered Tribal Areas (FATA). For the last six decades, the atmosphere of misunderstanding and mistrust in relation to the border between the two neighbors has cast a shadow over any effort to achieve security and stability in the region. Pakistan's weak hold over FATA and Baluchistan has provided space in which extremist groups, such as al-Qaeda and the Taliban, have been able to establish bases, training camps, seek refuge, and conduct cross-border attacks into Afghanistan. This thesis provides a detailed analysis of the history and contemporary significance of the Durand Line. It argues that a key imperative of future operations in the region is the need for the governments of Afghanistan and Pakistan to come to an agreement that delineates the official border (currently the Durand Line) between the two nation-states. Until there is a border that is recognized by all concerned, their ability to cooperate with each other and their allies, and deal with al-Qaeda, the Taliban, and a range of other issues, remains profoundly constrained. The future of Afghanistan and Pakistan is dependent on a range of levels with dealing with the unresolved border issue, which has hung over both countries since Pakistan was carved out of British India in 1947.

**KEYWORDS:** Pakistan, Afghanistan, Instability and Insecurity, Durand Line, Pak-Afghan Border, Pashtunistan, Baluchistan, Afghan Refugees, Federally Administered Tribal Areas, FATA, Global War on Terror, GWOT

### THE SMO-COIN NEXUS: USING SOCIAL MOVEMENT THEORY TO DEMOBILIZE INSURGENCY

**Robert Steve Lewis—Major, United States Army**

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**Douglas A. Borer, Department of Defense Analysis**

Victory in irregular war and insurgency is not simply a matter of combat actions and civic aid; it is a matter of population mobilization. Winning the sympathy of the population will do little good for either the state or the insurgent if he fails to mobilize the population in a manner that allows him to reap the resources and legitimacy that either side needs to win. A winning strategy by the state must be one that either limits the insurgent's ability to mobilize the population or allows the state to mobilize the population more efficiently than the insurgent. The use of social movement organizations offers an effective method for insurgents to mobilize a population during an insurgency. In many cases, the use of social movement organizations is more efficient as a mobilization strategy than are other strategies, such as coercion or persuasion. A strategy by the state that disrupts the insurgent's ability to use a sympathetic social movement organization offers the state an effective means to limit the resources available to the insurgents. In these cases, the state can also create its own social movement organizations to allow it to mobilize the population effectively in support of the government.

**KEYWORDS:** Insurgency, Irregular Warfare, COIN, Mobilization, Social Movement Theory, Social Movement Organizations, Darul Islam, Jemaah Islamiyah, Baath Party, Sunni Uprising, Indonesia, Iraq, Civil Affairs, McAdam, Mao, Galula, McCuen

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### THE DE-RADICALIZATION OF MUSLIM COMMUNITIES IN THE U.K.

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Master of Science in Defense Analysis—June 2009

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This study examines why and how the Islamist message of radicalization spread like a social contagion among UK Muslim communities during the 1990s. The thesis hypothesizes that a small number of Islamists with smartly contextualized ideas, given a receptive environment, can spread their influence rapidly. Borrowing from Social Movement Theory and other works, this thesis elaborates how, through word-of-mouth and interpersonal communications, a relatively small number of people can successfully initiate a social epidemic of religious extremism. By following simple rules of marketing, Islamists made their message stickier. To counter radicalization, the study suggests a paradigm shift: instead of countering the Islamists on theological grounds, reinvigoration of family is proposed as an all-in-one counter-radicalization tool that would remove social strains, hamper the Islamists' mobilization mechanisms, and trump their teaching of propagating the message based on cultivated familiarity.

**KEYWORDS:** Radicalization Path, Identity Crisis, Gradual Indoctrination, Culturing, Law of the Few, Stickiness Factor, Power of Context, De-Radicalization, Diffusion of Innovation, Strengthening Family System, Hizb ut-Tahrir, Al-Muhajiroun, Construction of Narrative

### THE PRINCIPLES OF STRATEGIC, COMBINED, JOINT, SPECIAL OPERATIONS

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Throughout the history of warfare, different countries have used special operations in their efforts to achieve key strategic objectives. The objectives of these special operations ranged from hostage rescue to foreign government overthrow. Nonetheless, all of these objectives were of strategic importance for the high-level decision makers who conceived and ordered the missions. Thus, because of their high potential payoff, these particular special operations aimed to achieve strategic objectives that could be defined as strategic special operations. As a consequence of the international terrorism threat within the context of globalization, there is an increased likelihood for strategic, combined, joint special operations to be used in the future as an efficient method for solving potential international crises.

This thesis proposes the following principles: a balance between common and national interests, intelligence sharing, interoperability, and a division of responsibilities, as the key factors for the success of strategic, combined, joint special operations. Each principle is analyzed, highlighting the possible issues that may appear during the design, preparation, and execution of strategic, combined, joint special operations. A model of implementing these principles is proposed as a useful tool for political and military decision makers.

**KEYWORDS:** Strategic Combined Joint Special Operations, Common Interest, National Interest, Intelligence Sharing, Interoperability, Division of Responsibilities

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## THE PRINCIPLES OF WAR RECONSIDERED

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Contemporary militaries waging wars tend to rely on the fundamental principles of war. These principles have been defined during centuries of study, and they give the appearance of being undisputedly stable with the possibility of their application assumed to be ongoing. This view is deceptive. In fact, many famous strategists of the past have warned oncoming generations of warriors not to misuse these fundamentals; rather, these principles need to be modified over time. The application of past principles is problematic for future wars as they have been shaped according to historical conditions; these principles need to be reevaluated in terms of the present. Such principles can only provide the basics for the creation of new or modified warfighting concepts, and cannot be applied unthinkingly. This study analyzes the classical principles of war from the perspective of modern warfare in order to reconsider their meaning, significance, and applicability.

**KEYWORDS:** Principles of War, Information Age, Military History, Military Doctrine, Military Strategy

## THE STRATEGIC UTILITY OF U.S. NAVY SEALS

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Master of Science in Defense Analysis—June 2009  
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Second Reader: Col Brian H. Greenshields, USAF, Naval Postgraduate School SOCOM Liaison

The current insurgency in Iraq has necessitated the overwhelming use of special operations forces (SOF) in operational and tactical roles. With an expected draw-down in Iraq, it is time to re-focus the Special Operations Command (SOCOM) on the strategic utility of SOF, specifically on the maritime arm of SOCOM, the SEALs. SEALs bring unique capabilities based on their comparative advantage in direct action and their familiarity with the maritime domain. This comparative advantage contributes to their strategic utility as a short-duration direct-action force working from land and sea.

The SEAL culture – based on the history of the organization, and their recruitment, selection, and training – has historically focused on direct-action operations. Insistence on indirect action will atrophy the skill-sets of these maritime commandos.

Historic research is used to illustrate the successful strategic use of SEALs in an effort to provide guidelines to decision makers. These decision makers must incorporate a balanced approach to the war, where an over-reaction and over-commitment of forces to one mission set will likely imperil, not help, U.S. strategy. The Navy SEALs have a historic and proven comparative advantage in direct-action-based operations and they best serve SOCOM’s strategy fulfilling their strategic utility.

**KEYWORDS:** U.S. Navy SEALs, SEALs, Naval Special Warfare, NSW, Special Operations Forces, SOF, SOCOM, SOF Culture, Comparative Advantage, Strategic Utility

## A PERMANENT PRESENCE FOR THE PERSISTENT CONFLICT: AN ALTERNATIVE LOOK AT THE FUTURE OF SPECIAL FORCES

**Christopher D. Pratt**—Major, United States Army  
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Second Reader: Col Brian H. Greenshields, USAF, Department of Defense Analysis

This study addresses two questions: 1) what is the future role for special forces (SF) in the Long War Strategy; and 2) how will the roles and missions of SF have a strategic impact or high utility function in the current fight and in future endeavors? This thesis asserts that the future role for SF Soldiers rests in a permanent OCONUS presence and

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engagement, so that SF teams can leverage and refine their unique skills and gain a more comprehensive and deeper understanding of the regions in which they can be expected to operate.

The arguments presented in this thesis are conceptual in nature, and are designed to offer the Department of Defense an alternative approach for persistent presence and engagement. What the author is advocating is a complete and total career commitment to living abroad. SF groups in their entirety would be forward deployed OCONUS. The roles and posture of SF would change, but the seven primary missions would remain the same. If, as so many people argue, the U.S. needs to move forward with a smaller footprint, a forward-deployed SF would provide a permanent global posture of strategic significance – one that would certainly help prosecute the Long War more effectively.

**KEYWORDS:** Special Operations, U.S. Army Special Forces, Global War on Terror, GWOT, WOT, Irregular Warfare, IW, Regional Engagement, Enduring Engagement, Permanent/Persistent Presence, Building Partnership Capacity, Foreign Internal Defense, FID, Security Force Assistance, SFA, Global Counterinsurgency, COIN, Long War

### **ACEH CONFLICT RESOLUTION: A LESSON LEARNED AND THE FUTURE OF ACEH**

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The Aceh conflict has been one of the longest running conflicts in Asia. The memorandum of understanding between the Government of Indonesia (GoI) and GAM (Free Aceh Movement) was finally signed on 15 August 2005 in Helsinki, Finland. The agreement brought an end to nearly thirty years of bloody armed conflict, which had claimed 15,000 lives, displaced tens of thousands, and impacted the whole country economically and politically. Early in the process, many expressed skepticism with the government in handling this conflict due to the failure of two previous peace settlements. Many believed that GAM had to be eliminated by employing military operations. The military options, however, proved ineffective in eliminating rebellion. Instead, the military abuses and resource exploitation have only increased the GAM's public support. The Helsinki peace agreement appears to have a better chance at ending the separatist conflict in Aceh. This win-win solution has worked well so far. However, lessons learned from this conflict will be beneficial for any government and military in handling future conflicts. Indeed, instead of military options, Helsinki's peace agreement has always been the best solution for the future of Aceh.

**KEYWORDS:** Aceh Conflict, Insurgency, Counterinsurgency, Peace Agreement, GAM, Indonesia

### **AL QAEDA AS A CHARISMATIC PHENEMENON**

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This study establishes that the presence of charismatic effect in terrorist or insurgent groups tends to make them more violent. Bradley's theory forms the backbone of the study; it focuses on identifying a charismatic effect in a group, measuring the level of the charismatic effect, and analyzing how the dimensions of the effect relate to the survivability or viability of the led groups. The theory envisages that endogenous interaction between two relational elements in a social group, "flux or communion" and "control or power structure," is responsible for the creation and sustenance of the charismatic effect. The theory also discovers that an imbalance in the presence of flux and control leads to charismatic instability. Based on theoretical dimensions and an exploratory, analytic technique involving quantitative ratings, the study estimates al Qaeda's systemic state on two key theoretical variables, and suggests possible counter-strategies to negate the undesirable effects of charisma in al Qaeda. The study concludes that there is a strong presence of charismatic effect in al Qaeda and suggests that by manipulating the level of the flux and control of al Qaeda, its ability to cause violence or disruption may be reduced.

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## DEFENSE ANALYSIS

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**KEYWORDS:** Al Qaeda, Osama bin Laden, Charisma, Charismatic, Radicalism, Terrorism, Insurgencies, Radical Social Movements, Cohesion, Power Structure, Flux, Control, Communion, Stability, Islam, Islamic

### ENHANCING THE EFFECTIVENESS OF AD-HOC UNITS: A REVISED TRAINING MODEL

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To meet the personnel shortfalls resulting from the Global War on Terror, the United States Civil Affairs and Psychological Operations Command developed an integrated approach to strength management – use of the ad hoc unit. This came at a cost, however, generally in terms of lost efficiency and decreased capabilities to conduct tactical and operational civil-affairs operations. This thesis encapsulates fifteen months of studying eight United States Army civil-affairs units that deployed to Iraq as part of *Operation Iraqi Freedom*, Rotation 06–08. The research objective is to determine if the units were effective and what, if any, changes are needed to improve the training program prior to deployment. Analysis reveals cyclical patterns in teams’ task progress, in their attention to outsiders and their mission, and in members’ interpersonal work relations. Although different teams handled these issues differently, and moved through the cycles at different speeds, they showed striking convergence in the way they alternated between periods of continuity and periods of change. The research indicates that there is a better method for preparing ad hoc units for deployment. By creating a collaborative approach to task management and linking social, cultural, and task cohesion, the Army can more effectively execute pre-deployment training plans for ad hoc units.

**KEYWORDS:** Cohesion, Training Model, Effectiveness, Collaboration, Efficiency, Management Planning and Control, Interpersonal Relations, Group Dynamics, Teams, Ad Hoc, Case Studies, Systems Approach, Civil Affairs



# MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

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## THE EFFICACY OF VARIOUS WAVEFORMS TO SUPPORT GEOLOCATION

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This thesis investigates the impact of various waveform parameters on the ability to accurately estimate the position of the source of a known data-less emission that is visible to multiple, simultaneous collectors. It provides an overview of the basic geolocation problem and identifies various parameters affecting geolocation accuracy, showing those that are affected by the waveform and those that are not. Performance estimates are provided for detecting the signal and for estimating the time-of-arrival (TOA) and the frequency-of-arrival (FOA) of the signal, which are the key measure of a waveform's ability to support geolocation. Several exemplar waveforms are chosen to illustrate the effects of various waveform parameters, and the performance of these example waveforms is verified through software simulations.

Results show for additive white Gaussian noise (AWGN) interference that accuracy of estimates is predominantly determined by the transmit power (i.e., received SNR), signal bandwidth (for TOA), and signal duration (for FOA). For a given SNR, occupied bandwidth, and total duration, a waveform can be “shaped” in the time and frequency domains to improve performance relative to a reference direct-sequence spread-spectrum (DSSS) signal. Software simulations confirm theoretical performance estimates.

This thesis summarizes the effects of various waveform parameters on geolocation performance, demonstrates these by modeling exemplar waveforms, and provides software that can be used to simulate performance.

**KEYWORDS:** Geolocation, Cross Ambiguity Function, CAF, Matched Filter Detection

## SUCCESSIVE INTERFERENCE CANCELLATION IN RAKE RECEIVERS FOR CDMA SIGNALS

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Various techniques of successive intracell interference cancellation (SIIC) for wideband-code division multiple access (W-CDMA) are investigated. This can improve the performance of CDMA interceptors and enhance the operation of cellular mobile communication systems. The research focuses on the forward link (downlink) where orthogonal covering is employed. Three interference cancellation techniques that suppress the intracell multiuser interference are examined. The first method is called subtraction and the second method is called projection. A third method, which is a modification of the second method called the alternative projection method, is also examined. Although the receiver seems more complex compared to a conventional Rake receiver, it is shown to be effective in increasing the channel capacity. Independently from the above, the performance of the Walsh Index Detector (WID) is demonstrated. This detector provides an opportunity to detect the indexes that are being used in W-CDMA signals without prior knowledge of them.

**KEYWORDS:** Successive Intracell Interference Cancellation, Wideband-Code Division Multiple Access, Walsh Index Detector

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# ELECTRICAL ENGINEERING

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## **DOUBLY FED INDUCTION MACHINE CONTROL FOR WIND-ENERGY CONVERSION**

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Due to increasing concerns about CO<sub>2</sub> emissions and the shortage of fossil fuels, renewable energy has become a major topic in economic discussions. One renewable source is energy that can be extracted from wind. This thesis covers the basics of using a doubly fed induction generator (DFIG) to convert the mechanical energy of wind into useful electrical power that can be used to supply electricity to any grid. Implementation and simulation results are analyzed. The design implements digital, four-quadrant control of a DFIG with a direct current (DC) machine serving as the prime mover. Digital control of voltage, current, and frequency in the rotor windings is accomplished using a voltage source inverter, while the stator voltage and frequency are maintained by the grid. Simulation is accomplished using Matlab and Simulink software. The simulations are verified with lab hardware.

**KEYWORDS:** Renewable Energy, Wind Energy Conversion, Doubly Fed Induction Generator, DFIG, Field Programmable Gate Array, FPGA, Voltage Source Inverter, VSI, Generator Control

## **INVESTIGATING THE ELECTROTHERMAL CHARACTERISTICS OF A GATE TURN-OFF THYRISTOR DURING TURN-OFF USING SILVACO ATLAS**

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This thesis presents data from a simulation study of the thermal and electrical characteristics of a Gate Turn-Off (GTO) thyristor. At present, most of the research on GTO thyristors has focused on their use in power electronic systems at high switching frequencies. As a result, the behavior of GTO thyristors at very low switching frequencies is not well understood. Previous research has shown experimentally that GTO thyristors are capable of interrupting significantly more than their nominal turn-off current rating when used in pulsed-power applications at low switching frequencies.

This work demonstrates the use of physics-based computer simulation to study the electrothermal turn-off characteristics of a GTO thyristor at low switching frequencies. The computer model used simulates both the electrical and the thermal characteristics of a GTO thyristor and allows its internal properties—such as current density, electric fields, and lattice temperature—to be investigated. The model is used to track the generation, transfer, and dissipation of energy within the structure of the device; and to show that the current interruption capability of a GTO thyristor may depend on its switching frequency due to the thermal energy that is generated and stored in the device during turn-off.

**KEYWORDS:** Gate Turn Off Thyristor, GTO, Pulsed Power, Current Interruption, Thermal and Electric Modeling, Inductive Turn-Off, Safe Operating Area, SOA

# MASTER OF SCIENCE IN ENGINEERING SCIENCE

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## FLOW VISUALIZATION STUDIES OVER A UCAV 1303 MODEL

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Master of Science in Engineering Science–June 2009

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This study is a qualitative documentation of the main flow features over an Unmanned Combat Air Vehicle (UCAV) 1303 model by flow visualization techniques where it gives the first understanding of the UCAV maneuverability under steady and unsteady maneuver conditions. The relevant fluid flow physics is not available presently and, hence, this thesis concentrated on generating those critical details. Towards this goal, model studies were conducted on the United States Air Force (USAF) geometry, described as same UCAV 1303, which is essentially a flying wing in the Naval Postgraduate School (NPS) water tunnel using dye-flow visualization technique. This study adapted the UCAV model 1303 for the NPS water tunnel by incorporating multiple ports for dye injection and was manufactured using rapid prototyping techniques. To obtain conditionally sampled flow images, especially for unsteady flow conditions, special phase locking circuitry was designed, fabricated, and integrated with high-resolution digital cameras and tunnel-flow monitoring software. Flow visualization images at various Reynolds numbers, model attitudes, and pitch rates were obtained. Strong vortical flow was observed as expected for a 47 degree delta-wing. The shallow sweep angle and tail-less geometry seemed to present some unusual aerodynamic characteristics in regard to vortex bursting.

**KEYWORDS:** Unsteady Aerodynamics, UCAV Maneuvers, 2D-Unsteady Flows



# MASTER OF SCIENCE IN HUMAN SYSTEMS INTEGRATION

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## **MENTAL MODELS, TRUST, AND RELIANCE: EXPLORING THE EFFECT OF HUMAN PERCEPTIONS ON AUTOMATION USE**

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**Second Reader: Nita L. Miller, Department of Operations Research**

Today's military increasingly uses automation to perform or augment the performance of complex tasks. Automated systems that support or even make important decisions require that human operators understand and trust automation in order to rely on it appropriately. This study examines the effect of varying degrees of information about an automated system's reliability on mental model accuracy, trust in, and reliance on automation.

Forty-two participants were divided into three groups based on level of information received about the reliability of a simulated, automated, target-detection aid. One group received little information, one group received accurate information, and one group received inaccurate information about the target-detection aid's reliability. Each participant completed a series of 120 tasks in which he or she was required to identify the presence of a threat target and then decide whether to use an automated aid for assistance.

Results indicate a significant difference between the groups in trust in and reliance on automation. The experimental group that received little information trusted the automation less but relied on it more. These findings, accompanied by observational data collected regarding the formation of mental models, demonstrate the necessity of continued research in the field of automation trust.

**KEYWORDS:** Trust in Automation, Reliance on Automation, Mental Models

## **RAPTOR: AN EMPIRICAL EVALUATION OF AN ECOLOGICAL INTERFACE DESIGNED TO INCREASE THE WARFIGHTER'S COGNITIVE PERFORMANCE**

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**Second Reader: Nita L. Miller, Department of Operations Research**

A prototype interface is developed to support military practitioners with enhanced levels of situation awareness and better decision making as they conduct command and control activities during tactical operations. A laboratory experiment is conducted to evaluate the capability of this interface's cognitive systems engineering and ecological interface-design principles to support critical activities (i.e., assess anticipated enemy actions on friendly force operations). Qualitative tactical simulations and an alternative interface (an experimental version of an existing U.S. Army interface) are developed. Participants are blocked against one interface and provided estimates of perceived cognitive workload while collecting, integrating, and reporting various forms of friendly and enemy force information during two realistic tactical scenarios. The results suggest that the prototype interface produced significantly better performance in six out of seven statistical comparisons examined. The cognitive systems engineering and ecological interface-design strategy is very effective in this experimental context. The potential for this design to be useful for other complex work domains is explored. Actual or potential applications of this study include both specific interface-design strategies for military command and control and general interface-design principles for civil transportation domains.

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# HUMAN SYSTEMS INTEGRATION

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**KEYWORDS:** Cognitive Systems Engineering, Ecological Interface Design, Direct Perception, Direct Manipulation, Situation Awareness, Decision Making, Cognitive Workload, DMSC, C-SWAT

**AN EVALUATION OF THE EFFECTIVENESS OF U.S. NAVAL AVIATION CREW  
RESOURCE-MANAGEMENT TRAINING PROGRAMS: A REASSESSMENT FOR THE  
TWENTY-FIRST-CENTURY OPERATING ENVIRONMENT**

**Douglas W. Jones—Lieutenant Commander, United States Navy  
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**Master of Science in Human Systems Integration—June 2009**

**Advisor: LCDR Paul E. O'Connor, USN, Department of Operations Research**

**Second Reader: Michael E. McCauley, Department of Operations Research**

This thesis describes a multi-faceted evaluation of the U.S. Naval Aviation Crew Resource Management (CRM) program. CRM training is used to instruct Naval aviators in safety critical, non-technical behaviors. Reactions are evaluated by using a single item from command safety climate questionnaires (n=51, 570 observations over nine years). Attitudes are assessed using a 37-item survey (364 responses). Knowledge is evaluated using a 10-item multiple-choice test (123 responses). Finally, the causes of Naval aviation mishaps from FY97–FY07 (238 mishaps) are examined to identify how many were attributed to failings related to CRM concepts. It is found that aviators perceive CRM training to be useful, have positive attitudes towards concepts addressed in the training, and the level of knowledge is constant across rank and aircraft type. Nevertheless, human error still accounts for more than 80% of all mishaps in naval aviation, and over 65% of those are attributed to at least one failure in CRM. As human error continues to plague Naval aviation, routine evaluations of the CRM program's effectiveness are critical in achieving its goal to "improve mission effectiveness by minimizing crew preventable errors, maximizing crew coordination, and optimizing risk management" (CNO, 2001).

**KEYWORDS:** Crew Resource Management, CRM, Naval Aviation, Training Evaluation, Cockpit Resource Management, Safety, Aviation Mishaps, Training Effectiveness Evaluation

# **MASTER OF SCIENCE IN INFORMATION OPERATIONS**

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## **SMALL NATION, BIG DIFFERENCE: HOW THE NORWEGIAN ARMED FORCES SHOULD CONDUCT COUNTERINSURGENCY OPERATIONS**

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**Master of Science in Information Operations–June 2009**

**Hans-Marius Pedersen–Captain, Royal Norwegian Army**

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**Second Reader: Hy S. Rothstein, Department of Defense Analysis**

This thesis postulates the need for the Norwegian armed forces to conduct counterinsurgency operations into the future and attempts to answer the question of how such operations should be conducted.

First, the fundamental dynamics of an insurgency and a counterinsurgency are described using a generic model. The role and importance of information operations in such conflicts is discussed. The process of nation-building is considered, with the aim of extracting implications for military forces. After establishing a theoretical foundation through discussing insurgencies, information operations, and nation-building, the thesis turns to a discussion of the relevant capabilities under the control of the Norwegian government in order to elicit important possibilities and limitations. Finally, the thesis suggests both missions and important priorities for the Norwegian Armed Forces in a counterinsurgency operation based upon theoretical foundation and the means available. The thesis concludes that while the Norwegian armed forces should be considered suitable for counterinsurgency operations, there is a significant need for education about and understanding of such conflicts.

**KEYWORDS:** Insurgency, Counterinsurgency, Information Operations, Nation-Building, Norwegian Armed Forces

## **THE DE-RADICALIZATION OF MUSLIM COMMUNITIES IN THE U.K.**

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**Master of Science in Information Operations–June 2009**

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This study examines why and how the Islamist message of radicalization spread like a social contagion among UK Muslim communities during the 1990s. The thesis hypothesizes that a small number of Islamists with smartly contextualized ideas, given a receptive environment, can spread their influence rapidly. Borrowing from social movement theory and other works, this thesis elaborates how, through word-of-mouth and interpersonal communications, a relatively small number of people can successfully initiate a social epidemic of religious extremism. By following simple rules of marketing, Islamists made their message stickier. To counter radicalization, the study suggests a paradigm shift: instead of countering the Islamists on theological grounds, reinvigoration of family is proposed as an all-in-one counter-radicalization tool that would remove social strains, hamper the Islamists' mobilization mechanisms, and trump their teaching of propagating the message based on cultivated familiarity.

## INFORMATION OPERATIONS

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**KEYWORDS:** Radicalization Path, Identity Crisis, Gradual Indoctrination, Culturing, Law of the Few, Stickiness Factor, Power of Context, De-Radicalization, Diffusion of Innovation, Strengthening Family System, Hizb ut-Tahrir, Al-Muhajiroun, Construction of Narrative

# **MASTER OF SCIENCE IN INFORMATION SYSTEMS AND OPERATIONS**

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## **DISRUPTING SOMALI PIRACY VIA TRUST AND INFLUENCE OPERATIONS**

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**Master of Science in Information Systems and Operations–June 2009**

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**Second Reader: Steven J. Iatrou, Department of Information Sciences**

This thesis analyzes the piracy problem in East Africa, focusing specifically on Somali pirate networks. It provides an historical background of the political unrest in Somalia during the late 1980s and early 1990s, and the subsequent government collapse that followed, in an attempt to identify the root cause of the piracy problem and facilitate the derivation of solutions based on trust and influence operations. The study then examines the make-up, motivation, and structure of Somali pirate networks to understand how they organize and operate and how the organizations might be disrupted. The study addresses current anti-piracy efforts and the reasons why they are ineffective in preventing and deterring Somali pirates. Alternative solutions based on instilling distrust and suspicion within the pirate groups, and undermining the alliances between the groups and their support structures, are proposed. The techniques and methods proposed in this study have been used to disrupt criminal organizations in the past and they may be effective in combating Somali piracy.

**KEYWORDS:** Piracy, Somalia, Somali Piracy, Trust, Influence, Networks, Disruption, Africa, Pirates, Trust and Influence Operations, Information Operations



# **MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT**

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## **RAPID, VALUE-BASED, EVOLUTIONARY ACQUISITION AND ITS APPLICATION TO A USMC TACTICAL SERVICE-ORIENTED ARCHITECTURE**

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Acquisition project success versus failure is defined from the perspective of the system operator, or the warfighter for Department of Defense tactical systems. Using this definition, causes of project failure are analyzed in terms of the system itself and in terms of the timeliness of the acquisition process, pointing out the value of a rapid process. This analysis serves as the foundation for the introduction of rapid, value-based, evolutionary acquisition, or RVEA. The principles of RVEA focus on rapidly and iteratively providing valued products to the warfighters, while continually concentrating on how the acquisition action officer can improve the next product and the acquisition process itself. This thesis applies the principles of RVEA to a system of direct interest to the Marine Corps, a tactical service-oriented architecture, anticipating increasing the chances of its successful acquisition.

**KEYWORDS:** Acquisition, Defense Acquisition, Rapid Acquisition, Project Management, Program Management, Service Oriented Architecture, Tactical Service Oriented Architecture

## **FACILITATING DECISION MAKING, REUSE, AND COLLABORATION: A KNOWLEDGE- MANAGEMENT APPROACH TO ACQUISITION PROGRAM SELF-AWARENESS**

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**Master of Science in Systems Technology—June 2009**

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Decades of reform have been largely ineffective in improving the efficiency of the Department of Defense acquisition system. Such inefficiency is, in part, due to complex processes and stovepipe activities that result in duplication of effort, lack of reuse, and limited collaboration on related development efforts. This research applies knowledge-management (KM) concepts and methodologies to the DoD acquisition enterprise to increase “program self-awareness.” This research supports the implementation of reform initiatives such as capability portfolio management and open systems architecture, which share the common objectives of reducing duplication of effort and promoting collaboration and re-use of components. The DoD maritime domain awareness (MDA) program will be used as a test case to apply KM tools to identify duplication and/or gaps in the features of select MDA technologies. This paper may also provide the foundation for future development of the program self-awareness concept and KM tools to support decision-making and to improve the effectiveness of the DoD acquisition system.

## INFORMATION TECHNOLOGY MANAGEMENT

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**KEYWORDS:** Defense Acquisition System, Knowledge Management, KM, Open Architecture, OA, Capability Portfolio Management, CPM, Business Intelligence, BI, Maritime Domain Awareness, MDA, Data Mining, Text Mining, Data Visualization, Program Self-Awareness

# **MASTER OF SCIENCE IN MANAGEMENT**

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## **OPTIONS FOR MEETING U.S. NAVY FOREIGN LANGUAGE AND CULTURAL EXPERTISE REQUIREMENTS IN THE POST 9/11 SECURITY ENVIRONMENT**

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Stephen L. Mehay, Graduate School of Business and Public Policy  
William D. Hatch, Graduate School of Business and Public Policy**

This thesis examines foreign language and cultural awareness skills vital to the U.S. Navy, analyzes the stock of such skills already resident in the Navy, and explores options for meeting current and future requirements for these skills. Information sources include a comprehensive review of literature. This thesis also reviews Defense- and Navy-identified, mission-critical, foreign-language proficiency and cultural-awareness skills, and the manpower requirements and billets requiring such skills. Navy linguists, concentrated in the Cryptologic Technician Interpretive (CTI) rating, require up to two years of foreign language and technical training, a top secret security clearance, and eligibility for sensitive compartmented information. CTIs increasingly perform foreign language duties outside of their core intelligence-analyst competencies, such as translator or interpreter, which could be filled by sailors who are native speakers. However, security clearance requirements of the CTI rating typically exclude sailors who possess the native foreign language skills and cultural background. This thesis investigates how to optimize resident Naval foreign language and cultural diversity; and proposes alternative recruitment, training, employment, and retention methods. It recommends that the Navy develop a Translator/Interpreter rating for those ineligible for security clearances, reinstitute the Warrant Officer-1 rank, and pay ad hoc linguists.

**KEYWORDS:** Foreign Language, Cultural Awareness, Enlistees, Global War on Terror, Noncitizens, U.S. Navy, Citizenship, Translator/Interpreter, Linguist

## **THE EFFECTS OF INCORPORATING NETC SCHOOL ENROLLMENT DATA IN THE NAVY'S REENLISTMENT PREDICTION (ROGER) MODEL**

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The Navy's Selective Reenlistment Bonus Management System (SRBMS) uses a model known as ROGER to identify the SRB-eligible population and to predict the number of SRB takers for the following fiscal year. The Enlisted Bonus Manager uses the ROGER model to determine the SRB plans during the execution year. Over the years, constant changes in the structure of the SRB program have led to increased levels of predictive error in the ROGER model. Specifically, the ROGER model has routinely under-identified the SRB-eligible population, which, in turn, led to under-predictions in the size of the predicted number of SRB takers and the SRB budget. One of the reasons for the under-predictions is that the ROGER model does not account for sailors who acquire an SRB-eligible NEC during the execution year.

The objective of this thesis is to determine whether the predictive errors in the Navy's SRBMS (ROGER) model can be reduced by accounting for new NEC/skill acquisition by sailors each fiscal year. NEC/skill acquisitions are accounted for by incorporating data from the Naval Education and Training Command (NETC) on annual school enrollments and graduations into the ROGER model. This thesis analyzes the impact of adding the NETC skill-acquisition data to the ROGER model by analyzing the predicted SRB-eligible population and the predicted number of SRB takers and by assessing the resulting impact on the predicted SRB budget.

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## MANAGEMENT

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**KEYWORDS:** Selective Reenlistment Bonus Management System, SRBMS, ROGER Model, CeTARS

**APPLYING THE COMBINATORIAL-RETENTION-AUCTION MECHANISM TO A COST-BENEFIT ANALYSIS OF THE POST-9/11-ERA GI BILL TRANSFERABILITY BENEFIT**

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**Master of Science in Management–June 2009**

**Advisor: Bill Gates, Graduate School of Business and Public Policy**

**Second Reader: Pete Coughlan, Graduate School of Business and Public Policy**

This research determines the costs, benefits, and efficiency of the post-9/11-era GI Bill transferability benefit by employing four different mechanisms that provide retention levels of sailors who value the transferability benefit more than or less than the cost of transferability. The mechanisms utilized are a purely monetary auction, a universal incentive package (UIP) auction, the combinatorial-retention-auction mechanism (CRAM), and the positive/negative surplus evaluation.

All four mechanisms are simulated, data are analyzed, and results are compared. The CRAM is clearly shown to be the most efficient method for meeting retention objectives while maximizing cost savings to the Navy. Cost savings to the Navy range from 27% to 51% over cash-only selective reenlistment bonuses (SRB).

Furthermore, this report confirms that an across-the-board benefit such as GI Bill transferability significantly reduces the positive surplus when more sailors who have a value of transferability less than the cost of transferability exploit it.

Maintaining the status quo SRB policy, combined with the estimated negative retention effects of the GI Bill transferability benefit, only magnifies the cost ineffectiveness of the post-9/11-era GI Bill.

**KEYWORDS:** MGIB, Post 9/11 Era GI Bill Transferability, CRAM, Universal Incentive Package, UIP, Selective Reenlistment Bonus, SRB, Non-Monetary Incentive, NMI, Retention, Total Reward, Auction, Positive Surplus, Negative Surplus

**DOES THE METHOD OF INSTRUCTION AFFECT THE PERFORMANCE OF SAILORS IN THE TUITION-ASSISTANCE PROGRAM?**

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This study analyzes the impact of the Navy's tuition assistance (TA) program on the retention and performance of first-term Navy enlisted personnel by method of instruction. This study is unique in that it estimates the effect of overall TA usage, as well as the effect of courses delivered via distance learning (DL) versus courses delivered via traditional methods of instruction. In 2006 DL surpassed traditional classroom courses as the most commonly used form of TA. DL usage grew 1000% between FY2000 and 2007, while traditional classroom usage dropped by 29%. This study utilizes a natural control group as proposed by Mehay and Pema (2009) to produce estimates that adjust for potential selection bias in the retention and performance models. Further, the study includes nine accession cohorts between 1994 and 2003 to increase the generalizability of the results. The recruits are tracked through their first four years of service. The analysis indicates that DL usage has greater positive effects on the performance of sailors than traditional classes. Additionally, the study finds that the course-passing rates depend on the subject and method of delivery. In particular, certain courses delivered via DL are associated with lower passing rates for TA-users.

**KEYWORDS:** Tuition Assistance Program, TA Program, Retention, Performance, Distance Learning, DL, Method of Instruction, Passing Rates

# MASTER OF SCIENCE IN MECHANICAL ENGINEERING

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## STALL ANALYSIS IN A TRANSONIC COMPRESSOR STAGE AND ROTOR

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Master of Science in Mechanical Engineering–June 2009

Advisor: Anthony J. Gannon, Department of Mechanical and Astronautical Engineering

Second Reader: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

Gas-turbine engine design is based on simplifying assumptions, including axi-symmetric flow. These assumptions break down in the real machines, especially when operating near to stall. The reduction in operating surge margin associated with current trends to develop high-performance military fighter aircraft further highlights the need to develop a thorough understanding of the flow in rotor blade passages, especially when operating close to stall. This research investigates the behavior of a transonic compressor rig (TCR) as it approaches stall in the rotor-only and full-stage configuration using combinations of frequency and time domain analysis in the subsonic (70% rated speed), sonic (80% rated speed), and transonic ranges (90%, 95%, and 100% rated speed). A steady state analysis of the pressure measurements across a rotor passage of the TCR is conducted to identify potential pre-stall indicators, the structure of the flow field within the blade passages, and to correlate changes in flow structure with changes in pressure measurements. Further investigation using flow visualization techniques within the blade passages demonstrates how the TCR rotor departs from an idealized rotor when the axi-symmetric assumption holds in steady operation and near stall. This identification of potential stall indicators and characterization of the time-variant flow field within the passages will impact future compressor design to enable operation closer to stall and increased performance across an operating spectrum.

**KEYWORDS:** Compressor, Transonic, Stall, Surge

## FRICION-STIR PROCESSING OF AS-CAST AA5083: SUPERPLASTIC RESPONSE

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Jianqing Su, National Research Council Research Associate

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Plates of continuously cast AA5083 are subjected to friction stir processing (FSP) by three overlapping plunge and traverses. The FSP uses a threaded pin tool with a pin diameter of 3 mm, a pin length of 3 mm, and a shoulder diameter of 10 mm. The process is run at constant tool rotation and traverse speeds of 800 rpm and 76.2 mm min<sup>-1</sup>, respectively. The microstructure of the processed region is examined by optical microscopy and orientation imaging microscopy. FSP of the AA5083 reduces the average grain size from approximately 60 μm in the base metal to 3-4 μm in the processed zone. In addition, it creates a homogeneous microstructure and, in particular, a refined and homogenous particle distribution without damage to the particles. Large tensile samples with gage sections of 1x3x8 mm are prepared by wire EDM for high-temperature tension testing. Tensile tests are carried out at 450°C under different strain rates. The relationship between strain rate and elongation is established. A maximum superplastic elongation of ~550% is obtained at a strain rate of  $3 \times 10^{-3} \text{ s}^{-1}$ . The formation mechanism of refined grain structure and the superplastic characteristic of FSP material is discussed.

**KEYWORDS:** Friction Stir Processing, Superplasticity, Elevated Temperature, Aluminum, Grain Refinement, Strain Rate

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# MECHANICAL ENGINEERING

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## A COMPUTATIONAL FLUID DYNAMIC MODEL OF STEAM INGESTION INTO A TRANSONIC COMPRESSOR

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**Master of Science in Mechanical Engineering–June 2009**

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The U.S. Navy's concern with steam-induced jet-engine stall has become more pertinent with the introduction of the F-35C. During takeoffs on aircraft carriers, steam from aging catapult systems can potentially seep onto the flight deck. When ingested into jet engines, this steam may increase the engines' susceptibility to stall. The serpentine air-inlet ducts and single engine of the F-35C could make it especially vulnerable to this steam-induced stall during takeoff. To better understand and predict steam-induced stall, this study creates a computational fluid dynamics (CFD) simulation of steam-induced stall on a single blade passage of a compressor rotor. A single blade passage of the transonic Sanger rotor is generated using computer-modeling software. This model is then used in the ANSYS CFX computational fluid dynamics program to simulate steady-state and steam-ingestion operations at 95% and 100% rotor design speeds. These CFD simulations generate compressor maps and throttle and steam-induced stall points. The CFD results are then compared to results from throttle-induced stall and steam-induced stall experiments conducted on the Sanger rotor in the transonic compressor rig. This study verifies that CFD can estimate steam-induced stall operating margin reduction.

**KEYWORDS:** Computational Fluid Dynamics, Transonic, Compressor, Steam Ingestion, Sanger Rotor

## SCARF JOINT MODELING AND ANALYSIS OF COMPOSITE MATERIALS

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**Master of Science in Mechanical Engineering–June 2009**

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**Second Reader: Douglas C. Loup, NSWSCCD**

The objective of this study is to investigate the joint strength of the scarf joint configuration, constructed from carbon and glass-woven fabric hybrid laminates, with different material combinations. Glass/glass, glass/carbon, carbon/glass, and carbon/carbon are tested under various loading conditions, such as tension, compression, bending and shear loading. Both experimental and computational studies are conducted. For the experimental study, specimens made of scarf joints using carbon and glass-woven fabrics are tested under compressive loadings to determine their joint failure strengths. Computational models are then developed to predict the joint strengths under the same conditions as in the experiments using the discrete resin layer model along with fracture mechanics and virtual crack-closure techniques. The comparisons are good. Once the computational models are validated from the test results, the scarf joint strengths are computed under different loading conditions.

**KEYWORDS:** Scarf Joint, Finite Element Method, Energy Release Rate, Virtual Crack Closure Method, Ansys, Composites, Overlap Joint, Fracture Mechanics

## COOPERATIVE CONTROL OF DISTRIBUTED AUTONOMOUS SYSTEMS WITH APPLICATIONS TO WIRELESS-SENSOR NETWORKS

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**Isaac I. Kaminer, Department of Mechanical and Astronautical Engineering**

This thesis extends previously developed, self-tuning, adaptive-control algorithms to be applied to a scenario where multiple vehicles autonomously form a communication chain that maximizes the bandwidth of a wireless-sensor network. In the simulated scenario, multiple unmanned, aerial vehicles (UAV) are guided to positions that optimize communication links between multiple ground antennas. Guidance is provided by a self-tuning extremum controller,

which uses adaptive techniques to autonomously guide a vehicle to the optimal location with respect to a cost function in an uncertain and noisy environment. In the case of high-bandwidth communication, this optimal location is the point where the signal-to-noise ratio is maximized between two antennas. Using UAVs as relay nodes, an optimized communication chain allows for greater communication range and bandwidth across a network. Control system models are developed and tested using computer and hardware-in-the-loop simulations, which will be validated with a flight test at a future date.

**KEYWORDS:** Unmanned Aerial Vehicle, UAV, Extremum Seeking, Simulink, High Bandwidth Communication Links, SNR Model, Coordinated Control, Cooperative Control, Decentralized Control, Wireless Sensor Network



# MASTER OF SCIENCE IN METEOROLOGY

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## CLIMATE ANALYSIS AND LONG-RANGE FORECASTING OF RADAR PERFORMANCE IN THE WESTERN NORTH PACIFIC

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**Master of Science in Meteorology–June 2009**

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**Paul A. Frederickson, Department of Meteorology**

The ability to predict the evaporative duct has important applications for naval activities, such as electronic countermeasures, surveillance, communications, and the radar detection and tracking of submarine periscopes, low-flying missiles and aircraft, and surface combatants. This study addresses two major research questions: 1) can state-of-the-science datasets, models, and methods be used to create more accurate and useful climatologies of atmospheric radar propagation, and 2) can skillful long-range forecasts (LRFs) of evaporative duct heights and radar detection ranges be developed for mission planning purposes?

To answer these questions, modern climate datasets and methods are applied to investigate climate scale variations in evaporative duct height (EDH) and radar detection range (RDR) in the western north Pacific (WNP). Multi-decadal hindcasts of winds, EDH, and RDR in the WNP are also conducted to assess the potential for producing skillful LRFs of these variables. Significant variations that have the potential to be predicted at lead times of one to four months are identified. Analyses of these and similar variations have the potential to significantly improve electromagnetic (EM) propagation climatologies by providing a more complete description of the range of possible environmental conditions for which military planners need to prepare. LRFs of these variations have the potential to provide planners with predictions of which variation is most probable for a given time and location. The combination of such climate analyses and LRFs can provide environmental guidance, for example, guidance for use in planning antisubmarine warfare operators in the WNP.

**KEYWORDS:** Climatology, Smart Climatology, Evaporative Duct Height, Radar Detection Ranges, Western North Pacific, East China Sea, Radar Propagation, Sensor Performance, Performance Surface, Climate Variations, U.S. Navy, El Nino, La Nina, NPS ED Model, AREPS

## STATISTICAL-DYNAMICAL FORECASTING OF TROPICAL CYCLOGENESIS IN THE NORTH ATLANTIC AT INTRA-SEASONAL LEAD TIMES

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**B.S., Naval Postgraduate School, 2004**

**Master of Science in Meteorology–June 2009**

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**David W. Meyer, Department of Operations Research**

The research team created a combined statistical-dynamical model to predict the probability of tropical cyclone (TC) formation at daily,  $2.5^\circ$  horizontal resolution in the North Atlantic (NA) at intraseasonal lead times. Based on prior research and their own analyses, the researchers chose five large-scale environmental factors (LSEFs) to represent favorable environments for TC formation. The LSEFs include 850 mb relative vorticity, sea surface temperature, vertical wind shear, Coriolis, and 200–mb divergence. The team uses logistic regression to create a statistical model that depicts the probability for TC formation based on these LSEFs. Through verification of zero lead hindcasts, it is determined that the regression model performs better than climatology. For example, these hindcasts had a Brier skill score of 0.04 and a relative operating characteristic skill score of 0.72. The researchers then forced the regression model with LSEF fields from the NCEP Climate Forecast System to produce non-zero lead hindcasts and

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forecasts. The team conducted a series of case studies to evaluate and study the predictive skill of the regression model; results show that the model produces promising results at intraseasonal lead times.

**KEYWORDS:** Tropical Cyclones, Tropical Cyclogenesis, North Atlantic, Intraseasonal Forecasting, Smart Climatology, Tropical Genesis Parameters, Large Scale Environmental Factors, NCEP Climate Forecast System

# MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

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## CLIMATE ANALYSIS AND LONG-RANGE FORECASTING OF DUST STORMS IN IRAQ

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Master of Science in Meteorology and Physical Oceanography–June 2009

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CDR Rebecca Stone, USN, Department of Oceanography

Skillful, long-range forecasts of dust storms have the potential to be very useful in planning operations by the Department of Defense and other organizations. This study assesses the potential to predict Iraq dust storms at long lead-times (e.g., several weeks to several months). The authors examine two variables associated with dust storms: precipitation rate and surface winds. To characterize conditions during dust storms, the authors generate averages (conditional means) of Iraq precipitation prior to, and winds during, dust storms, as well as the anomalies in those variables, and compare them to their long-term means. The authors then identify statistically significant correlations between those Iraq variables and remote climate system variables. Those correlations are used to develop two long-range predictors of dust-favorable precipitation and winds in Iraq: a) sea surface temperature in the Indian Ocean, and b) an index of the difference between sea level pressure near Tunisia and Kazakhstan (an indicator of surface winds). The authors use these predictors in an adaptation of the composite analysis forecast (CAF) method to hindcast and forecast dust-favorable conditions in Iraq at lead-times of one and two months. Verification of the results indicates that this method has a high potential for producing skillful, long-range forecasts of the potential for dust storms in Iraq.

**KEYWORDS:** Iraq, Climatology, Long Range Forecast, Composite Analysis Forecast, CAF, Dust, Military Operations, Climate, Seasonal Forecast, Shamal, El Nino, La Nina, Precipitation Rate, Statistical Forecast



# **MASTER OF SCIENCE IN MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION**

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## **AN EVALUATION OF THE TACTILE SITUATION AWARENESS SYSTEM AS AN AID FOR IMPROVING AIRCRAFT CONTROL DURING PERIODS OF IMPAIRED VISION**

**James S. Brown—Lieutenant Commander, United States Navy**

**B.S., United States Naval Academy, 1995**

**Master of Science in Modeling, Virtual Environments, and Simulation—June 2009**

**Advisor: William J. Becker, MOVES Institute**

**Second Reader: Michael E. McCauley, Department of Operations Research**

This thesis describes the use of a prototype tactile situational awareness system (TSAS) as an approach to aid pilot performance following simulated laser blindness modeled during a virtual approach in an SH-60 helicopter. Situational awareness and spatial awareness remain critical factors for successful control of manned aircraft. Helicopter and fixed-winged aircraft pilots react to spatial orientation challenges during the takeoff and landing phases of flight. U.S. and NATO aircraft pilot surveys examined the human-machine interaction and revealed degraded vision as an important human factor contributing to mishaps or near mishaps. Vision was identified as an information chokepoint limiting command and control of the aircraft. Fortunately, restricted or limited human vision can be augmented with available technology in haptics. Therefore, an experiment using X-Plane output for haptics-generated input from a torso-worn TSAS is developed. Participants receive haptic cues during runway approaches after experiencing simulated loss of vision. Participant performance after simulated laser blinding with and without the TSAS compares time advantage and navigation accuracy. Simulator performance data indicates that pilots using TSAS following simulated laser blindness respond to haptic cues, have more time to prevent the aircraft from obtaining an unsafe pitch or roll condition, and could position the aircraft closer to the landing zone.

**KEYWORDS:** Aviation, Haptics, Human Factors, Modeling and Simulation, Situational Awareness, Telepresence, Virtual Environments, Human Computer Interface



# MASTER OF SCIENCE IN OPERATIONS RESEARCH

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## MODELING THE AIM-9 SIDEWINDER REPAIR LINE THROUGH DISCRETE-EVENT SIMULATION

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Master of Science in Operations Research—June 2009

Advisor: Robert L. Shearer, Department of Operations Research

Second Reader: Kirk C. Benson, Army Material Systems Analysis Activity

Tobyhanna Army Depot (TYAD) is required through Department of Defense (DoD) Lean initiatives and directives to reduce the cycle time of its repair and overhaul lines. The activities involved at DoD repair and overhaul depot facilities are a multi-billion dollar expenditure within the DoD budget. The DoD, in an attempt to reduce expenditures, has focused on Lean manufacturing as an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste across all depot systems and processes. A discrete-event simulation model is established to study the AIM-9 Sidewinder Missile repair process line, specifically the repair of the guidance and control section component of the missile. TYAD does not currently employ a computer simulation model to support the leaning technique for its repair and overhaul processes. This thesis is the first attempt to model the Sidewinder repair line with a computer-aided discrete-event simulation. TYAD will implement results from this analysis to help reduce cycle time and garner insights into current policies and procedures employed on the Sidewinder repair line. TYAD has identified potential for future use of this analysis by employing the technique of discrete event simulation to augment its DoD-mandated Leaning procedures.

**KEYWORDS:** Discrete Event Simulation, Sidewinder Repair Line Model

## THE RISK OF USING THE PAST TO PREDICT THE FUTURE: A CASE STUDY OF JAMMING RADIO-CONTROLLED, IMPROVISED, EXPLOSIVE DEVICES

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Master of Science in Operations Research—June 2009

Advisor: Kyle Y. Lin, Department of Operations Research

Second Reader: Michael A. Herrera, Department of Information Sciences

The radio-controlled, improvised, explosive device (RCIED) is one of the deadliest threats to military personnel supporting the global war on terrorism. Due to its success, the RCIED is expected to play a major role as a weapon of choice in future insurgencies. To mitigate the risk of an RCIED attack, electronic jamming devices are utilized to interrupt the communications between a remote control and the RCIED trigger. In this research, two approaches are considered to determine the optimal jamming strategy for the coalition force. First, a mixed integer program based on recent RCIED attack data is formulated to find the optimal jamming strategy. Second, a two-person zero-sum game is formulated to determine the optimal mixed strategy for jamming. With a simulation study, it is found that with the first approach the coalition force tends to be overly optimistic in predicting the outcome, and is likely to underperform. In addition, the first approach allows the possibility for smart insurgents to deploy RCIEDs to purposely mislead the coalition force on what they plan to do in the future. The second game-theoretic approach provides a robust jamming strategy no matter how Red chooses to deploy their RCIEDs.

**KEYWORDS:** Game Theory, Zero-Sum Game, Radio Controlled Improvised Explosive Device Loadset, RCIED Loadset, Active Jamming Loadset, Optimizing Active Jamming Loadset

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# OPERATIONS RESEARCH

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## DETERMINATION OF CRITICAL FACTORS IN UNMANNED CASUALTY EVACUATION IN THE DISTRIBUTED ENVIRONMENT

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Master of Science in Operations Research—June 2009

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Second Reader: Sergio Posadas, Department of Operations Research

The current battlefield is changing rapidly. Combat operations against irregular forces are set in a dispersed, non-linear battlefield. Vast distances between small units (such as the infantry squad), and the distances from these small elements to their supporting organizations, pose unique challenges.

Casualty evacuation is an evolving challenge. The goal of casualty evacuation is to transport an injured Marine from the point of injury to a medical care facility. Increased dispersion results in longer distances from the point of injury to a medical care facility, with a corresponding increase in the delay between the time of injury and life-saving surgical care. The non-linear aspects of this battlefield increase the threat to aircraft crews and platforms conducting casualty evacuation.

Unmanned, aerial systems offer an alternative means of air casualty evacuation. This alternative may provide time-critical response while reducing the threat to aircraft crews.

This thesis determines the probability distribution of mission completion times and identifies the most influential factors on mission success.

**KEYWORDS:** Simulation, Design of Experiments, DOE, Unmanned Little Bird, Unmanned Aerial Systems, Casualty Evacuation, CASEVAC, Enhanced Company Operations

## EFFICIENT RETIREMENT FINANCIAL PLANS: AN INVERSE OPTIMIZATION AND PARAMETERIZATION OF INTERTEMPORAL DISCOUNTED HABIT FORMATION UTILITY

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Master of Science in Operations Research—June 2009

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Second Reader: William F. Sharpe, STANCO 25, Stanford University

Over the past decade, retirement systems have undergone significant changes, shifting from employer-sponsored pension plans to defined contribution plans, commonly referred to as 401(k) or individual retirement accounts (IRA). A critical aspect of these plans is that the individual, as opposed to the employer, is responsible for managing the account and its associated investments.

Demographic data indicates that the proportion of the American population older than 55 is projected to increase considerably through 2050. In the very near future, millions of Americans will require sound advice regarding a myriad of retirement financial decisions.

Retirement strategies currently employed by financial planners are based on rules of thumb and have been shown to be inefficient and poorly matched with retiree preference. This thesis demonstrates the feasibility of applying inverse optimization and utility maximization as a means of developing efficient retirement portfolios based on individual investment preferences.

A survey is administered to collect investment preference data. Next, a habit formation utility model is implemented and a bi-level inverse optimization technique is developed to quantify, estimate, and parameterize retiree preference. Using this estimate, preference-based optimal investment portfolios are generated.

**KEYWORDS:** Nonlinear Optimization, Retirement, Habit Formation, Maximum Utility, 4% Rule, Asset Allocation, Optimal Investment Portfolio, Inverse Optimization, Investment Survey

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# OPERATIONS RESEARCH

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## OPTIMIZING OPERATIONAL AND LOGISTICAL PLANNING IN A THEATER OF OPERATIONS

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**Master of Science in Operations Research–June 2009**

**Advisor: Gerald G. Brown, Department of Operations Research**

**Second Reader: Kevin J. Maher, Department of Operations Research**

The United States Navy (USN) and other allied naval forces deploy their ships worldwide to support and conduct various maritime missions ranging from humanitarian aid to combat. In order to accomplish these missions and maintain a sustained deployment, it is paramount to establish a robust means of logistic support. This research presents two operational planning tools to respectively plan Combat Logistics Force shuttle-ship schedules to simultaneously support all U.S. Navy operating ships worldwide, and a Navy Mission Planner with new logistics features to decide where combatants should locate to perform their missions in a particular area of operations, and how to arrange logistics support of these combatants. These operational decision aids use optimization to suggest alternate courses of action for operational and logistics planners to consider. This project includes a discussion regarding how the former model has been used by the U.S. Second Fleet in their Trident Warrior 09 exercise. A face valid scenario is presented for the Navy Mission planner showing different planning results when logistics are incorporated into the planning process.

**KEYWORDS:** Optimization, Navy Logistics, Operational Planning, Navy Mission Planner, Combat Logistic Force Planner, Ship Scheduling, Optimization Decision Aid, Integer Programming, Mathematical Programming

## COMBAT SIMULATION OF INDIVIDUAL SOLDIER SEARCH IN URBAN TERRAIN

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**Master of Science in Operations Research–June 2009**

**Advisor: Timothy H. Chung, Department of Operations Research**

**Second Reader: Paul F. Evangelista, TRAC-Monterey**

This thesis investigates the search process and the effect of contextual information on the search process in an urban combat environment. High-resolution combat-simulation models implement a parallel sweeping or “windshield wiper” search process that is not representative of human visual-search behavior. Furthermore, combat models do not account for additional situational awareness in the form of contextual information. This thesis proposes a Discrete Myopic Search Model, which is a statistical model based on human performance data. This model prioritizes search efforts where participants believe that targets are most likely to occur. Nineteen volunteers search 16 static urban scenes with zero to five targets. These data are used to develop probabilities that a target is located in each cell in each discretized scene. The Discrete Myopic Search Model chooses the cell with the highest probability for each discrete look. Hypothesis testing on experimental data reveals a nearly 20% increase in search performance of the Discrete Myopic Search Model over the windshield wiper model. Further investigation reveals a significant change in search behavior and detection performance based on the addition of contextual information. This research shows that combat models should prioritize search patterns and account for added situational awareness.

**KEYWORDS:** Visual Search, Fixation, Contextual Information, Myopic Search, Eye Tracking, Combat Models

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# OPERATIONS RESEARCH

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## THE ASSOCIATION BETWEEN DRIVER-REPORTED SLEEP AND PREDICTED LEVELS OF EFFECTIVENESS BASED ON THE FATIGUE-AVOIDANCE SCHEDULING TOOL

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Master of Science in Operations Research—June 2009

Advisor: Nita L. Miller, Department of Operations Research

Second Reader: Matthew G. Boensel, Department of Systems Engineering

Current military operations require a high state of operational readiness. Service members and civilian workers are tasked with performing in a near-non-stop environment without proper rest and recuperation. Unit and individual effectiveness depend upon initiative, judgment, courage, and motivation, which are all enhanced by the ability to think clearly and logically – attributes that are degraded by fatigue. This thesis seeks to determine the extent to which fatigue plays a part in human-factors-related large-truck mishaps. This study is conducted using the Large Truck Crash Causation Study database and assesses drivers' predicted level of effectiveness employing the Sleep, Activity, Fatigue, and Task Effectiveness Model as instantiated in the Fatigue-Avoidance Scheduling Tool (FAST). The entire population of truck crashes is categorized into two groups, those with human factors causes, and those with non-human factors causes. A comparison of the two groups shows a statistically significant difference between the two groups in reported sleep and predicted levels of effectiveness. This result shows that fatigue is more prevalent and is potentially an important contributing factor to human-factors-related mishaps. Heightened levels of fatigue diminish situational awareness, judgment, and decision-making capabilities and can result in serious, sometimes even deadly consequences. It is recommended that fatigue avoidance strategies such as FAST be implemented in training and operational planning. Such strategies can assist in the development of more efficient and potentially safer sleep-work schedules.

**KEYWORDS:** Large Truck Crash, Long-Haul Truck Drivers, Heavy Truck Operations, Large Truck Crash Causation Study, Effects of Fatigue on Driver Performance, Long-Haul Operations, Commercial Transportation Carriers, Federal Motor Carrier Safety Administration, National Highway Traffic Safety Administration

## EVALUATING ALTERNATIVE NETWORK CONFIGURATIONS AND RESOURCE ALLOCATIONS FOR DEPLOYED MARINE CORPS AVIATION-LOGISTICS UNITS

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Master of Science in Operations Research—June 2009

Advisor: Moshe Kress, Department of Operations Research

Second Reader: David Alderson, Department of Operations Research

This thesis develops a model and performs an analysis to estimate the operational effectiveness of the Marine Aviation Logistics Support Program II (MALSP II) under different system configurations and resource allocation policies. MALSP II is designed to protect the aviation logistics system from uncertain, possibly high-variance demand that could have a significant detrimental impact on the material readiness of deployed aircraft. Although a MALSP II pilot program has produced positive results since 2005, the overall design of the logistical support network has not yet been evaluated. An inter-temporal network simulation model is developed that measures the operational effectiveness of the network—with and without an additional level of supply called an Enroute Support Base—using four inventory buffer sizing policies. Two measures of effectiveness (MOE) are used: PackUp Effectiveness and PartShort. Packup Effectiveness is the current metric used by the Marine Corps to evaluate aviation logistics performance in a deployed setting. It represents the percentage of demands satisfied on the day demanded. PartShort, which is a new MOE proposed in this thesis, represents the magnitude and duration of unsatisfied demands during a certain finite-time horizon. For different levels of acceptable risk, recommendations are provided for network configurations and inventory buffer levels. These results can help operational planners improve the efficiency of available resources and maximize the effectiveness of logistical support to deployed bases.

**KEYWORDS:** MALSP II, Inter-Temporal Network Simulation Model, Simulation Model, Marine Corps Aviation Logistics, Deployed Aviation Logistics

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# OPERATIONS RESEARCH

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## AN ANALYSIS OF SENSOR EFFECTIVENESS TO INFORM A PREDICTIVE MAINTENANCE POLICY

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**Master of Science in Operations Research—June 2009**

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**Donald P. Gaver, Department of Operations Research**

**Second Reader: Roberto Szechtman, Department of Operations Research**

Joint Vision 2020 presents a plan for military dominance over the spectrum of military operations. One program that allows this to happen is Performance Logistics, which intends to increase availability and lower life-cycle costs for weapon platforms. The ability to sense impending failures plays an important role in Performance Logistics. This thesis studies how sensor performance, as a tool of condition-based maintenance, affects the availability and cost of a generic component. Different types of maintenance policies are evaluated and compared using mathematical models. The maintenance protocols considered are reactive and proactive: run to failure, scheduled inspection times, sensor-based, and a combined inspection and sensor policy. Given parameters such as time and cost of repairs due to warnings or failures and frequency of inspection, it is found that a sensor influences the benefits of implementing a condition-based maintenance policy. In this thesis, results show improvement in availability and a reduced long-run, average operating cost when the median of the random ratio of warning to failure time is roughly 0.8; the standard deviation is less than 0.1; and the mean time of maintenance for failure is greater than three times the mean time of repair due to warning.

**KEYWORDS:** Condition Based Maintenance, CBM+, Renewal Reward Process, Correlated Failure Time and Warning Time of Impending Failure

## ASCERTAINING VALIDITY IN THE ABSTRACT REALM OF PMESII SIMULATION MODELS: AN ANALYSIS OF THE PEACE-SUPPORT OPERATION MODEL

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**Master of Science in Operations Research—June 2009**

**Advisor: Thomas W. Lucas, Operations Research**

**Second Reader: Seth A. Howell, DoD Civilian**

The Department of Defense has recently declared that irregular warfare is as strategically important as traditional warfare. Unfortunately, there is a dearth of mature training and analysis tools that can be used to support contemporary military operations. One popular wargaming simulation is the campaign-level Peace Support Operations Model (PSOM). This thesis provides a quantitative analysis of PSOM. The results are based on over 75,000 simulated runs of an *Operation Iraqi Freedom* scenario. The study concludes with the identification of the critical factors within PSOM, recommended potential uses for the model, an accuracy assessment, and an assessment of the risks assumed by using the model. Results indicate that the critical factors within the model are indicative of contemporary operations. PSOM should be used for its original purpose, as a wargame to further study the societal implications of modern military operations. As a wargame, PSOM has strong potential as a high-level staff and leader training tool and as a planning aid for course-of-action development. Within the confines of this study, the model proves limited in its ability to model changes in force capabilities. Due to its limited ability to 1) model uncertainties in irregular warfare without the human-in-the-loop or 2) give multiple potential outcomes, further development and analysis is required before the model is used for large-scale analysis.

**KEYWORDS:** PSOM, Design of Experiment, PMESII Models, Social Modeling, Peace Support Operations Model, Irregular Warfare Models, Simulation

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# OPERATIONS RESEARCH

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## OPTIMAL TRANSMITTER PLACEMENT IN WIRELESS MESH NETWORKS

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**Master of Science in Operations Research—June 2009**

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**Second Reader: Brian Steckler, Department of Information Sciences**

Wireless mesh networks are systems of wireless access points interconnected in a mesh to provide digital services to client devices via radio transmission. The challenges of quickly and optimally designing a wireless mesh network are considered in this research. The focus is on maximizing the client coverage area by choice of access point locations, subject to constraints on network service, quantity and technical capabilities of access points, environmental information, and radio propagation over terrain. A non-differentiable, non-convex, nonlinear, optimization problem is created to quantify the value of a given network, and a sampling algorithm is used to quickly find very good solutions. Field tests are conducted using commercial equipment in real-world scenarios, and it is concluded that this technique can provide working wireless mesh network topologies. The techniques and associated decision support tool can be used by humanitarian assistance or disaster relief personnel and combat communications planners to quickly design wireless mesh networks. The decision support tool runs on a laptop computer, accepts map data in a generic file format, creates network topologies for virtually any type of terrain and mesh access point device, and does not require any additional software or solver licenses.

**KEYWORDS:** Wireless Mesh Networks, Humanitarian Assistance, Disaster Relief, Distributed Operations, Enhanced Company Operations, Network Design, Nonlinear Programming, Terrain Integrated Rough Earth Model, TIREM, Hata COST-231, Simultaneous Routing and Resource Allocation, Dividing Rectangles, DIRECT, Access Points, Access Point Placement

## EVALUATION AND COMPARISON OF THE FREEDOM-CLASS LITTORAL COMBAT SHIP AND OTHER FRIGATES/CORVETTES AGAINST SMALL BOAT, FPB, AND SUBMARINE THREATS IN CONFINED WATERS

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**Jeffrey E. Kline, Department of Operations Research**

**Second Reader: Thomas W. Lucas, Department of Operations Research**

This thesis compares the performance of the Freedom-class littoral combat ship (LCS) with five similar international frigates and corvettes in a littoral combat environment. The alternative ships are: the Formidable-class frigate, Singaporean navy; the MILGEM (Milli Gemi)-class corvette, Turkish navy; the Steregushchiy-class frigate, Russian navy; the Sigma-class corvette, Indonesian navy; and the Visby-class corvette, Swedish navy. The study is conducted within a fictitious scenario in the Strait of Hormuz, countering Iran's naval capabilities. Hughes' salvo equations model is used to evaluate a variable number of friendly combatants versus a fixed opposing force. The results identify the number of ships required to dominate the threat in the scenario.

Based on the comprehensive results, including changes by adding hardkill and introducing countermeasure effectiveness, an optimum design suggestion is made. In the end, optimum design is a relative subject because the issues of sustainment and cost play a significant role in the decision. The LCS is shown to be the most combat-effective performer, but its cost detracts from its operational advantages. MILGEM is a medium-size ship with high performance and lower cost, making her the most cost-effective candidate. Visby has the lowest cost and can be as combat-effective as others because of its stealth, but it is not nearly as sustainable. Thus, the decision depends on the weight placed on these several factors.

**KEYWORDS:** LCS, MILGEM, Formidable, Steregushchiy, Sigma, Visby, Iran, Strait of Hormuz, IRGN, Hughes' Salvo Equations, Surface Warfare, ASUW, ASW, C-802, C-701, Torpedo, ASCM, Harpoon, Exocet, RBS, RAM, CIWS, PDMS, SAM, SSM, Seahawk, Hellfire, Countermeasure Effectiveness, ECM, ESM, RCS, Jane's, MANA

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# OPERATIONS RESEARCH

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## OPTIMIZING THE EMPLOYMENT OF SEARCH PLATFORMS TO COUNTER SELF-PROPELLED SEMISUBMERSIBLES

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Self-propelled semi-submersibles now transport an estimated 75% of the cocaine originating from Colombia and headed for the United States. There are several types of search platforms (i.e., units to detect, classify, and interdict) employed by the Joint Interagency Task Force South to combat the semisubmersibles. A defender-attacker optimization model is used to maximize the defender's probability of successful detection and classification of the semi-submersible through the advantageous disposition of these search platforms against an intelligent attacker operating the semi-submersible. It is assumed that the attacker has imperfect knowledge of defender platform disposition, but is aware that there are defenders that must be avoided. Given this assumption, the solution to the defender-attacker model is a mixed (i.e., probabilistic) strategy for the defender and a least-risk path for the attacker. The defender-attacker model is demonstrated with both an eastern Pacific and a Caribbean scenario using five representative search-platform types whose detection and classification performance vary by platform and geography. In each of these cases, it is found that the model prescribes a face-valid defensive plan; defenders take advantage of geography by positioning at chokepoints in constrained waterways, and they provide coverage near attacker origins and destinations in the less geographically constrained scenarios.

**KEYWORDS:** Optimization, Mathematical Programming, Semisubmersibles, Search and Detection, Defender-Attacker Optimization

## IMPROVING MARINE CORPS TOTAL LIFECYCLE MANAGEMENT BY CONNECTING COLLECTED DATA AND SIMULATION

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Second Reader: Stephen H. Mount, Marine Corps Systems Command

Marine Corps Total Lifecycle Management (TLCM) is critical in meeting requirements established in Department of Defense Directive 4151.18, notably, “optimizing ... concepts to deliver efficient and effective performance to the operating forces.” Modeling and simulation (M&S) creates an opportunity to explore improvement opportunities before costly decisions are implemented. Unfortunately, applying M&S to TLCM efforts has been hampered in the past by an inefficient, error-prone process of moving gathered data to an M&S platform.

This research uses Visual Basic for Applications to link two Marine Corps TLCM tools: the Systems Operational Effectiveness Decision Support Tool (SOE DST) and the Total Lifecycle Management Assessment Tool (TLCM-AT). The Bridging Operational Logistics Tool (B-OLT) is created to allow TLCM-AT models to be built automatically, using existing SOE DST data and limited expert inputs.

The B-OLT—built models are assessed, exercised with state-of-the-art design of experiments, and used to predict future events.

The research shows a link between data currently collected, and simulation allows for quantitative analysis. This analysis explores the Marine Corps' data collection and summary techniques and their application to modeling, demonstrating how B-OLT can be used to aid in future analytical efforts.

**KEYWORDS:** Simulation, Design of Experiments, Life Cycle Management, VBA, Modeling

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# OPERATIONS RESEARCH

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## PREDICTING HOSPITAL ADMISSIONS WITH POISSON REGRESSION ANALYSIS

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In this thesis, Poisson regression is used to predict and analyze inpatient hospital admissions for two inpatient units (Four East and Four West) at the Naval Medical Center in San Diego. Data, including age group, gender, beneficiary category, enrollment site, and fiscal month, are collected for the patient population. This information is used along with additional details about past admissions, such as the location and source of admission. These data are fit to four different models that correspond to Four East (enrolled and un-enrolled beneficiaries) and Four West (enrolled and unenrolled beneficiaries). Stepwise selection techniques are used to arrive at final models. The final models are used to observe trends in predicted hospital admissions based on trends in current population sizes.

**KEYWORDS:** Poisson Regression, MTF, Military Treatment Facility, Hospital Admissions

## OPTIMIZING SECURITY-FORCE GENERATION

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**Second Reader: LTC P. Lee Ewing, USA, Department of Operations Research**

Manpower modeling plays a significant role in the growth and management of today's militaries. Unfortunately, existing models do not properly address the challenges facing the growth of recently established, indigenous security forces. This thesis develops a linear program to plan the generation of a recently established, indigenous security force over an unknown (infinite) horizon. The security force generation model (SFGM) is different from standard personnel models in four ways: it combines the growth of the enlisted and officer corps into a single model; it plans force growth over an infinite horizon; it provides a variable-time planning horizon with monthly and annual fidelity; and it incorporates the growth of the force through standard recruitment, a legacy force, and enlisted accessions. SFGM prescribes monthly and annual promotion rates, recruitment goals, accessions from the enlisted corps, and inclusion of the preexisting security apparatus. The SFGM is demonstrated using current data from the Afghan national army (ANA), under scenarios focused on the recently announced need to increase its size from 81,000 to 134,000 Soldiers. Analysis shows that the ANA is capable of reaching the desired end strength in 28 months, but this requires enlisted accessions as the primary means of filling the officer corps and inclusion of the legacy force. Without the legacy force, the officer corps will not reach its desired strength for five years.

**KEYWORDS:** Manpower Planning, Optimization, Infinite Horizon, Variable Time Model, Officer Management, Enlisted Management

## OPTIMIZING HELICOPTER ASSAULT SUPPORT IN A HIGH-DEMAND ENVIRONMENT

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**Matthew Carlyle, Department of Operations Research**

**Second Reader: Jeffrey E. Kline, Department of Operations Research**

Helicopter-assault support planning for a large Marine Corps operation is complex and time consuming. Hundreds of constraints and millions of potential solutions exist. The Marine Corps currently does this planning manually. The short planning deadline necessary to support the warfighters' logistical needs requires a quick solution; therefore, speed is usually more important than a tight guarantee of optimality. The Marine Assault Support Helicopter Planning Assistance Tool (MASHPAT) assists planners by leveraging automation speed and accuracy to consider

# OPERATIONS RESEARCH

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millions of solutions and suggest a desirable plan. It demonstrates an ability to produce more efficient plans faster. MASHPAT runs on Navy Marine Corps (NMCI) computers in theater and is available now at no cost.

**KEYWORDS:** Optimization, Math Programming, Helicopter Planning, Assault Support

## **AN EXPLORATION OF THE USE OF UNMANNED, AERIAL VEHICLES AND OTHER ASSETS TO ENHANCE BORDER PROTECTION**

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**Second Reader: Thomas Anderson, TRAC-Monterey**

Border protection is a vital national security issue for most countries. U.S. Customs and Border Protection (CBP) is responsible for protecting the borders of the U.S. from terrorism, human and drug smuggling, and illegal migration. The U.S. CBP improves manpower, technology, and infrastructure along the border through various projects.

In this study, part of the Tucson sector in Arizona is modeled in an agent-based model (MANA) to explore the effects of using a hand-launched, mini unmanned aerial vehicle (mini UAV) and other assets, such as Border Patrol (BP) agents, surveillance towers, the Predator B, seismic sensors, and communication centers.

The results from the runs of different scenarios, created by a Nearly-Orthogonal Latin Hypercube (NOLH) design, are analyzed using comparison tests, linear regression, and regression trees.

The use of mini UAVs is found to be beneficial in capturing the illegal entrants and could potentially provide more secure borders. Adequate manpower (in this case BP agents) and a reliable communication web to compose a common operational picture emerge as the most important factors regarding border protection.

**KEYWORDS:** Border Security, Border Protection, Border Patrol, Unmanned Aerial System, UAS, UAV, MANA, Nearly-Orthogonal Latin Hypercube, Regression Tree, Linear Regression



# MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

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## FIELD OBSERVATIONS AND SWAN-MODEL PREDICTIONS OF WAVE EVOLUTION IN A MUDDY COASTAL ENVIRONMENT

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It is well known that the presence of mud deposits on the continental shelf can cause dramatic damping of ocean surface waves, but quantitative field observations are very scarce. Wave prediction models currently lack a physics-based representation of the mud-induced dissipation process; hence, the accuracy of wave predictions in muddy littoral environments is unknown. This thesis presents a comprehensive field dataset for comparison with the operational wave model SWAN (Simulating Waves Nearshore). During February to March 2008, an extensive array of 16 wave-measuring instruments was deployed on the muddy shelf of western Louisiana in depths ranging from 13 to 4 m. Box cores were collected at all instrument sites to characterize bottom sediment properties (Garcia-Garcia, et al., 2008). Analysis of local wind–sea events along two cross-shore transects shows a decay of waves from the deeper to the shallower instruments, with the strongest decay at the muddiest site. The wave spectra evolution shows strong decay of high frequency, wind–sea spectral levels and weaker decay at the lower swell frequencies. The default bottom-friction parameterization (the JONSWAP model with coefficient value  $0.067 m^2/s^3$ ) in the SWAN model generally yields reasonable estimates of nearshore wave heights that are sufficiently accurate for most operational Navy applications. However, the predicted cross-shore wave decay is more gradual than is observed and the model does not capture the spectra decay at high frequencies.

**KEYWORDS:** Ocean Waves, Continental Shelf, Mud, Littoral, SWAN



# MASTER OF SCIENCE IN PHYSICS

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## **OBJECT LOCALIZATION AND RANGING USING STEREOVISION FOR USE ON AUTONOMOUS GROUND VEHICLES**

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Nancy M. Haegel, Department of Physics**

This thesis integrates stereovision into the existing Naval Postgraduate School robot architecture. It demonstrates that image cross-correlation can be used to measure ranges as theory predicts. It also demonstrates that objects can be ranged and stored into a database map for later use as common reference points in position determination.

**KEYWORDS:** Stereovision, Autonomous Robotics, Image Correlation

## **GENERATION OF A MID-WAVE INFRARED SIGNATURE USING MICRORADIATING DEVICES FOR VEHICLE-MOUNTED IDENTIFICATION, FRIEND OR FOE, APPLICATIONS**

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Friendly fire continues to be a major source of casualties on the modern battlefield. The Vehicle-Mounted Identification, Friend or Foe (VMIFF) is a device designed to provide instantaneous feedback to the shooter identifying itself as friendly when interrogated by a friendly target laser designator or laser range finder. Current prototypes provide an omnidirectional near-infrared signature visible through night-vision devices but not thermal imagers; and therefore, are effective only during night operations. Thermal imagers require a 3–5  $\mu\text{m}$  mid-wave infrared (MWIR) signature. The integration of an MWIR signature into VMIFF will add a daytime capability.

A new generation of compact MWIR sources is emerging to meet demands from a range of spectroscopy and communications applications. An evaluation is conducted on three commercially available, thermal microradiators to determine suitability as MWIR signature generators for VMIFF applications. Frequency response and angular irradiance measurements are made in both the 3–5  $\mu\text{m}$  and 8–12  $\mu\text{m}$  regions using single-pixel thermal detectors and thermal-imaging cameras. Based on data collected, a next-generation VMIFF design incorporating a thermal signature is proposed.

**KEYWORDS:** Thermal Emitter, Vehicle Mounted Identification Friend or Foe, Thermal Imaging



# MASTER OF SCIENCE IN PROGRAM MANAGEMENT

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## **A DEFENSE PORTFOLIO ANALYSIS**

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**Eric Bala–DoD Civilian**

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This research provides a systematic decomposition and industrial comparison of the U.S. defense decision-support process methodologies of Portfolio Analysis (PA). Included are current methods, tools, and models for ranking and evaluating strategic alternatives and options. The PA decision-support process analyzed in the study is used by the Department of Defense to allocate resources to satisfy national strategic goals. The working premise is that an effective decision-support process provides data-driven knowledge directly to relevant decision makers to meet all U.S. defense and national strategic requirements, including proper balance of costs, risks, and capabilities in both routine operational and tactical battlespace scenarios. To conduct this evaluation, four program management (PM) and two PA tools are researched with a view to modeling identifiable strategic requirements juxtaposed with technical, financial, and implementation factors to meet today's strategic capabilities requirements. It is learned that that when used correctly, PA and PM tools together provide useful tools for decision makers at all levels of government. While utilizing the modeling programs, experts in strategic and program analysis need to evaluate acquisition programs to rate the potential estimated military value in meeting the strategic needs of the United States.

**KEYWORDS:** Portfolio Analysis, Portfolio Management, Markowitz Efficient Frontier, Risk Simulation, Risk Modeling, Real Options Valuation, Strategic Planning, Decision Support Analysis

## **THE U.S. ARMY ACQUISITION WORKFORCE: REFLECTING MODERN STRUCTURAL CHANGES**

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The acquisition workforce is examined through the lens of The New Organization, a framework depicting modern organizational structural and process changes for improved performance. A Massachusetts Institute of Technology team developed five alternative organizational design factors: reliance on networks, flat (lean) hierarchy, flexible practices, building and embracing diversity, and capabilities for global and international efforts. This effort examined fifteen Army areas and programs to determine the extent to which structural changes are more or less reflective of the five characteristics. A baseline is established and implications to various acquisition initiatives and projects are analyzed. Conclusions are drawn and recommendations are offered for continuing development and evolution towards a more modern and responsive acquisition community. Findings indicate that some Army acquisition projects appear to be shifting their structures and processes toward a greater use of networks,

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## PROGRAM MANAGEMENT

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flatter/leaner structures, and a more diverse workforce, including flexible recruiting and retention practices. The objectives are to ascertain how reflective various areas and programs are alongside five, overarching “new” organizational features, and to assist leaders and managers in continuing to adapt structures and processes into the 21st century.

**KEYWORDS:** Acquisition Workforce, Networks, Flat Hierarchy, Flexible Practices, Diversity, Global Trends

### **IMPROVING THE FUTURE OF THE ARMY’S FUTURE-COMBAT-SYSTEM PROGRAM**

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**Jack Wong–DoD Civilian**

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The Future-Combat Systems (FCS) program is the U.S. Army’s ambitious attempt to modernize its forces in a systematic way, so that everything interoperates. This “system of systems” approach contrasts with the “stovepipe” solutions of the past, in which individual systems were designed to meet specific requirements, but with much less thought about how they would interact in the overall force. The “stove-pipe” approach has worked well enough in the past because the self-contained requirements were more important than how well a platform could interact with other platforms. However, as we move further into the digital age, where information superiority and speed of action are such key enablers of the force, it has become increasingly critical to tie the entire force together. The Army has gambled that the best way to do this is to design the future force holistically, fielding a sum that is greater than its parts. However, the enormity of the task was not originally apparent to its designers. This fact is becoming increasingly clear to Congress as the Army has been forced to increase funding requests and extend timelines several times. In response, Congress is considering a number of actions, including cancellation of the program. This paper examines the status of the FCS program and provides several recommendations on how the FCS program office could reduce risk while still bringing critical, new technology to the U.S. Army in a timely manner.

**KEYWORDS:** Future Combat System, System of Systems, Army, Lead System Integrator, Government Accounting Office, Congressional Budget Office, Program Risks and Constraints, Analysis of Alternatives

# MASTER OF SCIENCE IN SOFTWARE ENGINEERING

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## AN INVESTIGATION INTO THE IMPACTS OF MIGRATION TO EMERGENT NSA SUITE-B STANDARDS

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As information sharing becomes increasingly necessary for mission accomplishment within the Department of Defense, the rules for protecting information have tightened. The sustained and rapid advancement of information technology in the 21st century dictates the adoption of a flexible and adaptable cryptographic strategy for protecting national security information. RSA techniques, while formidable, have begun to present vulnerabilities to the raw computing power that is commercially available today.

This thesis is a comprehensive characterization of the current state-of-the art in Department of Defense encryption standards. It emphasizes the mathematical algorithms that facilitate legacy encryption and its proposed NSA Suite-B replacements. The authors look at how the new technology addresses the latest threats and vulnerabilities that legacy methods do not fully mitigate; and then summarize the findings of the security capabilities of NSA Suite-B standards as compared to the costs in manpower and money to implement them. Suggestions are made regarding how to best utilize NSA Suite-B technology for the purpose of providing confidentiality, integrity, and availability in an environment with real-world threats.

**KEYWORDS:** Elliptical Curve Cryptography, ECC, Rivest Shamir and Adleman, RSA, NSA Suite B, Encryption, Digital Signature, Key Agreement, ECC Migration, Risk Mitigation



# MASTER OF SCIENCE IN SPACE SYSTEMS OPERATIONS

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## THE NAVAL POSTGRADUATE SCHOOL CUBESAT-LAUNCHER DESIGN, PROCESS, AND REQUIREMENTS

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Access to space has always been a challenge, especially for organizations with limited budgets. In the last decade, a group of universities has overcome many of the obstacles associated with placing experiments on orbit by using a nanosatellite standard called the “cubeSat.” In addition to universities, many private, commercial, and government organizations are now coming to appreciate the advantages of the cubeSat standard, resulting in rapid growth in the cubeSat development community. Although the cubeSat standard has helped increase access to space, the number of cubeSat launch opportunities has not increased at the rate necessary to meet demand because the hardware and processes necessary to do so do not exist. U.S.-based cubeSat developers face additional challenges as almost all cubeSats are launched overseas.

This thesis proposes the NPS CubeSat Launcher (NPSCUL) as a solution to the lack of cubeSat launch availability. The NPSCUL is a high-capacity cubeSat launch mechanism that could facilitate rideshare opportunities onboard U.S. launch vehicles. This thesis studies the design, program management, and advantages associated with such a device, and promotes its development at the Naval Postgraduate School.

**KEYWORDS:** Satellite Launch, Space Systems, CubeSat, NPSCuL, CubeSat Launcher, Nano-Satellite, Rideshare, P-POD, ESPA, ABC, Aft Bulkhead Carrier, NPSCuL-Lite

## INTEGRATION AND ENVIRONMENTAL QUALIFICATION TESTING OF SPACECRAFT STRUCTURES IN SUPPORT OF THE NAVAL POSTGRADUATE SCHOOL CUBESAT-LAUNCHER PROGRAM

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The purpose of this thesis is to document the process of designing, constructing, and testing a qualification article in support of the NPS cubeSat Launcher (NPSCUL) project, in the NPSCUL-Lite configuration. NPSCUL-Lite is designed to launch a significant volume of cubeSats into orbit in a single launch. The NPSCuL-Lite will be a secondary payload on U.S. launch vehicles, and will be attached to the launch vehicle via the EELV Secondary Payload Adapter (ESPA), the Atlas-Centaur Aft Bulkhead Carrier, or other ESPA-compatible launch-vehicle interfaces. NPSCuL-Lite will host cubeSats in up to eight Poly Picosatellite Orbital Deployers (P-PODs) developed by the California Polytechnic State University. To meet launch requirements, the designer must prove that NPSCUL-Lite and its subsystems (the P-PODs and cubeSats) will operate properly in space and will not interfere with the launch vehicle, the primary payload, or other secondary payloads. To this end, qualification testing will ensure that NPSCUL-Lite can survive ground transport, launch, and cubeSat deployment. Additionally, the initial development of procedures and equipment necessary for ground handling and launch-vehicle integration are addressed.

**KEYWORDS:** Atlas, ABC, CubeSat, ESPA, EELV, NPSCUL-Lite,, Picosatellite, Satellite, Space, Spacecraft, Structure, Launcher, Launch, ABC, Centaur, Qualification, Testing, Integration, Vibration

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# SPACE SYSTEMS OPERATIONS

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## ENERGY-CHANGE DETECTION TO ASSIST IN TACTICAL INTELLIGENCE PRODUCTION

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Currently, signals intelligence (SIGINT) analysts are constantly overwhelmed by the amount of data they ingest. A relatively new technology, known as Energy Change Detection (ECD), was fashioned in order to alleviate a portion of the “background noise,” or signals of non-interest to the SIGINT analyst. ECD has been tested and its operational capability verified and validated by senior analysts. With the current organizational structure within which ECD resides, its utility to the tactical user is limited. This limitation affects both the timeliness of intelligence production and the volume of users it can accommodate. An analytical model is devised to determine the sources of latency in response to a request for information (RFI). Various obstacles are highlighted and a revised operating procedure is modeled. This thesis analyzes four aspects of an organization (task, technology, structure, and actors) and proposes a change in ECD implementation to affect the production of tactical intelligence. The intent of the revision, along with providing ECD to a tactical intelligence cell, is to allow the tactical commander to make more effective decisions with respect to the employment and deployment of forces, the types of forces (kinetic versus non-kinetic) to employ, and maximizing the efficiency of organic, intelligence-collection assets. The organizational revision, coupled with required analyst training, allows information to be pushed to a tactical intelligence cell and commander within a window of six hours from collection of the signal. This window allows for the production of actionable intelligence, increases the efficiency of SIGINT analysts, and potentially drives tactical operations.

**KEYWORDS:** Tactical Intelligence, Leavitt’s Diamond, OODA Loop, Kendall’s Notation, Global War on Terror, GWOT, Energy Change Detection, Information Theory, Information Entropy

## THE NAVAL POSTGRADUATE SCHOOL CUBESAT LAUNCHER-LITE SEQUENCER

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**Second Reader: Daniel J. Sakoda, Space Systems Academic Group**

This thesis documents the author’s activities related to designing and constructing a flight-like payload-deployment sequencer. The sequencer is a model of the operational sequencer to be used in the NPS cubeSat launcher (NPSCUL) project. NPSCuL is being built to address a need for domestic cubeSat launch capability, and is designed to launch a significant volume of cubeSats into orbit in a single launch. The NPSCuL will be a secondary payload on U.S. launch vehicles; it will be attached to the launch vehicle via the EELV (Evolved Expendable Launch Vehicle) Secondary Payload Adapter (ESPA), or compatible launch-vehicle structures. A small version of NPSCUL, called NPSCUL-Lite, will house cubeSats in up to 8-1x1x3 (“3U”) Poly Pico-Satellite Orbital Deployers (P-PODs) developed by the California Polytechnic State University. The sequencer’s function is to issue commands and drive the circuitry to open the P-PODs in the proper sequence. The sequencer may be mounted either externally from the NPSCUL-Lite or internally. A functional flight-similar model and a mass model of the correct size and CG are both required for future testing.

**KEYWORDS:** NPSCuL, NPSCuL-Lite, P-POD, Sequencer, Launcher, Launch Vehicle, Microcontroller, Space, Satellite

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## SPACE SYSTEMS OPERATIONS

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### **THE NPS-SCAT: A CUBESAT COMMUNICATIONS SYSTEM DESIGN, TEST, AND INTEGRATION**

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B.S., United States Naval Academy, 2000**

**Master of Science in Systems Technology—June 2009**

**Master of Science in Space Systems Operations—June 2009**

**Advisor: James H. Newman, Space Systems Academic Group**

**Second Reader: Terry E. Smith, Department of Information Sciences**

Telemetry, tracking, and command (TT&C) systems on traditional small satellites have advanced significantly in capacity, throughput, and complexity over the last several decades. The cubeSat community is in need of similar advancements. The Naval Postgraduate School's solar-cell-array tester (NPS-SCAT) seeks to provide the foundation for advances in future iterations of cubeSats at NPS. This thesis explains the design, test, and integration of a full TT&C sub-system for NPS-SCAT. The satellite will have two TT&C systems that provide full telemetry for the experiment through a primary communications channel and secondary telemetry through an amateur band beacon. The thesis explains the development of the concept of operations for the satellite that drove the data requirements provided by the TT&C system. The thesis also explains the testing procedures of the transceiver and the design, test, and integration of the primary and secondary antennas. Finally, the thesis explains the frequency licensing process through the Navy-Marine Corps Spectrum Center and the Federal Communications Commission.

**KEYWORDS:** Satellite, CubeSat, NPS-SCAT, Solar Cell Tester, Communications, Antenna Patch, Dipole Antenna, Beacon, TT&C, Frequency Coordination, Navy-Marine Corps Spectrum Center

### **SPACE SUPPORT FOR THE WARFIGHTER: DETERMINING THE BEST WAY TO PROVIDE SPACE CAPABILITIES AT THE ARMY DIVISION AND BRIGADE LEVELS**

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**Second Reader: Alan Scott, Space Systems Academic Group**

This thesis examines personnel resources for space support currently available to division and brigade commanders and recommends methods to provide those resources more efficiently. Current, standardized, space support for divisions and brigades exists in the Space Support Element (SSE). When first envisioned, the SSE provided organic space capabilities to the lowest practical tactical level, but as requirements evolved, the need for full-time space staff at those levels has diminished. Space capabilities are currently found on the Division staff and at the brigade level, but the amount of time spent by space operations officers on space has dwindled to very low levels. Personnel with minimal training can provide the limited amount of space knowledge needed on a permanent basis. Rather than maintain organic space staff, a more effective use of those personnel would be to assign them to Army space-support teams (ARSST) where they would spend more time on space-related duties. This thesis provides three key recommendations to improve the utilization of Army space personnel. The first is to educate leadership on how space can impact operations. The second broadens the Army space cadre to utilize space-skilled staff officers other than FA40s and develop an enlisted space specialty. The final recommendation is to reallocate SSE personnel to enhance the ARSST model of space support.

**KEYWORDS:** Army Space Support, MILSATCOM, Space Support Element, Functional Area 40, Tactical Space



# MASTER OF SCIENCE IN SYSTEMS ENGINEERING

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## IMPROVING SITUATIONAL AWARENESS IN THE COUNTER-IED FIGHT WITH THE UTILIZATION OF UNMANNED SENSOR SYSTEMS

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An organized and thorough systems-design framework is necessary to successfully address large-scale, complex problems, such as the utilization of unmanned sensor technologies to provide situational awareness (SA) in the counter-improvised explosive device (C-IED) fight. An appropriate systems-engineering design process was used to develop such a framework, as the completion of the first two phases—problem definition and solution design—provides a basis for analysis of alternatives and a design recommendation. This process generated the following problem statement: design a system that, through the use of unmanned sensors, provides effective and efficient SA to the commander in a C-IED scenario. By effective, the system must maximize the ability to process sensor imagery and detect, classify, identify, and counter IEDs. To be efficient, the system must address important characteristics of operational suitability and survivability. Thus, providing SA, maximizing operational suitability, and maximizing Soldier survivability are the primary objectives in the effective and efficient employment of unmanned sensors in C-IED. Three physical alternatives are generated and synthesized: baseline, near-term, and long-term. Each alternative consists of a combination of sensors, satellites, and unmanned systems to ensure that the top-level SA functions are addressed. Each alternative's basic specifications, battlefield flow (highlighting each unmanned sensor's use for observing, processing information, and understanding the environment), and drawbacks are addressed.

**KEYWORDS:** Improvised Explosive Device, Counter-IED, Situational Awareness, Unmanned Sensor Systems



# MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY

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## **THE COMMAND AND CONTROL OF THE GRAND ARMEE: NAPOLEON AS ORGANIZATIONAL DESIGNER**

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**Second Reader: Steven J. Iatrou, Department of Information Sciences**

The purpose of this thesis is to investigate Napoleon Bonaparte’s command and control of the Grand Armeé through the lens of organizational design. Napoleon’s methodology behind the design of the Grand Armeé is analyzed using modern principles of organizational design. The structure that Napoleon created within his organizational design was a vast information network that served as the framework for a highly effective command and control system. This command and control network allowed Napoleon to dominate a war with his enemies within the information domain.

The Grand Armeé transited the European countryside with lightning speed as Napoleon out-maneuvered his enemies. Napoleon’s dominance was a direct result of the organizational masterpiece that was the Grand Armeé. From an organizational design perspective, Napoleon’s methodology applied the ideas of others and exploited existing technology to affect his design.

The reorganization of the military corps became one of the most important transformations made by Napoleon. The army corps was considered a key component in Napoleon’s strategic deployments. The command and control system he engineered for his corps was essential in the Napoleonic philosophy to march divided and fight united.

**KEYWORDS:** Napoleon Bonaparte, Information Systems Engineering, Systems Engineering, Command and Control, Organizational Design, Grand Armeé

## **ENERGY-CHANGE DETECTION TO ASSIST IN TACTICAL INTELLIGENCE PRODUCTION**

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**Master of Science in Systems Technology–June 2009**

**Master of Science in Space Systems Operations–June 2009**

**Advisors: Karl D. Pfeiffer, Department of Information Sciences**

**Daniel W. Bursch, Space Systems Academic Group**

Currently, signals intelligence (SIGINT) analysts are constantly overwhelmed by the amount of data they ingest. A relatively new technology, known as Energy Change Detection (ECD), was fashioned in order to alleviate a portion of the “background noise,” or signals of non-interest to the SIGINT analyst. ECD has been tested and its operational capability verified and validated by senior analysts. With the current organizational structure within which ECD resides, its utility to the tactical user is limited. This limitation affects both the timeliness of intelligence production and the volume of users it can accommodate. An analytical model is devised to determine the sources of latency in response to a request for information (RFI). Various obstacles are highlighted and a revised operating procedure is modeled. This thesis analyzes four aspects of an organization (task, technology, structure, and actors) and proposes a change in ECD implementation to affect the production of tactical intelligence. The intent of the revision, along with providing ECD to a tactical intelligence cell, is to allow the tactical commander to make more effective decisions with respect to the employment and deployment of forces, the types of forces (kinetic versus non-kinetic) to employ, and maximizing the efficiency of organic, intelligence-collection assets. The organizational revision, coupled with required analyst training, allows information to be pushed to a tactical intelligence cell and commander

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## SYSTEMS TECHNOLOGY

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within a window of six hours from collection of the signal. This window allows for the production of actionable intelligence, increases the efficiency of SIGINT analysts, and potentially drives tactical operations.

**KEYWORDS:** Tactical Intelligence, Leavitt's Diamond, OODA Loop, Kendall's Notation, Global War on Terror, GWOT, Energy Change Detection, Information Theory, Information Entropy

### **AN EMPIRICAL EVALUATION OF A MODEL OF TEAM COLLABORATION USING SELECTED TRANSCRIPTS FROM SEPTEMBER 11, 2001**

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**Master of Science in Systems Technology—June 2009**

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**Second Reader: Karl D. Pfeiffer, Department of Information Sciences**

The extraordinary events that occurred on the morning of September 11, 2001, left Federal Aviation Administration (FAA) air traffic controllers in New York, Boston, Washington, and Cleveland, and their colleagues at the North American Aerospace Defense Command (NORAD), without precedent as to how to respond to the hijacking of four American commercial airliners. Despite the chaos and confusion, the two agencies put forth a joint effort in order to decide when and how to scramble fighter aircraft to escort the airliners. The collaboration that occurred between the agencies was recorded in radio transcripts between NORAD and FAA air traffic controllers. The goal of this thesis is to utilize the September 11, 2001, NORAD/FAA channel three transcripts to offer a real-world example of how a team works together on a one-of-a-kind problem. Further, transcripts of recorded audio are coded and analyzed in an effort to empirically validate the Office of Naval Research model of team collaboration. The model focuses on individual and team cognitive processes used during team or agency collaboration with the goal of understanding how individuals and teams work together in order to reach a decision.

**KEYWORDS:** Team Collaboration, Team Communication, NORAD, NEADS, September 11, 2001, Cognition, Macrocognition, Model of Team Collaboration

### **FACILITATING DECISION MAKING, REUSE, AND COLLABORATION: A KNOWLEDGE- MANAGEMENT APPROACH TO ACQUISITION PROGRAM SELF-AWARENESS**

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**M.B.A., University of South Carolina, 1996**

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**Christopher W. Odell—Lieutenant Commander, United States Navy**

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**Douglas J. MacKinnon, Department of Information Sciences**

Decades of reform have been largely ineffective in improving the efficiency of the Department of Defense (DoD) Acquisition System. Such inefficiency is, in part, due to complex processes and stovepipe activities that result in duplication of effort, lack of re-use, and limited collaboration on related development efforts. This research applies Knowledge Management (KM) concepts and methodologies to the DoD acquisition enterprise to increase "Program Self-Awareness." This research supports the implementation of reform initiatives such as Capability Portfolio Management and Open Systems Architecture, which share the common objectives of reducing duplication of effort and promoting collaboration and re-use of components. The DoD Maritime Domain Awareness (MDA) Program will be used as a test case to apply KM tools to identify duplication and/or gaps in the features of select MDA technologies. This paper may also provide the foundation for future development of the Program Self-Awareness concept and KM tools to support decision-making and to improve the effectiveness of the DoD Acquisition System.

**KEYWORDS:** Defense Acquisition System, Knowledge Management, KM, Open Architecture, OA, Capability Portfolio Management, CPM, Business Intelligence, BI, Maritime Domain Awareness, MDA, Data Mining, Text Mining, Data Visualization, Program Self-Awareness

### **INVESTIGATING THE TEAM COLLABORATION OF AIR COMBAT OPERATIONS**

**EXERCISE TREX 09-1 FROM 22-25 OCTOBER 2008 (U)**

**Lensworth A. Samuel—Lieutenant Commander, United States Navy**

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**Master of Science in Systems Technology—June 2009**

**Kenneth R. Yates—Lieutenant, United States Navy**

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**Second Reader: Karl D. Pfeiffer, Department of Information Sciences**

During the period of 20-25 October 2008, a training research exercise (TREX) was conducted to integrate operational concepts and training techniques from different commands. The collaborative teamwork demonstrated in the highly asymmetric, threat-exercise scenario was recorded in Microsoft internet relay chat logs across fifteen different chat rooms. The goal of this thesis is to use chat-room-recorded data from the air operations center to evaluate a measurement model of macrocognition developed under the Collaboration and Knowledge Integration Program, sponsored by the Office of Naval Research. The model focuses on the cognitive processes used by team members during collaboration: the goal is to understand how individuals collaborate to build new knowledge and accomplish their tasks. Effective chat communications may expedite the process of moving the team towards achieving the ultimate goal, which was to produce optimum combat effectiveness in a timely manner. Thesis results will be provided to the Office of Naval Research to help improve collaboration among teams while operating in stressful and dynamic environments.

**KEYWORDS:** Team Collaboration, Team Communication, Air Operations Center, TREX -09 20-25 October 2008, Macrocognition

### **THE NPS-SCAT: A CUBESAT COMMUNICATIONS SYSTEM DESIGN, TEST, AND INTEGRATION**

**Matthew P. Schroer—Captain, United States Marine Corps**

**B.S., United States Naval Academy, 2000**

**Master of Science in Systems Technology—June 2009**

**Master of Science in Space Systems Operations—June 2009**

**Advisor: James H. Newman, Space Systems Academic Group**

**Second Reader: Terry E. Smith, Department of Information Sciences**

Telemetry, tracking, and command (TT&C) systems on traditional small satellites have advanced significantly in capacity, throughput, and complexity over the last several decades. The cubeSat community is in need of similar advancements. The Naval Postgraduate School solar cell array tester (NPS-SCAT) seeks to provide the foundation for advances in future iterations of cubeSats at NPS. This thesis explains the design, test, and integration of a full TT&C sub-system for NPS-SCAT. The satellite will have two TT&C systems that provide full telemetry for the experiment through a primary communications channel and secondary telemetry through an amateur band beacon. The thesis explains the development of the concept of operations for the satellite that drove the data requirements provided by the TT&C system. The thesis also explains the testing procedures of the transceiver and the design, test, and integration of the primary and secondary antennas. Finally, the thesis explains the frequency licensing process through the Navy-Marine Corps Spectrum Center and the Federal Communications Commission.

**KEYWORDS:** Satellite, CubeSat, NPS-SCAT, Solar Cell Tester, Communications, Antenna Patch, Dipole Antenna, Beacon, TT&C, Frequency Coordination, Navy-Marine Corps Spectrum Center

# SYSTEMS TECHNOLOGY

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## AN INVESTIGATION INTO THE IMPACTS OF MIGRATION TO EMERGENT NSA SUITE-B STANDARDS

**Jacob P. Venema—Captain, United States Marine Corps  
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**Master of Science in Systems Technology—June 2009**

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As information sharing becomes increasingly necessary for mission accomplishment within the Department of Defense, the rules for protecting information have tightened. The sustained and rapid advancement of information technology in the 21st century dictates the adoption of a flexible and adaptable cryptographic strategy for protecting national security information. RSA techniques, while formidable, have begun to present vulnerabilities to the raw computing power that is commercially available today.

This thesis is a comprehensive characterization of the current state-of-the art in Department of Defense encryption standards. It emphasizes the mathematical algorithms that facilitate legacy encryption and its proposed NSA Suite B replacements. The authors look at how the new technology addresses the latest threats and vulnerabilities that legacy methods do not fully mitigate; and then summarize the findings of the security capabilities of NSA Suite B standards as compared to the costs in manpower and money to implement them. Suggestions are made regarding how to best utilize NSA Suite B technology for the purpose of providing confidentiality, integrity, and availability in an environment with real-world threats.

**KEYWORDS:** Elliptical Curve Cryptography, ECC, Rivest Shamir and Adleman, RSA, NSA Suite B, Encryption, Digital Signature, Key Agreement, ECC Migration, Risk Mitigation

**MASTER OF ARTS**

**Security Studies**



# **MASTER OF ARTS IN SECURITY STUDIES**

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## **THE ROLE OF AIRPOWER FOR COUNTERINSURGENCY IN AFGHANISTAN AND FATA (FEDERALLY ADMINISTERED TRIBAL AREAS)**

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**Feroz H. Khan, Department of National Security Affairs**

This thesis examines the role of airpower in counterinsurgency (COIN) in Afghanistan and Pakistan. The direct use of airpower is kinetic application to physically destroy the insurgents; indirect use involves support roles, such as transportation, logistics, surveillance, and reconnaissance. The former requires near-perfect intelligence and precision strikes to minimize unintended damage; the latter complements information warfare and supports ground mobility. This thesis focuses on how the direct application of airpower affects COIN in Afghanistan and Pakistan's Federally Administered Tribal Areas (FATA). Excessive use of sophisticated U.S. airpower and Predator strikes has produced undesirable collateral damage, forcing exodus into FATA and complicating the regional situation. The Pakistan Air Force operates under operational, technological, and cultural constraints. The use of drones in FATA, conducted without adequate coordination, planning, and political sensitivity, added to the trust deficit between crucial allies, making the use of airpower controversial and counterproductive. This thesis concludes that air power produced tactical gains, but was strategically costly; it destroyed enemies, but lost friends in the process.

**KEYWORDS:** Afghanistan, Pakistan, FATA, Airpower, COIN, Insurgency, Militancy

## **THE IMPACTS OF JAPANESE COLONIALISM ON STATE AND ECONOMIC DEVELOPMENT IN KOREA AND TAIWAN, AND ITS IMPLICATIONS FOR DEMOCRACY**

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**Second Reader: Jan Breemer, Naval War College**

Promoting democratization has taken the forefront of international diplomacy in ensuring world stability. Determining how best to promote democracy is challenging and requires a keen understanding of a developing country's history. Of particular importance is the country's colonial legacy and how this legacy continues after independence. This thesis examines the impact of the Japanese colonial period in Korea and Taiwan, and how economic and bureaucratic development in these countries was subsequently affected. Examining the institutions developed during this period in these countries will better allow policy-makers to formulate similar (though non-colonial) programs in other developing countries, and this will give these developing countries a much better chance at success during the period of democratization.

**KEYWORDS:** Japan, Korea, Taiwan, Colonialism, Democratization

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## SECURITY STUDIES

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### THE IMPACT OF THE TYPE 094 BALLISTIC MISSILE SUBMARINE ON CHINA'S NUCLEAR POLICY

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**Second Reader: Jeffrey E. Kline, Department of Operations Research**

This thesis examines the implication of China's near completion of a viable nuclear triad. The objectives are to determine 1) how this submarine will fit into China's "No-First-Use" policy with regards to their nuclear weapons, and 2) how advanced this weapon platform will be. With the introduction of multiple Type 094 "Jin" Class ballistic missile submarines, has Beijing set the stage for a possible return to Cold War-level anti-submarine warfare (ASW) operations by the United States?

The Type 094 has been discussed at length in open source publications. This thesis advances those discussions by examining them in detail. Expected noise level, target sets, and class size are dissected and compared to historical data to verify the likelihood of mission tactics. This technical data, combined with a summary of the challenges faced in terms of submarine communications and control, will highlight Beijing's decision to deploy this new technology conservatively to maximize the intended target set. Washington must view the Type 094 as a vast improvement over the single Type 092 "Xia" Class ballistic missile submarine. Atrophied United States ASW assets must be upgraded to meet this new challenge.

**KEYWORDS:** Type 094, Chinese Nuclear Policy, No First Use, Jin, Ballistic Missile Submarine

### HUMAN TRAFFICKING IN SOUTHEAST ASIA: CAUSES AND POLICY IMPLICATIONS

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**Advisor: Michael S. Malley, Department of National Security Affairs**  
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This thesis examines human trafficking within Southeast Asia to identify the similarities and differences between the causes of labor and sex trafficking. The thesis also analyzes how three case-study countries have tailored their anti-trafficking policies to causes present in each country. The causes examined are divided into two distinct categories, universal and specific. The universal causes studied are large-scale social issues that affect the majority of countries, such as poverty and globalization. Specific causes are those that are limited to the Southeast Asian region or the individual case-study country. The three countries selected are Cambodia, Indonesia, and Thailand; they are selected due to the unique trafficking profile of each. The thesis finds that all three governments have failed to address all of the causes that led to human trafficking in their country. The policies of each country tend to be universally focused and do not account for the unique circumstances present in the individual country. As a result, anti-trafficking policies are not as successful at reducing human trafficking. A country must create policies that directly address its unique combination of causes, universal and specific, to effectively combat the challenging issue of human trafficking.

**KEYWORDS:** Human Trafficking, Southeast Asia, Cambodia, Thailand, Indonesia, Sex Tourism, Poverty, Globalization, Women's Rights, Education Levels, Uneven Regional Economic Development, Labor Trafficking, Corruption, Anti-Trafficking Policy

### **THE POLICY OF THE BHARATIYA JANATA PARTY, 1980 AND 2008: THE POSSIBLE INFLUENCE OF HINDU NATIONALISM ON INDIAN POLITICS**

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**Second Reader: Samir Kapur, Department of National Security Affairs**

The Bharatiya Janata Party (BJP) is one of the few Indian political parties which contest nationwide. Its Hindu nationalistic appeal changed over time. In 1998, the BJP gained power and formed a coalition to rule India. Against some expectations, it did not transfer its Hindu nationalistic ideology into practice when it came to domestic and international politics. This thesis answers the question of which factors affected the behavior of the BJP and influenced the BJP's policy. It argues that the BJP did not change its basic Hindu nationalistic character. It is still a political party with a nationalistic party identity. However, the political diversity of India led to an adjustment of enforceable political goals and the development of a flexible policy to gain political power. India's federal system, in combination with the trend towards factionalism, led to the need for coalition building among political parties. Thus, even the BJP had to use tactical shifts to partly moderate its rhetoric, along with other strategies in different states, to build coalitions with different political parties.

**KEYWORDS:** Bharatiya Janata Party, BJP, Party Politics, National Identity, Hindu Nationalism, Hinduism, Hindutva, Sangh Parivar, Rashtriya Swayamsevak Sangh, RSS, Vishwa Hindu Parishad, VHP, Bharatiya Jana Sangh, BJS, Ayodhya Campaign, Kashmir Case

### **CHINA'S RISE AND SATISFACTION WITH THE MODERN GLOBAL ORDER**

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**Alice L. Miller, Department of National Security Affairs**

In this thesis, the current international order and China's position within it is assessed in order to place it within a hierarchy of states. After concluding that China has increased its relative power within the global order, its satisfaction with various elements of the international system is discussed. Tammen and Kugler's model for assessing satisfaction is used to determine if China is at present a "status quo" state, and whether it might have revisionist intent in the future. Compliance with international norms, economic integration, military modernization, territorial disputes, and the role of ideology are assessed to predict whether China is in fact satisfied with the distribution of benefits within the global system. This thesis concludes with a discussion of the implications of an increasingly powerful China, able to demand more benefits from the system that the United States developed. Several policy recommendations are made, generally advising that the United States should continue to integrate China into the global order and maintain its position as the dominant state, guiding the international relations dialogue and shaping China's influence on it.

**KEYWORDS:** International Order, United States, China, Satisfaction, Hierarchy, International Norms, Economic Integration, Military Modernization, Territorial Disputes, Ideology

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## SECURITY STUDIES

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### THE POLITICS OF NORTH KOREAN REFUGEES AND REGIONAL SECURITY IMPLICATIONS

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Second Reader: Edward Olsen, Department of National Security Affairs**

The North Korean refugee issue is a challenge to regional stability. In addition to humanitarian concerns, a mass flow of refugees would have enormous impact on operations of the Republic of Korea's military and the U.S. forces stationed in Korea and Japan. Regional players have an obligation to contribute to regional security. Proactive and cooperative policy-making by China, Russia, Japan, South Korea, and the United States to protect North Korean workers and help North Korean immigrants assimilate could diminish the destabilizing triggers of the refugee issue and offer multiple benefits, including increased regional stability.

**KEYWORDS:** North Korean Refugees, Six Party, Republic of Korea, ROK, South Korea, Democratic People's Republic of Korea, DPRK, North Korea, China, Japan, Russia, Northeast Asia Regional Stability, UNC, CFC, USFK, UNC Rear, UNC Sending States, Korean Diaspora, Assimilation, Immigration, Human Rights, Humanitarian Assistance, Stability and Reconstruction Operations

### TRANSATLANTIC RELATIONS: THE ROLE OF NATIONALISM IN MULTINATIONAL SPACE COOPERATION

**Heather R. Crooks—Captain, United States Air Force  
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Master of Arts in Security Studies—June 2009**

**Advisor: Donald Abenheim, Department of National Security Affairs  
Second Reader: James Clay Moltz, Department of National Security Affairs**

Transatlantic partnerships are becoming integral to the success of modern-day aerospace programs. NASA and the European Space Agency have cooperated for decades on such programs. As with all such collaboration between nations, conflicts have and continue to arise between the U.S. and Europe concerning joint aerospace initiatives. This thesis investigates the hypothesis that nationalism has been the major driver within ESA, as well as between ESA and NASA, that hampers multinational cooperation; this thesis also looks to international space visions and the notion of joint space exploration as a partnership, not a competition. Additionally, multiple case studies of space cooperation between the European Union and the U.S. are analyzed, as well as what this could mean for future partnerships. This thesis concludes that cooperation within ESA's member states is hampered by nationalism; however, as a multinational organization, ESA rarely allows nationalism to interfere with international cooperation in space. Though NASA has participated in a range of successful international programs, it has allowed periodic shows of nationalistic actions to hamper some of these projects. The author recommends that future space policy allow for more international cooperation, taking heed of lessons learned from past programs.

**KEYWORDS:** NASA, European Space Agency, ESA, International Cooperation, Transatlantic Relations, Nationalism, INTELSAT, Ulysses, Galileo, SOFIA, ISS, International Space Station, Constellation, Aurora, Vision for Space Exploration, Moon, Mars

### THE POLITICAL INTEGRATION OF HEZBOLLAH INTO LEBANESE POLITICS

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**Master of Arts in Security Studies—June 2009**

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**Anne Marie Baylouny, Department of National Security Affairs**

Hezbollah has proven itself to be a resilient, relevant, military and political force within Lebanon and across the Middle Eastern region. This thesis focuses on the approach through which Hezbollah, as a military, political, and social organization, integrates itself into Lebanese society and polity. This thesis looks at how an Islamic organization, perceived as a “terrorist-group” in the mid-1980s, continues to transform itself and achieve success in being perceived as a legitimate political actor participating in Lebanese government.

Political integration is problematic for Hezbollah, since it must balance its need to be a legitimate actor within Lebanon’s political system with its original, and continuing, militant objectives of liberating Lebanon and other territories under Israeli control, and in general protecting the country from Israeli incursion. The first objective requires Hezbollah to be sensitive to the needs of Lebanon and its many political factions and internal interests. The second objective requires Hezbollah to maintain its radical stance toward a neighboring state, maintain a large armed militia, and form alliances with external actors, such as Syria and Iran, independent of the policies of the Lebanese government. How can Hezbollah balance these interests? This thesis explores how Hezbollah seeks to reconcile these seemingly contradictory objectives.

**KEYWORDS:** Hezbollah, Hizbullah, Lebanon, Political Integration, Social Movement Theory, Islamic Movements

### SHIFTING THE PARADIGM OF TRAUMA MEDICINE TO POSITIVELY INFLUENCE CRITICAL MORTALITY RATES FOLLOWING A MASS CASUALTY EVENT

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Medical providers, patients, and their families have always been able to enjoy the abundance of U.S. society. When medical resources exceed the demand for care, all necessary medical resources are used to improve the health or save the life of each individual. However, the health care system in the U.S. is severely under-prepared to care for hundreds to thousands of victims simultaneously from a mass casualty event (MCE). The influx of patients would severely overwhelm emergency rooms. Although global events indicate that the U.S. must prepare, the medical community has historically been uncomfortable openly discussing standards of care during a mass casualty event because it is equated with the “rationing” of care. Through four case studies, this thesis demonstrates that critical mortality was reduced and a greater number of critically injured survived due to improved triage accuracy, rapid movement to definitive care, implementation of damage control procedures, and coordinated and collaborative regional preparedness. The medical community must appreciate that altering standards of care during an MCE does not reduce overall care rendered; rather, care is strategically directed so critical mortality is lowered.

**KEYWORDS:** Critical Mortality, Triage Accuracy, Definitive Care, Damage Control, Regional Preparedness, Standard of Care, Mass Casualty Event, Trauma Medicine, Rationing, Spain, Israel, United Kingdom, Tactical Combat Casualty Care, TCCC

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## SECURITY STUDIES

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### **RUSSIA AND NATO ENLARGEMENT: THE ASSURANCES IN 1990 AND THEIR IMPLICATIONS**

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This thesis examines the alleged assurances made to Moscow during German unification discussions in 1989-1990. Specifically, Moscow alleges that Western governments offered assurances to the Soviet Union that NATO would not expand beyond its then-current borders if Moscow agreed to allow a unified Germany to join NATO as a full member. Since the first post-Cold War round of NATO expansion in 1997-1999, Moscow has raised the issue of broken promises made to the Soviet Union several times. While it can be argued that the Soviet Union had little choice but to yield to Western pressures, it appears that in 1990 some U.S. and West German officials gave informal assurances with respect to Soviet security concerns, including potential NATO expansion eastward. This thesis examines the hypothesis that the United States, the Federal Republic of Germany, and other NATO countries did not make – and did not intend to make – a commitment ruling out future NATO enlargement, but that Soviet officials got the mistaken impression that such a commitment was made. The thesis investigates whether this hypothesis is supported by the evidence and considers how the Soviets received this impression. The thesis also discusses the implications of these misunderstandings for NATO-Russia relations.

**KEYWORDS:** Cold War, NATO, German Unification, Russia, Soviet Union, NATO Expansion, NATO-Russian Relations

### **MUQTADA AL-SADR: HOW TO DEMILITARIZE AL-SADR**

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Muqtada al-Sadr has been one of the most influential individuals in Iraq since the U.S. invasion in March 2003. His Mahdi Army has actively confronted coalition forces and engaged in ethnic cleansing, which has resulted in the displacement of thousands of Iraqis. This raises the question of how best to deal with this movement in order to stabilize Iraq. This thesis looks at the history of the Sadrist movement, explains its growth, and attempts to analyze means to integrate it into the political process. It borrows insights from literature on how terrorism ends to make policy recommendations for the Iraqi government. A three-pronged economic, military, and political approach to channel al-Sadr into the political process is recommended. The economic approach includes providing services and welfare programs for the poor, urban Shia that make up Sadr's constituency. The military approach includes securing Shia neighborhoods from insurgent activities and bombings, a critical service that until recently has been provided by the Sadrists. Political integration is the final and most important element in the integration process. Sadr has already displayed increased interest in institutional politics, and he could be enticed to distance himself from criminal and terrorist activity.

**KEYWORDS:** Al-Sadr, Demilitarize, Mahdi Army, Sadrists, Militia

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## SECURITY STUDIES

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### MANAGING THE REPUTATION OF THE DEPARTMENT OF HOMELAND SECURITY AND ITS COMPONENTS

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The Department of Homeland Security and some of its components have gained less than favorable reputations since DHS was stood up in 2003. Based upon the available literature on reputation and upon data collected from a Delphi survey of public affairs officers within DHS and its components, this thesis addresses the value, measurement, and management of reputation for DHS and its components. It also looks at the relationship between the reputation of DHS and that of its components. This thesis shows that reputation has a strong impact on such areas as public trust, Congressional funding, and employee morale. It offers several recommendations for how DHS and its components can manage their reputations more effectively. These recommendations include understanding the value of reputation, identifying key stakeholders, measuring stakeholders' perceptions, and addressing "reputation spillover." It also adds to the available literature on reputation, which comes primarily from the private sector.

**KEYWORDS:** Reputation, Reputation Management, Reputation Spillover, Image, Identity, Public Affairs

### THE RISING DRAGON: INFRASTRUCTURE DEVELOPMENT AND CHINESE INFLUENCE IN VIETNAM

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China and Vietnam have recently stepped up cooperation in cross-border infrastructure development in both overland and electric power sectors. While this development is done in the name of "economic development," these projects may have unintended consequences. Using Albert Hirschman's theory of trade as national power, this thesis argues that the cross-border infrastructure development provides China with two mechanisms to apply the influence effect of trade on Vietnam. Both sectors of cross-border infrastructure development are analyzed in national, regional, and bilateral contexts. The results of this analysis demonstrate that China may not be intentionally creating the mechanisms to use the influence effect of trade. Regardless of the intentions, these mechanisms are being created. China could, in the future, use Hirschman's influence effect of trade to modify Vietnamese behavior. These mechanisms could be used in the event of a territorial dispute in the South China Sea or in the broader geopolitical affairs of the region.

**KEYWORDS:** China, Vietnam, Greater Mekong Subregion, GMS, Infrastructure Development, Albert Hirschman, Cross-Border Trade, Transportation, Electric Power

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## SECURITY STUDIES

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### **EL SALVADOR AND GUATEMALA: SECURITY SECTOR REFORM AND POLITICAL PARTY SYSTEM EFFECTS ON ORGANIZED CRIME**

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Since the signing of peace treaties in El Salvador and Guatemala in 1992 and 1996 respectively, both countries have experienced exploding levels of crime and violence as a result of gangs, drug trafficking organizations, and organized crime. Because both nations share many common traits, a general perception is that the causes and effects of criminal activity are similar in both countries. The patterns, causes, and effects of criminal activity, however, vary significantly between El Salvador and Guatemala. Specifically, organized crime — with its hallmarks of violence, corruption, and penetration of state institutions — is a problem that afflicts Guatemala much more than El Salvador. Security sector reforms and the demilitarization of security forces in El Salvador prevented organized crime from gaining hold over time; whereas police reform in Guatemala failed to purge the security apparatus of former militarized forces with ties to organized crime. A strong political party system in El Salvador acts as a gatekeeper in preventing many organized crime elements from penetrating the state; a weak party system in Guatemala allowed for much greater infiltration of illicit entities. Future policy regarding both countries should give greater attention to organized crime and political party systems.

**KEYWORDS:** El Salvador, Guatemala, Organized Crime, Police Reform, Political Party System, Peace Accords, Gangs, Drug Trafficking Organizations

### **SECURING SUB-SAHARAN AFRICA'S MARITIME ENVIRONMENT: LESSONS LEARNED FROM THE CARIBBEAN AND SOUTHEAST ASIA**

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The United States has a growing vested interest in the geopolitical status of Africa, as reflected in guiding national strategic documents. United States Africa Command (AFRICOM) was established in 2008 to effectively manage many of the key strategic issues surrounding Africa. One of AFRICOM's areas of focus is the relatively unsecured and lawless maritime environment of coastal Sub-Saharan Africa, which suffers from a myriad of security threats, including piracy and trafficking in drugs, persons, and weapons. In order to gain insight into how best to fully operationalize U.S. strategy in the African maritime environment, this thesis turns to two regions of the world where the United States has extensive experience countering maritime security threats, either directly or through significant assistance to regional states. The drug war in the Caribbean and antipiracy efforts in Southeast Asia are studied to determine the effect of two independent variables, that of coordination (both interagency and international) and maritime security capacity (the ability to man, train, and equip security forces), on the flow of drugs through the Caribbean and the rate of piracy in Southeast Asia. This thesis finds that while each has a positive effect on both security threats, the combination of robust coordination at the interagency and international levels and enhanced maritime security capacity was key to success in counterdrug and antipiracy operations. The implications of these findings for U.S. strategy in Sub-Saharan Africa are discussed in the conclusion.

**KEYWORDS:** Africa, Drug War, Piracy, Maritime Strategy, Caribbean, Coast Guard, Southeast Asia, Indonesia, Singapore, Malaysia

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## SECURITY STUDIES

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### THE USE OF CONVENTIONAL U.S. NAVAL FORCES TO CONDUCT FOREIGN INTERNAL DEFENSE IN COLOMBIA

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Colombia is the largest recipient of U.S. monetary and military aid in Latin America. As the U.S. enters its sixth year in the war on terror, the U.S. Navy has a unique opportunity to support Colombia and redefine maritime security operations. This thesis discusses shifting conventional naval forces away from traditional roles into the realm of irregular warfare. With the creation of the Naval Expeditionary Combat Command, the Navy has an irregular warfare force capable of conducting foreign internal defense (FID). This force, if deployed to Colombia, would re-energize U.S. efforts to combat the war on drugs and simultaneously support Colombian efforts in counterinsurgency. By analyzing policy, doctrine, and conventional naval forces, this thesis emphasizes the need to expand the role of the U.S. Navy to include FID, thereby reducing the operational burdens of U.S. special forces. With three to five years of dedicated emphasis on irregular warfare, the U.S. Navy will have the capability to execute FID in Colombia. This shift to irregular warfare will build Colombian capacity and enhance regional maritime security, while combating drugs and insurgency in Colombia.

**KEYWORDS:** Conventional Naval Forces, Irregular Warfare, Naval Expeditionary Combat Command, General Purpose Forces, Foreign Internal Defense, Insurgency, Counter Drug Operations, Counter Insurgency Operations, Maritime Security Operations, Riverine, Colombia, Naval Mission, Overseas Contingency Operations.

### HIGHLIGHTING THE EFFECTS OF CURRENT GLOBALIZATION TENETS, NAMELY DEMOCRACY, CAPITALISM, AND CULTURAL TRANSFORMATION, ON THE ARAB ISLAMIC MIDDLE EAST

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This thesis examines the shape of globalization in the Middle East, specifically with respect to three major elements of globalization: politics, economics, and culture. This thesis attempts to shed light on the importance and difficulties of fostering positive conditions, which could facilitate favorable terms for Islamic Arabs in the Middle East to fully embrace current globalization, thus increasing regional and global prosperity and stability. This thesis also addresses and analyzes the compatibility of Islamic Arabs in the Middle East with current globalization trends. Acknowledging that Middle Eastern globalization is a fairly large subject to cover, the scope of this research has been narrowed to answer the question of whether or not the acceptance of democracy, capitalism, and cultural changes by Arab Islamic Middle Eastern societies, specifically the secular authoritarian regimes and the opposing Islamist organizations, could increase prosperity and stability within the region, and if so, bring to light the obstacles standing in the way of such progress.

**KEYWORDS:** Middle East, Globalization, Democracy, Capitalism, Cultural, Islam, Arabs, Muslims, Terrorism

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## SECURITY STUDIES

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### **STRATEGIC OBJECTIVES: CONTEXTUAL UNDERSTANDING OF THE EXPANDED RUSSIAN–VENEZUELAN RELATIONSHIP**

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The rise to power of Vladimir Putin and Hugo Chávez in the beginning of this century was accompanied by steady commodity price increases. Both leaders benefited enormously from the increased profit produced, as the gross domestic product of both countries is closely tied to the energy market, especially to oil. The course of the recent relationship between Russia and Venezuela is marked by a steady increase in cooperation as these two countries grow increasingly close. The relationship is touted by Russian and Venezuelan leaders as a rejection of U.S. hegemony and the establishment of a multipolar world through openness and international cooperation.

Thus far, U.S. reaction has focused on non-confrontationally expressing the U.S. position on specific actions of each country, while paying little attention to potential strategic aims. To date, the serious analysis has been centered on arms deals and other agreements resulting from the relationship instead of on the long-term goals of the parties involved. As Russia and Venezuela use the relationship to reject U.S. influence, achieve strategic goals, and interact internationally with other countries, U.S. policy decisions and international relations would be better served to acquire a deeper understanding of, and appreciation for, the relationship and its future.

**KEYWORDS:** United States, Venezuela, Russia, Vladimir Putin, Dmitry Medvedev, Hugo Chávez, Perception, Constructivism, Oil, Arms Sales, Petroleum, Energy, International Relations Theory, Strategic, Realism, Liberalism, Siloviki, PDVSA, GAZPROM, Democracy

### **THE DOMINICAN-REPUBLIC–CENTRAL-AMERICAN FREE-TRADE AGREEMENT (DR-CAFTA): UNDERSTANDING THE REASONS WHY THE DOMINICAN REPUBLIC JOINED THE CAFTA NEGOTIATIONS**

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In 2004, the Dominican Republic (DR) joined the Central American Free Trade Agreement (CAFTA) negotiations, which had been started between the nations of Central America and the U.S. For the DR, this was a major step towards permanently opening up its domestic market and securing access to the markets of the other member nations. This thesis addresses the question of why a small country like the DR would choose to enter into a free trade agreement. Although it is possible to look only at the reasoning behind the specific decision, it is equally important to understand the domestic and international pressures the DR has experienced over the last 25 years and how such experiences influenced their preference. This thesis examines the DR's choice through the overall framework of regionalization and how that influenced a proliferation of preferential trade agreements throughout the Western Hemisphere. The DR's economy has always been closely linked to U.S. influence and policies, and specific changes in the global economic climate drove both nations to seek strategic partnerships with each other. The DR has had to make major adjustments to take advantage of potential economic opportunities, and this thesis concludes that the DR-CAFTA can be seen as a continuation of those efforts.

**KEYWORDS:** DR-CAFTA, Western Hemisphere Regionalization, Free Trade Area of the Americas, FTA, Central America Common Market, CACM, Caribbean Community, CARICOM, Caribbean Basin Initiative, CBI, Economic Restructuring, Trade Liberalization, Nontraditional Exports, Free Trade Zones, FTZs, Dominican Banking Crisis 2003-2004, Niche Markets

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## SECURITY STUDIES

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### **THE TRANSFORMATION OF THE FEDERAL BUREAU OF INVESTIGATION TO MEET THE DOMESTIC INTELLIGENCE NEEDS OF THE UNITED STATES**

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This thesis explores the challenges confronted by the United States government and the intelligence community after September 11, 2001. It describes criticism leveled at government agency action, specifically the Federal Bureau of Investigation (FBI), in the years prior to the terrorist attacks on the World Trade Center and the Pentagon. The author provides an overview of the state of the FBI prior to September 11, 2001, and then discusses both the transformational challenges and successes encountered by the FBI. The Bureau is making an effort to create a predictive intelligence capability while maintaining its current statutory responsibilities as the nation's primary federal investigative and law enforcement agency. The thesis examines both military transformational processes and the British Model of Domestic Intelligence. Recommendations relevant to the ongoing and strategic transformational efforts by the FBI are provided.

**KEYWORDS:** Federal Bureau of Investigation, FBI, Domestic Intelligence, Predictive Intelligence Capability, Transformation

### **PEACE THROUGH TRADE: AN ANALYSIS OF THE EFFECT OF DOMESTIC TRADE ON INTERNATIONAL CONFLICT AND CIVIL WAR**

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This thesis examines how different levels of domestic trade affect the intensity of conflict within and between states. Specifically, the thesis utilizes a cross-sectional analysis of pooled time-series data, both previously collected conflict datasets and published economic data, to test the hypothesis. The data is analyzed by conducting a correlation analysis followed by linear regression of the independent and dependent variables, controlling for certain variances between the cases by utilizing control variables. The findings reveal that high levels of domestic trade decrease a state's propensity to initiate an inter-state dispute or to fall into civil war. The policy implications of the findings are that advancing domestic trade will have the greatest statistical effect on decreasing a state's propensity to initiate an inter-state dispute or fall into civil war.

**KEYWORDS:** Domestic Trade, International Conflict, Civil War, Inter-State Dispute

### **NUCLEAR ENERGY IN SOUTHEAST ASIA: PULL RODS OR SCRAM**

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Southeast Asia is experiencing a nuclear energy renaissance. Why have some Southeast Asian countries chosen to pursue nuclear power while others have not? Among those pursuing nuclear energy, why are some moving more quickly than others? The hypothesis of this thesis is that countries are more likely pursue nuclear power if its benefits outweigh benefits from the same level of effort in other sources of energy. Analyses of these countries with respect to nuclear energy – using electricity demand, alternative energy sources, political will, means of production, technical capacity, and international support – result in three categories: countries that abstain from it (Brunei, Cambodia, East Timor, Laos, and Singapore), countries that may pursue it (Burma, Malaysia, and the Philippines)

and countries that are pursuing it (Indonesia, Thailand, and Vietnam). Countries that abstain do so either because greater benefit can be achieved with the same level of national effort in other areas or because nuclear energy is politically ill-suited to their specific needs. Countries on the fence face political obstacles that have yet to be overcome. Countries pursuing it do so based on a need to expand electricity capacity to sustain economic development, with the rate of pursuit dominated by their political circumstance.

**KEYWORDS:** Nuclear Energy, Nuclear Power, Nuclear Reactor, Electricity Generation, Electricity Production, Southeast Asia, Proliferation, Nuclear Weapon

### **DEPORTATIONS: SECURING AMERICA OR RUNNING IN CIRCLES?**

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The United States was attacked by terrorists in 2001, and the country entered into a highly publicized debate on how to keep the country safe. Immigration reform to counter the ability of terrorists to circumvent U.S. immigration laws became the focus of much anti-terrorism legislation. Many immigration laws, especially concerning the deportability of an individual, which had been in place since the mid-1990s, were expanded and additional enforcement mechanisms were created. However, policies emplaced have created new challenges in terms of cooperation with Latin America due to the overwhelming impact the laws have had on Latin Americans, whether documented or undocumented. Additionally, the laws are written and passed due to political pressure resulting from acts of terrorism, but there are significant provisions that can be applied to countering criminal activity. This broad approach has sent contradictory messages to Latin America in comparison to U.S. plans for economic integration. The impact on cooperation from Latin America is just one way the overall strategic goals of the United States have been affected by deportation policy. As the United States seeks faster mechanisms to emplace borders and return non-citizens, Latin America must reintegrate them into a society that is improperly prepared to deal with them. This strategy may serve the short-term goals of the United States, if it was effectively implemented, but the sheer amounts of undocumented immigrants in this country do not make that possible. Additionally, deportation policy has not addressed the long-term goals of U.S. security strategy to promote freedom and economic opportunity to counter terrorism and crime.

**KEYWORDS:** Deportation, Latin America, Immigration Enforcement, National Security

### **HAMAS: BETWEEN VIOLENCE AND PRAGMATISM**

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In this thesis, the author analyzes the Hamas movement, its decision making, and the factors that influence those decisions. Far from being solely a terrorist organization, Hamas is a heterogeneous movement that has situational awareness and uses violence or political participation after a cost-benefit analysis. Hamas' main objective is to stay in power and preserve its identity. Hamas is unlikely to publicly reject its ideology. Two opinions about Hamas are prevalent. On the one hand, Hamas is assessed as a radical terrorist organization. The policy implication of this first opinion is simple: Hamas cannot be reformed and will continue to use violence. Therefore, Hamas must be neutralized. On the other hand, Hamas is assessed as a social movement that does not necessarily need to use violence. This school of thought assesses Hamas as a movement that can learn to refrain from violence. The policy implication of this position is that Hamas' inclusion in politics supports the process of moderating Hamas into a non-violent organization. Both policies either prove to be ineffective or imply risks. This thesis asserts a middle position. Hamas' decisions to act depend on two factors. First, its internal situation is of importance. Second, and even more important, the political and situational circumstances on the ground in Palestine have a strong impact on

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Hamas. The middle position implies that the situation on the ground can be influenced in a way that may give Hamas little or no incentive to use violence.

**KEYWORDS:** Hamas, Israel-Palestinian Conflict, Peace Process, Gaza Strip Current Situation, West Bank, Social Movement Theory, Islamist Movements, Islamic Nationalism, Palestinian Political Parties, Operation “Cast Lead,” Oslo Peace Accords, Palestinian 2006 Elections

### **THE HUNTING OF THE SNARK: ORGANIZING AND SYNCHRONIZING INFORMATIONAL ELEMENTS FOR HOMELAND DEFENSE AND CIVIL SUPPORT**

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The tension between public affairs (PA) and information operations (IO) illustrates the struggle to organize and synchronize informational elements in support of homeland defense and civil support. PA focuses on credibility by providing factual information in a responsive manner to present a positive image of the organization. IO focuses on proactive operations that use influence to shape the information environment. The purpose of PA and IO is to communicate the command mission and operations. The current informational landscape does not support a cohesive, informational strategy. Current doctrine creates a tension between these two elements that centers on credibility. This tension prevents cohesive, informational efforts. The principles of war and the nature of the information environment compel a need for an organizing construct and synchronizing force for effectiveness. This study examines policy and doctrine to understand the nature of the information environment, PA, IO, and strategic communication. The study examines an optimal organizational strategy using the Star Model that provides the organizing construct and the required synchronizing force. The outcome of this research is a set of policy and doctrine recommendations that will support optimal organization and synchronization of information elements in order to communicate effectively for the homeland.

**KEYWORDS:** Public Affairs, Information Operations, Strategic Communication, Information Environment, Information, Organization, Homeland Defense, Civil Support



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