# Compilation of Abstracts, December 2013

Monterey, California; Naval Postgraduate School

NPS-04-14-001


COMPILATION OF

# ABSTRACTS

## Unrestricted Dissertations, Theses, and Final Projects

## NPS Class of December 2013


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NAVAL POSTGRADUATE SCHOOL
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# PREFACE

This publication, Compilation of Abstracts, contains abstracts of unrestricted dissertations, theses, and capstone project reports submitted for the doctor of philosophy, astronautical engineer, master of arts, master of business administration, and master of science degrees for the Naval Postgraduate School's December 2013 graduating class. A digital copy of this publication can be found at https://calhoun.nps.edu/handle/10945/60865 while the corresponding metadata for December 2013 abstracts can be found at https://calhoun.nps.edu/handle/10945/39047.

This compilation is published to acquaint those interested in the fields represented with the nature and substance of Naval Postgraduate School student research, which covers a wide range of defense-related topics. An online copy of this and previous editions can be found at https://calhoun.nps.edu/handle/10945/27474. Calhoun, the institutional archive of NPS, provides a convenient way to search the content of unrestricted theses. Search for specific full-text theses and dissertations by author, advisor, branch of service, date issued, degree, department, or type at http://calhoun.nps.edu/handle/10945/16.

Guidelines for obtaining printed copies of unrestricted dissertations, theses, and capstone project reports are outlined on the last page of this volume. Restricted theses are available for viewing on the NPS SIPRNet and through the Defense Technical Information Center at http://www.dtic.mil/dtic/.

Additional Information on NPS Research and Academic Programs Summary of Research, an annual compilation of research projects and publications, is also available online at https://calhoun.nps.edu/handle/10945/13736. "Research," a monthly newsletter highlighting some of the newest developments in NPS research, can be found at https://calhoun.nps.edu/handle/10945/7839.

For other inquiries about student and faculty research at NPS, please contact the Dean of Research, Jeffrey Paduan:

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Monterey, CA 93943-5138
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For details on degree programs at NPS, please contact the director of admissions at (831) 656-3093 or grad-ed@nps.edu. The NPS academic catalog is available at http://www.nps.edu/Academics/GeneralCatalog/Layout.html. The admissions website is at http://www.nps.edu/Academics/Admissions/Index.html.

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## INTRODUCTION



## DOCTOR OF PHILOSOPHY



## ASTRONAUTICAL ENGINEER



## MECHANICAL ENGINEER



## MASTER OF ARTS IN SECURITY STUDIES

## MASTER OF BUSINESS ADMINISTRATION



## MASTER OF SCIENCE

### Master of Science in Applied Mathematics



### Master of Science in Applied Physics

# INTRODUCTION

The Naval Postgraduate School is pleased to present the dissertation, thesis, and capstone project report abstracts for unrestricted research completed in December 2013 by the graduating class.

## MISSION

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

*To increase the combat effectiveness of commissioned officers of the naval service to enhance the security of the United States. In support of the foregoing, and to sustain academic excellence, fosters and encourages a program of relevant and meritorious research which both supports the needs of the Navy and Department of Defense (DOD) while building the intellectual capital of the Naval Postgraduate School faculty.*

To fulfill its mission, the Naval Postgraduate School advances innovation in the Navy and prepares officers for employing new technologies. The research program at NPS supports the mission of graduate education. Research at NPS

- advances knowledge in a wide range of disciplines relevant to DON/DOD;
- maintains upper-division course content and cutting-edge programs;
- provides the opportunity for students to demonstrate independent graduate-level scholarship in their areas of study;
- challenges students with creative problem solving experiences on DOD-relevant issues;
- solves warfare problems; and
- attracts and retains quality faculty with state-of-the-art expertise.

To meet its educational requirements, the Navy has developed a unique academic institution at NPS and via distance learning (DL) through specially tailored academic programs and a distinctive educational experience tying academic disciplines to naval and joint warfighting applications. NPS has aligned its education and research programs to achieve three major goals:

1. nationally recognized academic programs that support the operations of the Navy and Marine Corps, our sister services, and our allies;
2. research programs that focus on the integration of education and research in support of current and emerging national security technologies and operations; and
3. executive and continuing education programs that support sustained intellectual innovation and growth throughout an officer's career.

## ACADEMIC PROGRAMS

### School of International Graduate Studies (SIGS)

*The unique programs and faculty expertise within SIGS seek to identify and address current and emerging security challenges and strengthen multilateral and bilateral defense cooperation between the United States and other nations. Areas of expertise range from nuclear nonproliferation to counterterrorism; from the history of war to emerging biological and cyber threats; and from the security aspects of political economy to international law.*

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

## Graduate School of Business and Public Policy (GSBPP)

*GSBPP reflects the management side of national defense in support of operational requirements, with programs open to the U.S. uniformed services, DOD employees and contractors, federal employees, and international military and government employees. An integrated civilian and military faculty focuses on defense organizations, system applications, and instruction supported by extensive defense-oriented research.*

- Acquisition and Contract Management
- Advanced Acquisition Program
- Contract Management (DL)
- Defense Business Management
- Defense Systems Analysis
- Defense Systems Management
- Executive MBA (DL)
- Financial Management
- Information Systems Management
- Material Logistics Support
- Manpower Systems Analysis
- Program Management (DL)
- Supply-Chain Management
- Systems Acquisition Management
- Transportation Management

## Graduate School of Engineering and Applied Sciences (GSEAS)

*GSEAS provides advanced education in engineering and applied sciences while developing technological advances with strict application to DOD needs, thus setting it apart from civilian graduate schools of engineering. It is focused on preparing the next generation of U.S. and international leaders, military and civilian alike, for the uncertainties and challenges of a rapidly changing technological world.*

- Applied Mathematics
- Combat Systems Sciences and Technology
- Electronic Systems Engineering (residential and DL)
- Mechanical Engineering for Nuclear-trained Officers (DL)
- Meteorology and Oceanography
- Meteorology
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors–Mechanical/Electrical Engineering (DL)
- Space Systems Engineering
- Space Systems Operations (residential and DL)
- Systems Engineering (residential and DL)
- Systems Engineering Management (DL)
- Undersea Warfare
- Underwater Acoustic Systems (DL)

*GSOIS delivers graduate-level education and conducts cutting-edge research in four non-traditional knowledge domains responsive to U.S. military needs: information science and technology, military computer science, military operations analysis and research,*

- Applied Cyber Operations
- Computer Science (residential and DL)
- Computing Technology (DL)
- Cyber Systems and Operations
- Cost Estimating and Analysis (DL)
- Electronic Warfare Systems (International)
- Human Systems Integration
- Identity Management and Cyber Security (residential and DL)
- Information Sciences
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Joint C4I Systems
- Joint Information Operations
- Joint Operational Logistics
- Modeling, Virtual Environments, and Simulation
- Operations Analysis
- Remote Sensing

## Office of the Provost

*The Office of the Provost provides oversight to a specialized degree program that leads to a master of science in systems engineering analysis. Students benefit from cross-disciplinary course offerings and research opportunities found in GSEAS systems engineering and GSOIS systems and operational analysis curricula.*

- Systems Engineering Analysis

## STUDENT POPULATION

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government, and international military officers and government civilians. The student population distribution for December 2013 is shown in Figure 1.

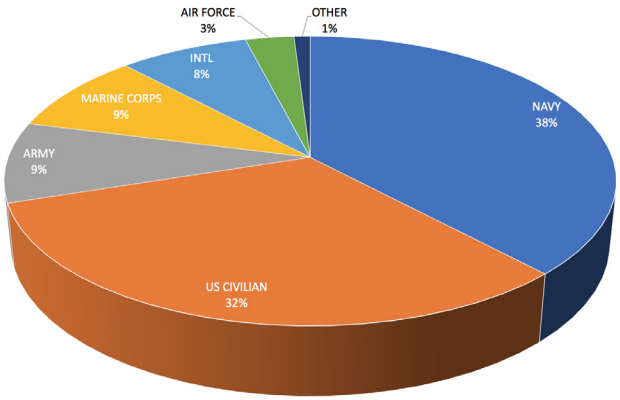
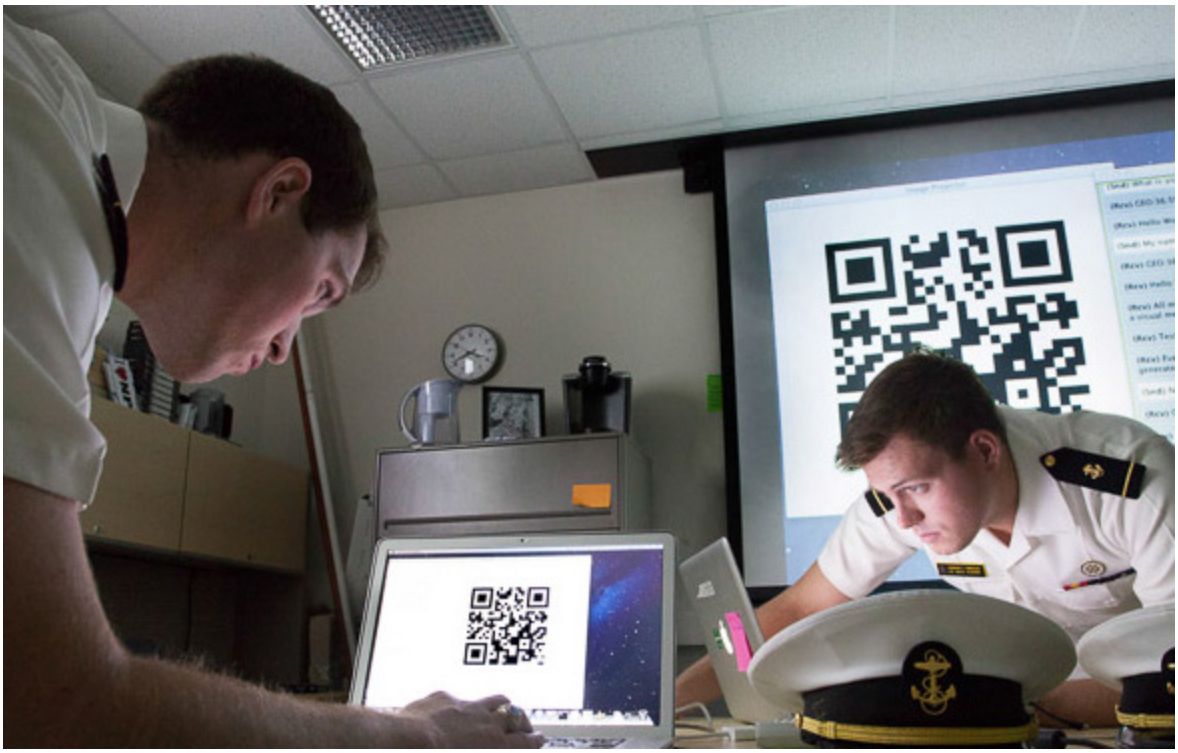



*Figure 1: Total enrollment by student type for the first quarter of 2014. Source: NPS Academic Affairs Quarterly Enrollment Report, AY2014/Quarter 1.*

## STUDENT RESEARCH

Independent scholarly work in the form of a dissertation (PhD), thesis (master's/engineer), or capstone project is required for most academic programs. Student research projects address issues ranging from the current needs of the fleet and joint forces to the science and technology required to sustain long-term superiority of the Navy and DOD. Guided by faculty advisors, NPS students represent a vital resource within the DOD for addressing war-fighting problems and maintaining cutting-edge expertise, particularly in a time when technology and information operations are changing rapidly. Naval Postgraduate School alumni think innovatively and possess the knowledge and skills to apply nascent technologies in the commercial and military sectors. Their firsthand grasp of operations, when combined with challenging projects that require them to apply their focused graduate coursework, is one of the most effective elements in solving fleet, joint-force, and regional problems. NPS graduate education encourages a lifelong capacity for applying basic principles and creative solutions to complex problems. NPS is also unique in its ability to conduct classified research. Classified theses are available on the NPS SIPRNet.



*Source: Naval Postgraduate School Public Affairs Office*

## DEGREES OFFERED

Curricula meet defense requirements within the traditional degree framework through residential or distance-learning programs. The curricula listed below lead to master's, engineer, or doctor of philosophy degrees. NPS also offers certificate and executive education programs, which do not require theses.

**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
- Security Studies
- Software Engineering
- Systems Engineering

**Engineer**
- Astronautical
- Electrical
- Mechanical

**Master of Arts**
- Identity Management and Cyber Security
- Security Studies

**Master of Business Administration**
- Master of Business Administration
- Executive Master of Business Administration

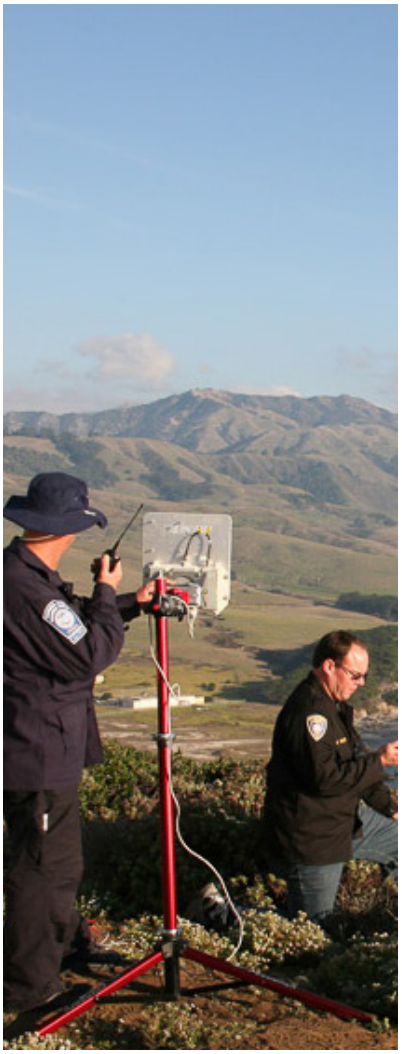
**Master of Computing Technology**

**Master of Cost Estimating and Analysis**

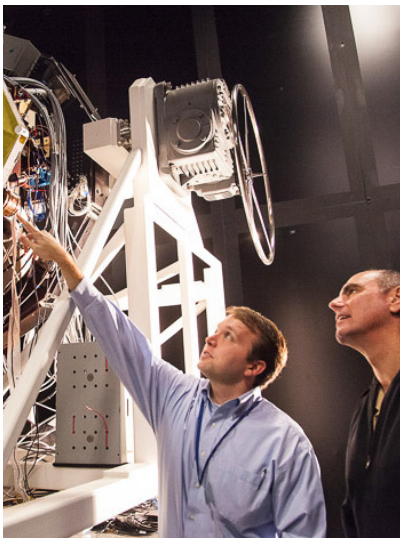
**Master of Engineering**
- Computer Engineering
- Electrical Engineering

**Master of Engineering Acoustics**

**Master of Human Systems Integration**



*Source: NPS Public Affairs Office*



*Source: NPS Public Affairs Office*

**Master of Science**
- Applied Cyber Operations
- Applied Mathematics
- Applied Physics
- Applied Science
- Astronautical Engineering
- Combat Systems Technology
- Computer Science
- Contract Management
- Cyber Systems and Operations
- Defense Analysis
- Electrical Engineering
- Electronic Warfare Systems Engineering
- Engineering Acoustics
- Engineering Science
- Engineering Systems
- Human Systems Integration
- Information Strategy and Political Warfare
- Information Technology Management
- Information Warfare Systems Engineering
- Management
- Mechanical Engineering
- Meteorology
- Meteorology and Physical Oceanography
- Modeling, Virtual Environments, and Simulation
- Network Operations and Technology
- Operations Research
- Physical Oceanography
- Physics
- Product Development
- Program Management
- Remote Sensing Intelligence
- Software Engineering
- Space Systems Operations
- Systems Engineering
- Systems Engineering Analysis
- Systems Engineering Management
- Systems Technology

**Master of Systems Analysis**

## DECEMBER 2013 DEGREES CONFERRED

The December 2013 graduating class produced 173 unrestricted dissertations, theses, and capstone project reports as part of the graduation requirement. Figure 2 indicates the distribution of degrees awarded by academic school.

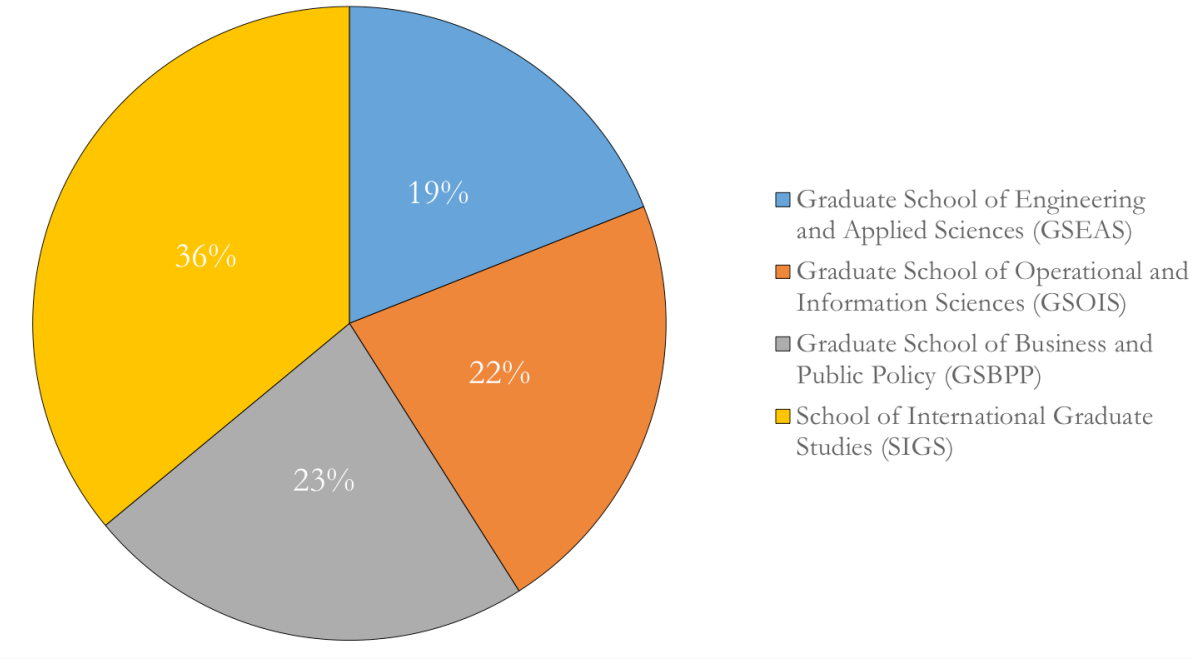
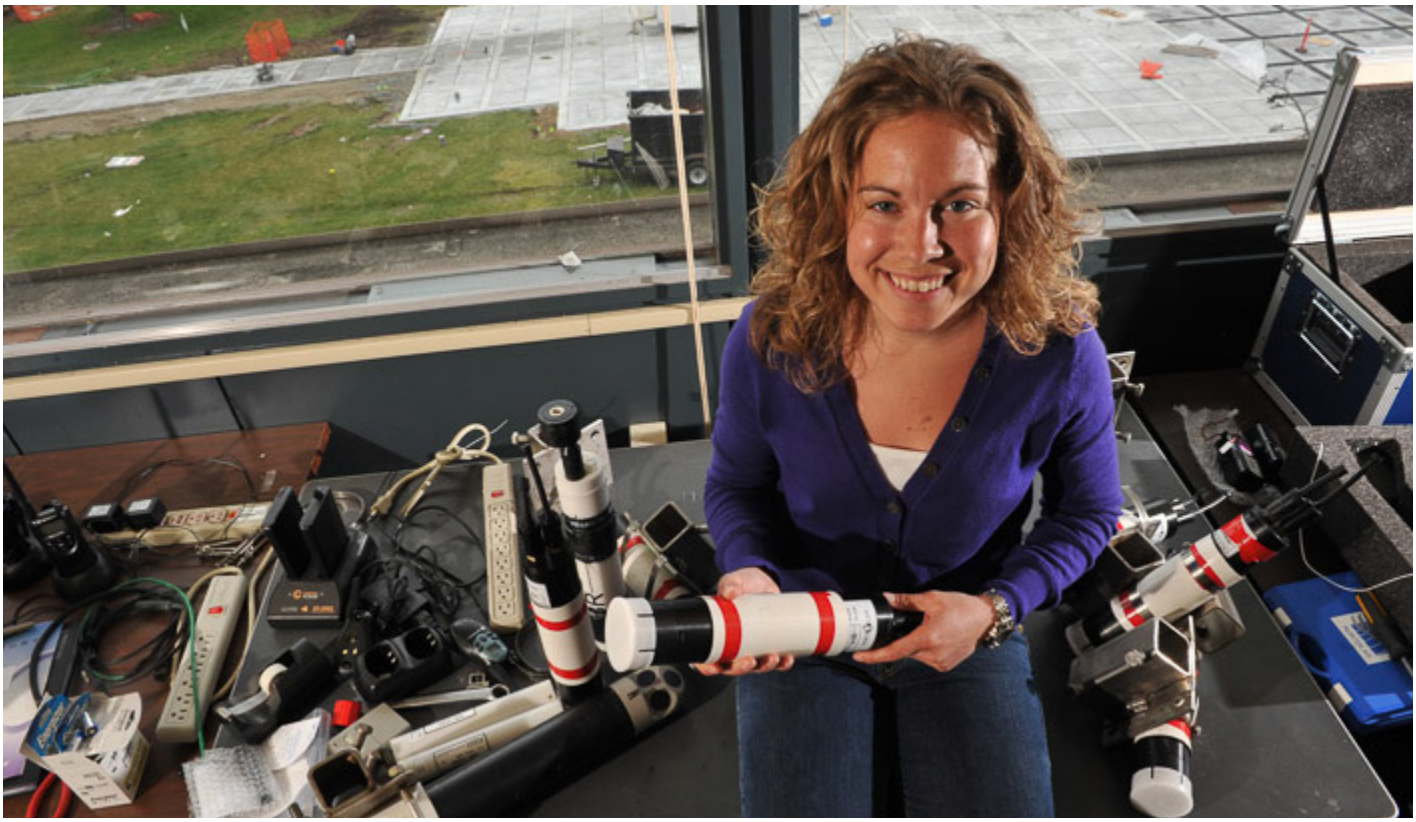



*Figure 2. Distribution of degrees conferred by academic school, December 2013 (unrestricted theses)*



*Source: NPS Public Affairs Office*

## ACADEMIC AWARDS ANNOUNCED DECEMBER 2013

Many departments honor graduating students for the quality and contributions made by their dissertations, theses, or capstone reports. The following listing recognizes students selected by NPS faculty and military associations for superior academic achievement and outstanding theses.

**Campus-wide**

- Monterey Council Navy League Award for Highest Academic Achievement: Major Jacob C. Urban, USMC—Outstanding Thesis: *Contemporary Salafism and the Rightly Guided Caliphate: Why Is It Emulated and What Was Its Reality?*
- Association of the United States Army, General Joseph W. Stilwell Chapter, Award for Outstanding Army Student: Major Erich Schneider, USA
- Naval Postgraduate School Outstanding Academic Achievement Award for International Students: Lieutenant Commander Geir O. Svendsen, Norwegian Navy
- The International Student Award for Excellence in Regional or Security Studies: Captain Vedat Er, Turkish Army
- The Hans Jones Award for Excellence in Thesis Research in Special Operations and Irregular Warfare or Security, Stabilization, Transition Reconstruction: Major Pedro J. Rosario , USA; Major Davis D. Tindoll . III, USA; Major Mark T. Newdigate, USA; and Major Joshua S. Bowes, USA
- Naval Intelligence Foundation, Admiral Bobby Ray Inman Award for Outstanding Performance in the Field of Intelligence and Information Dominance: Lieutenant Gregory Allen Chasse , USN—Outstanding Thesis: *Awaiting a Spark: How Three Chinese Territorial Disputes Could Jeopardize Peace in Asia*
- Naval Postgraduate School Outstanding Academic Achievement Award for Department of Defense Student: Mr. Thomas Frerichs, Puget Sound Naval Shipyard
- The Curtis H. "Butch" Straub Achievement Award: Lieutenant Thomas Monahan, Las Vegas Police Department, Nevada
- The Army Acquisition Corps Award for Scholastic Achievement: Mr. Derrick Torgerson and Ms. Virginia Babcock
- Captain David S. Bill, Jr., Leadership Award: Major Ramey L. Wilson, USA

**Graduate School of Business and Public Policy (GSBPP)**

- The Louis D. Liskin Award for Excellence in Business and Public Policy: Major Eric Henzler, USMC
- RADM Donald R. Eaton Logistics Award for Outstanding Achievement: Major Eric Henzler, USMC
- The Graduate School of Business and Public Policy Faculty Outstanding International Student Award: Mr. Gay Taur "Jason" Oh; Lieutenant Commander Christopher Barry, Australian Navy; and Ms. Li Huang "Joyce" Tan, Civilian, Defence Science & Technology Agency, Singapore—Outstanding Thesis: *An Analysis of Internal Controls and Procurement Fraud Deterrence*
- The Louis D. Liskin Award for Excellence in Business and Public Policy: Mr. Thomas Frerichs, Puget Sound Naval Shipyard
- Naval Supply Systems Command Award for Academic Excellence in Management: Lieutenant Jonathan D. Albano, USN
- CDR Philip A. Murphy-Sweet Memorial Award for Excellence in Acquisition: Lieutenant Jonathan D. Albano, USN
- Department of the Navy Award for Academic Excellence in Financial Management: Lieutenant Commander Bradley J. Garms, USN
- Rear Admiral Thomas R. McClellan Award for Academic Excellence in the Graduate School of Business and Public Policy - Lieutenant Commander Bradley J. Garms, USN
- Conrad Scholar Award for Distinguished Academic Achievement in Financial Management: Lieutenant Commander Bradley J. Garms, USN; and Lieutenant Francisco Salazar, USN

**Graduate School of Engineering and Applied Sciences (GSEAS)**

- John McReynolds Wozencraft Electrical and Computer Engineering Academic Honor Award: Lieutenant Ashley S. M. McAbee, USN
- Space and Naval Warfare Systems Command Award in Electronic Systems Engineering: Lieutenant

Brandon F. Clare, USN
- Naval Sea Systems Command Award for Excellence in Combat Systems: Lieutenant Matthew Van Horn, USN
- Naval Sea Systems Command Award in Naval/Mechanical Engineering: Lieutenant Commander Jamie E. Cook, USN
- The Space Systems Engineering Award for Academic Excellence: Lieutenant Reid Smythe, USN
- Astronaut Michael J. Smith, CAPT, USN, and Astronaut William C, McCool, CDR, USN Astronautics Award: Lieutenant Commander Richard Gargano, USN
- Meyer Award for Outstanding Student in Systems Engineering (Distance Learning): Mr. Michael Boyett, Civilian, Department of the Air Force
- The Space Systems Engineering Award for Academic Excellence: Major Steven Crews, USA

**Graduate School of Operations and Information Sciences (GSOIS)**
- The Pat Tillman Leadership Award: Major Matthew S. Balint, USA

**School of International Graduate Studies (SIGS)**
- The Louis D. Liskin Award for Excellence in Regional Security Studies: Major Jacob C. Urban, USMC; and Major Timothy R. Mayer, USMC—Outstanding Thesis: *Intractability and Mediation of the Nagorno-Karabakh Conflict*
- The Outstanding United States Air Force Graduate Award, Department of National Security Affairs: Major William J. Pogue, USAF
- The Philip Zimbardo Award: Captain David Franklin, Texas Department of Public Safety

**Outstanding Thesis Recognition**
- Lieutenant Commander Dianna L. Bo, USCG: *Estimating the Organizational Cost of Sexual Assault in the U.S. Military*
- Lieutenant David M. Camp, USN: *Evaluation of Object Detection Algorithms for Ship Detection in the Visible Spectrum*
- Lieutenant Commander Daniel Peixoto de Carvalho, Brazilian Navy: *Dynamics, Heat Transport, Spectral Composition and Acoustic Signatures of Mesoscale Variability in the Ocean*
- Mr. Janos Csengeri, Civilian, Hungary: Civil Society as a Game Changer: *A Comparative Study of Political Transitions in Eastern Europe and the Middle East*
- Lieutenant Ashley S. M. McAbee, USN: *Traffic Pattern Detection using the Hough Transformation for Anomaly Detection to Improve Maritime Domain Awareness*
- Lieutenant Commander John Mullen, USN; Lieutenant Commander Kevin Wilson, USN; and Lieutenant Ian Burgess, USN: *An Analysis of Personal Financial Management Training within the Department of the Navy*
- Major Truc T. Pham, USA; and Major Michael J. Sieber, USA: *Positive Communications: The Keystone of Counterinsurgency Strategy*
- Major Simon J. Powelson, USA: *Enduring Engagement Yes, Episodic Engagement No: Lessons for SOF from Mali*
- Ms. Diana Solymossy, Assistant County Manager and Director of Communications, Arlington, Virginia: *High-Tech, Low-Tech, No-Tech: Communications Strategies during Blackouts*
- Commander James J. Watson, USN: *Correcting Surface Figure Error in Imaging Satellites using a Deformable Mirror*
- Captain Trenton Wilhite, USA; Captain Adam Stover, USA; and Captain Jeffrey Hart, USA: *Management Levers That Drive Services Contracting Success*

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# DOCTOR OF PHILOSOPHY

## A DATA-DRIVEN FRAMEWORK FOR RAPID MODELING OF WIRELESS COMMUNICATION CHANNELS

**Douglas Horner, Naval Postgraduate School**
**Doctor of Philosophy in Computer Science**
**Advisor: Geoffrey Xie, Department of Computer Science**

Accurate estimation and prediction of wireless signal strength holds the promise to improve a wide variety of applications in networking and unmanned systems. Current estimation approaches use either simplistic attenuation equations or detailed physical models that provide limited accuracy and may require a lengthy period of environmental assessment and computation. This dissertation presents a new, data-driven, stochastic framework for rapidly building accurate wireless connectivity maps. The framework advances the state-of-the-art in three aspects. First, it augments the classic spatial interpolation procedure known as Kriging with a complementary additive approach to capture the typical anisotropic nature of wireless channels in cluttered environments. Second, it includes a technique for rapidly creating and maintaining a connectivity map in near real-time through the use of a spatial Bayesian recursive filter. Third, it introduces a novel methodology to adapt the resolution of a connectivity map based on the spatial characteristics and the quantity of available sample measurements. Detailed analyses, using several datasets collected recently in the Monterey Harbor, have confirmed the power and agility of the proposed approach. Full text

**Keywords:** wireless connectivity maps, random fields, Kriging, Gaussian process models, $\ell_1$ regularized logistic regression, Kalman filtering, underwater acoustic networking

## DISTRIBUTED DIGITAL SUBARRAY ANTENNAS

**Bo-Kai Feng, Major, Taiwan Army**
**Doctor of Philosophy in Electrical Engineering**
**Advisor: David Jenn, Department of Electrical and Computer Engineering**

A system that incorporates distributed digital subarrays working cooperatively as a single array can potentially increase the output signal-to-noise ratio and provide better spatial resolution compared with using the subarrays individually. However, collectively combining periodic widely separated subarrays results in unacceptable grating lobes, and these lobes cannot be suppressed using traditional windowing methods. In this research, we focus on distributed subarray antennas that are comprised of subarrays that can operate individually or collectively. We develop techniques for grating lobe suppression on both the transmitting and receiving sides of the distributed array system. Traditional solutions and new methods are examined in detail via numerical simulation to quantify the performance limitations when applied in combination. One contribution of this research is a hybrid approach that uses a combination of suppression techniques on both the transmitting and receiving sides. Another contribution is the development of new receiving processing methods to suppress grating lobes and improve the signal-to-clutter ratio and signal-to-interference ratio. A final contribution shows the relationship between thermal noise, array errors, and the grating lobe suppression effectiveness. The consideration of array errors addresses the issue of array calibration and synchronization, which are critical concerns when multiple arrays operate coherently. Full text

**Keywords:** digital distributed subarray antenna, virtual filling, random array

## USE OF SYMMETRICAL NUMBER SYSTEMS IN ELECTRONIC WARFARE

**Thomas Tedesso, Commander, United States Navy**
**Doctor of Philosophy in Electrical Engineering**
**Advisor: Phillip Pace, Department of Electrical and Computer Engineering**

The use of symmetrical number systems and wideband technologies is investigated to develop novel concepts for use in electronic warfare (EW) receivers. A computationally efficient algorithm for determining the dynamic range of the robust symmetrical number system (RSNS) is used to derive additional closed-form expressions for the RSNS dynamic range using a curvefitting method. A photonic direction-finding array employing dual-electrode Mac-Zehnder modulators with RSNS preprocessing is developed and validated through simulations and experimental testing. Additional EW receiver concepts using the symmetrical number system (SNS) and CS are also examined. An SNS-CS cueing receiver is proposed that places a multichannel undersampling receiver, based on the SNS, into a CS framework and applies CS recovery algorithms to resolve the signal's frequency components. The SNS-CS cueing receiver's performance is evaluated through Monte Carlo simulations. The final concept examined is a multichannel Nyquist folding receiver (NYFR) with SNS-based uniform sampling rates (NYFR-B). The NYFR-B's performance is evaluated through Monte Carlo simulations and performance curves are presented. Full text

**Keywords:** symmetrical number systems, robust symmetrical number system, compressive sensing, photonics, Mach-Zehnder modulator, direction finding array, electronic warfare

## SOURCES OF WIND VARIABILITY AT A SINGLE STATION IN COMPLEX TERRAIN DURING TROPICAL CYCLONE PASSAGE

**Joel Feldmeier, Commander, United States Navy**
**Doctor of Philosophy in Meteorology**
**Advisor: Wendell Nuss, Department of Meteorology**

Although Sasebo, Japan's harbor is usually a typhoon haven from tropical cyclone winds, due to terrain-blocking effects, in rare cases damaging winds occur that may be attributed to terrain channeling. Prediction techniques are developed and tested to improve forecast capability of maximum sustained winds and wind gusts that are the basis for tropical cyclone conditions of readiness. Verification observations from a site that was available from 1990–1998 were found to provide a false sense of security due to its urban location and 13m anemometer height. Representing the Sasebo terrain effects with a large database of reanalysis winds had limited success unless the top 1,000 wind speeds from each cardinal wind direction were used. A parametric wind model that utilized the Joint Typhoon Warning Center wind radii to represent the wind profile shape resulted in better local wind prediction at Sasebo and a small, flat island but demonstrated the requirement for a wind-reduction factor to represent frictional effects. This parametric wind model, which is multiplied by directionally-dependent acceleration factors to represent Sasebo terrain effects, was most successful for an independent sample of tropical cyclones passing within 200 nautical miles of Sasebo from 2011 to 2012 and for selected forecast case studies. Full text

**Keywords:** single station forecasting, Sasebo, tropical cyclones, terrain effects, probabilistic forecasting

# ASTRONAUTICAL ENGINEER

## AUTOMATED TECHNIQUES FOR RAPID ANALYSIS OF MOMENTUM EXCHANGE DEVICES

**Reid Smythe, Lieutenant, United States Navy**
**Astronautical Engineer and Master of Science in Astronautical Engineering**
**Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Isaac Ross, Department of Mechanical and Aerospace Engineering**

This thesis develops a suite of automated techniques aimed at analyzing the characteristics of arrays of control moment gyroscopes (CMGs) and/or reaction wheels (RWs). Three specific areas, relevant to the design of new spacecraft, are examined: momentum space, torque space, and reaction forces. The momentum space analysis creates a maximum saturation envelope for both pure CMG/RW arrays and for hybrid arrays. The torque space analysis creates a maximum envelope for RWs and presents the idea of state-space analysis for CMGs, which leads to the ability to determine singularity-free operational envelopes. These envelopes allow satellite slew performance to be estimated, allowing for an initial determination of component size. The reaction forces and moments seen at the attachment points of the RWs and CMGs during maneuvers is also analyzed. This analysis, which has not been reported in the literature, utilizes telemetry data and the geometry of the spacecraft to explore the relationship between maneuver types and the loads seen by the CMG/RW mechanism. Full text

**Keywords:** reaction wheel, control moment gyroscope, reaction forces

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# MECHANICAL ENGINEER

## MICROSTRUCTURAL ANALYSIS OF THE FAILURE MECHANISMS OF CARBON NANOFIBERS AND INORGANIC FULERENE-TYPE TUNGSTEN DISULFIDE

**Jamie Cook, Lieutenant Commander, United States Navy**
**Mechanical Engineer and Master of Science in Mechanical Engineering**
**Advisor: Claudia Luhrs, Department of Mechanical and Aerospace Engineering**
**Second Reader: Garth Hobson, Department of Mechanical and Aerospace Engineering**

This thesis summarizes the failure mechanisms found in carbon nanofibers (CNF) and inorganic fullerene-type tungsten disulfide (IF-$WS_2$) nanoparticles treated with diverse pressure loading methods. CNF were generated using nickel as catalyst and ethylene as carbon source, while IF-$WS_2$ was acquired commercially. Approaches utilized to induce failure include the use of a gas gun, ultrasonic treatment, and impact with military rounds. Samples were characterized using electron microscopy, powder x-ray diffraction, energy dispersive x-ray spectroscopy, and BET surface area analysis. CNF produced from nickel showed agglomeration from all testing methods but no evidence of fiber breakage or delamination. IF-$WS_2$ failure modes observed were related, primarily, to the transition between 3D and 2D polymorphs, with subsequent agglomeration of the plate-like 2D structure, producing larger particle sizes. The secondary mechanism identified was delamination of IF-$WS_2$, which, in contrast to the former, gave origin to smaller particulates. The failure modes identified herein were used to re-design the CNF material and test it using the gas gun. CNF with larger diameter distributions were grown from palladium catalyst, producing ultralow density carbon foam. This architecture presented viscoelastic properties that recovered the original shape after unloading, not showing evidence of failure under the gas gun test regime employed. Full text

**Keywords:** carbon nanofiber, inorganic fullerene-type tungsten disulfide, gas gun, ultrasound, military rounds, agglomeration, delamination

## MECHANICAL AND ELECTRICAL CHARACTERIZATION OF NOVEL CARBON NANO FIBER ULTRALOW DENSITY FOAM

**D. Chris Daskam, Lieutenant Commander, United States Navy**
**Mechanical Engineer and Master of Science In Mechanical Engineering**
**Advisor: Claudia Luhrs, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Jonathan Philips, Department of Physics**

Concomitant mechanical and electrical testing of carbon nanofiber foam samples, generated using the constrained formation of fibrous nanostructures process, reveal the material to be a unique ultra-low-density foam with electrical properties appropriate for application as strain gauge. Samples of CFF, essentially a solid mat of intertwined nanofibers of pure carbon, were grown in a steel mold at ~550°C from a variety of catalysts exposed to fuel rich mixtures of ethylene and oxygen. Only those created from palladium (Pd) particle catalysts were found to produce macroscopic objects sufficiently robust for static and dynamic stress/strain tests. Transient and dynamic tests were used to fully characterize the mechanical properties of the novel foam. These tests clearly demonstrated that the material generated from Pd particles has viscoelastic behavior. The foam was subjected to compression cycles over diverse periods of time employing a die to maintain a fixed cross sectional area. The ultralow density material has a modulus of ~3.5 MPa, close to the one encountered in rubber-like substances. Given its carbonaceous nature, the new foam maintains its thermal stability up to

550°C in air. Simultaneous resistance/stress/strain measurements showed that there is a linear relationship between electrical resistance and strain that is remarkably consistent over many cycles. The novel ultralow density foam has many potential applications, including sensing element of a strain gauge or energy absorber. Full text

**Keywords:** carbon, fiber, carbon nanofiber, viscoelastic, strain gauge, gauge factor, ultra-low-density foam, relaxation modulus, and creep compliance

# MASTER OF ARTS IN SECURITY STUDIES

### BORDER SECURITY AGENCY STRUCTURE: A HINDRANCE TO DEMONSTRATING BORDER SECURITY SUCCESS

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Long-awaited immigration reform may become a reality in 2013, as Congress debates the merits of a comprehensive overhaul. The primary criteria for triggering reforms in the Border Security, Economic Opportunity, and Immigration Modernization Act (S.744), involves demonstrated control of the Southwest border. The debate has been complicated, however, because only a few analysts and not the Department of Homeland Security itself have been able to produce acceptable metrics that illustrate success at enforcing border operations at or between the ports of entry. Full text

**Keywords:** DHS, Department of Homeland Security, border security, border patrol, CBP, Customs and Border Protection, Coast Guard, Immigration and Naturalization Service, INS, immigration, Immigration and Customs Enforcement ICE, Hart-Rudman, HSA, Homeland Security Act, USCS, United States Customs Service, BTS, Border and Transportation Security Directorate, appreciative inquiry, VSP, Visa Security Program, inspection

### NAFTA EFFECTS ON INCOME INEQUALITY BETWEEN 1998 AND 2006: A COMPARATIVE ANALYSIS

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Income inequalities constitute visible manifestations of differences in living standards within each country. High levels of income inequalities indicate a waste of human resources in the form of a large share of the population being without work or relegated to low-paid and low-skilled jobs. The term income inequality, either measured by income or wages, is an important topic that has been continuously debated among academics and the media. Since the 1980s, most countries in the world experienced an increase in wage inequality, and, for some countries, this trend continued during the 1990s. Mexico was no exception and went through a period of increasing inequality by the end of the 1980s. However, wage inequality in Mexico started to decline after 1994, the period after NAFTA was enacted. Although Mexico still seems to be experiencing inequality, the post-NAFTA period of 1998 to 2006 saw a decline in income inequality. Finding the reasons for the decline in income inequality during this period in Mexico is important because societies generally value a more democratic distribution of resources. Hence, the example of Mexico can be useful to other countries that are eager to reach lower inequality levels and overcome poverty. Full text

**Keywords:** Mexico, income inequality, NAFTA, Gini coefficient

## IMPROVING TSAS PUBLIC IMAGE: CUSTOMER-FOCUSED INITIATIVES TO ENCOURAGE PUBLIC TRUST AND CONFIDENCE

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The Transportation Security Administration (TSA) can improve its public image by looking at the problem from the customer's perspective. This thesis explores TSA's public-image challenges and identifies customer-focused solutions. Research methods include a case study analysis on Southwest Airlines and Disney and an extensive literature review to identify smart practices that are applicable to TSA. TSA needs to implement customer-focused strategies that are more effective in dealing with the agency's public-image challenges. A TSA strategy designed to build a more positive work environment, improve messaging and information sharing, increase the focus on customer service, and utilize customer feedback to improve operations, will begin to improve public opinion. There is a disconnect between TSA's intentions and the public's perceptions, and it is time to seek new opportunities to improve the public's trust and confidence. It is easy for some to be critical about an agency that screens over 1.7 million passengers each day and often has to get into the passengers' personal space in order to do so. TSA's first priority is and should be security, but public opinion is also important. Increasing public confidence in TSA may also result in more acceptance and cooperation with security processes, resulting in increased security effectiveness. Full text

**Keywords:** public image, customer service, reputation, customer feedback

## BIOLOGICALLY FIT: USING BIOTECHNOLOGY TO CREATE A BETTER SOLDIER

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Biotechnology plays a critical role in treating war injuries, preventing and diagnosing disease, and protecting the force against exposure to harmful agents. While effective in its ability to provide medical intervention, biotechnology's non-medical side reveals the opportunity to create a superhuman soldier who is more effective in combat and equipped to survive the rigors of war. Scientists in the field have proposed ideas on how to neurologically and physically enhance soldiers at the genetic level. These developments may help build soldier resistance to battle fatigue, increase endurance, and enhance intelligence, making soldiers more decisive on the battlefield. Creating soldiers that are stronger, faster and able to counter unpredictable enemy tactics will increase the military's ability to adapt to changing battlefield conditions and conduct major operations using a smaller force. This thesis examines performance and cognitive enhancement of the soldier via genetic engineering and its potential ability to arm the military with the capabilities to maintain rapid deployment cycles despite the reduction in force, and to fight wars using sophisticated techniques in order to reduce casualty rates. Understanding the ends and means of soldier enhancement and the novel ethical issues associated with genetic modification is critical to its future in military application. Full text

**Keywords:** genetic engineering, biotechnology, super soldier, ethics, biopolitics

## THE PERFECT MODEL FOR THE PERFECT STORM: CREATING AN EFFECTIVE STATE TO GRASSROOTS COMPREHENSIVE PUBLIC HEALTH AND MEDICAL STRATEGIC COMMUNICATION MODEL

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Every emergency situation presents unique challenges. It is absolutely essential to have a good grasp on the specific situation to be able to make the best decisions possible for public health response and mitigation. Clear situational awareness can mean the difference between life and death, which allows all partners to collect information, collaborate, and communicate prior to making critical decisions during an emergency. This applies to all stakeholders, whether at the state, regional, or local levels. Ultimately, the communication between those who have information and those who need the information must be shared; to be most effective, the information must be timely, accurate and credible. This thesis describes the development of a strategic communications model for Emergency Support Function-8 (ESF-8) public health and medical partners from the state to comprehensive grassroots level in Mississippi. The development of the MS ESF-8 Healthcare Coalition (MEHC) single model allows for information sharing across the entire medical enterprise in MS, including both public and private entities. Through case studies, events, an exercise, and workshops, the MEHC model was developed, and a common operating picture was realized. This thesis proposed an effective way to close an information gap and will ultimately help to save lives. Full text

**Keywords:** public health, medical, strategic communication, ESF-8, emergency management, public health emergency preparedness, coalition, situational awareness

## THE STUDY OF COUNTERTERRORISM MECHANISMS IN TAIWAN

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The 9/11 terrorist attack remains one of the darkest moments in American history and has had a great impact on the global strategic relationship in the beginning of the twenty-first century. To respond to this incident, Taiwan and the United States exchanged information and intelligence and signed the Sino-American Mutual Legal Assistance Treaty, which represents Taiwan's willingness to participate in and cooperate with the international community in regards to information exchange, security, and anti-money laundering activities and in strengthening an emergency response mechanism. At the time, the Taiwanese government, from the standpoint that "Taiwan needs to have what others have," established a Counterterrorism Office in January 2004, which was reorganized as the Office of Homeland Security in 2007. The Office of Homeland Security does not directly carry out intelligence gathering and counter-terrorism tasks. Instead, it combines intelligence from different intelligence apparatuses for further research, analysis, and lateral communication and consultation. The purpose of this thesis is to assess whether this two-track mechanism—the separation of intelligence and response systems—can respond efficiently to a major terrorist attack and whether a comparison of the approaches and experience of the United States and Japan offers useful insight into how to organize Taiwan's system. Full text

**Keywords:** counterterrorism mechanisms, national security affairs, intelligence, Anti- Terrorist Action Law

## AWAITING A SPARK: HOW THREE CHINESE TERRITORIAL DISPUTES COULD JEOPARDIZE PEACE IN ASIA

*This paper has been recognized as outstanding by its department*

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The rapid growth and modernization of China's economic, political, and military strength over the past two decades has inspired growing acrimony and concern in the United States. Washington strongly desires the continued peace and stability in Asia, and China's subsequent rise may eventually threaten American interests in the Pacific. Furthermore, China's various territorial disputes could upset regional stability, and as China grows stronger, it may decide to use its increasing military strength to push for resolutions to the disputes in China's favor. The question remains: how likely is China to use force to solve its territorial disputes; and, should China use force, will the United States ultimately be drawn into the conflict? Case studies that involve three of the most potentially volatile of China's territorial disputes in Central Asia, India, and the Diaoyu/Senkaku Islands seem to suggest that war is not inevitable, and that historically China has very rarely gone to war to resolve a territorial dispute. Ultimately, historical analysis suggests that China prefers to maintain its territorial disputes so they can be used in diplomatic negotiations as bargaining pieces, and that China has only gone to war when it has lost all bargaining power. Therefore, the current situation, wherein China seemingly has increased its bargaining leverage as its military power has grown, seems to suggest that, for the near term, war is highly unlikely. Full text

**Keywords:** China, Central Asia, India, Japan, United States, military, modernization, borders, independence, diplomacy

## THE ROLE OF STATE AND LOCAL JURISDICTIONS IN IDENTIFYING AND PROTECTING CRITICAL INFRASTRUCTURE

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Over the last several years, the aftereffects of several major disasters have severely impacted state, local, and regional critical infrastructure. Research was conducted via an analysis of the National Infrastructure Protection program and a case study of the State of New Hampshire Critical Infrastructure Program to determine to what extent the federal criteria for identifying federal critical infrastructure and key resources apply to state and local identification of critical infrastructure and key resources. The analysis of the National Infrastructure Protection Plan and subsequent sector-specific plans indicates that there is no clear connection between the National Infrastructure Protection Plan and local government critical infrastructure and key resources protection and resiliency planning. Research also found that, despite clear references to engaging state and local jurisdictions in planning, there was no evidence to support collaboration efforts between federal, state, and local jurisdictions. Full text

**Keywords:** critical infrastructure, state, local, National Infrastructure Protection Plan, resiliency, and collaboration

## OF NASA AND NEANDERTHALS, ELEPHANTS AND MACHINES: METAPHORS AND THE CONCEPTUALIZATION OF HOMELAND SECURITY

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The homeland security enterprise is still struggling to find a sense of self: the common cause, common language, and common understanding. In effect, the homeland security culture is still elusive. This thesis explores the idea that metaphors can provide a means for conceptualizing, defining, and representing the homeland security enterprise. The use of metaphor encompasses elements of language, philosophy, psychology, and cognition, and, therefore, how a phenomenon, organization, system, or endeavor is comprehended depends on the metaphors that are applied to aid in that comprehension. To understand what roles metaphors currently play in the homeland security paradigm, a document analysis of seminal and subsequent homeland security writings was conducted in search of the metaphors employed to conceptualize the enterprise. The research found that homeland security metaphors are limited to simple words and/or phrases, and no extended metaphors were employed. This thesis advances that metaphors are necessary for the conceptualization of phenomena in general and that there is a need to find and apply alternative and/or additional metaphors to comprehend the homeland security enterprise and culture. Full text

**Keywords:** metaphors, homeland security, conceptualization, conceptual metaphors, analogy, defining homeland security, homeland security culture, homeland security self, pan-specialization

## MITIGATE SOFT TARGETS VULNERABILITY AND PREVENT CRIME THROUGH BIOMETRICS

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Identifying a known criminal or terrorist, and providing protection for soft targets, is not only the concern of New York City, but also of law enforcement agencies and municipalities throughout the country. The research reveals several challenges that may arise in utilizing facial recognition and behavioral recognition technology in closed-circuit television systems. In recognizing these challenges, the writer looks to mitigate the vulnerability and prevent crime. The research indicates that the project's success increased when the environment was controlled. Data sources reviewed show that camera angles or lighting are two factors that can impact the environment control. The thesis also looked at the accuracy of the system and legality of any privacy concerns, as well as what political, public and media influence may have on an emerging technology system. Biometric emerging technology surveillance is an industry that is rapidly growing in both the public and private sector. However, It lacks the monitoring of one central authority to ensure that civil liberties are safeguarded. The research expanded on a Closed-Circuit Television (CCTV) system that is currently in place and devises a system that will be the foundation for the future of law enforcement by integrating biometric technology into a security surveillance system. Full text

**Keywords:** closed-circuit television, facial recognition, behavioral recognition, soft target, central authority

## THE GHANAIAN ECONOMIC RECOVERY

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From 1961 to the present, Ghana's gross domestic product (GDP) change deviated significantly (more than 5.8 percent) from that of the region eight times; of these eight deviations, four were positive, outperforming the region, and four were negative, underperforming the region. This study utilizes process tracing in order to test whether economic policies—protectionist and liberal—had any impact on those deviations. This study shows that every negative deviation year was preceded by protectionist policies, and, with one exception (explained by currency devaluation), every positive deviation year was preceded by economic liberalization policies. This relationship suggests that the nature of economic policies (liberal versus protectionist) do not necessarily cause large, acute GDP movement, but they may be prerequisites for significant GDP movement in any given year. Full text

**Keywords:** Ghana, economy, structural adjustment, economic reform, IMF

## COLLABORATIVE RESPONSE AND RECOVERY FROM A FOOT-AND-MOUTH DISEASE ANIMAL HEALTH EMERGENCY: SUPPORTING DECISION MAKING IN A COMPLEX ENVIRONMENT WITH MULTIPLE STAKEHOLDERS

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This thesis recommends ways to support decision-makers who must operate within the multi-stakeholder complex situation of response and recovery from a major foot-and-mouth disease outbreak. This is important because poor decision-making and uncoordinated response and recovery execution to a foot-and-mouth disease outbreak may lead to increases in the size and scope of the outbreak with associated increased economic costs. The United States can strengthen its preparedness posture and can improve its ability to support effective decision-making in responding to and recovering from a foot-and-mouth disease outbreak in the following three ways. Maintain Regional Multi-Stakeholder Partnerships; Strengthen Data and Information Support to Decision-Makers; and Understand the Complexity of the Situation and Approach Decision-Making Accordingly The first sets up an ongoing, regional, multi-stakeholder enabling structure that can be used to build trust by convening collaborative people from the multiple stakeholder groups. The second supports the provision of credible and rapid information upon which to make decisions. The third provides decision makers with a sense-making framework for understanding and working in complex situations with multiple stakeholders. Full text

**Keywords:** complexity, multiple stakeholders, foot-and-mouth disease, animal health emergency, collaboration, cynefin

## PROTECTING OUR FUTURE : DEVELOPING A NATIONAL SCHOOL SECURITY STANDARD

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This research examines the risk to schoolchildren posed by hostile intruders and the implementation of a national school security standard designed to mitigate this vulnerability and evaluates the utility of innovative perimeter security strategies modeled to reduce risk while preserving the requisite academic environment. This project originated after the mass murder of 20 defenseless first-graders and six heroic faculty members at the Sandy Hook Elementary School in Newtown, Connecticut. A methodological analysis of existing school security policy was utilized to define the problem, evaluate the variance between school communities, and construct plausible alternative strategies. This project sought to enhance the understanding of risk management, offer strategic insight to decision-makers and key stakeholders, and provide meaningful options for future school security planners. The literature on this subject demonstrates that traditional school security guidance is provided to local school districts by an array of federal agencies. It is primarily focused on incidents of peer hostility and gang violence, and there has been marginal attention given to an attack perpetrated by an adult intruder that is unaffiliated with the targeted school. This type of violence is infrequent, but the extreme consequences evoke emotions similar to terrorist attacks in creating public fear, often leading to rash and reactive decisions. Many parents trust leaders in the academic community to care for their children and provide them a safe and secure environment. This expectation of protection has become a significant responsibility for school officials, and the establishment of a national school security standard, complete with guidelines and oversight, would help ease this burden and change the present school security narrative. Full text

**Keywords:** school security, hostile intruder, perimeter security, Newtown, Sandy Hook Elementary School, mass murder, active shooter, target hardening

## THE USE OF SOCIAL MEDIA AND SMARTPHONE APPLICATIONS FOR REPORTING SUSPICIOUS AND CRIMINAL ACTIVITIES TO MASS TRANSIT LAW ENFORCEMENT AGENCIES

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The threat of terrorism remains in the forefront daily, and public transportation systems remain a preferred target for terrorist attacks. Mass transit customers have long served as the eyes and ears of the public transportation environment. In support of the Department of Homeland Security's See It Say It campaign, mass transit customers contribute to this effort by reporting suspicious and criminal activities on subways and buses. The use of social media networks and mobile phone applications by mass transit law enforcement is slowly evolving as a tool for reporting suspicious and criminal activities on subways and buses. By reviewing the data and current use of social media networks and smartphone applications such as by mass transit law enforcement agencies, this thesis demonstrates that citizens want to play a role in assisting law enforcement in solving crimes. Mass transit law enforcement agencies can leverage community involvement and reduce crime by providing customers with an anonymous means for reporting suspicious and criminal activities. However, the question as to whether the use of social media networks and smartphone applications has resulted in an increase in reporting suspicious and criminal activities and a reduction in crime is unresolved, warranting future study in this area. Full text

**Keywords:** Social Media Networks, Mass Transit, Mobile Phone Applications

## IMPROVING RISK MANAGEMENT AND RESILIENCY: A PLAN FOR A PROACTIVE NATIONAL POLICY ON INSURANCE PRACTICES IN FEMAS PUBLIC ASSISTANCE PROGRAM

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Disasters happen. The risks cannot be completely eliminated. However, the risks to insurable public infrastructure can be reduced or controlled through better federal guidance that shapes the value and importance of insurance in risk financing and improves mitigation utilization for risk control. This thesis explores the areas where the federal guidance on insurance can be updated. The intent of Congress is clear. However, the federal guidance on insurance is dated, imprecise, and incentivizes poor risk management. Updated federal guidance can more accurately provide the appropriate incentives and disincentives to promote better risk management in the protection of insurable facilities. Federal policy must allow the flexibility to manage risk while encouraging sound insurance decision-making by facility owners to reduce or eliminate the reliance of federal disaster assistance. This can be accomplished through the requirement of insurance, ineligibility of deductibles, flexibility in types of insurance, and promoting resiliency through incentives for hazard mitigation. By improving risk control for insurable infrastructure, we can begin to reduce the costs of disasters and increase the resiliency of communities across the nation. Full text

**Keywords:** insurance, public assistance, disaster assistance, FEMA public assistance, public assistance policy

## HOMELAND SECURITY AS A STOCK MARKET: ANTIFRAGILITY AS A STRATEGY FOR HOMELAND SECURITY

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Since 2002, there have been varying definitions of homeland security. Disagreements about what homeland security is can cause misalignment with budgets and homeland security priorities. The objective of this thesis is to better understand homeland security through the lens of risk and uncertainty using a metaphorical approach comparing homeland security and financial markets. The usefulness of the financial market metaphor is that it allows one to conceptualize homeland security as an investor's financial portfolio that is subject to market volatility, market sentiment and mood, investing costs, and market booms and busts. This metaphorical approach for understanding homeland security suggests a nontraditional risk-based antifragile strategy. More than being robust or resilient, which resists or absorb volatility, an antifragile strategy benefits from volatility, adapts, and becomes better. To make something antifragile, individuals and organizations should invest more time in identifying things or processes that are negative rather than focus on the positive. Removing things that are negative can uncover hidden options that can better prepare people or organizations for uncertainty and market volatility. This is a strategy that relies less on definitions of homeland security and is a bottom-up, rather than a top-down, approach to risk management. Full text

**Keywords:** homeland security, risk, uncertainty, financial markets, stock market, behavioral economics, psychology, prospect theory, complex systems, complexity, biases, perceptions, antifragility, antifragile, black swan, bubble, strategy

## SOCIAL MOVEMENTS IN POST-REVOLUTIONARY IRAN

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This thesis questions in what ways two major social movements, the Student Movement in 1999 and Green Movement in 2009, affected Iranian domestic politics. It argues that, although these movements seemed to fail, they succeeded in important ways. Essentially, these movements altered domestic politics by their emergence and resilient continuity as an alternative way of political participation for Iranians. The result of their continuation and expansion encouraged, and continues to encourage, more liberal tendencies. These movements occurred since the 1979 Iranian revolution itself planted its seeds in post-revolutionary Iran by its outcomes, which created political opportunities, mobilizing structures, resources, and framing. Social movements became an alternative way of political participation, beginning with the Student Movement, and initiated the early changes in public opinion for a more liberal regime in 1999. Although the Iranian government brutally suppressed the Student Movement, its participants continued their struggle. The Green Movement in 2009 was a pro-democracy movement that united separate opposition groups in society, with broader frames and peaceful tactics, as a continuance of the Student Movement. It arguably shook the Islamic government's legitimacy and changed Iranians' opinion, which was reflected in the election of a reformist candidate in the 2013 presidential elections. Full text

**Keywords:** Iran, Islamic Republic of Iran, Iranian domestic politics, social movements, political opportunities, mobilizing structures and resources, framing, consequences of social movements, Student Movement, Green Movement, liberalization

## THE IMPACT OF LAND BORDER SECURITY ON TERRORISM FINANCING: TURKEYS SOUTHEAST LAND BORDER AND THE PKK

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Terrorism has become the one of the major threats facing many states. Understanding the potential sources of financial support and preventing its delivery to terrorist organizations plays an important role in countering terrorism. This thesis focuses on the Kurdistan Workers Party's (PKK's) financing activities through the land border of Turkey. In doing so, this study mainly examines how the Turkish border security system can stop the trans-border financial activities of PKK along its land borders with Iran, Iraq and Syria. This thesis also takes the United States as a case study in terms of border security measures, and within that framework, makes recommendations for safeguarding Turkey's land borders to prevent financial activities of the PKK terrorist organization without affecting free trade and the economic flow of services. Presently, the Turkish border security system is fragmented and poorly coordinated. Border management is currently split between the army, gendarmerie, police, and coast guard. Moreover, international and interdepartmental collaborations are extremely limited. The prevention of cross-border financial activities of the PKK might be accomplished by forming an independent border security agency, adopting modern international standards and the latest technological innovations, and sustaining international and interdepartmental cooperation. Full text

**Keywords:** terrorism, terrorism financing, border security, PKK

## MEDIATION OUTCOMES FROM THE SECOND SUDAN CIVIL WAR: AN ANALYSIS OF ABUJA AND IGAD PEACE INITIATIVES

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Context and process factors influenced mediation outcomes between the Sudan Peoples Liberation Movement/Army and the government of Sudan during the second Sudanese civil war. This research analyzed the impact of the nature of the parties, mediator, mediator strategy, and mediation timing as contributing factors toward conflict resolution during the Abuja peace process and Inter-Governmental Authority for Development peace initiatives on mediation outcomes. The factors most influential to mediation outcomes were based primarily on belligerents' perceptions of the usefulness of mediation. Third-party intervention created a forum for the disputants to negotiate, but mediator attributes and strategy had a negligible effect on mediation outcomes. Mediation resulted in failure when parties had not yet encountered conditions that made mediation a viable option to achieve their goals; however, mediation conducted at the right time, when parties were ready to negotiate, resulted in successful outcomes. No single factor determined mediation outcomes, but context variables were the primary determinant of mediation outcomes in Sudan civil war mediations. Full text

**Keywords:** Sudan peace talks, mediation, IGAD, ripe for resolution, peace negotiations, conflict resolution

## STATE LEVEL INTELLIGENCE DOCTRINE: BRIDGING THE GAP

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**Co-Advisor: Pat Miller, Center for Homeland Defense and Security**

Current intelligence activities conducted by law enforcement agencies in the United States are primarily limited to criminal investigations. This is a problem because, as the 9/11 commission recognized, the fight against terrorism requires a greater focus on domestic intelligence and greater coordination between national, local, state and tribal agencies. Existing guidance and laws create an environment in which state and local law enforcement agencies have limited knowledge on how to navigate and participate in the broader national intelligence and homeland security effort. The research question posed is: How can state police agencies, in conjunction with Department of Homeland Security-recognized state-level fusion centers, establish field intelligence operational doctrine to develop or enhance existing police intelligence operations while bridging the gap between federal intelligence community partners and local stakeholders? Establishing a formal doctrine on domestic law enforcement intelligence will bridge the gap of information and intelligence flow in the intelligence cycle by defining methods, strategies, field craft and ethos. Case studies were reviewed, and it was determined that blending practices from the U.S. military, the United Kingdom, and current law enforcement strategies will begin the establishment of doctrine and dismantle barriers between the formal intelligence community and the domestic law enforcement agencies. Full text

**Keywords:** intelligence, doctrine, intelligence-led policing, problem oriented policing, community oriented policing, counter terror, CONTEST, intelligence strategy, domestic intelligence, domestic law enforcement intelligence, law enforcement counter terror, criminal intelligence, law enforcement intelligence

## ANTI-AMERICANISM: A PERFECT ADDITION TO A RUSSIAN AUTHORITARIANS POLITICAL TOOLBOX

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**Co-Advisor: Michael Glosny, Department of National Security Affairs**

This thesis analyzes anti-Americanism in Russia during the era of Vladimir Putin. The objective is to evaluate Vladimir Putin's anti-Americanism and the political implications of Putinist anti-Americanism within Russia. The central questions that this thesis strives to answer are: (1) What are the roots of Putin's anti-Americanism and the anti-American tendencies of segments of the Russian populace from the 1990s to the present day? (2) What is the relationship between the progression of Putin's anti-Americanism and the anti-American sympathies of the Russian public? (3) What are the potential domestic political benefits garnered by Putin's hybrid authoritarian regime as a result of his anti-American rhetoric and policy positions? This thesis concludes that Putin is inherently anti-American and the Russian populace's anti-American mood is directly manipulated by Putin. Putin employs the mechanics of his state to propagate anti-Americanism within Russia for domestic political reasons. Full text

**Keywords:** Russia, anti-Americanism, United States, Putin, politics

## A SOCIAL NETWORK ANALYSIS OF THE CHINESE COMMUNIST PARTYS POLITBURO

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This thesis combines social network analysis (SNA) with historical case studies and political science research to examine elite Chinese politics in the Chinese Communist Party's Politburo. Specifically, I develop models of the group dynamics based on academic theories using SNA methodologies. These academic theories are founded on analysis of the role of group dynamics within the Politburo—political factionalism, individual ideology, and institutionalism—and they assess how these dynamics are useful in explaining Politburo behavior. After developing models of the theories, I created an SNA observation of the current Politburo and then compared that network with these models in order to test which theory provides the best explanation or closest fit. My analysis suggests that a combination of institutionalism and personal ideology, as exemplified by the core leader dynamic, best explains current Politburo behavior. Full text

**Keywords:** Chinese Communist Party, CCP, Social Network Analysis, domestic politics

## ASSESSING AUTOMATIC AID AS AN EMERGENCY RESPONSE MODEL

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The Northern Virginia Mutual Response (NVMR) Agreement is a time-tested successful model of an automatic-aid system. Since the 1970s, neighboring jurisdictions have collaborated and developed trust while providing efficient service to the public. Political borders do not create barriers to emergency services but provide an opportunity for collaboration. This thesis sought to answer: (1) How does the automatic-aid response model work? (2) What benefits and challenges do participants experience? (3) What factors influence the adop-

tion and continuation of automatic aid? The methodology of this research was a multiple case study of three participating jurisdictions in the NVMR Agreement. The analysis triangulated data from three levels of three organizations, along with various documents to describe feelings, experiences, and causes within the NVMR Agreement. The conclusions of this study stem from the common themes found in the data. Automatic aid leverages resources to maximize efficiency and has several additional benefits, including increased levels of leadership, collaboration, and trust. Full text

**Keywords:** automatic aid, interagency, collaboration, trust, equity, leadership, District of Columbia Fire

## COMPARATIVE INTERNATIONAL AIR CARGO SOLUTIONS: THE PATHWAY TO A RESILIENT, ADAPTABLE, BALANCED AND SUSTAINABLE SECURE GLOBAL AIR CARGO SUPPLY CHAIN

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A substantial challenge to reducing security gaps in the international air cargo supply chain is the lack of a method of evaluating existing levels of risk based upon points of origin, points of departure, and cargo and aircraft type. This is particularly challenging, since the current U.S. air cargo security protocol requires 100 percent screening of all air cargo without objectively analyzing or evaluating the risk posed by the air cargo. This thesis proposes a risk-based intelligence-driven approach to identify and mitigate the threat of the successful introduction of an improvised explosive device into the international air cargo supply chain. The primary thrust of this research effort is to conduct a comparative analysis of the United States' international air cargo policies and the European Union's international air cargo policies as a means of evaluating and proposing a risk-based intelligence-driven international air cargo policy that capitalizes on the strengths of the United States' and European Union's systems. Full text

**Keywords:** international air cargo, air cargo security, air cargo supply chain, risk-based security, secure supply chain

## CORRUPTION IN THE BALKANS: AN EXAMINATION OF THE TIES BETWEEN GOVERNMENT AND CRIME IN SEVERAL SOUTHEAST EUROPEAN COUNTRIES

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The problem of corruption in civil administration has been around for as long as individuals have held public office. The Balkans has proved to be no exception. As early as the 16th century, corruption began to be tolerated and widely accepted within the region. The corruption problem was greatly exacerbated following the disintegration of communism and the successive civil wars that plagued Yugoslavia throughout the 1990s. During this period, governmental officials forged strong, unhealthy relationships with criminal elements. These close ties between organized crime and governmental officials have continued unabated until the present day and help form the basis of a pervasive culture of corruption in the region. This high level of corruption in the Balkans is problematic, since both the EU and NATO have continued to expand eastward since the breakup of the Soviet Union in the early 1990s. Any new members admitted to either organization must share the same liberal democratic values that helped shape the original organizations and that are held dear by the current members. This thesis examines the corruption of six countries in the Balkans—Albania, Bosnia

and Herzegovina, Bulgaria, Croatia, Kosovo, and Serbia—and provides recommendations that the countries should follow in their ongoing fight against corruption. Full text

**Keywords:** corruption, organized crime, political elite, governmental officials, grand corruption, North Atlantic Treaty Organization, European Union, World Bank

### THE ROLE OF ISOLATION IN RADICALIZATION: HOW IMPORTANT IS IT?

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This thesis will provide readers an in-depth analysis of three well-known terrorists in order to highlight the role that isolation played in their radicalization process. This thesis researched Timothy McVeigh, responsible for the 1995 Oklahoma City bombings; Anders Behring Breivik, responsible for the 2011 massacres in Oslo and Utya, Norway; and Omar Hammami, an American-born individual believed to have been involved in numerous terrorist attacks throughout Somalia on behalf of al-Shabaab. The research evaluated both international and domestic terrorists with differing ideologies, and these individuals were found to represent a broad spectrum. The thesis specifically evaluated whether or not each individual experienced social, emotional, or perceived isolation at any point throughout his radicalization process. It was determined that isolation does play a very multifaceted role in both the initial involvement and initial engagement phases of radicalization. By better understanding the contributing factors of radicalization, homeland security officials may be better positioned to effectively intervene, prevent, or deter radicalization. Full text

**Keywords:** social isolation, perceived isolation, emotional isolation, radicalization, al-Shabaab, Oklahoma City bombings, terrorism prevention

### THE FUTURE OF RESPONDER FAMILY PREPAREDNESS: THE NEW NORMAL

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The U.S. government has recently contended that communities cannot be prepared without first ensuring the safety of responders and their families. Organizations have generally done little to nothing to ensure that the families of their responders are adequately prepared to survive and function on their own in the absence of the responder. Consequently, there exists a widespread policy gap concerning family preparedness in the first-responder community. Research indicates that much of the U.S. population has ignored the U.S. government's preparedness message and opted not to prepare. This thesis used a selection-research method to explore whether the development and execution of a family preparedness program would assist the Delaware State Police (DSP) in maintaining its capability during a major crisis. Good ideas and precedent for creating such policy were captured from existing literature, leading to the conclusion that the DSP should mandate a comprehensive family preparedness program that includes emergency records management, the development of family-liaison troopers, and go-kits for families as issued equipment. The thesis further concludes that responder-family preparedness is different from general-citizen preparedness and that leaving it in the optional category is insufficient. Full text

**Keywords:** preparedness, resilience, first responder, government, Delaware State Police, police officer, emergency responder, disaster, catastrophe, go-kit, planning, continuity of operations, policy gap, mandate

## TURKEY AND THE NORTH CAUCASUS: AN ANALYSIS OF INTERNAL AND DOMESTIC RELATIONS

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This thesis examines the Circassians' history starting from their deportation in 1860s from the Russian Empire to Ottoman lands to the present day. Although the Circassian minority constitutes a significant part of Turkey's population, the actual history of this small nation is disproportionately not well known both within the Circassian diaspora and the Turkish population at large. This thesis investigates the evaluation of Circassian identity and the Circassian diaspora during the late Ottoman Era and during the Republic of Turkey from a theoretical, historical and practical view, and evaluates the role of the various domestic and international factors in the course of the current diaspora structure in Turkey. This thesis also traces the role of Circassian associations and organizations in the establishment of diaspora identity and the representation of this ethnic group both within the Turkish population and within the state structure. Full text

**Keywords:** Circassian, Adyge, Adige, North Caucasus, Caucasus, Cerkes

## CHINA'S INTERESTS IN AFGHANISTAN: CURRENT PROJECTS AND FUTURE PROSPECTS

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With the United States and NATO mission coming to a close at the end of 2014, Afghanistan's future is in doubt. China shares a border with Afghanistan, shares terrorism and security concerns with Afghanistan, and shares an interest in developing the resources of the country. In the scope of China's foreign policy, its dealings with Afghanistan are not unique. Chinese state-owned enterprises hope to extract resources to fuel the Chinese economy. Beijing hopes to use its economic influence to stabilize the country as it waits for the security situation to improve. Afghanistan would benefit from Chinese investment and infrastructure development, but the role China will play in Afghanistan's future is unclear. By looking at Chinese activity in Afghanistan, this thesis will show how Beijing's actions have shaped development in Afghanistan and how it could shape its development in the future. The United States and China are both interested in stability in Afghanistan but have pursued different policies to achieve stability. In the end, Chinese investment in Afghanistan could result in the emergence of the region either as a world economic player or as a continuously watched trouble spot. Full text

**Keywords:** China in Afghanistan, China and Afghanistan, China, People's Republic of China, PRC, Afghanistan, Xinjiang, Chinese foreign policy, Central Asia, Mes Aynak copper mine, Amu Darya oil field, energy security, terrorism in China, ETIM, East Turkistan Islamic Movement, security in Xinjiang, security in Afghanistan, Afghan economy

## U.S. PROLIFERATION POLICY AND THE CAMPAIGN AGAINST TRANSNATIONAL TERROR: LINKING THE U.S. NON-PROLIFERATION REGIME TO HOMELAND SECURITY EFFORTS

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The non-proliferation treaty regime that the international community has utilized for over half a century is insufficient to combat emerging global threats—specifically, WMD terrorism. The current landscape of transnational terrorism requires a major shift in U.S. nonproliferation policies if the current regime is to address WMD threats and the proliferation of weapons and materials by non-state actors adequately. From a policy perspective, nonproliferation and counterterrorism still largely operate as separate and distinct missions, which creates a disconnect that can be exploited. Recent efforts have been instituted in an attempt to fill gaps but they still fall short because these measures operate in the absence of an overarching international framework, which results in the failure to capture fully the integration of the convergence of issues in the fields of counter-proliferation transnational terrorism and weapons of mass destruction. This thesis explores how the traditional non-proliferation policy regime can be connected to domestic homeland security efforts as an effective counter-terrorism strategy. It recommends a modern policy approach, including leveraging the non-proliferation framework already in existence, by supplementing with efforts to combat international criminal networks and overarching counterterrorism objectives to keep pace with current threats. Full text

**Keywords:** nonproliferation, counter-proliferation, weapons of mass destruction, WMD terrorism, threat convergence, globalization, CBRNE

## SECURING PUBLIC SAFETY VEHICLES: REDUCING VULNERABILITIES BY LEVERAGING SMART TECHNOLOGY AND DESIGN STRATEGIES

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The threat of public safety vehicles being used by criminals or terrorists to commit violent acts is real. The problem is that public safety vehicles are vulnerable to criminal activity and terrorist use because they do not routinely utilize security technology measures involving three core aspects: theft prevention, authentication to specific operators (authorized use), and ability to track and recover public safety vehicles that get into the wrong hands. Consequences from such acts create great risk for the public's safety, including significant injury and loss of human life, as well as exposure to financial liabilities in the form of lost equipment, damage to property, and lawsuit settlements. This thesis provides a model solution to agencies for securing emergency response vehicles with engineering (SERVE). The SERVE model was developed by the author and provides a framework for implementing public safety vehicle security enhancements that take into account the complex interaction between technological fusion, vehicle system integration and end-user interface design. Tier I Theft Prevention, Tier II Authorized Use, Tier III Tracking and Recovery can be implemented in stages, allowing agencies to utilize the technologies based on budgetary restraints and allocation of resources. Lastly, Tier IV Human Machine Interface emphasizes the importance of the human machine interface by taking into account how technologies and operators communicate to ensure critical task proficiency is not disrupted. Full text

**Keywords:** vehicle security, theft prevention technology, anthropometrics, eVID, authentication, unauthorized, engineering, public safety, SERVE model, vehicle theft prevention

## PREPARING FOR UPHEAVAL IN NORTH KOREA: ASSUMING NORTH KOREAN REGIME COLLAPSE

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**Second Reader: Robert Weiner, Department of National Security Affairs**

This thesis will attempt to provide the optimal policy prescription for the Republic of Korea (ROK) Army on how to disarm, demobilize and reintegrate (DDR) the North Korean people in the case of their regime collapse. It is important to anticipate the likely environment in which post-conflict reconstruction efforts will be implemented. The viability of any contingency plan should be assessed, based on an assumption about the environment being in probable upheaval. However, little analysis of the viability of the contingency plan, including the DDR program, has been undertaken in the context of North Korean regime collapse. In particular, the research about expectations and assumptions related to the possible North Korean attitude and probable post-regime collapse environment has been rare. The contingency planning thus needs further research and empirical supporting data, which can enhance its viability in practice. Given this perspective, this thesis attempts to predict the North Korean people's possible attitude in their upheaval, based on analysis of the current regime's control system and recent changes. This thesis also assumes different scenarios in which DDR would be implemented to reconstruct a post-conflict society, by differentiating critical uncertainties in each case. Full text

**Keywords:** DDR; Disarmament, Demobilization, and Reintegration; stabilization operation; regime collapse; Songbun; Juche

## CHINA ON THE MEKONG: LEGITIMACY IMPERATIVES AND POLICY CASE STUDIES

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**Co-Advisor: Michael Malley, Department of National Security Affairs**

China's economic reforms revealed the Chinese Communist Party's search for a new basis for political legitimacy and authority. The PRC's contemporary political bargain is best characterized as a tenuous balance between economic modernization and political repression. This dichotomous political bargain yields a fragile legitimacy, aspects of which activate to shape China's Mekong River policies. This paper examines the impact of the CCP's fragile legitimacy on two case studies involving China's Mekong River economic interests, involving (1) hydropower dams and (2) counter-narcotics enforcement. China's hydroelectric pursuits on the Mekong are predominantly shaped by the regime's economic growth mandate, concerns about domestic inequality, and demands to alleviate social costs arising from recent development. China's counter-narcotics efforts on the Mekong River are also tied to economic considerations but increasingly reflect the Party's efforts to enhance its nationalist and security credentials. China's Mekong River policies illustrate how the CCP's domestic motivations deserve greater weight in explaining the perception of China's increasing assertiveness. Full text

**Keywords:** China, Mekong, legitimacy, policy

## USING INFORMATION-SHARING EXCHANGE TECHNIQUES FROM THE PRIVATE SECTOR TO ENHANCE INFORMATION SHARING BETWEEN DOMESTIC INTELLIGENCE ORGANIZATIONS

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Security and intelligence organizations have challenges in information sharing that have resulted in incomplete information. Since 2001, state and local governments in the United States have formed information sharing hubs called fusion centers, which request information from peer-fusion centers as well as sharing situation reports about emerging and ongoing security situations. The requests for information (RFI) and situation awareness reporting processes are manual and occur without data standards or process standards. Public sector and private sector information sharing systems utilize both process and data standards to automate routine information sharing between organizations like those exchanges between fusion centers. These standards are coupled with information sharing tools that better enable consumer services, such as searching and booking airline travel through online systems, exchanges of criminal justice information using the National Information Exchange Model, and sharing of patient and medical information utilizing the Health Information Exchange. This thesis combines the process and tools from both the public and private sectors' data and process standards and the use of information sharing tools to propose a conceptual national intelligence-sharing model (NISM). SMEs from the intelligence, counterterrorism and technology communities, within the fusion center environment, were used to review, modify, and validate NISM. Full text

**Keywords:** information sharing, intelligence, technology, fusion centers

## NORTH KOREA'S CHOICE OF THE TYPES OF PROVOCATION AGAINST SOUTH KOREA

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This research starts from the question of how North Korea decides upon the types of its provocations against the South. To find the answer, the author divides the major provocations into three periods, according to their characteristics, and examines how the major decisive factors of the North's crisis policy making, such as military strength, relations with China and the Soviet Union (Russia), regime stability, and economic power, affected its choice of provocation types. The results of the analysis suggest that Pyongyang has chosen the targets, scale, and methods of provocation by thoroughly evaluating its current military, diplomatic, political, and economic conditions. Therefore, what types of provocations will be initiated by North Korea in the future? One of the obvious points is that Pyongyang's confidence to defeat Seoul will not be restored soon, and the unexpected strong response of the United States and South Korea will confuse the North's strategic decision-making. For that reason, the most effective way for South Korea to deter any possible provocations by the North is to put more pressure on the Kim regime by using its overwhelming national power and conveying its strong intention to retaliate against the North's threats on the basis of the firm ROK-U.S. military alliance. Full text

**Keywords:** provocation, crisis management strategy, fait accompli, attrition, controlled pressure, regime stability, terror, maritime conflict

## BORDER SECURITY: A JOURNEY WITHOUT A DESTINATION

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Since the terrorist attacks of September 11, 2001, an increase in the public's awareness concerning border security has resulted in an outcry to secure this nation's borders. Congress, the Department of Homeland Security, border states, and local governments have all defined what constitutes a secure border differently, which makes the measurement of success or failure virtually impossible. By utilizing a case study methodology, this thesis seeks to answer the question: can the project management process be applied to the border security effort to generate an accepted definition of a secure border? Findings indicate that the absence of empirical data that can demonstrate a secure border has generated a tremendous amount of debate in regards to the exact level of border security, but the project management process could be utilized to bring stakeholders together and create a definition of a secure border that can be more widely accepted. However, various issues with the definition remain that will not be resolved, which stems from the social-psychological aspect of separating a secure border from a sealed border, and some citizens in the United States will never accept anything other than a completely sealed border. This area can and should be studied in detail in the future. Full text

**Keywords:** border, border security, secure border, DHS, CBP, USBP, immigration, measures, project management, project visioning

## SURVIVING THE STORM: EXPANDING PUBLIC HEALTHS CAPABILITIES IN RESPONSE TO THE INCREASING THREATS POSED BY NOVEL VIRUSES

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As the planet's population continues to grow at rate that will see a global population of nine billion people by the year 2050, is an era being entered into in which pandemics involving novel viruses are the new norm? If that idea is possible, then are drug therapies (approved by the FDA or in the pipeline for its approval) available that either limit virus replication within a host cell, or reduce the body's hyper-immune response (also known as cytokine storm) to novel or pandemic strain viruses with which states could supplement their existing stockpiles? This research explores six classes of medications that could potentially assist state-level governments in expanding their state-level stockpiles, to include more treatment and prophylaxis options, in the face of pandemics involving novel viruses. The results of this research were filtered through three criteria (medical efficacy, cost, logistical considerations) that narrow the field of candidate therapies down to four specific findings: one generic version of the antiviral called Ribavirin, and generic versions of the statins called Lipitor, Zocor and Gemfibrozil. This research may be applied to state and local-level public health agencies interested in bolstering their existing stockpiles for pandemic preparedness. Full text

**Keywords:** public health, pandemic influenza, H1N1, H5N1, H7N9, severe acute respiratory syndrome, SARS, Middle Eastern respiratory syndrome, MERS, human coronavirus, HCo-V, prophylaxis, treatment, acute respiratory distress syndrome, ARDS, Cytokine Storm, Nevada, public health preparedness, PHP, epidemiology, medications, therapies, antivirals, antibiotics, statins, corticosteroids, interferons, herbal medications

## GERMANY, EUROPE AND THE EURO CRISIS: ECONOMY, STATE AND SOCIETY IN THE PAST AND PRESENT

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This thesis examines Germany's role at the center of the European Monetary Union (EMU). It explores German socio-economic policies and experiences in order to provide a more comprehensive understanding of why the EMU operates with German influence as well as in opposition to it. Historically, Germany's economic experience, from the Weimar Republic to 2013, has been uniquely shaped by its population and the embeddedness of its marketplace. From this experience, Germany has erected certain elements of government protection forged by a century of civil protection. These experiences also shape Germany's place in the Euro area as well as its policies toward the European economic crisis from 2007 through 2013. As of 2013, most Euro area members consider Germany the economic backbone to the union but rarely internalize Germany's economic past. Therefore, an application of the development of the German social market bears considerable importance upon the future of the Euro area as well as the policies enacted within the union, which Germany seeks to shape. Full text

**Keywords:** Germany, Euro, Finance, Economy, Weimar, Social Market

## INTRACTABILITY AND MEDIATION OF THE NAGORNO-KARABAKH CONFLICT

*This paper has been recognized as outstanding by its department*

**Timothy Mayer, Major, United States Marine Corps**
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Nearly two decades following a ceasefire, the conflict between Armenia and Azerbaijan over the disputed territory of Nagorno-Karabakh remains unresolved. Often referred to as a frozen conflict, the status quo that has developed between these two nations has developed roots that touch many aspects of life in both countries. This thesis examines intractability by analyzing three distinct levels of this conflict. It scrutinizes the reasons underlying failed mediation attempts since 1994 at the level of the elite, the nation, and the international structure. It also explores the linkages between these three distinct levels that contribute to the complexity of conflict resolution. Despite periodic optimistic media reports suggesting that mediators are nearing a final resolution, it will likely be decades before real progress can be made. Resolution of this conflict will require a compromise between these two nations that may only be possible through greater democratization on both sides. Simultaneously, the influence of larger states—notably, Russia—has placed this regional dispute on the global stage and embedded the conflict in a larger polarized geopolitical contest for power and influence. Effective mediation depends on a shift in the regional balance of power or national interests of regional stakeholders. Full text

**Keywords:** Nagorno-Karabakh, Armenia, Azerbaijan, South Caucasus, intractable conflict, mediation, frozen conflict, former Soviet Union, OSCE, Minsk Group

### THE GERMAN NAVY: FROM WORLD POWER TO ALLIANCE POWER

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This paper is a case study of the German Navy. The analysis centers on the role of naval institutions within state and society, the interplay between naval strategy and statecraft, and the factors affecting civil-military relations. The progression from, first, a young empire driven by Weltpolitik and navalism, to, ultimately, a compact and multilaterally focused naval institution operating within alliance collective security systems demonstrates the limits and potentials of naval strategy under widely disparate statecraft. Unlike the long-established maritime democracies, such as Britain, France, or the United States, Germany's naval experience is rife with discontinuities and in many ways can be viewed as infant in its contemporary form. To the professional naval officer serving in a democracy, the failures and successes of the various iterations of the German Navy provide myriad universal, timeless lessons that can be applied toward the effective conduct of one's duties. More then a handy reference of narrowly focused operational naval tales, this paper offers the aspiring naval officer with an understanding of the imponderable aspects of navies: the importance of melding strategic purpose with long range construction planning, the role of tradition in fostering a healthy naval cadre, and the importance of respecting geostrategic and economic realities. Full text

**Keywords:** Germany, German Navy, Kaiserliche Marine, Reichsmarine, Kreigsmarine, Bundesmarine, Volksmarine, Deutsche Marine

### THE ROLE OF THE PRIVATE SECTOR IN THE NATIONAL RESPONSE SYSTEM

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As indicated by the 9/11 Commission, the private sector accounts for approximately 85% of the critical infrastructure in the United States and accounts for approximately 80% of the gross domestic product. The private sector clearly is the engine that drives U.S. economic vitality, and, as such, it is critical that it maintains business continuity in the face of a disaster. Moreover, it is equally important for the private sector that communities affected by a disaster recover as quickly as possible to enable them to conduct normal day-to-day business once again, which drives the bottom-line for most companies. The impact of disasters on economic vitality is readily available in numerous studies. It was estimated that the worldwide economic losses incurred during 2004 due to natural disasters was over $145 billion, or more than twice as much as in 2003. Moreover, disasters such as Hurricane Katrina have highlighted the inadequacies of the national response system when faced with catastrophic disasters and the further inability to incorporate willing participation and resources properly from the private sector. The purpose of this thesis is to demonstrate how response and relief operations at the federal, state and local level can be further improved by providing a better implementation of a network-based methodology for the private sector to participate in the national response framework. Full text

**Keywords:** private sector, National Response Framework, society, resiliency, network, megacommunity, U.S. Coast Guard

## PROTECTING NEW YORK'S INFRASTRUCTURE: IMPROVING OVERALL SAFETY AND SECURITY THROUGH NEW PARTNERSHIPS AND CONCENTRATION ON PLANNING, ENGINEERING AND DESIGN

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The infrastructure that supports New York State and its citizens is constantly faced with threats that test its resilience. These threats range from those brought upon by nature to man-made threats, such as those from terrorists. Understanding that these threats are persistent, and that the challenge of infrastructure protection is complex, stakeholders must consider methods to mitigate risk. This paper seeks to answer two questions, both of which strive to decrease risk over the long term for the state's citizens. First, what are the benefits and challenges of the state's placing a greater focus on the planning, engineering, and design phase for new or significantly reconstructed infrastructure? Second, how could a new partnership model at the state level be designed to support infrastructure protection activities during this phase? To accomplish these two outcomes, three approaches focused on planning and design within the public and private sectors are analyzed and compared. This paper expands upon the partnership incentives utilized to reach desired outcomes in such infrastructure programs. Finally, this research concludes that the state should do more to improve safety and security during the planning, engineering and design phase, and recommends two parallel paths forward for implementation at the state level. Full text

**Keywords:** infrastructure, infrastructure protection, planning, engineering and design, partnership model, resilience

## NORTH KOREA'S 7.1 POLICY

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This thesis evaluates North Korea's July 2002 economic reforms. It does so by analyzing the content of the reforms, their economic impact on the North Korean people, and the problem areas of the reforms. This thesis makes five arguments. First, the July 2002 economic reforms were intended not to reform North Korea's economic system but to provide temporary relief for the regime's survival. Second, unless the problems in monetization and decentralization in the industrial and agricultural sectors are eliminated, the economic development effort is doomed to fail. Furthermore, if Pyongyang solves international, administrative and infrastructural problems within Special Economic Zones, it can spur economic development in the country. Third, the growing economic interdependence may help to leverage upon North Korea. Fourth, North Korea's current political system forms the biggest obstacle for present and future reforms. Finally, for the U.S. and international sanctions to have a more effective impact, there should be a consensus on them, and the subsiding effect of other countries should be avoided. In conclusion, the thesis makes policy recommendations and extracts overall lessons for international policy makers, economic leaders, and diplomats that can be applied to this and other cases. Full text

**Keywords:** North Korea, 7.1 Policy, July 2002 reforms, monetization, decentralization, Special Economic Zone, Sanction, North Korea's Political Economy, Juche, Seongun, 2002 Nuclear Crisis, 2006 Missile and Nuclear Crisis, 2009 Currency Reform, Economic Interdependence

### ALLEGIANCE: EGYPT SECURITY FORCES

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In Egypt, opposition groups challenged the Mubarak Regime and toppled it. More than two years later, demonstrators against the military-backed government that deposed President Morsi were brutally put down, and rule stayed with the junta. This thesis examines those events in Egypt and focuses on opposition tactics used and the response elicited from security force elements. It seeks to discover where, in 2011, security forces were not given or disobeyed the order to shoot protestors and, in 2013, ruthlessly followed that order. This thesis analyzes opposition tactics and questions whether those actions elicited loyalty shifts within security forces and how any such shifts impacted the ability to achieve political change. The thesis uses a synthesis of objectives developed by Anika Binnendijk, labeled the Five Strategic Objective framework, along with social movement theory as they apply to challenger actions. To these, the author adds foreign involvement and internal dynamics. Data is gathered through in-depth review of relevant documentation: published news, discussions, books, and reputable web sources. Analysis of the sources shows that, in 2011, a broad-based appeal generated sympathy within security forces that precluded obeying a shoot order and that such sympathy was not present in 2013. Full text

**Keywords:** allegiance shift, loyalty shift, Egypt, Arab Spring, Arab Uprising, Mubarak, Morsi, uprising, security forces, SCAF, Ministry of Defense, Ministry of Interior, demonstrations, protests, regime change

### SOCIAL MEDIA PRINCIPLES APPLIED TO CRITICAL INFRASTRUCTURE INFORMATION SHARING

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Social media is on the forefront of leading capabilities to share information faster, more broadly, and to extremely large, targeted audiences. To many in the business of disseminating information quickly to these broad audiences, social media is a critical enabler. Areas of homeland security and, in particular, critical infrastructure protection, rely significantly on sharing information with partners across the mission yet are consistently criticized for their inability or ineffectiveness at sharing information. Social media principles, the fundamentals that make social media unique and successful, may have applicability to critical infrastructure information sharing and, in turn, may further the information-sharing goals of this mission area. This thesis explores the principles of social media, the resultant outcomes as seen in case studies with information sharing objectives similar to those in the critical infrastructure arena, and proposes applicability of those social media principles to the information sharing practices of the critical infrastructure discipline. Full text

**Keywords:** critical infrastructure, information sharing, social media, Web 2.0

## COLLABORATIVE RADIOLOGICAL RESPONSE PLANNING

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**Second Reader: Lauren Fernandez, Center for Homeland Defense and Security**

From the events of September 11, 2011, the United States learned that a large-scale disaster can strike without warning. President Bush issued a series of Homeland Security Presidential Directives (HSPD) intended to increase coordination among response agencies. However, despite the enactment of the HSPDs, coordination and collaboration among response agencies is significantly lacking with respect to radiological emergency planning and preparedness activities. Planning for nuclear/radiological events is unique in that they often occur with no notice, with great complexity, and require broad scenario planning to cover the important potential contingencies. Radiological events demand that actions be taken by responsible organizations, in a timely and effective manner, to mitigate consequences on populations, infrastructure and environment. This thesis is intended to help officials better understand the many factors that impact coordination and collaboration. These factors range from information sharing to multidisciplinary participation. This thesis will also assist officials in better understanding the Capabilities-Based Planning Model and how it may be implemented to enhance radiological emergency planning and preparedness. The elements included in this paper are intended to enhance the planning and associated decisions made by all partners involved in local radiological planning efforts. In conclusion, the thesis recommends enhancing radiological emergency planning and preparedness at the local level, through integrating the jurisdictions' approach with the use of the Capabilities-Based Planning Model to encourage performance partnership and collaborative methods. Full text

**Keywords:** radiological response, planning, homeland security, national preparedness, capabilities-based planning

## DEVELOPING A RESILIENT GREEN CELLULAR NETWORK

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As technology drives society to a ubiquitously wireless world, the paradox of mobile wireless network accessibility versus resilience is disturbingly trending in opposite directions. The demand for cellular networks with greater capacity and bandwidth appears to be the primary factor in expanding coverage nationwide, with resilience becoming a secondary thought. It is expected that resilient systems will be able to withstand shocks and stresses from critical incidents and still be able to function as intentionally designed. However, the fragility of cellular networks affected by recent disasters within the last ten years has demonstrated otherwise. The purpose of this research is to direct attention to the importance of cellular base station functionality during power outages and illustrate how these assets require modification to provide critical communications for the public to summon aid, and first responders to coordinate response efforts. Prior research offers strategies to implement post-disaster remediation, supplanting failed localized communication infrastructure. This mitigating strategy requires substantial time, labor, and planning to deploy, which subsequently detracts from conducting immediate response and recovery. This research is intended to propose a path forward for resiliency in U.S. mobile cellular networks using renewable/alternative energy outlined in India's National Telecom Policy for 2012. Full text

**Keywords:** Cellular Network Resilience, Green cell sites/base stations, renewable/alternative energy powered telecom networks, national public safety broadband network, India's cellular network

## THE USE OF SATELLITE IMAGERY FOR DOMESTIC LAW ENFORCEMENT

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From an event management standpoint, and in concert with digital mapping applications, satellite imagery has proven its utility to support first responders and emergency services in a wide range of both natural and manmade disasters. Imagery data has also supplemented police activities in developing operational plans that can be prepared for short-time, high-risk responses at either public facilities or events. This policy options analysis draws a side-by-side comparison of three approaches for the law enforcement community to readily acquire satellite imagery. One approach will make added use of the Civil Applications Committee, the second approach will explore the reactivation of the National Applications Office, and the third will investigate making greater use of commercially available sources. All three approaches have clear advantages and disadvantages, some more than others. In the final analysis, the best policy option presented was making greater use of commercial providers. The relative ease of collecting material and managing it with fewer obstacles, in comparison to the Civil Applications Committee and National Applications Office alternative, made it the better option. Full text

**Keywords:** national assets, satellite surveillance, Posse Comitatus Act, satellite imagery, National Applications Office, Civil Applications Committee, law enforcement, privacy rights, Fourth Amendment

## HIGH-TECH, LOW-TECH, NO-TECH: COMMUNICATIONS STRATEGIES DURING BLACKOUTS

*This paper has been recognized as outstanding by its department*

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How do emergency managers communicate vital life-safety information when disaster strikes and the power goes out, sometimes for extended periods? Time and again, our power grid, aging and stretched beyond its intended capacity, has experienced failures. Power outages can quickly shift from being annoying to deadly—especially when temperatures are extreme—particularly for elderly and other vulnerable populations. Emergency managers will be able to use the findings of this research to communicate critical information to the community, even in the direst circumstances, without relying on a techno-fix. A structured, focused comparison of three disasters revealed that a high-tech, low-tech, no-tech framework can be implemented successfully and inexpensively. Throughout the three disasters studied, communications methods in the high-tech, low-tech, and no-tech areas were successful in communicating with the public. The thesis recommends that every community be prepared with this three-pronged approach. To go a step further, the study recommends that FEMA consider incorporating the high-low-no-tech approach into its COOP (Continuity of Operations Plan) template, which currently assumes that communications systems—phones, Internet, email, two-way radios—will be operational within 12 hours of activation, an optimistic assumption. A sample implementation plan with cost estimates is included. Full text

**Keywords:** blackout, power outage, communications, information, social media, emergency management, radio, COOP

## BORDER SECURITY: A CONCEPTUAL MODEL OF COMPLEXITY

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**Second Reader: Nadav Morag, Center for Homeland Defense and Security**

This research applies complexity and system dynamics theory to the idea of border security, culminating in the development of a conceptual model that can be used to expand exploration of unconventional leverage points, better understand holistic implications of border policies, and improve sense-making for homeland security. How can border security be characterized to better understand what it is, and why are so many divergent opinions being voiced on whether it can be achieved? By demonstrating the border as a complex adaptive system (CAS) through the use of graphic system dynamics models, exploring by way of example the influences surrounding the movement of trade and transnational terrorists across borders, four policy-centric pillars became evident: (1) institutional capacity, (2) criminal capacity, (3) ability to move people and goods across borders rapidly, and (4) operational capacity. Culture, identity, adversarial adaptation, enforcement, and moral values influence and are influenced by, perceptions of what are seen as threats. This research illustrates the value of thinking in systems (instead of missions or programs), challenges assumptions of what borders and border security are thought to be, and intends to inspire creativity in thinking about 21st-century borders: what they represent and the challenges they pose. Full text

**Keywords:** complexity, borders, border security, globalization, system dynamics, sense-making, systems thinking, model, interdependent, interconnected, feedback loop, influence, relationship, adaptation, behavior, stock-and-flow, interface, global context

## ALTERNATE CARE SITES FOR THE MANAGEMENT OF MEDICAL SURGE IN DISASTERS

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This research compares federal and state approaches to managing disaster medical surge. The comparison identifies the varieties of regulations, assets and response methods available for federal and state responses to mass casualty incidents from which local communities can develop plans and acquire resources to create a seamless disaster medical care system. Following a disaster, survivors self-evacuate or are transported by EMS to a nearby hospital. Arrival of disaster survivors, combined with an often high daily number of non-disaster patients, leaves the facility overwhelmed both in terms of medical resources and personnel. The lack of local resources to manage the incident may require state and federal assets to be deployed. The time it takes for the additional resources to arrive from outside the area leaves the facility unable to respond effectively for hours and even days. A whole community approach to medical surge management organized by a collaborative regional healthcare coalition may provide a solution. Such a coalition can engage stakeholders to assess and manage resources (space, staff, and stuff) and develop surge response plans that will integrate with state and federal resources when needed. Seamless coordination will minimize the complexities of medical surge needs and lead to doing the best for the most. Full text

**Keywords:** alternate care site, disaster healthcare coalition, medical surge, healthcare capacity, healthcare capability, whole community, hospital, emergency department, emergency medical services

## EMPLOYING THE INTELLIGENCE CYCLE PROCESS MODEL WITHIN THE HOMELAND SECURITY ENTERPRISE

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The purpose of this thesis was to examine the employment and adherence of the intelligence cycle process model within the National Network of Fusion Centers and the greater Homeland Security Enterprise by exploring the customary intelligence cycle process model established by the United States Intelligence Community (USIC). This thesis revealed that there are various intelligence cycle process models used by the USIC and taught to the National Network. Given the numerous different training entities and varied intelligence cycle process models, challenges exist to providing a well-defined training program that ensures consistent and clear intelligence cycle process model employment. Finally, this thesis offers an overview pertinent to researchers and/or practitioners regarding the viability of employing the intelligence cycle process model as the principle guide for domestic intelligence activities. This thesis employed a qualitative research method that analyzed and interpreted publicly available academic and policy information gathered from government and nongovernment institutions regarding the conceptual and practical intelligence cycle process model narratives. A case study analysis was conducted of the April 15, 2013 Boston Marathon bombing as a platform to discuss the active and effective employment of the intelligence cycle process model by the National Network. The principal conclusion offers that, while literature clearly agrees that the intelligence cycle process model is a cyclical structure of actions, literature also finds there are common themes suggesting the intelligence cycle does not sufficiently describe how the intelligence process works at the operational stages of domestic intelligence activities within the National Network. Full text

**Keywords:** domestic intelligence, intelligence cycle, intelligence, fusion centers, national network, homeland security enterprise, homeland security intelligence enterprise, US Intelligence Community, 28 CFR Part 23, national criminal information sharing plan, information sharing environment

## CHINA'S EXCHANGE RATE POLICY: A DOUBLE-EDGED SWORD

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Few policies have as far-reaching an influence on an economy as exchange rate controls. Over the last decade, China has maintained an artificially devalued currency by purchasing U.S. dollars while selling domestic Renminbi (RMB). In theory, this practice will benefit the economy by making exports cheaper. Cheap exports have been an important component of the PRC's investment-driven growth model, which transformed China into an economic powerhouse. Although a devalued currency makes exports cheaper, it also makes imports more expensive. As China's economy evolves, the PRC recognizes the need to shift to a more innovative consumption-driven growth model from the current investment-driven model. This study argues that a devalued RMB is inhibiting this progress because it undermines the consumptive power of its citizens through more expensive imports, financial repression, and capital controls, all of which are closely linked to a devalued RMB. This study will look at imbalances in China's consumption and production structures affected by a devalued RMB and identify the artificial winners and losers of the current policy. Also, gradual RMB appreciation over the last decade will be analyzed to determine the extent to which an increasing RMB has moved economic imbalances. Full text

**Keywords:** China, economy, exchange rate policy, trade imbalance, economic imbalance, foreign exchange reserves, manufacturing, capital controls, financial repression, job loss

## SCHOOL SHOOTINGS: LAW ENFORCEMENT AND SCHOOL DISTRICT NETWORKING

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School shootings have happened in the past and will happen again. The history of school shootings prompts all stakeholders to look at ways to prevent them from happening, and, if they do happen, to be resilient. Change is needed in the prevention of school shootings. The case studies of the Virginia Tech, Sandy Hook, E. O. Green Junior High, and Beslan school shootings reveal that the lack of information sharing and lack of communication were flaws; and that the incidents might have been preventable. Prevention is a key element that both schools and law enforcement need to improve upon. In order to make strides in prevention, there needs to be advanced planning, continuous information sharing among stakeholders regarding those individuals who conduct themselves in ways that cause concern, a change in organizational culture with law enforcement and schools regarding sharing information, legal solutions, and resiliency if a shooting does occur. School shootings can never be completely preventable; however, it is feasible to have systems that prevent school shootings and increase the safety of the students and the community. Full text

**Keywords:** school shootings, law enforcement, collaboration, communication, Sandy Hook, Beslan, Virginia Tech, Green Jr. High, Columbine, information sharing, planning, organizational culture, challenges, implementation, legal, school shootings, COMPSTAT

## THE EFFECTS OF GERMAN MILITARY COMMISSION AND BALKAN WARS ON THE REORGANIZATION AND MODERNIZATION OF THE OTTOMAN ARMY

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This thesis investigates the consequences of the Ottoman Army reform initiatives from the establishment of the German Military Commission (1882–1918) to the outbreak of World War I (1914–1918). The Ottoman Army undertook huge change, supported by the German Military Commission, for the survival of the Empire. During this period, the results of the Balkan Wars (1912–1913) provided a critical impetus to accomplish these reform efforts. The effects of the German Military Commission and Balkan Wars on the Ottoman Army have not been studied by scholars in detail. Furthermore, most of the literature about this period only focuses on the Balkan Wars and German Military Commission separately; however, it is crucial to consider these subjects together to evaluate the effectiveness of the reform initiatives correctly. This thesis research uses a historical study approach to attempt to fill this lacuna. Generally speaking, this examination of the German Military Commission and Balkan Wars will provide a broader view on military reforms between 1882 and 1914. Although these initiatives were not enough to improve the Ottoman Army because of wars (the Balkan Wars and World War I) and Ottoman financial problems, this period was the watershed for the Ottoman Army in terms of military renaissance. Full text

**Keywords:** German Military Commission, Balkan Wars, reorganization, modernization, Ottoman Army, Ottoman officer corps, Abdulhamid II, Enver Pasha, Colmar von der Goltz, Mustafa Kemal Ataturk, Liman von der Sanders

## ADVANCING U.S. FOREIGN POLICY THROUGH HOMELAND SECURITY: THE LOGIC FOR INTERNATIONAL TRAINING AND PROFESSIONAL EXCHANGES

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The role of soft power in U.S. foreign policy has become a common theme among government agencies. International training and professional exchanges are a part of soft power. Since the egregious attacks on 9/11, many have argued for an increase in this tool of statecraft. This thesis reviews the role of soft power in U.S. foreign policy and how that pertains to homeland security. Specifically, the study notes the importance of international military and law enforcement training and how these exchanges can enhance U.S. security and advance foreign policy. Moreover, the research reviews models of current Department of Defense international training efforts for consideration by the Department of Homeland Security. The many professional exchanges and international training efforts from agencies such as U.S. Customs and Border Protection, the U.S. Coast Guard, and the International Law Enforcement Academies are also reviewed. A model for an international program to take place at the Global Borders College is presented. In conclusion, the paper will argue that, through attraction and influence, the United States will be better suited for security in the future. Furthermore, the encouraging of international training and exchanges will assist in improving U.S. multilateral relationships in the 21st century. Full text

**Keywords:** homeland security, foreign policy, international training, diplomacy, soft power, exchange programs

## CONTEMPORARY SALAFISM AND THE RIGHTLY GUIDED CALIPHATE: WHY IS IT EMULATED AND WHAT WAS ITS REALITY?

*This paper has been recognized as outstanding by its department*

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The contemporary Salafist movement idealizes the Rightly Guided Caliphate. Given the tumultuous nature of the period and the grandeur of the Golden Age of Islam that occurred several centuries later, its veneration seems paradoxical. To explain the reality of the Rightly Guided Caliphate and the reasoning behind its emulation, this study explores both the traditional historical account and the contemporary Salafist narrative of the period. Comparative analysis indicates that the period is revered, despite the paradoxical turmoil and violence associated with it, because it is perceived as the summit of both spiritual purity and temporal power in Islamic history. Contemporary Salafists long for a resurgence of Muslim power in the world but do not want to sacrifice religious purity to obtain it. The Rightly Guided Caliphate epitomizes this notion because its earliest generation was the most pure, in terms of the practice of Islam, of any Muslim generation. In addition, its seemingly miraculous expansion signified enormous temporal power—relative to its competitors, who have since overtaken them—that is easily romanticized. Much of the period's violence is omitted from the narrative to protect an idealized remembrance of the state's power, not its religious unity. Full text

**Keywords:** contemporary Salafism, Rightly Guided Caliphate, Islamic sectarianism, Mohammad, Quran, Sunna, Hadith, companions

### THE CULTURE OF NATIONALISM

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What was the role of high culture in the newly unified societies of Germany and Italy amid the ideology of nationalism in the late 19th and early 20th century? More specifically, the question at hand is, how did the visual arts—paintings and monuments, in particular—reflect and inform politics and society in both liberal and illiberal European states in the age of mass politics, mass culture, and total war? Further, what is high culture's relationship to the development of the totalitarian state? This thesis presents a historical study of the art and monuments considered significant to the development of fascist Germany and Italy. High culture in Italy and Germany worked alongside other social and political realities and eventually became the pinnacle of the nation-state relationship, providing a well-defined road linking the distant benign intentions of 19th century nationalism and 20th century extremism. Full text

**Keywords:** nationalism, fascism, high culture, nationalist art, fascist art, Nazi Art, integral nationalism

### STABILIZATION LESSONS LEARNED FROM SIERRA LEONE

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This thesis examines the near failure and ultimate success of the United Nations Mission in Sierra Leone. This operation is an interesting case study as it followed failed attempts at regional peacekeeping, in many ways mirrored them, but ultimately ended the conflict. This was the last operation the UN started before the Brahimi report and was effectively a tipping point for UN operations in general. This research analyzes the strategy and actions of the UN force as the situation progressively deteriorated to near-total failure and the changes made to both that led to the dramatic turnaround in a short period of time. The overall strategy of the UN mission, mandates and their interpretation, troop levels, and responses to threats are considered. The shift from a peacekeeping to peace-enforcement strategy and the simultaneous shift in tactics to favor aggressive response to threats earned the credibility necessary to deter aggression. This underscores the need to tailor strategy and mandate to the specific conditions on the ground and to allow the force the flexibility to adapt quickly. Full text

**Keywords:** Peacekeeping, United Nations, Sierra Leone, UNAMSIL, ECOMOG, Peacemaking

### TENSION IN THE SOUTH CHINA SEA: WHY THE PHILIPPINES IS CHALLENGING CHINA'S IMPROVED MILITARY MIGHT

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Since 1995, the Philippines has had several disputes with the People's Republic of China (PRC) over territory in the South China Sea. Between 1995 and 2010, Manila adopted policies with the PRC centered on accommodation and improving diplomatic relations with Beijing. After the election of President Benigno Aquino in 2010, the Philippines became more aggressive in its policies towards the PRC, and it has made more efforts to counter Chinese aggression than to accommodate Beijing. The Aquino administration has made military

modernization, especially in regards to its naval capabilities, a top priority. In addition, Manila has also attempted to strengthen its security relationship with the United States significantly. What are the reasons for this change in policy? Through the analysis of Philippine policy decisions between 1995 and 2010, and policy decisions after the election of President Aquino, this thesis attempts to answer the question: Why has Philippine policy towards Beijing's aggression changed since 2010? Full text

**Keywords:** Philippines, China, United States, Association of Southeast Asian Nations, South China Sea, ASEAN, Policy, Disputes, Military, Alliances, United Nations Convention on the Law of the Sea, UNCLOS, Military Aid, Military Modernization, Status of Forces Agreement, SOFA, Armed Forces of the Philippines, AFP, Visiting Forces Agreement, VFA, Joint Marine Seismic Undertaking, JMSU

## CHALLENGES TO THE CONSOLIDATION OF DEMOCRACY: A CASE STUDY OF THE MALDIVES

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This thesis explores the consolidation of democracy in the Maldives and challenges it faced during its first five years of democratic life, with special emphasis on the circumstances that led to the premature resignation of the first democratically elected head of state, President Mohamed Nasheed. It analyzes the political history of Maldives and the role of the military in the society. A long history of authoritarian rule and the very sudden transfer to a democratic system left many institutions to be reformed democratically in due course. In an effort to hasten the reform process, the ambitious new president unfortunately at times resorted to undemocratic means, especially using the military. His actions surpassed his authority, resulting in the public demand for his resignation, and, in the midst of many calamitous events that took place during the last few days of his presidency, President Nasheed resigned, casting a cloud of doubt over the fate of democracy in the Maldives. This study concludes that despite the many challenges the infant democracy of Maldives has faced, it overcame them all by the role played by local institutions. Thus, Maldives is thriving as a democratic success story. Full text

**Keywords:** road to democracy, efforts to consolidate democracy, challenges to consolidate democracy, resignation of President Nasheed and the allegations, military and its role in the society and politics, President Waheed and the continuation of democracy

# MASTER OF BUSINESS ADMINISTRATION

### OPTIMIZING LOGISTICS SUPPORT FOR BALLISTIC MISSILE DEFENSE SHIPS IN SIXTH FLEET

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**Co-Advisor: Aruna Apte, Graduate School of Business and Public Policy**

This research analyzes the optimal and most cost-efficient stationing of critical ship parts that will directly support Ballistic Missile Defense (BMD) ships deployed and stationed in Europe. The goal is to inform and recommend to decision-makers where and how many critical parts should be staged to best support the operational readiness of BMD ships on European Phased Adaptive Approach missions. To effectively accomplish this task, the research analyzes eight high-demand, high-dollar value spares that are forward-staged in Sigonella, Italy. Through modeling and simulation, we determine the most effective method to optimize ship readiness in a cost-constrained environment. Full text

**Keywords:** AEGIS, ballistic missile defense, Sixth Fleet, optimization, modeling

### THE CONTRACT MANAGEMENT BODY OF KNOWLEDGE: A COMPARISON OF CONTRACTING COMPETENCIES

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Contract management is instrumental in supporting the mission of the Department of Defense (DoD) but continues to face significant problems with regard to management and oversight. The skills and training of contracting personnel continues to be a contributing factor to DoD's contracting deficiencies. Additionally, as the DoD and other federal agencies continue to lose experienced contracting personnel due to retirement, the contracting knowledge gap continues to widen. In response to increasing knowledge deficiencies in contract management, DoD and other federal agencies have put more emphasis on training and certification. Despite this, contract management problems continue to exist. Perhaps the training received by the workforce does not reflect basic contracting competencies, and perhaps contracting competencies between the government and industry are inconsistent. This research conducted a detailed comparative analysis of the contracting competencies established by the DoD, the Federal Acquisition Institute (FAI), and the National Contract Management Association (NCMA). It identified similarities and differences in the models and competencies. Both NCMA's Contract Management Body of Knowledge (CMBOK) and DoD/FAI's competency models contain categories reflecting two out of three phases of the contract life cycle. The CMBOK contains both Pre-Award and Post-Award categories, whereas DoD/FAI's model contains one category titled Pre-Award and Award. Contracting competencies established by the DoD/FAI compare favorably to those set forth in the CMBOK. Of the 19 technical contracting competencies analyzed, 17 were covered by both DoD/FAI and the

CMBOK. The level of detail provided in the CMBOK is much greater than that of DoD/FAI competency model. Full text

**Keywords:** contract management, body of knowledge, National Contract Management Association, Department of Defense, Federal Acquisition Institute

## UNDERSTANDING THE GLOBAL SPECIAL OPERATIONS NETWORKS VALUE TO COUNTERTERRORISM: A BALANCED SCORECARD APPROACH

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**Shaun Carrizales, Lieutenant, United States Navy**
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**Co-Advisor: Thomas Albright, Graduate School of Business and Public Policy**

The United States Special Operations Command (USSOCOM) has placed great importance on working by, with, and through partners during the Global War on Terrorism. Grand strategies such as Line of Operation #2: Expand the Global SOF Network and the millions of dollars allocated to security force assistance are evidence of this emphasis. We develop and present a model to measure the value of the Global Special Forces Operation Network to counterterrorism operations. This model translates the strategy into clear objectives at the operational and tactical level. The model is based on a performance measurement tool for strategy implementation widely accepted in the private sector called the Balanced Scorecard. We introduce the natural unit of policy options created as a measure. This non-financial measure is a modification the traditional balanced scorecard and supports use by USSOCOM elements in the Global War on Terrorism. We argue that implementation of the model presented in this paper could enhance operational assessment and resource allocation decision-making by enabling assessment of the health of U.S. policy options in a region and identifying USSOCOM activities that can positively influence the quality and the quantity of those options. Full text

**Keywords:** Global Special Operations Forces Network, GSN, Special Operations Forces, SOF, United States Special Operations Command, USSOCOM, Global War on Terrorism, GWOT, security force assistance, SFA, building partner capacity, BPC, Joint Special Operations Task Force, JSOTF, Balanced Scorecard, BSC, Robert Kaplan, strategy map

## ARMY AVIATION EQUIPMENT USEFUL LIFE COST BENEFIT ANALYSIS

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**Jeremy Scott, Major, United States Army**
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Army Aviation is considering pursuing the development of a future vertical lift (FVL) aircraft to replace its aging medium variant helicopters, which are the UH-60 Blackhawk and AH-64 Apache. The medium variant platforms comprise about 75 percent of the current Army fleet. Although its current fleet is over 30 years in age, to date, the Army is unsure if the fleet should be replaced based upon cost, material condition, and technological capability. The critical issue is that the Army lacks objective research data to support the decision to either pursue a new aircraft or retain the current fleet. The intent of our research is to determine exactly how much any individual medium variant platform costs per flight hour and project its cost behavior over time.

That information will then be compared to a cost benefit analysis of a new build platform to help Army Aviation leadership with its FVL ambitions. Full text

**Keywords:** Army Aviation, cost analysis, future vertical lift, ALMIS, maintenance

## ESTIMATING THE ORGANIZATIONAL COST OF SEXUAL ASSAULT IN THE U.S. MILITARY

*This paper has been recognized as outstanding by its department*

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This research estimates the organizational costs of sexual-assault incidents involving active-duty members of the U.S. military in FY 2012. The study builds on previous work by Robert H. Faley, in which he and his colleagues presented a model for estimating the organizational annual cost of sexual harassment. In this study, I develop a comprehensive framework of all organizational costs related to sexual assaults in the military workplace. Using behavioral-costing methodology, I quantify organizational cost estimates for 24 cost components, some of which were ignored by previous studies. The goal of this research was to arm leadership and decision makers with critical information about the organizational costs of sexual assault, to use in the battle to eradicate sexual assault from the U.S. armed forces. Full text

**Keywords:** sexual assault, organizational cost estimate, unwanted sexual contact, behavioral costing methodology, separation and replacement costs, case prosecution costs, court-martial costs, productivity reduction costs, medical costs, mental health costs, investigative costs, administrative action costs, non-judicial punishment costs, WGRA

## DEFINING SELF-SUFFICIENCY IN THE UNITED STATES MARINE CORPS

**Joshua Brindel, Captain, United States Marine Corps**
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**Corey Meche, Captain, United States Marine Corps**
**Master of Business Administration**
**Advisor: Aruna Apte, Graduate School of Business and Public Policy**
**Co-Advisor: John Khawam, Department of Operations and Logistics Management**

The purpose of this project is to define self-sufficiency as it relates to the Marine Corps, identify the primary elements of self-sufficiency, and describe the interrelationships among these elements. Upon reviewing applicable literature, we have found three primary elements of self-sufficiency to be environment, time, and supply chain. Upon analyzing these elements and their interrelationships, we present a framework of self-sufficiency that (1) Marine Corps units can apply to internally increase their self-sufficiency and (2) others can use to conduct further in-depth research on how to increase or optimize Marine Corps units self-sufficiency. Full text

**Keywords:** self-sufficiency, supply chain, Marine Corps, environment, time, sustainment, expeditionary energy

## APPLYING AND MEASURING THE VALUE OF UTILITY MODELING IN DEFENSE ACQUISITION DECISION-MAKING

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This research project is intended to determine if utility modeling could be used within the Department of Defense (DoD) acquisition community. The primary effort of this research is to create a linear programming-based utility model that could assist a program manager in making purchase decisions. The final solution, given all available data regarding cost, schedule impacts, unique program constraints, and quality factors, will be the optimal allocation of budgetary resources to achieve the best overall value for the end user and taxpayer. Data for this research were obtained from the Apache Block III Modernization Program, after which a utility model was created to assess the utility of linear programming in the DoD acquisition decision-making process. The model compared 16 unique potential upgrades from the Apache Block III Modernization Program against each other and determined an optimal solution given the unique conditions of the program. Utility modeling proved to be an effective tool to help program managers make better purchase decisions. Utility modeling, coupled with sensitivity analysis, weighted utility modeling, and decision-support analysis, has the ability to optimize resource allocation decisions, thus maximizing overall value and reducing waste. This research project identified opportunities for further exploration into project management forecasting, game theory and retroactive program analysis. Full text

**Keywords:** acquisition, Apache Block III, evolutionary acquisition, block upgrades, integer programming, linear programming, major defense acquisition program, multiple criteria decision making, program manager, program management, quality index score, retroactive program analysis, utility model, weighted utility modeling

## A FEASIBILITY STUDY OF IMPLEMENTING A BRING-YOUR-OWN-COMPUTING-DEVICE POLICY

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**Timothy Walker, Lieutenant, United States Navy**
**Jason Williams, Lieutenant, United States Navy**
**Master of Business Administration**
**Advisor: Douglas Brinkley, Graduate School of Business and Public Policy**
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Our team conducted an information technology study on the feasibility of reduction of hardware and software procurement expenditures at the Naval Postgraduate School's Graduate School of Business and Public Policy (GSBPP). The objectives were to calculate the total cost of the GSBPP's current expenditures, develop alternative hardware and software procurement plans, and measure these costs against the alternative plan of implementing a bring-your-own-device policy for economic, operational, and technical feasibility. Full text

**Keywords:** bring-your-own device, BYOD, hardware and software procurement plans, cost analysis, cloud computing, simplified structures, management server licensing

## RESPONSES TO FISCAL STRESS: A COMPARATIVE ANALYSIS

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**Peter Moon, Captain, United States Marine Corps**
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The Budget Control Act of 2011 (BCA; Pub. L. No. 11225, 101, 125 Stat. 240) resulted from downward pressure on federal spending as tax revenues decreased faster than expenditures and deficits became unsustainable. The BCA's discretionary spending caps mandate that the Department of Defense (DoD) cut $500 billion in outlays between fiscal years 2013 and 2022. These spending caps, temporarily delayed by the American Taxpayer Relief Act of 2012 (ATRA; Pub. L. No. 112240, 901, 126 Stat. 2313), were realized on March 1, 2013, when $37 billion was sequestered from DoD's current year budget. The discretionary spending caps and sequester resulted from Congress's inability to stipulate $1.2 trillion in cuts over a 10-year period in accordance with the BCA. Challenged by financial retrenchment, the DoD must now make choices within the framework of a new fiscal reality and fewer resources. How do DoD's financial retrenchment choices compare to historical choices of other government, quasi-government, and publicly traded organizations encountering similar fiscal stress? This project creates a framework through examination of comparable government, quasi-government, and publicly traded organizations to conduct a comparative analysis of the DoDs financial retrenchment choices. Full text

**Keywords:** fiscal stress

## CASE STUDY OF THE U.S. ARMYS SHOULD-COST MANAGEMENT IMPLEMENTATION

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On May 22, 2009, President Barack Obama signed into law the Weapons Systems Acquisition Reform Act (WSARA). The intent of this law is to reform acquisition processes, control unsustainable cost growth, and make programs more affordable. In 2010, despite WSARA, program cost, schedule overruns, and less-than-desirable performance were still prevalent in DoD acquisition. In response, Ashton Carter, Under Secretary of Defense for Acquisition, Technology, and Logistics, issued his Better Buying Power (BBP) memorandum directing the implementation of Should-Cost Management (SCM). In April 2011, Carter issued an additional directive that should-cost estimates would be required for all acquisition category (ACAT) programs and that SCM initiative progress would be briefed at every milestone review. In November 2012, Frank Kendall, Carter's successor, issued an update to the original BBP initiative (BBPi), reinforcing the success of the BBPi. Kendall's update incorporated lessons learned from two years of implementation and feedback from the acquisition workforce. Our case study examines how the Army has implemented SCM as part of the BBPi. We analyze actions taken from the program manager to the Army acquisition executive using Program Executive Office (PEO) Aviation as our case study focus. Full text

**Keywords:** project management, weapon systems, military procurement, cost overruns, military acquisition, efficiency

## DRIVERS OF COMPLEXITY IN HUMANITARIAN OPERATIONS

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This project investigates the relationship between the geographical dispersion and speed of a disaster and how they increase the complexity of relief operations. Using the Emergency Events Database (EM-DAT) available from the Centre for Research on the Epidemiology of Disasters, information was collected and filtered for 281 U.S. disasters that occurred between 2000 and 2011. Data was utilized from the U.S. Census Bureau to supplement the EM-DAT information to determine the area affected for each disaster. Each disaster was then ranked and assigned a value to represent the speed of onset based on each type and subtype that was provided by EM-DAT. Plotting the disasters yielded a graph that was further analyzed to determine whether any patterns existed by comparing the number of personnel affected, number of casualties, and total damage costs incurred. The goal of this analysis is to determine whether the complexity of a disaster can be determined from its dispersion and speed of onset. Full text

**Keywords:** humanitarian assistance, disaster relief, disaster response, Federal Emergency Management Agency, Centre for Research on the Epidemiology of Disasters, Emergency Events Database

## KEY DRIVERS OF MARINES WILLINGNESS TO ADOPT ENERGY-EFFICIENT TECHNOLOGIES

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Why individuals adopt or resist technologies is a central question in technology management and energy conservation research. Much academic attention focuses on functional and economic advantages, but perceptions, habits, and norms play a more substantial role and are a particularly strong driver of resistance. Recognizing this, the Marine Corps Expeditionary Energy Office has called for research to better understand how messaging and behavioral factors will influence the shaping of a combat-effective energy posture within the Marine Corps. This research examines how particular individual attributes may affect Marines' assessments of energy-efficient technologies. Drawing on a framework developed from the academic literature, this research focuses on the impact of a person's prior conditions, knowledge, and perception of technologies on the decision to adopt, postpone, or resist new technologies. The research produced a summary of extant findings and implications for the United States Marine Corps concerning the typology of United States Marines' perceptions and willingness to adopt energy-efficient technologies. The research findings may offer the Marine Corps a clearer understanding of acceptance and resistance drivers, and the means to facilitate greater acceptance of energy-efficient technologies. Full text

**Keywords:** Marine Corps Expeditionary Office, energy-efficient technologies, technology resistance drivers and technology acceptance drivers

## DETERMINING OPTIMAL ALLOCATION OF NAVAL OBSTETRIC RESOURCES WITH LINEAR PROGRAMMING

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The U.S. Navy Bureau of Medicine and Surgery allocates funding for obstetric staffing resources, such as doctors, nurses, and midwives. Furthermore, these resources operate within a fixed number of labor/delivery and postpartum rooms, thereby establishing a theoretical maximum capacity of delivery volume. This study identifies the expected delivery volume created by the facility capacity of four major naval military treatment facilities (MTF) within the United States. Based on the calculated volume, this thesis utilizes a linear programming model to determine the optimum mix of doctors, nurses, and midwives to achieve the target delivery numbers. This is achieved while concurrently incorporating all relevant constraints within military medical treatment facilities. As a result, the model allows hospitals to meet target delivery volumes while simultaneously utilizing their allocated resources in the most effective manner. Additionally, the model can accommodate changes in the inputs and constraints and can be used to provide support for similar resource allocation decision problems. Full text

**Keywords:** Obstetrics, OB, medical treatment facility, MTF, diagnosis related group, DRG, bureau of medicine and surgery, BUMED, Naval Medical Center Portsmouth, NMCP, Naval Medical Center San Diego, NMCSD, Naval Hospital Camp Pendleton, NHCP, Naval Hospital Camp Lejeune, NHCL, labor delivery and recovery, LDR)

## BRINGING COST-WISE READINESS TO THE DECKPLATES OF A STRIKE FIGHTER SQUADRON USING THE BALANCED SCORECARD

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Budgetary pressures make it difficult for Naval aviation leaders to balance operations, procurement, and personnel to maintain appropriate levels of readiness to meet the demands of combatant commanders. The Naval Aviation Enterprise has had success in reducing the cost of Naval aviation, but operational squadrons are not systematically included in those efforts. This thesis explores how Naval aviation stakeholders define success for Navy strike fighter squadrons and develops a balanced scorecard that can align squadron success factors with the Commander, Naval Air Force's mission of delivering the right force with the right readiness at the right time with a reduced cost. Providing objectives, performance measures, and targets in a balanced scorecard framework will enable squadrons to reduce operating costs without sacrificing effectiveness or readiness. Full text

**Keywords:** Balanced Scorecard, Naval Aviation Flight Hour Program, Naval Aviation Enterprise, Cost-Wise Readiness, FID Fighter

## A COST ANALYSIS FOR LIFE-CYCLE PREVENTIVE MAINTENANCE, ADMINISTRATIVE STORAGE, AND CONDITION-BASED MAINTENANCE FOR THE U.S. MARINE CORPS MEDIUM TACTICAL VEHICLE REPLACEMENT

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This study provides a cost-based analysis of preventive maintenance and administrative storage for the U.S. Marine Corps medium tactical vehicle replacement (MTVR). In the years 1995–2013, the Marine Corps acquired approximately 8,750 MTVRs as overseas obligations increased. As the current conflicts wind down and the Marine Corps returns to lower force levels, the Marine Corps will see excess capacity in its MTVR fleet. This study begins the process of finding a solution to managing this excess capacity. Based on net present value analysis for various combinations of continued preventive maintenance and storage of excess vehicles over their life cycle, this study's findings contribute to determining the most cost-effective method of handling the Marine Corps MTVR fleet. Full text

**Keywords:** medium tactical vehicle replacement, MTVR, United States Marine Corps, USMC, preventive maintenance, administrative storage

## BUILDING A CAPABILITIES NETWORK TO IMPROVE DISASTER PREPARATION EFFORTS IN THE SOUTHERN COMMAND (SOUTHCOM) AREA OF RESPONSIBILITY (AOR)

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The U.S. Southern Command (SOUTHCOM) area of responsibility (AOR) encompasses 31 countries and 15 areas of special sovereignty and represents about one-sixth of the landmass of the world assigned to regional unified commands. To provide rapid and effective disaster relief in an area this large, a commander requires identification of available resources and effective coordination with those who can provide these resources. This research analyzes the capabilities of various in-theater non-government organizations and the interactive efforts between them and the U.S. military. This project will provide guidance to decision-makers in the SOUTHCOM AOR to avoid redundancy in efforts and more effectively distribute essential resources during humanitarian assistance and disaster relief operations. Full text

**Keywords:** disaster relief, disaster preparedness, humanitarian assistance, non-government organizations, NGO, capabilities

## IS ELECTRONIC LIFE-CYCLE TRACKING OF AIRCRAFT PARTS DEGRADING READINESS?

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The Naval Aviation Logistics Command Managed Information System (NALCOMIS), the current Navy and Marine Corps electronic tracking system for aircraft components, provides complete, up-to-date life-cycle information about aircraft and associated components to all maintenance agencies across the Naval Aviation Enterprise (NAE). By design, the system is meant to facilitate efficient receipt, repair, documentation, and transfer of all aircraft and components inducted into the maintenance cycle. However, many end users within the NAE still receive a significant volume of aircraft and associated components from higher echelon maintenance activities without current electronic life-cycle records entered in NALCOMIS. Consequently, components cannot be certified as ready for issue and utilized to revive non-mission-capable aircraft into full mission-capable status. As a result, the Navy and Marine Corps incur significant costs, including decreased availability of air assets, degraded operational readiness, early retirement of aircraft components, and inefficient utilization of aviation maintenance administrative personnel. This report applies the Six Sigma define, measure, analyze, improve, and control process approach to evaluate current procedures across the entire maintenance cycle and includes analysis of both quantitative and qualitative data in order to identify bottlenecks and inefficiencies. Recommendations are focused on cost reductions through overall process improvement and seek to minimize personnel-hour expenditures whereby aircraft availability and operational readiness can be increased. Full text

**Keywords:** NALCOMIS, Life-Cycle Tracking, DMAIC, Six Sigma, Aircraft Readiness

## A STUDY OF AN EFFECTIVE OFFSETS MODEL FOR KOREA

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One way of acquiring defense science technology is through offsets. When one country buys a weapon system from another country, it acquires critical technology and defense supplies as a return service. Korea has been using offsets since 1983 to develop a defense industry and to improve its defense science technology. Since the establishment of the Korean Defense Acquisition Program Administration, Korea has been trying to improve its policies regarding offsets and its system of offsets. This project conducts research and suggests a new Korean offsets model to improve Korea's defense science technology and promote Korea's defense industry. By thoroughly analyzing the current system, this project will improve the offsets process by reordering priorities and streamlining procedures. Full text

**Keywords:** Offsets, Korea, Korean Defense Acquisition Program Administration, KDAPA, Efficient Model

## QUALIFICATION REQUIREMENT PERCEPTIONS OF THE UNITED STATES ARMY ACQUISITION WORKFORCE SINCE IMPLEMENTATION OF THE DEFENSE ACQUISITION WORKFORCE IMPROVEMENT ACT (DAWIA)

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This project's purpose is to assess perceptions within the U.S. Army of qualification requirements of Army acquisition professionals since the Department of Defense implemented policies to conform to the Defense Acquisition Workforce Improvement Act passed by Congress in November 1990. This project's objective is to analyze the acquisition workforce perception of training requirements instituted by the Defense Acquisition University for professional certification in the acquisition functional areas and to determine if these requirements are perceived as an adequate technical baseline of knowledge and experience that ensures professionals will be more effective members of the acquisition Integrated Product Team. These perceptions were collected through visits to respective centers for excellence, from interviews, and from surveys of both military and civilian acquisition professionals. We acquired data from the U.S. Army Acquisition Support Center and the Defense Acquisition University, as well as surveys and interviews of acquisition leadership with a range of experience and positions. Full text

**Keywords:** acquisition workforce, perceptions, Defense Acquisition Workforce Improvement Act, DAWIA, qualification requirements, certification requirements

## IMPROVING RAPID ACQUISITION: A REVIEW OF THE RIVERINE COMMAND BOAT PROCUREMENT

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**DeAundrae Rogers, Lieutenant Commander, United States Navy**
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**Master of Business Administration**
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The Naval Expeditionary Combat Command procured the riverine command boat (RCB) under a General Services Administration multiple-award schedule contract. Four factors made this acquisition successful. First, an urgent requirement was identified. The global war on terrorism precipitated the need for a fast, maneuverable, highly lethal, and globally deployable naval riverine craft. Second was the ready availability of a proven commercial product; the RCB is a successful Swedish product. Third, the cost was within a procurement threshold that allowed its rapid acquisition. Fourth, funding was available. The approvals of the Bob Stump National Defense Authorization Act (NDAA) for Fiscal Year 2003 and the Ronald Reagan NDAA for Fiscal Year 2005 were the key legislative elements that enabled the RCB's swift acquisition, relaxed procurement restrictions, and allowed warfighters access to systems such as the RCB. Though this procurement satisfied immediate naval requirements, readiness shortfalls later revealed that the acquisition had failed to address the life-cycle management of maintenance and sustainability. This MBA project analyzes shortfalls in the process used to acquire the RCB and recommends improvements in life-cycle management, as it pertains to acquisition, maintenance, and sustainability. Full text

**Keywords:** rapid acquisition, riverine command boat, RCB

## COST-BENEFIT ANALYSIS OF PERMANENT CHANGE OF DUTY STATION (PCS) MODES OF TRAVEL FOR MOVES TO ALASKA

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**Co-Advisor: Wythe Davis, Graduate School of Business and Public Policy**

This research examines whether permanent change of station (PCS) travel by privately owned vehicle (POV) to Alaska is to the government's advantage. The objectives of this research are to determine estimated total costs of PCS travel to Alaska by various modes of travel; to identify which of the PCS cost drivers has the greatest impact on government expenditures; and to calculate and project potential cost savings to the government based on the results of the cost-benefit analysis. Historical costs collected from the Defense Finance and Accounting Service are used to create a database of costs incurred by service members traveling to Alaska over the course of two years (May 2010 through April 2012). Coupled with historical travel rates, shipping estimates, and other appropriate open source information, a cost-benefit analysis is conducted comparing the three modes of travel (POV, car ferry, and air travel) available to service members traveling to Alaska. Ultimately, this study confirms that completing PCS travel to Alaska via POV is, indeed, to the governments advantage. Full text

**Keywords:** Cost-Benefit, permanent change of station, PCS, Alaska, Per Diem, Defense Finance and Accounting Service, DFAS

## AN ANALYSIS OF PRIOR ENLISTED OFFICER RETENTION AT THE 20- YEAR POINT

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This thesis compares the retention rates of prior and non-prior enlisted naval officers who have served 20 years and are eligible to retire, and it finds that prior enlisted officers leave the Navy after 20 years of service at a greater rate, 310 percent, than non-prior enlisted colleagues. Furthermore, this study tests whether expanding the existing talent pool through increased diversification can offset talent leakage among the officer corps. The primary source of data is the Defense Manpower Data Center. The study uses a cost benefit analysis approach to quantify the opportunity cost for an officer leaving the Navy at 20 years of service in lieu of serving 30 years. Based off a wide range of financial variables considered, the cost benefit analysis in this study finds that prior enlisted naval officers are better off by $211,000 to continue service through the 30-year point. Several recommendations are made regarding future research and retaining prior enlisted officers. Full text

**Keywords:** prior enlisted officer retention

## AN ANALYSIS OF PERSONAL FINANCIAL MANAGEMENT TRAINING WITHIN THE DEPARTMENT OF THE NAVY

*This paper has been recognized as outstanding by its department*

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**Kevin Wilson, Lieutenant Commander, United States Navy**
**Ian Burgess, Lieutenant, United States Navy**
**Master of Business Administration**
**Advisor: Juanita Rendon, Graduate School of Business and Public Policy**
**Co-Advisor: Steven Landry, Graduate School of Business and Public Policy**

In today's Navy, budget concerns are a part of everyday life. The Department of the Navy (DON), like many other government organizations, is more budget-constrained and faces an uncertain future, to some degree, with fiscal issues. With the real threat of government shutdowns, downsizing threats, furloughs, and possible changes in military retirement, DON personnel must utilize sound personal financial management (PFM) to be prepared to face these future challenges. The purpose of this research was to determine the financial characteristics that lead to the financial fitness of DON personnel and to review the DON PFM training programs' coverage of those financial fitness characteristics, so that DON leadership can provide the necessary resources to improve the financial fitness of DON personnel. This research project accomplished the following: (1) defined the term financial fitness and the 14 associated characteristics, (2) developed a financial fitness index, (3) analyzed previously collected data from the 2011 Financial Health Quick Poll survey to test the financial fitness characteristics, (4) provided recommendations to improve DON personnel financial fitness, and (5) outlined areas for further research and follow-on PFM studies. Full text

**Keywords:** personal financial management, PFM, financially fit, financial fitness, inancial Fitness Index, financial health, DON personal financial management training

## USE OF ENERGY-EFFICIENT TECHNOLOGIES: U.S. MARINE CORPS PERCEPTIONS TO ADOPTION

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Identifying effective methods for influencing Marines to accept energy-efficient technologies is vital to achieving a positive and sustainable energy outlook for the United States Marine Corps (USMC). The purpose of this study is to support the adoption of energy-efficient technologies by the USMC to increase Marine combat effectiveness. Toward this end, Marines' concerns, awareness, and enthusiasm regarding energy-efficient technologies were explored, as well as the influencers on these factors. This study and final recommendations are based on an analysis of focus group data from two focus groups held at the Naval Postgraduate School and two at Camp Pendleton. This analysis revealed key influence drivers and suggested potential influence strategies that the Marine Corps Expeditionary Energy Office can implement to help foster its initiatives. Full text

**Keywords:** Marine Corps Expeditionary Office, energy-efficient technologies, influencers of technology adoption

## CONSOLIDATED AUTOMATED SUPPORT SYSTEM (CASS) EFFICIENCY AND ALLOCATION COST IMPROVEMENT

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In this research project, we provide a method in which we incorporated a nonlinear model to allocate consolidated automated support system (CASS) stations utilizing real demand. In reviewing available literature, we frame the allocation of CASS stations as a problem of discrete capacity allocation with stochastic demand and note that similar problems exist in the allocation of other types of service capacity (e.g., hospital beds). We employed a nonlinear model to present a better method for allocation. Currently, Naval Air Systems Command Program Manager Air 260 uses an algebraic formula to determine CASS station allocation. The nonlinear model takes into account factors that the algebraic formula does not, such as aircraft readiness and CASS station utilization. With the model, we generated an optimized allocation of CASS stations based on average demand from aircraft maintenance action forms received at a Fleet Readiness Center over a given period of time. Then, we demonstrate that the optimized allocation can account for monthly, non-stationary demand inputs, as potentially seen in a fleet response plan. Compared to the current allocation of the Fleet Readiness Center analyzed, the optimized allocation improves CASS station utilization rates with a decreased overall number of CASS stations without an adverse change in aircraft readiness. Full text

**Keywords:** consolidated automated support system, CASS, eCASS, non-linear programming, resource allocation, discrete stochastic capacity allocation, queuing congestion, utilization, operational availability, readiness

## ASSIGNMENT PROBLEM FOR THE U.S. MARINE CORPS: REGIONAL, CULTURE, AND LANGUAGE FAMILIARIZATION PROGRAM

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U.S. Marine Corps recently developed the Regional, Culture, and Language Familiarization Program (RCLF), which assigns newly promoted sergeants and commissioned officers to one of the 17 regions established by the RCLF office. As of now, there is no formal process established in assigning Marines to one of the 17 regions. The assignment is done manually and, oftentimes, by random allocation without a standard operating procedure. We developed two integer-programming models and a matching algorithm that utilizes top trading cycle and serial dictatorship. These models optimize the assignment based on Marine and USMC preferences. We find that the benchmark integer programing model is the best in terms of assigning most Marines within their top four choices. Regardless, satisfaction rate of any of the three models are higher than the random assignment model. Full text

**Keywords:** Assignment problem; integer programing; regional, culture, and language familiarization program;top trading cycle; serial dictatorship; optimization

## AN ANALYSIS OF INTERNAL CONTROLS AND PROCUREMENT FRAUD DETERRENCE

*This paper has been recognized as outstanding by its department*

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**Co-Advisor: Rene Rendon, Graduate School of Business and Public Policy**

The rise in globalization, coupled with the use of technology to accelerate approval, and payable cycles, the increase of outsourcing of goods and services, and the pressure to cut costs, has resulted in government organizations being more exposed to the risk of fraud in their procurement process. Hence, appropriate internal controls and fraud prevention strategies are necessary for deterring, detecting, and managing procurement fraud. The purpose of this research was to develop a guideline to help government organizations design an effective system of internal controls to deter fraud in public procurement processes and practices. This was done through a review, analysis, and discussion of 20 case studies of actual fraud incidents. In each case study, internal control weaknesses were identified and analyzed in terms of the fundamental principles that are associated with the five internal control components. The analysis revealed that the majority of the organizations in the case studies lacked three internal control components, namely control environment, control activities, and monitoring activities. Recommendations for improvements for each case study were presented by applying relevant internal controls into its procurement process to deter procurement fraud. The areas for further research were also provided. Full text

**Keywords:** procurement fraud, internal controls, fraud prevention, control environment, control activities, monitoring activities

## ESTIMATING THE FULLY BURDENED COST OF SUPPLY IN A SELF-SUSTAINING SUPPLY CHAIN USING AN INPUT-OUTPUT MODEL

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**Co-Advisor: Jay Simon, Defense Resources Management Institute**

Armed forces of many countries conduct various operations both at home and worldwide. These operations are conducted not only in areas where procurement is viable, but also in areas where commodities consumed by the logistics activities are not locally available. Estimating and calculating the fully burdened cost of supply in such areas where commodities consumed by the logistics activities are not locally available has become a major research and study field. This study focuses on the effects of change in vehicle fuel consumption rates on fully burdened cost of supplies in a self-sustaining supply chain and how the existence of demand at intermediate nodes affects the fully burdened cost of supplies. After modeling five different scenarios, the effects of changes in the size of convoy and delivery system were analyzed by comparing the results of each scenario. The results of this analysis show that small convoys in supply chains are more efficient than big convoys, and that the fuel consumption rate of vehicles is so crucial that it should not be disregarded when estimating fully burdened cost of fuel. Full text

**Keywords:** fully burdened cost of fuel, FBCF, self-sustaining cupply Chain, SSSC

## HOW CAN WE BEST ACHIEVE CONTRACTING UNITY OF EFFORT IN THE CENTCOM AREA OF RESPONSIBILITY?

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**Co-Advisor: Bryan Hudgens, Graduate School of Business and Public Policy**

The purpose of this research is to investigate how to better achieve contracting unity of effort in the U.S. Central Command area of operations and the implications for other combatant commands in similar contingency situations. In the U.S. Central Command area of operations, numerous contracting agencies operate in Afghanistan, each with its own contract authority, but these agencies have little synchronization and no common operating picture. In contrast, there is only one overarching operational command authority in this area with a clear chain of command to help accomplish common objectives and achieve operational unity of effort. After completing a literature review of our topic, we conducted in-depth interviews with senior Department of Defense individuals who were knowledgeable and/or experienced with contingency contracting in the U.S. Central Command area of operations. This approach allowed us to gain detailed information and examples from our respondents. After a detailed analysis of selected interview data, we made our final recommendations on improving contracting unity of effort and increasing the effectiveness of operational contract support across the department. Full text

**Keywords:** operational contracting support, contracting unity of effort, US Central Command, contingency contracting, Joint Theater Support Contracting Command

## MANAGEMENT LEVERS THAT DRIVE SERVICES CONTRACTING SUCCESS

*This paper has been recognized as outstanding by its department*

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**Master of Business Administration**
**Advisor: Rene Rendon, Graduate School of Business and Public Policy**
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Contracting for services in the Department of Defense (DoD) has grown over the last 21 years. This growth in dollars spent has brought increased political attention and scrutiny. DoD has responded to problems such as contract mismanagement and ill-defined requirements by improving service acquisitions, but it still has problems. The problems could be from a lack of standard definition for success. Since contract success and failure is recorded through the Contract Past Performance Assessment Reporting System (CPARS), this information is used for the proxy definition for success. This definition was used to address the following questions: (1) Do the types of services being acquired affect the success of a service contract? (2) Do the contractual amounts affect the success of a service contract? (3) Does the level of competition used affect the success of a service contract? (4) Does the contract type affect the success of a services contract? This report examined 715 CPARS entries. The findings revealed that contractual amounts and level of competition affect the success of a service contract. The findings also revealed that the failure rate in CPARS is lower than expected. From these findings, the report presents a discussion of the results and managerial implications, and recommends an alternate method in completing CPARS data. Full text

**Keywords:** service contracting, Contract Past Performance Assessment Reporting System (CPARS), stakeholder theory, service contract metrics of success

## BUSINESS CASE ANALYSIS OF THE SPECIAL OPERATIONS AIR MOBILITY VEHICLE

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Special operations air mobility vehicle is the military term used to describe the weight shift control (WSC) aircraft. The WSC aircraft is a type of light-sport aircraft that has certain characteristics that distinguish it from the more vague aircraft industry segment of light-sport aircraft. The WSC aircraft consists of three major but simple parts: the wing, the carriage, and the pilot. Everything about this aircraft is based on simple, portable, and inexpensive concepts with very little use of modern technology. This keeps the costs down and maximizes the basics of aviation, including calling on the skills and training of the pilot. Several manufacturers produce this commercial aircraft. They are Air Creation USA, Airborne, Evolution, Concept Aviation, Manta Aircraft S.A., and Northwing Design. This project has three objectives: (1) describe the WSC aircraft and its capabilities; (2) assess its benefits and costs relative to the V-22 Osprey, the newest troop transport helicopter, and the US Air Force Predator, an unmanned aerial vehicle drone; (3) perform an industry analysis of the WSC training and aircraft sales industry; and (4) determine the expected government training capabilities and costs. Full text

**Keywords:** Special Operations, mobility, air vehicle, weight shift control, WSC, light sport aviation, sport pilot, training, flight training

## ANALYSIS OF THE POTENTIAL IMPACT OF ADDITIVE MANUFACTURING ON ARMY LOGISTICS

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**Ellis Allen, Captain, United States Army**
**Master of Business Administration**
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**Co-Advisor: Bryan Hudgens, Graduate School of Business and Public Policy**

This study examines additive manufacturing and describes the potential impact it could have on Army logistics—specifically, contingency resupply operations. We research the three primary methods of additive manufacturing: sterolithography, selective laser sintering, and fused deposition modeling. Our research identifies how each process works, the varieties of materials used, and the build times utilized in each process. Our methodology examines industry and military applications of additive manufacturing and identifies advantages and disadvantages of its use. Our analysis examines aerial resupply operations during Operation Iraqi Freedom and the Department of Defense standard times for aerial resupply associated with each step in the process. A comparative analysis identifies how the availability of additive manufacturing at the point of embarkation could impact order-to-receipt time of repair parts. This study concludes with the identification of the pros and cons of additive manufacturing, its potential impact on future operations, and recommendations for further research. Full text

**Keywords:** additive manufacturing, aerial resupply, stereolithography, fused deposition modeling, selective laser sintering, order-to-receipt time

## MILITARY COMPENSATION IN THE ARMENIAN ARMED FORCES: LIFE CYCLE COST MODEL FOR THE ARMENIAN ARMY

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**Master of Business Administration**
**Advisor: Diana Angelis, Defense Resources Management Institute**
**Co-Advisor: Robert McNab, Defense Resources Management Institute**

The Armenian Armed Forces is moving from a conscript force to a volunteer force. They are based on a Soviet-era military structure but are attempting to adopt a Western-style of force structure, similar to the United States' and United Kingdom's. A key element in this is the establishment of a professional non-commissioned officer (NCO) corps within the Armenian Army. As they seek to develop the senior enlisted ranks, as well as move to an all-volunteer force, they have identified the need to re-evaluate their current military pay and compensation structure. This must all be done with an eye toward long-term personnel costs, which is currently not happening. This project developed a cost model to examine the various life cycle costs of the military compensation system for the Armenian Army. The focus is on the structure of the Armenian Army peacekeeping brigade and incorporates the new, proposed professional NCO corps into a new rank and pay structure. The model allows the Armenians to adjust criteria to look at the cost implications of various manpower policy decisions. It also provides total compensation costs on an annualized basis, allowing policy makers to make informed budgeting decisions. The results show the costs at different manpower and rank mixes. Full text

**Keywords:** Armenia, life cycle cost model, peace keeping brigade, PKB, International Partnership for Peace, NATO IPAP, professional NCO corps

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# MASTER OF SCIENCE

Applied Mathematics
Applied Physics
Astronautical Engineering
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Information Operations
Information Technology Management
Management
Mechanical Engineering
Meteorology and Oceanography
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Program Management
Systems Engineering

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# MASTER OF SCIENCE IN APPLIED MATHEMATICS

## OPTIMIZING UNITED STATES COAST GUARD PREVENTION JUNIOR OFFICERS ASSIGNMENTS

**Jose Rosario, Lieutenant, United States Coast Guard**
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**Second Reader: Carlos Borges, Department of Applied Mathematics**

For years, a diverse assignment history has been considered beneficial to the service and the member. Ideally, the United States Coast Guard (USCG) would like members to experience different geographical locations throughout their careers. Although geographical diversity is still considered beneficial, the USCG must find a way to provide geographical diversity at a lower cost. Currently, USCG officers are eligible for reassignment every three years for operational billets and every four years for staff billets. For AY13, the USCG decided to implement a more regional assignment process in order to reduce cost; we look into how regional assignments impact the professional development of USCG officers. The objective of this thesis is to find a balance between cost savings and the exposure that a junior officer must have in order to achieve the expertise needed for more senior positions later on in his or her career. We explore the impact distance between duty stations can have in assignments for USCG junior officers using a combinatorial optimization method called the Hungarian algorithm. Full text

**Keywords:** assignment problem, Coast Guard assignments, Hungarian algorithm

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# MASTER OF SCIENCE IN APPLIED PHYSICS

## CHARACTERIZATION PARAMETERS FOR A THREE DEGREE OF FREEDOM MOBILE ROBOT

**Jessica Fitzgerald, Lieutenant, United States Navy**
**Master of Science in Applied Physics**
**Advisor: Richard Harkins, Department of Physics**
**Second Reader: Andres Larraza, Department of Physics**

Control and Navigation logic was developed for a 3-Degree of Freedom Surf-Zone Robot to assist in the identification and characterization of platform parameters for use in the Shuey Dynamic model. These parameters included primarily platform rotational inertia and wheel slip. Data was collected in various track scenarios, including benign flat terrain and more complicated beach runs. Track lengths spanned short straight paths of no more than 10 meters to full-run point-to-point autonomous navigation paths of up to 80 meters. The longer runs included turns of up to 180 degrees and terrain inclines of 2 degrees or less. As expected, the Shuey model proved reliable for short runs of no more than 10 meters. For long length runs in the beach environment, the Dynamic model diverged quickly. This is attributed primarily to wheel slip conditions and the fact that the Shuey model is open loop. Motor current was monitored under load conditions to identify wheel slip, and simple algorithms were implemented to account for this with little success. However, closed loop heading input resulted in significant improvement to the model. Full text

**Keywords:** robots, robotics, amphibious vehicles, mobility, surf-zone, Dynamic model, Kinematic model, simulation, Lagrangian mechanics, slip, skid, autonomous

## DESIGN AND CONSTRUCTION OF MULTI-VARIABLE VORTEX-RING BUBBLE GENERATOR FOR USE IN INTERACTIVE EXHIBIT

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**Master of Science in Applied Physics**
**Advisor: Bruce Denardo, Department of Physics**
**Second Reader: Richard Harkins, Department of Physics**

The ultimate consequence of the current shortfall of students seeking higher education in the fields of science, technology, engineering and mathematics (STEM) is a lack of technical professionals trained to operate and maintain complex weapon systems crucial to the defense of this nation. A hands-on interactive exhibit able to capture the imagination and ignite curiosity is a powerful tool to advance the strategic goal of raising the number of students studying these disciplines. Vortex rings are a naturally occurring phenomenon that provides a medium for capturing the attention while providing the opportunity to teach complex subjects related to stable and unstable equilibrium, stochastic systems, and conservation laws. The diaphragm valve designed in this thesis provides the centerpiece for such an exhibition. The valve is capable of producing a broad range of vortex-ring bubbles through adjustment of three variables. The seal pressure, actuating pressure, and cycle time of the triggering solenoid valve each contribute to the type and quality of bubble produced. The behavior of the device through a select range of parameters is presented and future work to produce a fully interactive exhibit is discussed, including mechanical design, electronic circuitry, and micro-controller coding. Full text

**Keywords:** vortex ring bubble, vortex ring, interactive exhibit, STEM, diaphragm valve, toroidal ring

## EVOLUTION OF THE ELECTRON BEAM ENVELOPE IN A FREE ELECTRON LASER BEAMLINE

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**Advisor: Joseph Blau, Department of Physics**
**Co-Advisor: William Colson, Department of Physics**

The free electron laser (FEL) is a new generation of laser whose development motivates further research in basic and applied physics. Unlike a conventional laser that uses a gas or solid state gain medium, the FEL gain medium is a relativistic electron beam produced by a particle accelerator. This thesis will explore electron beam dynamics in an FEL, including the beam envelope equation, which will help us understand the evolution of electron betatron motion in the undulator. Dipole magnets, quadrupoles, and solenoids play important roles in transporting and focusing in an FEL beamline. The dipole magnets redirect the electron beam to a beam dump or recirculate the electrons for energy recovery. The quadrupoles and solenoids collimate and focus the electron beam. Simulations and theory are used to model and study a simple FEL beamline. Full text

**Keywords:** free electron laser beamline, betatron motion, beam envelope, quadrupole focusing, solenoid focusing, bending magnet

# MASTER OF SCIENCE IN ASTRONAUTICAL ENGINEERING

## DESIGN AND PROTOTYPING OF A SATELLITE ANTENNA SLEW TESTBED

**Gregory Contreras, Lieutenant, United States Navy**
**Master of Science in Astronautical Engineering**
**Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: I. Michael Ross, Department of Mechanical and Aerospace Engineering**

The purpose of this thesis is to contribute to the development of the next generation slewing antennas for spacecraft, ground or sea systems. Current antenna slewing systems may also benefit from the results. More specifically this thesis provides a new testbed for implementing slew maneuvers in a laboratory environment. The antenna slew testbed was built with in-house manufactured parts, 3-D printed parts, and commercial-off-the-shelf equipment. The approach for designing this testbed involved CAD analysis and rapid prototyping, the application of dynamic scaling and similitude concepts, and implementation of hardware and software to support experimentation of novel maneuver concepts. To illustrate this, a maneuver based on optimal control theory is implemented. The applicability of this testbed casts a wide net because of its scale size as compared to existing or future systems. Moreover, the testbed is designed in a modular form to allow a variety of different antenna systems to be represented for testing slews. These include ground, space, and shipboard antenna systems. Full text

**Keywords:** testbed, antenna system, optimal controls, gimbal, gimbals, testbed assembly, 3d printing, rapid prototyping, satellite antenna, slew testbed, slewing testbed

## PERFORMANCE OF THE SELF REFERENCING INTERFEROMETER IN THE PRESENCE OF SIMULATED DEEP TURBULENCE AND NOISE EFFECTS

**Lee Johnson, Lieutenant, United States Navy**
**Master of Science in Astronautical Engineering**
**Advisor: Brij Agrawal, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Jae-Jun Kim, Department of Mechanical and Aerospace Engineering**

Current laser weapon systems are limited to close range encounters because the laser beam attenuates quickly within the atmosphere. A phenomenon known as deep turbulence is characterized by strong scintillation and branch points in the wave-front phase. Many wave-front sensors perform poorly in the presence of deep turbulence and are unable to accurately reconstruct the wave-front. This paper examines a wave-front sensor, the self-referencing interferometer (SRI), that is theoretically immune to the effects of deep turbulence. The SRI is both simulated mathematically and constructed in the lab for comparison between analytical and experimental results. Performance of the SRI is analyzed in the presence of realistic deep turbulence effects generated by a spatial light modulator and realistic noise effects introduced by the digital imaging system. Simulated results show a significant loss of signal level as turbulence is increased but a resilience of the wave-front sensor above a signal-to-noise ratio of two. Analogously, in the experimental results, the signal drops off rapidly with increasing levels of turbulence and reaches unacceptably low levels above a Rytov number of 0.4. A qualitative analysis of the wave-front reconstruction shows remarkable similarity between simulated and experimental results, though the experimental results contain far more error-induced branch points than in

the simulation. Methods are being explored to boost the signal and reduce the noise at the camera to allow the system to handle higher levels of turbulence. Full text

**Keywords:** adaptive optics, self-referencing interferometer, SRI, spatial light modulator, deep turbulence

### PERFORMANCE IMPROVEMENTS TO THE NAVAL POSTGRADUATE SCHOOL TURBOPROPULSION LABS TRANSONIC AXIALLY SPLITTERED ROTOR

**Michael Lehrfeld, Lieutenant Commander, United States Navy**
**Master of Science in Astronautical Engineering**
**Advisor: Anthony Gannon, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Garth Hobson, Department of Mechanical and Aerospace Engineering**

Performance improvement investigations to the Naval Postgraduate School Turbo Propulsion Laboratory's (NPS TPL) Transonic Axially Splittered Rotor were investigated. Implementation of current NPS TPL design procedure that uses COTS software (MATLAB, SolidWorks, and ANSYS-CFX) for the geometric rendering and analysis was modified and documented. Numerical simulations were conducted, and experimental data were collected at the NPS TPL utilizing the transonic compressor rig. This study advanced the understanding of casing tip gap, rotor-stator interaction, stator relative blade placement of a hybrid tandem/splittered design, and performance benefits. The reduction in rotor tip gap produced higher performance bench marks as predicted. The addition and analysis of multiple blade rows proved to be straightforward, and the design methodology and in-house procedure was further optimized. While other studies sought to affect the pressure surface of the lead blade, it was determined that using the trailing blade to influence the high momentum flow over suction surface of the lead blade produced better performance gains. With tip gap closure and the addition of the stator stage, rotor-alone performance was improved from experimentally measured peak total-to-total pressure ratio of 1.69 to 1.99 and the peak total-to-total isentropic efficiency from 72 to 77 percent at 100 percent design speed. Full text

**Keywords:** turbomachinery, axial compressor, splittered rotor, hybrid stator

### DESIGN AND EXPERIMENTAL IMPLEMENTATION OF OPTIMAL SPACECRAFT ANTENNA SLEWS

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**Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: I. Michael Ross, Department of Mechanical and Aerospace Engineering**

This thesis investigates the development and implementation of optimal slew trajectories for positioning a spacecraft antenna. Conventional maneuvers are developed by considering each gimbal independently. Consequently, maneuver design is simple but may be highly sub-optimal and cause significant torques to be imposed on the spacecraft body. This work explores the impact of implementing optimal slew paths that best utilize system dynamics with the objective of increasing available customer time on communications links and enabling new missions. Accomplishing this required the development of a detailed multibody system model that can be easily tailored to any spacecraft antenna configuration. Various software suites were used to perform thorough validation and verification of the Newton-Euler formulation developed herein. The antenna model was then utilized to solve an optimal control problem for a geostationary communications satellite. The developed maneuvers not only reduce the antenna slew time, but also reduce the impact of the antenna motion on the spacecraft attitude. This reduces reliance on the spacecraft attitude control system to maintain pointing and minimizes the impact of antenna motion on the operation of other payloads. Successful implementation

of the designed maneuvers on a laboratory testbed validate the approach in a real hardware environment. Full text

**Keywords:** optimal slew maneuvers, spacecraft, antenna, communications satellite, multibody dynamics

## AUTOMATED TECHNIQUES FOR RAPID ANALYSIS OF MOMENTUM EXCHANGE DEVICES

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**Master of Science in Astronautical Engineering and Astronautical Engineer**
**Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Isaac Ross, Department of Mechanical and Aerospace Engineering**

This thesis develops a suite of automated techniques aimed at analyzing the characteristics of arrays of control moment gyroscopes (CMGs) and/or reaction wheels (RWs). Three specific areas, relevant to the design of new spacecraft, are examined: momentum space, torque space, and reaction forces. The momentum space analysis creates a maximum saturation envelope for both pure CMG/RW arrays and for hybrid arrays. The torque space analysis creates a maximum envelope for RWs and presents the idea of state-space analysis for CMGs, which leads to the ability to determine singularity free operational envelopes. These envelopes allow satellite slew performance to be estimated, allowing for an initial determination of component size. The reaction forces and moments seen at the attachment points of the RWs and CMGs during maneuvers is also analyzed. This analysis, which has not been reported in the literature, utilizes telemetry data and the geometry of the spacecraft to explore the relationship between maneuver types and the loads seen by the CMG/RW mechanism. Full text

**Keywords:** reaction wheel, RW, control moment gyroscope, CMG, reaction forces

## CORRECTING SURFACE FIGURE ERROR IN IMAGING SATELLITES USING A DEFORMABLE MIRROR

*This paper has been recognized as outstanding by its department*

**James Watson, Commander, United States Navy**
**Master of Science in Astronautical Engineering**
**Advisor: Brij Agrawal, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Jae-Jun Kim, Department of Mechanical and Aerospace Engineering**

A deformable mirror is proposed as a solution to correct aberrations on a satellite primary mirror surface. The deformable mirror is used in a double-pass configuration with an interferometer and a mirror segment on the Naval Postgraduate School segmented mirror telescope to test the ability of a deformable mirror to correct inherent surface figure aberrations of an imaging satellite mirror surface. Manual, iterative feedback, and constrained optimization control methods are used to control the deformable mirror to correct surface figure error on the segmented mirror telescope mirror segments to achieve 55% root mean square improvement for the primary mirror segment surface. Full text

**Keywords:** segmented mirror telescope, adaptive optics, deformable mirror, surface figure error

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# MASTER OF SCIENCE IN COMPUTER SCIENCE

**SOURCE FINGERPRINTING IN ADOBE PDF FILES**
**John Donaldson, Civilian, Department of the Navy**
**Master of Science in Computer Science**
**Advisor: Chris Eagle, Department of Computer Science**
**Second Reader: George Dinolt, Department of Computer Science**

Adobe Portable Document Format (PDF) documents are increasingly used as a vector for targeted attacks. Although there exist a number of tools and methodologies for performing content-level analysis to identify unwanted or malicious behavior or characteristics in these documents, these forms of analysis are hampered by increasingly complex obfuscation techniques and usually require execution of potentially malicious code. This thesis proposes a static analysis method that uses structural elements of PDF documents to identify the tools used to generate them. This method may be used to attribute malicious PDFs to particular toolkits. Full text

**Keywords:** static analysis, Adobe, Portable Document Format, PDF, structural analysis, n-gram analysis, document authorship

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# MASTER OF SCIENCE IN CONTRACT MANAGEMENT

## PROBLEMS WITH AWARD-FEE CONTRACTS IN THE DEPARTMENT OF DEFENSE

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**Tony Robertson, Civilian, Department of the Army**
**Dennis Jolliffe, Civilian, Department of the Army**
**Master of Science in Contract Management**
**Advisor: Matthew Jacobs, Graduate School of Business and Public Policy**
**Co-Advisor: Mike Coburn, Director, MICC Fort Rucker, Alabama**

Award-fee arrangements are a valuable contractual approach for the Department of Defense (DoD) when used properly. Award-fee contracts provide incentives to motivate contractor performance in areas critical to program success that are susceptible to judgmental and qualitative measurement and evaluation. The award-fee process allows the DoD to evaluate a contractor's performance, appropriately recognize accomplishments, and provide a reward. The DoD has the flexibility to develop criteria to evaluate both the performance levels and the conditions under which these levels were achieved during the evaluation period. An award-fee arrangement rewards satisfactory or better performance, provides incentives for the contractor to improve performance, and records the assessment of the contractor's performance. While it is DoD policy to use objective criteria whenever possible to measure performance, there are times when only an incentive based on subjective criteria will achieve the desired objectives. However, subjective evaluations may raise concerns that some award fees are paid but not earned. A lack of DoD acquisition workforce training and experience in utilizing award-fee type contracts coupled with subjective evaluations may contribute toward award fees being paid even when the contractor does not achieve the desired objectives for which incentives were offered. Full text

**Keywords:** award-fee contracts, incentive contracts, DoD contracting

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# MASTER OF SCIENCE IN DEFENSE ANALYSIS

### CALMING THE CHURN: RESOLVING THE DILEMMA OF ROTATIONAL WARFARE IN COUNTERINSURGENCY

**Andrew Aswell, Major, United States Army**
**Master of Science in Defense Analysis**
**Advisor: Anna Simons, Department of Defense Analysis**
**Second Reader: Brian Greenshields, Department of Defense Analysis**

The U.S. military currently utilizes a unit-rotational model to provide forces to geographic combatant commanders waging ground wars. This model has its roots in policy and historical perception, not strategy and tactics. When applied to counterinsurgency, weaknesses that undermine long-term effectiveness become apparent. Through an examination of the basis of the current model, its performance in the recent conflicts in Iraq and Afghanistan, and current and historical case studies, this thesis explores alternatives to the rotational model. This thesis finds that a hybrid model that combines the advantages of the current system with historical and current examples from other nations could increase the effectiveness of units in long-term counterinsurgency campaigns. Full text

**Keywords:** continuity, counterinsurgency, Operation Iraqi Freedom, Operation Enduring Freedom, Malayan Emergency, Dhofar, Kashmir

### WHY SO CONVENTIONAL? AMERICA'S PROPENSITY TO WAGE TRADITIONAL LARGE-SCALE WARFARE

**Matthew Balint, Major, United States Army**
**Master of Science in Defense Analysis**
**Advisor: Heather Gregg, Department of Defense Analysis**
**Second Reader: Robert O'Connell, Department of Defense Analysis**

The United States has repeatedly engaged in irregular warfare—including counterinsurgency, foreign internal defense, and unconventional warfare—throughout its history. However, despite its familiarity with irregular warfare, there is reluctance on the part of U.S. presidents, military leaders, and even the general public to engage in this form of war. This thesis asks why the U.S. security mindset is focused on traditional large-scale warfare, even when the threats the United States has faced, and will continue to face, are mostly irregular. To answer this question, this thesis uses Arregun-Tofts strategic interaction model, which looks at why same-approach and opposite-approach strategies (direct and indirect) favor strong and weak actors differently, to analyze the U.S. Revolutionary War, when the United States was the weak actor, and the Vietnam conflict, when the United States was the strong actor, and to assess whether the United States implemented the correct forms of strategic interaction in each conflict. This thesis finds that the United States' propensity for traditional large-scale warfare is based upon its desire to achieve victory in the shortest amount of time. Furthermore, a preponderance of resources and instruments of war has also impelled the United States to employ overwhelming mass, maneuver, and firepower, instead of irregular warfare with a protracted timeline strategy. Full text

**Keywords:** irregular warfare, traditional warfare, counterinsurgency, COIN, conventional warfare, asymmetric warfare strategy

## THE ENEMY BELOW: PREPARING GROUND FORCES FOR SUBTERRANEAN WARFARE

**Joshua Bowes, Major, United States Army**
**Mark Newdigate, Major, United States Army**
**Pedro Rosario, Major, United States Army**
**Davis Tindoll, Major, United States Army**
**Master of Science in Defense Analysis**
**Advisor: Leo Blanken, Department of Defense Analysis**
**Second Reader: John Arquilla, Department of Defense Analysis**

This capstone project analyses subterranean threats in the contemporary operational environment. It identifies the doctrinal gap in the U.S. military regarding operations within tunnels, urban and natural cavities, and other underground facilities, and outlines the changes necessary to prepare ground forces to operate in these complex environments. This paper reviews historical cases spanning over half a millennium, proposes a new typological classification system, and investigates the subterranean environment in terms of the United States Army doctrine, organization, training, matriel, leadership and education, personnel, and facilities process. Additionally, it provides analysis geared toward countering subterranean threats through indirect means, including incendiary weapons, cyber-based attacks, and military information support operations. The capstone finds that (1) current U.S. military doctrine does not properly prepare units for operations in subterranean environments; (2) future conflicts will require general purpose forces to deal with subterranean threats; and (3) understanding the use of indirect approaches is critical in the conduct of subterranean operations. This research leads to the recommendation that the Training and Doctrine Command Intelligence Support Activity recognize subterranean as an operational environment. Additionally, this capstone provides guidance to commanders and staff to assist in pre-mission training even before the doctrinal gap is filled. Full text

**Keywords:** subterranean warfare, subterranean typology, deep underground facilities, rudimentary and sophisticated tunnels, subterranean targeting factors, Siege of Constantinople, Siege of Petersburg, Messines Ridge, Battle of Okinawa, Cu Chi Tunnels of Vietnam

## THE OPERATIONAL ROLE OF ARMY NATIONAL GUARD SPECIAL FORCES: OPTIMIZING AN UNDERUTILIZED ASSET

**Matthew Bray, Major, Army National Guard**
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**Second Reader: Michael Jones, Naval War College**

The demands of the global war on terror have redefined the roles and requirements for Army National Guard Special Forces (ARNG SF). A part-time force, ARNG SF nonetheless participates in the full spectrum of ongoing operations, making them an essential operational component of U.S. Army Special Forces. Despite previous operational contributions and future demands for employment, ARNG SF is underutilized, and deficiencies consequently exist with readiness. Analysis of current policies, doctrine, guidance and directives reveal critical gaps in strategic guidance and force generation processes, contributing to these problems. The ability for ARNG SF to contribute strategic depth to United States Special Operations Command (USSOCOM) and United States Army Special Operations Command (USASOC) can provide balanced and integrated special operations capabilities to the nation. But there is a need for strategic guidance and changes in the processes under which ARNG SF are utilized. This will reduce strains on the active component forces and their families. This thesis examines methods for enhancing ARNG SFs contribution to USSOCOM and USASOC operational forces, thereby maximizing capabilities in support of national objectives. Full text

**Keywords:** Army National Guard Special Forces, ARNG SF, operational reserve, dual role, mobilization, Special Operations Force Generation, SOFORGEN, total force, global SOF network campaign plan, GSN

CAMPLAN, Special Operations command, SOCOM 2020, Army Special Operations Forces, ARSOF 2022, train-mobilize-deploy

## DRONING ON: AMERICAN STRATEGIC MYOPIA TOWARD UNMANNED AERIAL SYSTEMS

**Carlos Cabello, Chief Warrant Officer 4, United States Army**
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Throughout the past decade of wars, the United States has deployed unmanned aerial systems, commonly referred to as drones, from Africa to Asia collecting intelligence and targeting adversaries. The nation now stands at a crossroads, seeking to develop future American drone policy against an evolving threat while at the same time shaping global norms. The past decade of American drone use focused on short-term benefits, intelligence collection and lethal targeting, rather than on the long-term consequences of technology diffusion, or ethical and legal frameworks. Myopic drone strategies threaten to establish a global precedent that could undermine the stability of international relations, as state and non-state actors (SANSA) have begun to build, arm, and operate lethal unmanned systems at an alarming rate. Unmanned technology development and usage is outpacing international norms, regulations, and policies. These systems will usher in an era of unrestricted drone usage unless international regulations and standards are developed. This thesis examines whether American drone strategy is myopic and whether it is creating a dangerous international precedent. A qualitative analysis will identify the short-term benefits and long-term consequences of U.S. drone strategy, focusing on unmanned technology diffusion, ethical justifications, and legal frameworks. Examining American drone strategy can help explain why a myopic policy may be beneficial in the short-term, yet may increase threats to national interests in the long term. The thesis concludes with an assessment of whether strategic myopia has already set a dangerous international precedent, which SANSA will use to justify their future drone programs. Full text

**Keywords:** drones, remote, unmanned, myopia, diffusion, ethical, legal

## THE SUCCESS FACTORS TO DEFEAT INSURGENCY IN THE PHILIPPINES AND ITS APPLICABILITY IN THE COLOMBIAN CONTEXT

**Luis Cortes, Lieutenant Colonel, Colombian Army**
**Erwin Comendador, Major, Philippine Army**
**Master of Science in Defense Analysis**
**Advisor: T. Camber Warren, Department of Defense Analysis**
**Second Reader: Heather Gregg, Department of Defense Analysis**

The Colombian government has been coping with insurgent groups for almost 50 years. The evolution of the Colombian internal conflict reflects the states ongoing desire to defeat the insurgency militarily to bring the situation back to peace. The state's purpose in doing so is to boost the country to become a more robust and stable nation. Although many peace processes have been undertaken (including one in October 2012 sponsored by the international community in Oslo), the efforts have been unsuccessful. Terrorist groups, especially the Revolutionary Armed Forces of Colombia (FARC) and the National Liberation Army (ELN), remain unwilling to cooperate and have strengthened their capabilities, armaments and human resources, and increased their capacity and span of control. The study and comparison of similar cases for conflict resolution and peace achievement is a viable option to gain insight into and develop new solutions to cope with the Colombian internal conflict. The Philippines successful peace process in the province of Bohol deserves special consideration for parallel application to address the Colombian conflict. The peace process in Bohol particularly stands out because it is a unique instance of turning around an insurgency, and it is currently being used

as a model to counter other insurgent groups in the Philippines. Moreover, it could be applied to Colombia, given the similarity of the two states and the nature of their internal conflicts. This thesis will examine the success factors used in the province of Bohol to end the conflict and its applicability to the Colombian internal conflict. Full text

**Keywords:** Colombian internal conflict, Revolutionary Armed Forces of Colombia, FARC, National Liberation Army, ELN, Peace Process in Bohol (Philippines), holistic approach, success factors to reach peace, Security Plan Oplan Bayanihan, Democratic Security Policy for Prosperity, CPP/NPA/NDF Insurgent Groups, information operations, social awareness and peoples commitment to peace

## CIVIL SOCIETY AS A GAME CHANGER: A COMPARATIVE STUDY OF POLITICAL TRANSITIONS IN EASTERN EUROPE AND THE MIDDLE EAST

*This paper has been recognized as outstanding by its department*

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This study examines the role that civil society has played in bringing about political change in the totalitarian regimes of the former Communist Bloc in Eastern Europe and the authoritarian states challenged by the Arab Spring. Specifically, this thesis creates a list of criteria for evaluating the presence of a good (meaning vibrant and liberal) or bad (meaning anti-democratic and non-liberal) civil society and uses these criteria to predict the long-term prospects of democratization in the four countries studied: Poland, Russia, Tunisia, and Egypt. The study finds that the presence of a good civil society or the majority of its criteria enhances the prospects of democratization in countries undergoing political transitions, while the lack of all or most of its criteria significantly decreases the likelihood that a democratic system will take root. Full text

**Keywords:** civil society, democratization, political transformation, Arab Spring, Middle East, Eastern Europe, Tunisia, Egypt, Poland, Russia

## UNITED STATES SPECIAL OPERATIONS COMMAND PROFESSIONAL MILITARY EDUCATION

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The United States Special Operations Command (USSOCOM) does not have an intermediate-level professional military education (PME) program for its officers. Current service-provided PME programs are not adequately meeting the educational goals for officers as required by USSOCOM. Through the Joint Special Operations University, SOCOM could establish its own PME program for officers of all services who are assigned to USSOCOM. Through the review of formal documents and interviews with senior officers in USSOCOM, an education gap was identified and analyzed. Three courses of action are presented as to how USSOCOM can overcome this education gap and meet Admiral William H. McRaven's intent to have the best-educated force in the United States military. Full text

**Keywords:** Professional Military Education, PME, Special Operations, knowledge, skills, attributes, United States Special Operations Command, USSOCOM, Joint Special Operations University, Joint Professional Military Education, intermediate level education, Force Management and Development Division, gap analysis, formal documents, Command and Staff College, Admiral William H. McRaven, senior officers

## THE EVOLUTION OF THE CIVIL AFFAIRS FORCE

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Beginning with the U.S.–Mexican War in 1846 and continuing to the most recent combat operations in Afghanistan and Iraq, U.S. military history has repeatedly shown the importance of civil affairs operations: that is, shaping the civil component of the operational environment. During this span, civil affairs operations have evolved from operations conducted only by combat units to those conducted by a dedicated Civil Affairs force. The demand for Civil Affairs has increased significantly since September 11, 2001, and, in response to that demand, the Army has attempted to grow the Civil Affairs force in both the active and reserve components. The rapid growth in demand for Civil Affairs has led to the creation of a Civil Affairs force composed of one active-duty Civil Affairs special-operations brigade, one active-duty Civil Affairs brigade for conventional forces, and nine reserve civil affairs brigades. The current Civil Affairs force structure is subordinate to three commands: the U.S. Army Special Operations Command, U.S. Forces Command, and the U.S. Army Reserve Command. This thesis analyzes the current Civil Affairs force structure within the active and reserve components by using three metrics: training efficiency, organizational efficiency, and operational efficiency. It addresses the question of whether the current Civil Affairs structure reflects the most efficient design, and if not, what changes are needed to improve efficiency. Full text

**Keywords:** Civil Affairs, force structure, 95th Civil Affairs Brigade (A), 85th Civil Affairs Brigade, U.S. Army Civil Affairs and Psychological Operations Command, unification, unity of effort, operational efficiency, organizational efficiency, training efficiency, network

## SUCCESSFUL SEPARATIONISTS IN A UNITY FAN SOCIETY: AL-HIRAK AL-JANUBI SOCIAL MOVEMENT IN THE REPUBLIC OF YEMEN

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The Southern separatist movement in Yemen represents a major threat to the Republic of Yemen's stability and, consequently, to regional and international security. It started as a rights-based social movement led by the Southern military officers who were forced to retire after the 1994 civil war. Searching for solutions to the embers of unrest under the ashes of grievances against government ignorance and their marginalization, these separatists established a Southern-based social movement called Al-Hirak Al-Janubi. Al-Hirak Al-Janubi has had great political opportunities, mobilizing structures, and great narratives to sell. Al-Houthis' Northern problem, the 2006 presidential election, and the Arab Spring opened political opportunities for Al-Hirak Al-Janubi. Al-Hirak's charismatic leadership, financial resources, and activists' recruitment bases provided great mobilizing structures, and Yemeni government corruption, wrong policies, and discrimination against Southerners provided the movement with the cause and supported its narrative. However, Al-Hirak's success will be limited to disrupting Yemen's stability and security. It is not equipped to separate the South from the rest of Yemen but can cause much trouble. Therefore, the Yemeni government, with regional and international support, should act instantly to make an end to Southern grievances by returning stolen lands, restoring Southern dignity, and supporting moderate factions of the movement to accept dialogue. More importantly, the government should purify itself by fighting corruption, improving its public administration, making an

end to discrimination, and providing social services to its entire population regardless of the region, affiliation, gender, or status. Full text

**Keywords:** Al-Hirak Al-Janubi, Al-Houthis, Republic of Yemen, Ali Salem Al-Beedh, Arab Spring, General People's Congress, Yemeni Government, 2006 Presidential Election, reunification, social movement theory, separation, Separationists, unity, Yemen Socialist Party, security, stability

## A RESOURCE NETWORK STRATEGY FOR AFGHANISTAN

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With NATO planning to complete the withdrawal of most troops from Afghanistan by the end of 2014, both Afghanistan and the Coalition need to define a positive long-term vision for the country. In this thesis, I evaluate a proposed approach to achieving such a vision—something I call the Resource Network Strategy. In this approach, Afghan and Coalition efforts to develop the country's considerable natural resource endowment are integrated with the U.S. Special Operations Forces continuing village stability operations in a way that establishes a sustainable long-term counterinsurgency effort that will defeat the enemy at the village level while securing the support of Afghanistan's central government and minimizing the costs to the United States and its allies. Full text

**Keywords:** Afghanistan, Afghan Local Police, ALP, artisanal, counterinsurgency, large-scale, mining, networks, rational peasant, resources, small-scale, strategy, Taliban, USAID, United States Agency for International Development, USGS, United States Geological Survey, USSOF, United States Special Operations Forces, village stability operations, VSO

## PSYOP NEEDS MORE SCIENCE: THE ROOT CAUSE OF THE BRANCHS DIFFICULTIES WITH ASSESSMENT

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The Psychological Operations (PSYOP) branch has the unique responsibility for nesting assessment into every Military Information Support Operation it conducts. This critical element of PSYOP's operational design is capable of demonstrating psychological effects, identifying behavioral changes, eliminating ineffective programs, and facilitating continuous methodological improvement. Unfortunately, the PSYOP community has struggled for decades with providing valid assessments of psychological operations. Recently, numerous sources have admonished the branch for failing to deliver valid or reliable assessments. Drawing from organizational theory, this thesis develops the Dynamic Capability Alignment Model, which supports PSYOP branch's development of an officer with the professional educational foundation to conduct the core task: assess. The model provided a structured/focused question framework for analyzing the branch's officer selection, training, career progression, and operational design in an attempt to identify the root cause for the community's failure to deliver reliable assessments. The analysis identified the absence of a sound scientific foundation as the root cause of PSYOP's inability to conduct assessment. This fundamental problem is exacerbated by inadequate academic selection criteria and the existence of numerous organizational challenges. This thesis

concludes with recommendations for establishment of the appropriate scientific and professional educational foundation for the PSYOP branch to execute its new core task: assess. Full text

**Keywords:** Military Information Support Operations, MISO, Psychological Operations, PSYOP, measures of effectiveness, measures of performance, core task: assess, assessment, core tasks, behavioral psychology, organizational theory

## SPECIAL OPERATIONS AERIAL MOBILITY VEHICLE TRAINING SYLLABUS

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This project extends research initiated by Major Dave Kenney into Special Operations Forces' use of light-sport aircraft to gain an operational advantage over known and potential adversaries. Major Kenney's December 2012 master's thesis concluded that Special Operations air mobility vehicles (SOAMV) enabled a proven doctrine for sustainable circumvention of anti-access and area-denial technologies. This conclusion sparked intense interest across U.S. Special Operations Command (USSOCOM) and created demand for a feasible SOAMV program. This project represents a first step toward establishing a SOAMV program for USSOCOM by researching and developing a safe, effective, and efficient training protocol for training SOAMV fliers. If a full-scale program is not immediately required, building an established protocol will precisely define the cost and time required to build a SOAMV-capable force if needed. This syllabus project blends USSOCOM training standards with existing proven programs (Federal Aviation Administration Regulations) and adds military tactics, techniques, and procedures. Full text

**Keywords:** special operations, air mobility, light sport aircraft, SOF aviation, Air Force special operations command, irregular warfare, unconventional warfare, air mobility vehicle, AMV, air advisors, denied area

## LIBERATION TIGERS OF TAMIL ELAM, AUM SHINRIKYO, AL QAEDA, AND THE SYRIAN CRISIS: NONSTATE ACTORS ACQUIRING WMD

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This thesis analyzes the attempts of three groups (Liberation Tigers of Tamil Elam [LTTE], Aum Shinrikyo, and al Qaeda) to acquire, use, and deploy chemical, biological, radiological, or nuclear weapons. Terrorist groups seeking a weapon of mass destruction (WMD) capability face numerous constraints, such as intent to acquire/manufacture and/or use a WMD, recruiting the essential personnel with expertise in WMDs, obtaining the necessary materials, having access to the necessary facilities, and being able to make the technological leap in creating a delivery system. These constraints have severely limited most terrorist groups from pursuing a WMD capability; however, there are a few groups that made some effort to overcome these constraints, groups like the LTTE, Aum Shinrikyo, and al Qaeda. Each sought to realize this goal of achieving a WMD capability. The current situation in Syria may present an opportunity for terrorist groups to circumvent par-

ticular aspects of the constraints already mentioned, making it easier for them to develop a WMD capability. Full text

**Keywords:** weapons of mass destruction, WMD, chemical, biological, radiological, nuclear terrorism, CBRN, Liberation Tigers of Tamil Elam, LTTE, Aum Shinrikyo, al Qaeda, Syria

## IRREGULAR WARFARE AS A NATIONAL MILITARY STRATEGY APPROACH FOR SMALL STATES

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Today, the Western way of war is mainly based on conventional strategies and organizations, with a sense of a Clausewitzian view of war: achieving victory by defeating the opponent's army. Small states have been copying the larger nations' way of planning for war, with limited analysis as to whether this is the most effective strategy for them. Analyses of large numbers of historical cases show that a conventional approach is a road to defeat for small states when facing larger conventional opponents. Another solution might be to change the national strategy to an irregular one. The intention of this thesis is to illuminate the potential for small states to improve the effect of their military by adopting an irregular strategy. The thesis is based on analyses of the works of recognized military thinkers, as well as three distinct historical cases. Based on the irregular strategy, the authors have described irregular tactics, organizational principles, and enabling technology. Full text

**Keywords:** strategy, irregular warfare, small states

## STRATEGIES FOR COUNTERING TERRORIST SAFE HAVENS

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More than a decade after the attacks on 9/11, U.S. leadership continues to place a high priority on pursuing terrorists and denying them safe havens from which they can recruit, train, and plan operations. In a time of decreasing budgets and growing sentiment avidly against involvement in prolonged wars, the United States must adapt strategies to meet the future threats posed by terrorist safe havens. This thesis offers strategies for countering safe havens. It begins by arguing that safe havens are not just geographic areas, but that they also include a demographic component that allows terrorists a population among which to hide. The thesis then presents four strategies aimed at denying geographic and demographic safe havens: leadership targeting within safe havens, tactical containment, pseudo operations, and surrogate security forces. The thesis draws from four historical case studies to examine these strategies, including the Peruvian government's efforts to combat the Shining Path, French containment of the Casbah in Algeria's war of independence, Rhodesia's Selous Scouts' experience with pseudo operations, and U.S. co-option of the Sons of Iraq in Anbar Province. The thesis finds that no single strategy is sufficient for dealing with geographic and demographic safe havens. Rather, a combination of strategies, properly sequenced, can reduce terrorist safe havens. Furthermore, none

of these strategies works without counterinsurgency forces positively engaging the population, setting the necessary conditions for separating insurgents from their demographic and geographic supports. Full text

**Keywords:** safe havens, counterinsurgency, demographics, Shining Path, Sendero Luminoso, Peru, Algiers, FLN, Rhodesia, Selous Scouts, Anbar, Sons of Iraq, SOI, leadership targeting, decapitation, containment, pseudo operations, co-opting, surrogate security forces, insurgency

## POSITIVE COMMUNICATIONS: THE KEYSTONE OF COUNTERINSURGENCY STRATEGY

*This paper has been recognized as outstanding by its department*

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Over the last decade, the U.S. military has struggled to develop methodologies to assess success in its execution of counterinsurgency operations. By examining Zabul Province, Afghanistan, this study offers a quantitative method to measure the effectiveness of positive communications that counterinsurgents conduct as part of their information strategy to mobilize public support for the incumbent government. We test the hypothesis that positive communications play a significant role in shaping popular attitudes and, when conducted by counterinsurgents, influence the population to support the government and deny safe haven for insurgents. Estimating a variety of regression models, we utilize high-resolution spatio-temporal data to isolate the casual effect of population engagements and radio broadcasts in relation to levels of insurgent violence over time and space. The evidence supports our prediction that positive communications conducted by counterinsurgents reduce insurgent violence. Full text

**Keywords:** counterinsurgency, positive communications, measure of effectiveness, insurgent violence, regression models

## THICKENING THE GLOBAL SOF NETWORK

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Emotional intelligence (EI) refers to the competence to identify and express emotions, understand emotions, assimilate emotions in thought, and regulate both positive and negative emotions in oneself and others. EI is a necessary, but not fully sufficient, quality that Green Berets must possess to establish, nurture, and enhance effective relationships within the joint, interagency, intergovernmental, and multinational arena. As the Special Forces Regiment transitions from intensive participation in operations supporting the Global War on Terrorism to developing the forward-focused Global Special Operations Forces Network, thickening these critical relationships emerges as the foundation of any expected future success. This thesis strives to elucidate the substantial scientific evidence establishing EI as a critical and well-deserving addition to the traditional measures of competence, such as intelligence quotients and general personality. Specifically, the author demonstrates that the skills and abilities associated with EI were deemed most critical by the Office of Strategic Services assessment staff, and that these same skills remain key competencies for accomplishing partner-based

special operations today. The author recommends practical changes to the current assessment and selection of Special Forces personnel, as well as for the training and placement of selected Soldiers. Full text

**Keywords:** emotional intelligence, EI, Special Forces, Global SOF Network, Office of Strategic Services, assessment and selection, relationships

### ENDURING ENGAGEMENT YES, EPISODIC ENGAGEMENT NO: LESSONS FOR SOF FROM MALI

*This paper has been recognized as outstanding by its department*

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This thesis examines Special Operation Forces' (SOF) recent experience in Mali and determines where—or to what extent—it should be considered a failure. In addition to analyzing these encounters, a second aim of this thesis is to make recommendations for how SOF might better build partner capacity and capability in the future. The argument made is that enduring engagement is of enduring value; episodic engagement, on its own, is not. Examples of both types of engagement can be found in United States Special Operations Forces recent interactions with the Malian military. Full text

**Keywords:** enduring engagement, episodic engagement, Company Forces Spéciales, CFS, Echelon Tactique Inter-Armée, ETIA

### U.S. ECONOMIC ASSISTANCE TO COLOMBIA: A MODEL FOR U.S. ECONOMIC ASSISTANCE TO MEXICO?

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Strong, effective, economic assistance programs are a crucial part of U.S. foreign policy. They are a primary instrument for advancing U.S. national interests, enhancing global stability, expanding economic opportunities, and promoting American democratic values. From 2004 through 2010, the United States donated more than $16 billion in economic assistance to countries in the Western Hemisphere. Some ask why the United States spends so much money abroad on humanitarian programs and infrastructure investments in developing states. To address this question, this thesis looks at Colombia and Mexico, both of which are of crucial strategic importance to the United States. Under Plan Colombia (2000–2006), U.S. economic assistance and staunch political will enabled Colombia to improve from 14th (2005) to 57th (2013) on the Failed State Index scale. As a result, Colombia has also emerged as a stronger U.S. partner in the Western Hemisphere. The Colombian experience was historically specific, but lessons can be extracted for Mexico, even though its history and relationship with Washington is very different. In particular, the recent Merida Initiative (Plan Mexico, 2008–present) can benefit immensely from being carefully evaluated in light of the earlier success of Plan Colombia. Full text

**Keywords:** U.S. Economic Policy, foreign aid, economic assistance to Colombia, Plan Colombia, economic assistance to Mexico, Merida Initiative

## THE GOOD, THE BAD, AND THE UGLY: SELECTING AND VETTING INDIGENOUS LEADERS

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Determining who is the right indigenous leader for U.S. forces to work with in a complex environment during irregular and unconventional warfare is a complicated endeavor affected by countless factors. Selecting, vetting, and influencing indigenous leaders in foreign countries has been a key task of U.S. Special Operations Forces since its inception, but, to date, Special Operations Forces often struggles with mastering this, as evidenced by recent experiences in Iraq and Afghanistan. The primary aim of this thesis is to improve this capability. To assist with the future selection and vetting of indigenous leaders, this thesis introduces a leader selection heuristic. It is the authors' contention that to find the right individual requires correctly identifying particular attributes, features, and behaviors in both the individual and the environment. Full text

**Keywords:** non-lethal targeting, human domain, irregular warfare, unconventional warfare, special warfare, indigenous leader selection, indigenous leader vetting, influence, social movement theory, special operations, Hamid Karzai, Ramon Magsaysay, Ahmed Chalabi

## ERRORA-VOIDANCE THEORY: SNIPER EMPLOYMENT FOR MILITARY AND CIVILIAN LAW ENFORCEMENT

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Sniper operations are high risk, high reward missions with unique traits and distinctive capabilities, often resulting in great success or punishing failure. Within nearly all conceptions of sniper operations, there is a perceived difference between civilian and military sniper engagements. This thesis presents an error-avoidance theory for guiding successful sniper operations across both domains. Inside sniper operations, there are two critical errors that need to be avoided. These errors are defined as Type 1 and Type 2 errors. Type 1 errors are those that result in the death of an innocent individual. Type 2 errors occur when the targeted individual escapes the situation and the mission objective is not met, and, thus, the threat or potential threat remains active. Naturally, the goal is to avoid both errors. However, the rules of engagement established for any mission must, by necessity, privilege the avoidance of one error type over the other. The evaluation of three critical variables—operational environment, political and social context, and the stakes or risk in the situation—should prioritize which error to avoid. This thesis thereby establishes a theoretical framework that can be universally employed to establish rules of engagement by all those who use the sniper tactic, for both civilian and military operations. Full text

**Keywords:** sniper, error avoidance, law enforcement, sniper theory, sniper operations

## BALANCING THE TRINITY: U.S. APPROACHES TO MARGINALIZING ISLAMIC MILITANCY IN PAKISTAN

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Pakistan ranks among the top recipients of U.S. foreign aid in the world yet accounts for nearly 20 percent of the terrorist groups identified on the U.S. State Department Bureau of Counterterrorism Foreign Terrorist Organizations list. As a major non-NATO ally and valued U.S. partner in the Global War on Terrorism, Pakistan thus gives the appearance of being ineffective in its efforts to defeat Islamic extremism and militancy. This study aims to discover how the United States can better assist Pakistan to marginalize select militant Islamic groups that threaten regional and international security. Specifically, it investigates three possible strategies for mitigating violent extremism: counterterrorism, counterinsurgency, and foreign aid. These strategies are used to analyze U.S. and Pakistani efforts to marginalize four terrorist groups since 2001: the Haqqani Network, Lashkar-e-Tayyiba, Lashkar-i-Jhangvi, and Tehrik-e-Taliban Pakistan. This study offers suggestions for the United States and Pakistan to counter the effects of select militant Islamic groups through improved counterterrorism, counterinsurgency, and foreign aid strategies. Additionally, this study provides general recommendations for enhancing the U.S.–Pakistan relationship by improving Pakistani security forces' capabilities, disbursement of reliable U.S. foreign aid for economic development, and encouragement of Pakistan's democratization process. Full text

**Keywords:** militant Islamic groups in Pakistan, the Haqqani Network, Lashkar-e-Tayyiba, Lashkar-i-Jhangvi, Tehrik-e-Taliban Pakistan, violent extremism, counterterrorism, counterinsurgency, foreign aid

## MODELS, ANALYSIS, AND RECOMMENDATIONS PERTAINING TO THE RETENTION OF NAVAL SPECIAL WARFARES MID-LEVEL OFFICERS

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Naval Special Warfare (NSW) is facing a substantial deficiency within its midgrade (8–15 years of active duty service) officer ranks. This thesis employs two different models in order to provide recommendations to the NSW Community Managers office for potential changes that might improve retention of these officers. The NSW Community Managers should use findings from the annualized-cost-of-leaving model to improve near-term retention, and they should use recommendations from the analytical hierarchy process for improving long-term retention. Full text

**Keywords:** Naval Special Warfare, NSW, retention, annualized-cost-of-leaving, ACOL, financial, annualized, cost, leaving, analytical hierarchy process, AHP, model, sea air land, SEAL

## THE INTELLIGENCE PROBLEM OF POLICYMAKERS IN COUNTERINSURGENCY: ASKING AND ANSWERING THE RIGHT QUESTIONS

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Despite the volumes of material written on the conduct of counterinsurgency operations, little work has examined what intelligence is required to provide national policymakers with the information they need to make good decisions governing counterinsurgency. This thesis first reviews the problems experienced in Afghanistan with the collection and dissemination of intelligence from ground units to the national policymakers. It then takes a look at intelligence process doctrine encapsulated in service manuals of the U.S. Army and U.S. Marine Corps, as well as joint service intelligence doctrine, and determines that priority intelligence requirements are not being properly articulated to obtain the answers policymakers require. After a review of counterinsurgency doctrine and theories, this thesis proposes three priority intelligence requirements for use in counterinsurgency operations. These three intelligence requirements focus on (1) supporting operations that attack the insurgency's support infrastructure; (2) identifying host-nation government personnel or institutions that are not effectively supporting counterinsurgency policy; and (3) revealing how the insurgency is undermining popular support for the government. This thesis identifies a way to get the answers to those priority intelligence requirements from the ground units to the policymakers in a usable form. Full text

**Keywords:** counterinsurgency; intelligence assessment; assessment; priority intelligence requirement; PIR; essential elements of information; EEI; insurgency; structured analytic techniques; intelligence requirement; legitimacy; corruption; Cuba; Egypt; Iranian Revolution; Baath Party; Iraq; intelligence, surveillance and reconnaissance; ISR; human intelligence; HUMINT; signals intelligence; SIGINT; Afghanistan

## STRIKING AT THE UNDERBELLY: INFLUENCING WOULD-BE TERRORISTS

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Modern states are approaching the issue of terrorism from both kinetic and non-kinetic perspectives; however, the focus of the international community has largely been on terrorist organizations, their leadership and their active and passive members, in whom the terrorist ideology is already deeply ingrained, and thus, they are difficult to turn toward a peaceful path. However, this thesis focuses on would-be terrorists, who may be relatively easier to influence. It identifies the possible causes that lead candidates toward the path of terrorism. According to Kahneman and Tversky's prospect theory, people in the losses frame are more risk acceptant and, therefore, more prone to join terrorists causes. To counter this risk-acceptant behavior, the answer lies not only in identifying possible causes for their placement in the losses frame but also in finding ways to transfer the would-be terrorists to a gains frame, thereby preventing them from joining the terrorist organizations. By adopting this strategy, there will be an indirect influence on the current wave of terrorism in the long term, as well as a benefit in the short term by partially choking the inputs to the terrorist organizations. Full text

**Keywords:** terrorism, deterrence, influence, would-be terrorists, prospect theory, losses and gains frame

## ADAPTIVE REORGANIZATION OF GERMAN SPECIAL OPERATIONS FORCES

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According to official statements, German Special Operations Forces (GER SOF) ensure that Germany has military options to cope with specific situations at a strategic level. The Bundeswehr, and thus GER SOF, must be capable meeting current tasks and expected future developments. This thesis evaluates the demands on GER SOF by conducting a defense mission analysis. The results are compared with the current GER SOF force structure and capabilities to determine whether sufficient forces are available to meet current requirements. Based on the findings, this thesis provides recommendations to close gaps between demands and current limitations of GER SOF. It further proposes an optimized organizational structure for GER SOF by using Mintzberg's configurational theory to achieve greater internal coherence, and thus, greater effectiveness for current and future missions. Full text

**Keywords:** Germany, German, special operations, Special Operations Forces, SOF, GER SOF, strategic assets, Kommando Spezialkrfte, Kampfschwimmer, German Defence White Papers 2006, Defence Policy Guidelines 2011, organizational design, configurational theory, Mintzberg

## THE INFORMATION BARBER POLE: INTEGRATING WHITE INFORMATION AND RED INTELLIGENCE IN EMERGING CONFLICTS

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Militaries operate increasingly in social terrain and must focus on civilian populations as much they do the belligerents that take refuge among them. Current intelligence and planning doctrine fails to meet the needs of the emerging information environments. Secret intelligence information and open source information must find a means of merging to generate a holistic view of the environment. The failure of the existing system leads to shortcomings in strategy development and operational design, which in turn yields imprecise applications of military power. To overcome this gap in structure and doctrine, this thesis explores a new methodology that merges information and intelligence where appropriate and develops a common understanding across levels of command. The Barber Pole process, as it is termed here, maximizes the use of existing structures and capitalizes on resident professional military skills. The Barber Pole is a three-step process that flattens intelligence and information systems for the purposes of ensuring a common and shared understanding of the operating environment. These phases include the collection of information and provision of command guidance, the coordination and interpretation of collected data, and, finally, the production of plans tailored to the target population. Full text

**Keywords:** information and intelligence collection, social terrain, human doman, Barber Pole, special operations

## FAILURE AND SUCCESS OF JIHADI INFORMATION OPERATIONS ON THE INTERNET

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**Advisor: Glenn Robinson, Department of Defense Analysis**
**Second Reader: T. Camber Warren, Department of Defense Analysis**

Obscure entities, individuals, and organizations engaged in jihad have made the Internet their most powerful tool for conducting information operations. Internet outlets, especially social networking sites, provide jihadis with access to the whole world. At the same time, the current Internet environment allows sustainable research about the uses of these resources for the cause of jihad and, simultaneously, provides new opportunities to counterterrorist agencies. This thesis proposes an artisanal approach to analyze jihadism on the Internet. Specifically, by identifying prominent jihadi leaders' recommendations on the spread of the call to jihad by fellow jihadis, we set up assumptions on what potentially makes jihadi information operations on social networking sites successful. Sets of data publicly available on the Internet and within the most popular social networking sites are identified and framed in line with the jihadi leadership recommendations. A case study and related data are gathered and analyzed to test these assumptions. The results of the analysis may enable researchers to speed data collection by identifying only potentially successful jihadi presences on the Web, and allow counterterrorist bodies to target jihadi Web spaces efficiently. The thesis also provides a background on jihadi approaches to public relations, an empirical analysis of terrorists' challenges and counterterrorists' opportunities on the Internet, a case study and a methodology for analyzing jihadism on the most visited social networking sites. Full text

**Keywords:** jihadi information operations, social networking sites, intelligence, online jihad, web-based jihadism, Internet control, intelligence, counterterrorism, Albanian language

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# MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

## DIRECT TORQUE CONTROL OF A THREE-PHASE VOLTAGE SOURCE INVERTER-FED INDUCTION MACHINE

**Darin Andrews, Lieutenant, United States Navy**
**Master of Science in Electrical Engineering**
**Advisor: Alexander Julian, Department of Electrical and Computer Engineering**
**Second Reader: Roberto Cristi, Department of Electrical and Computer Engineering**

The scope of this thesis involves various techniques to control the torque of a voltage source inverter-fed induction motor. The three methods investigated here are voltage by frequency, known as scalar control; field-oriented control with and without space vector modulation; and direct torque control. Although all three techniques have been proven effective, each technique possesses its own advantages and disadvantages. In today's engineering world, time and money are saved by utilizing software developed to accurately model a physical system and to compare with hardware previously implemented in a lab. Comparisons can be made to determine how each of these torque control methods perform under static and dynamic modes of operation. The U.S. military can benefit from this study by modifying or adding onto the software models developed here with little cost and use these models to do trade studies without the cost of lab demonstrations. Full text

**Keywords:** voltage source inverter-fed, VSI-fed, voltage-by-frequency, V/f, field oriented control, FOC, direct torque control, DTC, space vector modulation, SVM

## FAULT-TOLERANT SEQUENCER USING FPGA-BASED LOGIC DESIGNS FOR SPACE APPLICATIONS

**Jason Brandt, Lieutenant Commander, United States Navy**
**Master of Science in Electrical Engineering**
**Advisor: Herschel Loomis, Department of Electrical and Computer Engineering**
**Co-Advisor: James Newman, Space Systems Academic Group**

The design of a device that controls the sequence and timing of deployment of CubeSats on the Naval Postgraduate School's CubeSat Launcher (NPSCuL) is detailed in this thesis. This design is intended to be implemented on a field-programmable gate array (FPGA) installed into the NPSCuL. This configuration allows flexibility in reprogramming the launch sequence and adding additional functionality in future designs. Operating an FPGA on orbit presents unique challenges due to the radiation environment. Radiation from space cannot be shielded efficiently, so devices must be tolerant of the expected effects. The most common effect, the single-event upset, can have detrimental effects on operating electronics, causing undesired changes to data. To combat this problem, fault-tolerant techniques, such as triple-modular redundancy (TMR), are explored. In these methods, multiple redundant copies of the design are operated simultaneously, and the outputs are voted on by special circuits to eliminate errors. Comparisons between manual and software generated TMR methods are tested, and the design is implemented on test hardware for further verification. Finally,

future research and testing is discussed to continue to ready the design for employment of the sequencer on an actual space mission. Full text

**Keywords:** single-event effect (SEE), single-event upset (SEU), multiple-bit upset (MBU), field programmable gate array (FPGA), fault tolerance, triple modular redundancy (TMR), quadruple force decide redundancy (QFDR), quadded logic, CubeSat, satellite, Actel, Microsemi, ProASIC3, Xilinx, Virtex, Synplify

## EVALUATION OF OBJECT DETECTION ALGORITHMS FOR SHIP DETECTION IN THE VISIBLE SPECTRUM

*This paper has been recognized as outstanding by its department*

**David Camp, Lieutenant, United States Navy**
**Master of Science in Electrical Engineering**
**Advisor: Douglas Fouts, Department of Electrical and Computer Engineering**
**Co-Advisor: Mathias Kolsch, Department of Computer Science**

The research described here examined computer vision algorithms for suitability to aid or replace the current methods of ship detection and tracking from a photonics mast. Evaluation was conducted on three object detection methods: a bag of words (BOW) robust multi-class classification method; a histogram of oriented gradient (HOG) method, originally used for pedestrian tracking; and a deformable parts model (DPM) that was originally designed for pose recognition and has been successful in multi-class classification. A fourth method that combines the HOG and BOW was created and successfully reduced false positive detections while maintaining a high recall rate. The object detection methods were evaluated through a search theory model to frame evaluation for operational ship detection. Each object detection method was optimized following a design of experiments approach utilizing a cluster computer. The BOW method had the highest recall for ships 25 pixels and smaller, while the HOG method was the fastest of all methods when implemented on a graphical processing unit. The DPM method had the highest average recall for ships greater than 25 pixels but the lowest recall for smaller ships. Finally, the hybrid HOG and BOW method had the highest mean recall and lowest mean false positive rate over all ship sizes. Full text

**Keywords:** ship detection, search theory, computer vision, cluster computer, graphical processor unit, GPU, parallel computing, design of experiments, object detection

## POWER TRANSFER EFFICIENCY OF MUTUALLY COUPLED COILS IN AN ALUMINUM AUV HULL

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**Master of Science in Electrical Engineering**
**Advisor: David Jenn, Department of Electrical and Computer Engineering**
**Co-Advisor: Julian Alexander, Department of Electrical and Computer Engineering**

To charge the U.S. Navy's Remote Environmental Measuring Units (REMUS) autonomous undersea vehicle (AUV) in situ requires the REMUS to mate with a docking station. There are two problems with this docking station. The docking system requires the REMUS to make electrical contact with the dock, which can lead to electrical shorting in an undersea environment. The dock is also designed to fit a single type of AUV. AUVs of different sizes require a new docking system. A different means of power transfer is required that can be used in a universal docking station. An inductive power transfer (IPT) system can be used in a universal docking station. In this report, we calculated the power transfer efficiency of an IPT system operating at 100 kHz using circular coils. These calculated results were then compared to three sets of measured efficiency data: an IPT system without ferrite tiles, an IPT system with the receiving coil attached to ferrite tiles, and an IPT system with the receiving coil/ferrite tile combination placed inside an aluminum AUV hull. Efficiency was poor—

less than 10 percent—with an air gap of 55 mm, when the receiving coil was placed inside the aluminum hull. Full text

**Keywords:** wireless power transfer, inductive power transfer, mutually coupled coils, autonomous undersea vehicle, AUV, power transfer efficiency, quality Factor (Q), coupling coefficient (k), two coil system

## TRAFFIC PATTERN DETECTION USING THE HOUGH TRANSFORMATION FOR ANOMALY DETECTION TO IMPROVE MARITIME DOMAIN AWARENESS

*This paper has been recognized as outstanding by its department*

**Ashley McAbee, Lieutenant, United States Navy**
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**Co-Advisor: Murali Tummala, Department of Electrical and Computer Engineering**
**Second Reader: David Garren, Department of Electrical and Computer Engineering**

Techniques for anomaly detection in the maritime domain by extracting traffic patterns from ship position data to generate atlases of expected ocean travel are developed in this thesis. An archive of historical data is used to develop a traffic density grid. The Hough transformation is used to extract linear patterns of elevated density from the traffic density grid, which can be considered the highways of the oceans. These highways collectively create an atlas that is used to define geographical regions of expected ship locations. Ship position reports are compared to the atlas of highways to flag as anomalous any ship that is not operating on an expected highway. The atlas generation techniques are demonstrated using automated information system (AIS) ship position data to detect highways in both open-ocean and coastal areas. Additionally, the atlas generation techniques are used to explore variability in ship traffic as a result of extreme weather and seasonal variation. Finally, anomaly detection is demonstrated by comparing AIS data from 2013 to the highways detected in the archive of data from 2012. The development of an automatic atlas generation technique that can be used to develop a definition of normal maritime behavior is the significant result of this thesis. Full text

**Keywords:** maritime domain awareness, Hough transformation, anomaly detection, automated information system, AIS, pattern extraction

## SOFTWARE-DEFINED RADIO GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS TRANSMITTER DEVELOPMENT FOR HETEROGENEOUS NETWORK VULNERABILITY TESTING

**Carson McAbee, Lieutenant, United States Navy**
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**Advisor: Murali Tummala, Department of Electrical and Computer Engineering**
**Co-Advisor: John McEachen, Department of Electrical and Computer Engineering**

The conversion from homogeneous global system for mobile communications (GSM) networks to heterogeneous GSM/universal mobile telecommunications system (UMTS) networks is rapidly expanding. Previous research identified vulnerabilities in the GSM network that were fixed in the UMTS standard; however, the mobile device must successfully access the UMTS network to take advantage of security improvements. Therefore, a possible vulnerability not addressed in either the GSM or UMTS standards is the potential for a malicious entity to prevent a mobile device from handing over from a GSM to UMTS network, because the GSM network maintains the stand-alone dedicated control channel (SDCCH) uplink time slots. The process of testing this vulnerability requires the development of a device that monitors a GSM base transceiver station, identifies when a handover to UMTS message is sent, tracks the time slots of the SDCCH uplink, and transmits a GSM handover-failure message. In this thesis, we present an open-source coding scheme that utilizes parts of the OpenBTS source code to transmit a GSM handover-failure message using the universal

software radio peripheral. The method is validated through the collection of the GSM transmitter messages by Airprobe's GSM-receiver software. Full text

**Keywords:** global system for mobile communications, GSM, universal mobile telecommunications system, UMTS, universal software radio peripheral, USRP, Airprobe, OpenBTS

## INTEGRATION AND CONTROL OF A BATTERY BALANCING SYSTEM

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**Master of Science in Electrical Engineering**
**Advisor: Alexander Julian, Department of Electrical and Computer Engineering**
**Second Reader: Giovanna Oriti, Department of Electrical and Computer Engineering**

The primary focus of this research was the integration of series-loaded resonant (SLR) converters into a field-programmable gate array controlled power converter for use in balancing a series-connected battery bank. As the limits of the power grid are continually extended, the market demand for alternate power sources and energy storage systems will continue to grow. The goal of this research was to build and integrate a bank of SLR converters for use in balancing a series-connected battery bank that is part of a broader system used for power storage and conversion. Voltage and temperature sensors were used to monitor individual cell state-of-charge and rate-of-charge and discharge. Voltage-to-frequency conversion was used to read sensor parameters. A battery balancing algorithm was designed, integrated and demonstrated with experimental results. Full text

**Keywords:** power storage, series loaded resonant converter, SLR converter, voltage calibration, temperature sensing, battery balancing, field programmable gate array, FPGA

## TACTICAL NETWORK LOAD BALANCING IN MULTI-GATEWAY WIRELESS SENSOR NETWORKS

**Kevin White, Lieutenant, United States Navy**
**Master of Science in Electrical Engineering**
**Advisor: Preetha Thulasiraman, Department of Electrical and Computer Engineering**
**Second Reader: Rachel Goshorn, Department of Electrical and Computer Engineering**

A tactical wireless sensor network (WSN) is a distributed network that facilitates wireless information gathering within a region of interest. For this reason, WSNs are finding increased use by the Department of Defense. A challenge in the deployment of WSNs is the limited battery power of each sensor node. This has a significant impact on the service life of the network. In order to improve the lifespan of the network, load balancing techniques using efficient routing mechanisms must be employed such that traffic is distributed between sensor nodes and gateway(s). In this thesis, we study load balancing from a cross-layer point of view, specifically considering energy efficiency. We investigate the impact of deploying single and multiple gateways on the following established energy aware load balancing routing techniques: direct routing, minimum transmission energy, low energy adaptive cluster head routing, and zone clustering. Based on the node die out statistics observed with these protocols, we develop a novel, energy efficient zone clustering algorithm called EZone. Via extensive simulations using MATLAB, we analyze the effectiveness of these algorithms on network performance for single and multiple gateway scenarios and show that the EZone algorithm maximizes network lifetime and service area coverage. Full text

**Keywords:** wireless sensor network, load balancing, networking, WSN, mobile ad hoc network, ground sensor network, microsensor, Dijkstra, cluster routing, zone routing, data aggregation, single gateway, multi-gateway

## INTERFERENCE AWARE ROUTING USING SPATIAL REUSE IN WIRELESS SENSOR NETWORKS

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A wireless sensor network (WSN) is composed of sensor nodes designed to collect and transmit data efficiently. For this reason, WSNs are relied upon by the Department of Defense for deployment in remote and hostile areas. The performance of a WSN is degraded by the amount of interference experienced by nodes during simultaneous transmissions. Transmitting in the presence of interference can affect the lifetime of sensor nodes by requiring multiple re-transmissions of data. In this thesis, we propose a routing algorithm that uses spatial time-division multiple access (STDMA) to schedule simultaneous transmissions such that interference is mitigated and transmission time slots are reused appropriately. We integrate STDMA with a physical interference model that facilitates the calculation of interference metrics based on signal-to-interference ratio. Using the interference metrics as link costs, we implement Dijkstra's algorithm to determine the least interference path from a sensor node to the gateway. Via simulations using MATLAB and QualNet, we show that this approach to interference mitigation helps network performance by decreasing end-to-end delay. We develop this algorithm as a proof-of-concept to show that, despite the computational complexity associated with interference based scheduling, STDMA can have a real impact on network design and performance. Full text

**Keywords:** WSN, wireless sensor network, physical interference, interference, time-division multiple access TDMA, spatial time-division multiple access, STDMA, routing, Dijkstra, routing protocol, MAC, medium access layer, physical layer, network layer

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# MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

## 3-D ACOUSTIC SCATTERING FROM 2-D ROUGH SURFACES USING A PARABOLIC EQUATION MODEL

**Ahmed Helmy, Lieutenant, Egyptian Naval Forces**
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**Second Reader: Daphne Kapolka, Department of Physics**

Rough surface scattering plays a crucial role in the statistics of acoustic propagation signals, especially at mid-frequencies and higher (e.g., acoustic communications systems). For many years, the effects of rough surface scattering were computed using simple models that were applied in two dimensions (2-D) only. A prescribed method of computing 2-D rough surface scattering directly in a parabolic equation model based on the Split-Step Fourier algorithm was introduced by Tappert and Nghiem-Phu in the mid-1980s. This method has been successfully implemented in various 2-D parabolic equation models, including the Monterey Miami Parabolic Equation model. However, some scientific research of more formal scattering predictions have suggested that out-of-plane, three dimensional (3-D) scattering may lead to significant disparities in the scattered field statistics. Introducing a hybrid implementation for the scattering effect in the field transformation equations using a tri-diagonal solution with the Pad approximant to obtain a system of equations for azimuthal corrections will support predictions of the effect of surface scattering on 3-D propagation, which is critical in evaluating the variability in underwater acoustic propagation. Results of the 3-D scattering calculations obtained are compared with the output of basic 2-D interface perturbations utilizing the standard 2-D approach. Full text

**Keywords:** acoustic propagation, acoustic scattering, sea surface perturbations, split-step Fourier algorithm, finite difference algorithm

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# MASTER OF SCIENCE IN INFORMATION OPERATIONS

## POSITIVE COMMUNICATIONS: THE KEYSTONE OF COUNTERINSURGENCY STRATEGY

*This paper has been recognized as outstanding by its department*

**Truc Pham, Major, United States Army**
**Michael Sieber, Major, United States Army**
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**Advisor: T. Camber Warren, Department of Defense Analysis**
**Second Reader: Alejandro Hernandez, Department of Systems Engineering**
**Second Reader: Kristen Tsolis, Department of Defense Analysis**

Over the last decade, the U.S. military has struggled to develop methodologies to assess success in its execution of counterinsurgency operations. By examining Zabul province, Afghanistan, this study offers a quantitative method to measure the effectiveness of positive communications that counterinsurgents conduct as part of their information strategy to mobilize public support for the incumbent government. We test the hypothesis that positive communications play a significant role in shaping popular attitudes and, when conducted by counterinsurgents, influence the population to support the government and deny safe haven for insurgents. Estimating a variety of regression models, we utilize high-resolution spatio-temporal data to isolate the casual effect of population engagements and radio broadcasts in relation to levels of insurgent violence over time and space. The evidence supports our prediction that positive communications conducted by counterinsurgents reduce insurgent violence. Full text

**Keywords:** counterinsurgency, positive communications, measure of effectiveness, insurgent violence, regression models

## NORWEGIAN CYBER DEFENSE

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This thesis postulates the need for a more proactive approach to cyber defense in Norway and offers recommendations about how Norway can be better prepared to counter cyber threats. It finds that Norway's strategic infrastructure is vulnerable to cyber attacks and that Norway has no coherent strategy for meeting this challenge. The thesis argues that an effective cyber defense requires a wide range of offensive and defensive measures as well as a central authority for command and control. Norway must increasingly be perceived as a serious and tough player in cyberspace; this requires proactive thinking and offensive capabilities. An important first step would be to make the Ministry of Defense responsible for the nation's cyber defense. Full text

**Keywords:** cyberspace, cyber warfare, cyber strategy, Chinese cyber warfare, Norwegian cyber defense policy, Norwegian Armed Forces

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# MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

## AN INVESTIGATION INTO THE USE OF 3D SCANNING AND PRINTING TECHNOLOGIES IN THE NAVY COLLABORATIVE PRODUCT LIFECYCLE MANAGEMENT

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**Co-Advisor: David Ford, Graduate School of Business and Public Policy**

The Navy Collaborative Product Lifecycle Management (CPLM) is notional for the construction of scenarios for this thesis. Theoretically, CPLM works with suppliers to design, manufacture, and distribute parts and equipment required for routine operations. However, there are some issues with this, including the length of time required for designing parts and supply chain interruption, which means that there is a need to improve the process. The option for improvement explored in this research is the use of three-dimensional (3D) scanning (3DS) and printing (3DP) technologies, which respectively offer the ability to generate a computerized shapefile from a 3D object and then to transform this shapefile back into a physical object. 3DS and 3DP technologies are widely used in product design, as they enable rapid production of prototypes, including functional prototypes. 3DP can also be used for rapid manufacturing on a small scale (such as production of spare parts) or large scale (especially using lost-wax casting). These technologies do have a potential benefit for the Navy's CPLM process because they could help solve problems like supply chain disruption, immediate replacement of parts, and the length of the product development lifecycle. However, 3D technologies can be expensive and, in some cases, may not be accurate enough for use. In this research, three distinct scenarios for implementation of 3D technology in the CPLM cycle are examined, including prototyping, small-scale shipboard manufacturing, and large-scale rapid manufacturing. The findings of the research suggest that, at the present time, the use of 3DS and 3DP technologies is best suited to the design stages of the research, although the rapid manufacturing application also has promise. The shipboard application, although it would resolve a supply chain problem, is too expensive and complicated to be effective at this time. Full text

**Keywords:** three-dimensional, 3D printing, 3D scanning, collaboration, information technology, collaboration, Navy shipyards, PLM, collaborative product lifecycle management, CPLM, cost benefit analysis, CBA, Stereolithography, SLA, selective laser sintering, SLS

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# MASTER OF SCIENCE IN MANAGEMENT

## ANALYSIS OF MARINE CORPS RENEWABLE ENERGY PLANNING TO MEET INSTALLATION ENERGY SECURITY REQUIREMENTS

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**Jack Templeton, Captain, United States Marine Corps**
**Master of Science in Management**
**Advisor: Nicholas Dew, Graduate School of Business and Public Policy**
**Second Reader: Geraldo Ferrer, Graduate School of Business and Public Policy**

The purpose of this thesis is to analyze Marine Corps installation energy consumption and the pursuit of increased renewable energy generation goals across Marine Corps installations. The main objective of this report is to determine the cost of interruption and the net present value (NPV) of renewable energy generation needed to meet the Marine Corps energy security objectives. First, we determine installation-specific energy consumption, resource requirements, and current renewable energy generation projects. Second, we analyze current Marine Corps installation energy portfolios to determine shortfalls from minimum energy targets and the cost to generate those shortfalls through renewable energy technologies. Finally, we identify installation energy security requirements, determine cost of interruption, and conduct a sensitivity analysis of the cost-benefit of renewable energy generation alternatives to meet energy security requirements. This study determines how investment in renewable energy to meet baseline energy consumption requirements increases energy security across Marine Corps installations. Furthermore, considering the cost of interruption, the investment in renewable energy technologies yields a positive NPV at the majority of Marine Corps installations. Based on this research, we recommend that the Marine Corps develops a quantitative method for assessing energy security and invest to meet energy security goals at each installation. Full text

**Keywords:** renewable energy, energy security, Marine Corps Installations, learning curve analysis, modern portfolio theory, solar, wind, biomass, waste-to-energy, energy planning, energy strategy, customer damage function, cost of interruption, probability of interruption

## COST-BENEFIT ANALYSIS OF MARINE CORPS SEARCH AND RESCUE (SAR): A STUDY OF ALTERNATIVES FOR MARINE CORPS AIR STATIONS AT CHERRY POINT AND YUMA

**Clinton Collins, Major, United States Marine Corps**
**Robert Williamson, Major, United States Marine Corps**
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**Advisor: Simona Tick, Graduate School of Business and Public Policy**
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Local base search and rescue (SAR) units were established to provide support for military operations. Civilian communities have also benefited, often utilizing the Marine Corps SAR capabilities to support local requests. However, SAR is not a core competency of the Marine Corps or a function of Marine aviation. The current fiscal climate demands that the Marine Corps seek ways to achieve cost savings while maintaining its core competencies. The divestiture of functions that do not support the Corps execution of its Title 10 responsibilities is a possible solution. Local base SAR units bear significant operations and support costs. Moreover, the Marine Corps faces additional modernization costs due to the age of its SAR aircraft. At the same time, the commercial helicopter industry has increased its ability to provide capable SAR services around the globe.

Our research provides a current analysis of SAR costs to the Marine Corps and presents a cost projection for a 10-year time horizon. The research also conducts an analysis of outsourcing; the main findings of our analysis show that the Marine Corps can achieve annual savings of approximately $14 million (fiscal year 2014) through the use of commercially contracted SAR services at MCAS Cherry Point and MCAS Yuma. Full text

**Keywords:** search and rescue, SAR, cost benefit analysis, cost effectiveness analysis, Marine Corps Aviation, analysis of alternatives, UH-1Y helicopter, commercial outsourcing

## ANALYSIS OF UNITED STATES MARINE CORPS OPERATIONS IN SUPPORT OF HUMANITARIAN ASSISTANCE AND DISASTER RELIEF

**Jared Gastrock, Captain, United States Marine Corps**
**Juan Iturriaga, Captain, United States Marine Corps**
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**Advisor: Aruna Apte, Graduate School of Business and Public Policy**
**Second Reader: Keenan Yoho, Graduate School of Business and Public Policy**

In order to improve the effectiveness of the United States Marine Corps (USMC) response to future international humanitarian assistance/disaster relief (HA/DR) missions, an analysis of the demands created by such disasters as well as the capabilities of the USMC is necessary. This research focuses on the primary response organization within the USMC, the Marine expeditionary unit (MEU), and those resources available to the MEU to conduct HA/DR operations. Recent HA/DR events will be examined to determine how common demands were met by the USMC as well as any gaps that may exist that should be addressed to improve future effectiveness. In this research, we explore the capabilities of the USMC MEU that satisfy demands arising from natural disasters. We follow the humanitarian and military core competencies framework for studying the USMC capabilities to match the supply with the demand from certain past disasters. Compiling and analyzing data from multiple USMC publications, historical records of disasters, and the USMC response to those disasters we identify those capabilities provided by the USMC that are the most critical and unique with respect to the conduct of HA/DR missions. We have collected data for the 2007 cyclone on the southwest coast of Bangladesh, the 2010 Haiti earthquake, and the 2011 Japan earthquake and tsunami. We selected these disasters due to their impact and the level of involvement of the USMC in relief operations. Full text

**Keywords:** humanitarian assistance and disaster relief, HA/DR, HADR, Marine expeditionary unit, MEU, Bangladesh Cyclone Sidr, Operation Sea Angel II, Haiti earthquake 2010, Operation Unified Response, Great East Japan earthquake and tsunami, Operation Tomodachi.

## RECRUITER AND RECRUIT MATCH: THE EFFECT OF GENDER AND RACE MATCH OR MISMATCH ON THE QUALITY OF RECRUITS

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**Co-Advisor: Jeremy Arkes, Graduate School of Business and Public Policy**

This study explores how the match or mismatch between recruiters and recruits in terms of gender and race/ethnicity is associated with various measures of the quality of recruits. Specifically, amongst recruits of a similar race/ethnicity and/or gender, we compare across recruiters, by race/ethnicity and by gender, Armed Forces Qualification Test (AFQT) scores, and the likelihood of Delayed Entry Program attrition and attrition at various points in the career. Personnel data on the universe of Navy recruiters and recruits over the past 15 years is used. The findings suggest that, while there is a statistically significant effect of the gender match on the quality of recruits, it is very small in economic terms. On the other hand, there is an economically (and statistically) large effect of the racial/ethnic match or mismatch on the quality of recruits. In particular, Hispanic and Black

recruits recruited by recruiters of the same race/ethnicity have lower AFQT scores as well as lower probability of being a Category A recruit. Furthermore, the recruits signed by Hispanic recruiters (within each racial/ethnic group) are less likely to attrite in the first year of service. As recruiters may not be randomly assigned to recruiting populations, it is impossible to determine whether these associations are reflecting a causal or correlational relationship, a fact which must be known in order to use these findings for policy purposes. Full text

**Keywords:** Navy Recruiting Command, Navy Recruiters, quality of Navy Recruits, gender interaction effect, racial/ethnic interaction effect, Armed Forces Qualification Test scores, AFQT, Category A, Delayed Entry Program (DEP) Attrition, Attrition

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# MASTER OF SCIENCE IN MECHANICAL ENGINEERING

## MICROSTRUCTURAL ANALYSIS OF THE FAILURE MECHANISMS OF CARBON NANOFIBERS AND INORGANIC FULERENE-TYPE TUNGSTEN DISULFIDE

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**Advisor: Claudia Luhrs, Department of Mechanical and Aerospace Engineering**
**Second Reader: Garth Hobson, Department of Mechanical and Aerospace Engineering**

This thesis summarizes the failure mechanisms found in carbon nanofibers (CNF) and inorganic fullerene-type tungsten disulfide (IF-$WS_2$) nanoparticles treated with diverse pressure loading methods. CNF were generated using nickel as catalyst and ethylene as carbon source, while IF-$WS_2$ was acquired commercially. Approaches utilized to induce failure include the use of a gas gun, ultrasonic treatment, and impact with military rounds. Samples were characterized using electron microscopy, powder x-ray diffraction, energy dispersive x-ray spectroscopy, and BET surface area analysis. CNF produced from nickel showed agglomeration from all testing methods but no evidence of fiber breakage or delamination. IF-$WS_2$ failure modes observed were related, primarily, to the transition between 3D and 2D polymorphs, with subsequent agglomeration of the plate-like 2D structure, producing larger particle sizes. The secondary mechanism identified was delamination of IF-$WS_2$, which, in contrast to the former, gave origin to smaller particulates. The failure modes identified herein were used to re-design the CNF material and test it using the gas gun. CNF with larger diameter distributions were grown from palladium catalyst, producing ultralow density carbon foam. This architecture presented viscoelastic properties that recovered the original shape after unloading, not showing evidence of failure under the gas gun test regime employed. Full text

**Keywords:** carbon nanofiber, CNF, inorganic fullerene-type tungsten disulfide, IF-$WS_2$, gas gun, ultrasound, military rounds, agglomeration, delamination

## MECHANICAL AND ELECTRICAL CHARACTERIZATION OF NOVEL CARBON NANO FIBER ULTRALOW DENSITY FOAM

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**Advisor: Claudia Luhrs, Department of Mechanical and Aerospace Engineering**
**Co-Advisor: Jonathan Philips, Department of Physics**

Concomitant mechanical and electrical testing of carbon nanofiber foam samples, generated using the constrained formation of fibrous nanostructures process, reveal the material to be a unique ultra-low-density foam with electrical properties appropriate for application as strain gauge. Samples of CFF, essentially a solid mat of intertwined nanofibers of pure carbon, were grown in a steel mold at ~550°C from a variety of catalysts exposed to fuel rich mixtures of ethylene and oxygen. Only those created from palladium (Pd) particle catalysts were found to produce macroscopic objects sufficiently robust for static and dynamic stress/strain tests. Transient and dynamic tests were used to fully characterize the mechanical properties of the novel foam. These tests clearly demonstrated that the material generated from Pd particles has viscoelastic behavior. The foam was subjected to compression cycles over diverse periods of time employing a die to maintain a fixed cross sectional area. The ultralow density material has a modulus of ~3.5 MPa, close to the one encountered in rubber-like substances. Given its carbonaceous nature, the new foam maintains its thermal stability up to

550°C in air. Simultaneous resistance/stress/strain measurements showed that there is a linear relationship between electrical resistance and strain that is remarkably consistent over many cycles. The novel ultralow density foam has many potential applications, including sensing element of a strain gauge or energy absorber. Full text

**Keywords:** carbon, fiber, carbon nanofiber, viscoelastic, strain gauge, gauge factor, ultra-low-density foam, relaxation modulus, and creep compliance

## COMPUTATIONAL ANALYSIS OF EFFECT OF TRANSIENT FLUID FORCE ON COMPOSITE STRUCTURES

**Scott Knutton, Lieutenant, United States Navy**
**Master of Science in Mechanical Engineering**
**Advisor: Young Kwon, Department of Mechanical and Aerospace Engineering**
**Second Reader: Garth Hobson, Department of Mechanical and Aerospace Engineering**

This study investigated the peak pressure applied to a composite structure under various transient velocity profiles and fluid boundary conditions, as well as structural geometric configurations and material properties. Then, the resultant dynamic responses of the composite structures were investigated. The study was conducted by modeling fluid-structure interaction using the finite-element and finite-volume analysis technique. The results showed that the peak pressure and the resultant stresses in the composite structures are significantly dependent on the accelerating state as well as fluid boundary conditions. The peak stresses determined in this study were between three and 16 times larger than the steady state stress for the given fluid acceleration profile. Full text

**Keywords:** fluid structure interaction, FSI, finite element, finite volume, ANSYS, E-glass, composite material, coupled interaction, Hamming, high performance computing, HPC, transient acceleration, transient fluid, transient velocity, transient stress

# MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

## TROPICAL CYCLONE RECONNAISSANCE WITH THE GLOBAL HAWK: OPERATIONAL THRESHOLDS AND CHARACTERISTICS OF CONVECTIVE SYSTEMS OVER THE TROPICAL WESTERN NORTH PACIFIC

**David Damron, Lieutenant Commander, United States Navy**
**Master of Science in Meteorology and Physical Oceanography**
**Advisor: Patrick Harr, Department of Meteorology**
**Second Reader: Barbara Scarnato, Department of Meteorology**

In a tropical cyclone (TC), in situ observations measure storm location, intensity, and structure. These parameters are valuable for initializing numerical models and providing forecasters with current conditions on which to base their forecast. Over the western North Pacific (WPAC), a lack of in situ observations in TCs is hypothesized to be one component that contributes to a recent leveling of forecast skill. In this study, the use of a Global Hawk (GH) unmanned aerial vehicle as an observing platform for TCs over the WPAC is examined. It is hypothesized that the GH can greatly benefit the Department of Defense by reducing the uncertainty in TC track forecasts, which has been mandated by the U.S. Pacific Command as a priority for increasing the area of sea maneuverability. A limit to successful GH operations is the ability to operate at altitudes above typical cloud tops of WPAC TCs. A climatology of WPAC TC cloud-top heights and temperatures was examined to relate these parameters to storm characteristics. It is concluded that use of a GH for tropical cyclone reconnaissance in the WPAC is a viable option to provide in situ observations of tropical cyclone characteristics for improved model and operational forecasts. Full text

**Keywords:** Global Hawk, tropical cyclone reconnaissance, top of convective cloud, top of cloud, cloud-top temperature, Joint Typhoon Warning Center, Tropical Western North Pacific

## COMPUTER-AIDED DETECTION OF RAPID, OVERT, AIRBORNE, RECONNAISSANCE DATA WITH THE CAPABILITY OF REMOVING OCEANIC NOISES

**James Fritz, Lieutenant, United States Navy**
**Master of Science in Meteorology and Physical Oceanography**
**Advisor: Peter Chu, Department of Oceanography**
**Co-Advisor: Chenwu Fan, Department of Oceanography**
**Second Reader: Ronald Betsch, Naval Oceanographic Office**

There have been three times more attacks on naval ships using sea mines than all other forms combined. Sea mines have always been viewed as underhanded and unchivalrous, yet they provide a weaker navy the capability to stall and damage a vastly superior navy. Utilizing unmanned sensors to detect sea mines is the goal of the navy for the future. Computer-aided detection (CAD) of sea mines is much faster and more consistent than a human operator, yet it is not currently being utilized by any of our mine countermeasure assets. Although there are many studies that have incorporated computer aided detection and classification algorithms with sonar imagery for mine warfare, few have used light detection and ranging (LIDAR). During an amphibious assault scenario, the ability to land assets quickly and mitigate risk is vital to the success. This thesis analyzes rapid overt aerial reconnaissance data from an Office of Naval Research experiment by Fort Walton Beach,

Florida. The CAD algorithm that was developed consistently detects sea mines in LIDAR data while having a manageable false alarm rate. Full text

**Keywords:** mine countermeasures, computer aided detection, CAD, computer aided identification, optimization, physical oceanography

## CLIMATE ANALYSIS OF EVAPORATION DUCTS IN THE SOUTH CHINA SEA

**Brian McKeon, Lieutenant Commander, United States Navy**
**Master of Science in Meteorology and Physical Oceanography**
**Advisor: Tom Murphree, Department of Meteorology**
**Co-Advisor: Paul Frederickson, Department of Meteorology**

Evaporation ducts have important implications for U.S. Naval activities involving electromagnetic propagation. The presence of an evaporation duct can affect naval operations involving communications, surveillance, electronic warfare, and detection of low-flying missiles, surface ships, or submarine periscopes. We conducted a climate scale analysis of evaporation duct heights (EDH) in the northern South China Sea (SCS), including how EDH varies throughout the year, how environmental variables affect EDH differently in each season, and how regional and global-scale climate variations are related to EDH. We identified climate variations that may enable skillful long-range forecasts of EDH at lead times of up to three months using anomalies in sea surface temperature, geopotential height, and outgoing longwave radiation (OLR) as potential predictors. SCS EDH showed significant correlations with several climate variation indices, including the Multivariable El Nino Southern Oscillation Index, Nino 4, and the Summer Asian Monsoon OLR Indices. Improved understanding and skillful predictions of seasonal and climate scale variations in EDH will aid in operational planning in locations for which real-time observations are sparse, and for interseasonal to seasonal lead times for which existing predictions are presently very limited. Knowledge of EDH in the SCS may become critically important given the increasing significance of the eastern and southeastern Asian area, and particularly for operations involving protection of high-value units and anti-submarine warfare. Full text

**Keywords:** climate, climatology, evaporation duct, electromagnetic propagation, South China Sea, electromagnetism, evaporation duct heights, EDH, long-range forecasting

## DYNAMICS, HEAT TRANSPORT, SPECTRAL COMPOSITION AND ACOUSTIC SIGNATURES OF MESOSCALE VARIABILITY IN THE OCEAN

*This paper has been recognized as outstanding by its department*

**Daniel Peixoto de Carvalho, Lieutenant Commander, Brazilian Navy**
**Master of Science in Meteorology and Physical Oceanography**
**Advisor: Timour Radko, Department of Oceanography**
**Second Reader: John Joseph, Department of Oceanography**

The general circulation of the global ocean is turbulent rather than laminar. Mesoscale eddies contribute to the transport of tracers like heat, salt, and oxygen, and affect large-scale ocean dynamics. The problem of representing mesoscale variability stems from the nonlinear character of eddy dynamics, which makes it difficult to predict equilibrated fluxes. The most intuitive solution is to apply a parameterization based on the eddy-driven transport observed in a global ocean that has been spinning up for centuries, which may not be feasible at present. An alternative approach involves constructing relatively simple analytically tractable equilibration models. In this study, the equilibration mechanism, called the growth rate balance (GRB) model, proposes an explanation to the eddy dynamics as a competition between primary and secondary instabilities. The GRB model is validated in two configurations: a two-layer model and a continuously stratified model. They identify the dependences of equilibrated fluxes on the characteristics of the background flow, and the applicability range

of the GRB model. Finally, acoustic signatures of a fully developed eddy field predicted by the GRB model characterize the role of mesoscale variability in the important naval problem of acoustic propagation. Full text

**Keywords:** mesoscale variability, mesoscale Eddies, eddy-induced fluxes, eddy-induced transports, eddy development, equilibration mechanism, instability growth, growth rate balance, GRB model

## CALIBRATION AND VALIDATION OF INERTIAL MEASUREMENT UNIT FOR WAVE RESOLVING DRIFTERS

**Jeffrey Portell, Lieutenant, United States Navy**
**Master of Science in Meteorology and Oceanography**
**Advisor: Thomas Herbers, Department of Oceanography**
**Second Reader: James Calusdian, Department of Electrical and Computer Engineering**

We examine the performance of the Yost Engineering Incorporated 3-Space Sensor Data-Logging (TSS-DL) for use in wave resolving drifters (WRDs) that collect ocean surface wave data. We create a surface wave orbital motion simulator to test the TSS-DL in a controlled, laboratory setting at the Naval Postgraduate School. Tests are conducted in three different configurations at five frequencies within the swell and wind-sea bands. Results from the tests show that the TSS-DL can accurately resolve the vertical simulated wave motions to within 37% of the analytic signal amplitude and can resolve the horizontal simulated wave motions to within 21–33% of the analytic signal amplitude. We further examine some field data collected using the TSS-DL onboard WRDs deployed in June 2013 near the mouth of the Columbia River. This analysis, based on comparison with independent GPS wave measurements, demonstrates that the TSS-DL yields reliable estimates of surface wave spectra and can track surface wave profiles even under extreme conditions with large breaking waves. Overall, this study shows that the TSS-DL is a suitable sensor for use in ocean surface drifters to accurately record surface waves. Full text

**Keywords:** ocean waves, wave buoys, drifters, inertial measurement units, micro-electro-mechanical systems, MEMS, sensor validation, reference frames, quaternions, wave orbital motion, mouth of the Columbia River

## PHYSICAL PROCESSES IN COASTAL STRATOCUMULUS CLOUDS FROM AIRCRAFT MEASUREMENTS DURING UPPEF 2012

**Pamela Tellado, Lieutenant Commander, United States Navy**
**Master of Science In Meteorology and Physical Oceanography**
**Advisor: Qing Wang, Department of Meteorology**
**Second Reader: Wendell Nuss, Department of Meteorology**

The objective of this thesis was to perform the initial analysis of aircraft measurements from the field campaign of the Unified Physical Parameterization for Extended Forecast. We examined the general characteristics of the observed stratocumulus-topped boundary layers and identified cases for future in-depth studies. We first determined the boundary layer heights from all sounding profiles. The results indicated the sharp westward increase of boundary layer height is limited to ~200 km offshore with an average slope of 2m per kilometer. Substantial west-east spatial variability of thermodynamic properties is also observed from vertical profiles. The sea surface temperature (SST) in the region varied significantly. Near surface measurements over the warm and cold SST regions for three cases were analyzed and compared. This research found that the small scale variability in the SST resulted in significant variation in the surface exchange of sensible and latent heat fluxes, and wind stress. Such variability makes it difficult to correctly parameterize surface fluxes. The presence of cool downdrafts in the upper cloud layer is evident in the joint probability density distribution

and buoyancy flux profiles. The results from this research will guide future cloud parameterization scheme development in forecast models. Full Text

**Keywords:** stratocumulus clouds, Marine Boundary Layer, Unified Physical Parameterization for Extended Forecast, UPPEF 2012, aircraft measurements, sea surface temperature, SST front

## DUCTING CONDITIONS FOR ELECTROMAGNETIC WAVE PROPAGATION IN TROPICAL DISTURBANCES FROM GPS DROPSONDE DATA

**David Ziemba, Lieutenant, United States Navy**
**Master of Science in Meteorology and Physical Oceanography**
**Advisor: Qing Wang, Department of Meteorology**
**Co-Advisor: Patrick Harr, Department of Meteorology**

In this thesis, more than 13,000 vertical profiles from GPS-enabled dropsondes, recorded from 1996 through 2010, were analyzed to determine the characteristics of electromagnetic and electro-optical ducting in the boundary layer, an environmental condition that significantly affects the propagation of radio waves. A radio wave propagation duct is formed when there are significant gradients in the humidity and temperature profiles of the atmosphere. In this study, the frequency of occurrence and the characteristics (height, depth, and strength) of a duct are identified using the temperature and humidity profiles measured by dropsondes. The identified ducts are separated based on duct types occurring in the lower troposphere: surface ducts, surface-based ducts, and elevated ducts. We further separate the duct occurrence based on the location relative to their respective storms. Based on the number of soundings in different types of tropical disturbances, we chose to further analyze duct conditions in hurricanes and tropical storms. The results suggest frequent occurrence of ducting, especially elevated ducts. This result is consistent with previous research of a similar nature. However, no preference of ducting was identified in any quadrant of the storm. Full text

**Keywords:** dropsonde, ducting, electromagnetic propagation

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

## THE USE OF SIMULATORS IN RULES OF THE ROAD TRAINING

**John Weaver, Lieutenant, United States Navy**
**Master of Science in Modeling, Virtual Environments and Simulation (MOVES)**
**Advisor: Joseph Sullivan, MOVES Institute**
**Co-Advisor: Perry McDowell, MOVES Institute**

The use of simulation technology, in conjunction with instructor led rules of the road (RoR) lectures, is in the infancy stages of curriculum development in maritime institutions. As a result, there are few studies that analyze whether using simulators will increase a student's ability to apply maritime rules that prevent collisions at sea in a simulation based scenario. This study hypothesized that students who used a Full Mission Bridge simulator and received lectures would achieve higher scores on a RoR test than those who did not receive simulator training but did receive lectures. Utilizing 27 active duty participants that used a simulator and 341 examinees who did not use a simulator at Surface Warfare Officer School Newport, our results showed statistically significant data that students who used the simulator performed better on a RoR test than those who did not. This study recommends that incorporating simulation technology into curricula that have traditionally been only instructed in a classroom environment is beneficial, especially in learning RoR. Based on the results of this study, there is a need for incorporating simulation technology in traditionally instructed courses, where applicable, and future studies using simulation technology should be extended to the fleet. Full text

**Keywords:** shiphandling training, shiphandling simulation, implicit learning, explicit learning, rules of the road, RoR, simulator

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# MASTER OF SCIENCE IN OPERATIONS RESEARCH

## OPTIMAL DAY-AHEAD SCHEDULING OF A HYBRID ELECTRIC GRID USING WEATHER FORECASTS

**Hamadi Bouaicha, Lieutenant, Tunisian Navy**
**Master of Science in Operations Research**
**Advisor: Emily Craparo, Department of Operations Research**
**Second Reader: Dashi Singham, Department of Operations Research**

The compromise between the stability of a hybrid electric grid (HEG) and the total operating cost can be reached by accurately anticipating the future renewable power productions. This thesis suggests the use of weather forecasts to establish day-ahead operating schedules for a grid that include the operating plan of dispatchable fuel-based generators, the charge or discharge of energy storage units, and the energy to exchange with the commercial grid if the configuration of the HEG allows it. The weather forecasts used as a key factor to establish the optimal plan are subject to uncertainty. In order to mitigate this problem, multiple weather forecast scenarios are used in the optimization. This thesis alters the optimization model to represent various configurations of the HEG and optimizes over a variety of weather forecasts. It then tests the operating plans suggested by the model using particular weather scenarios representing actual observed weather conditions. Finally, this thesis gives an illustration of how to run the optimization model with the rolling horizon method using updates of weather forecasts. Full text

**Keywords:** hybrid electric grid, HEG, microgrid, hybrid renewable energy system, energy management center, optimization, day-ahead scheduling, weather forecast, wind power, photovoltaic power

## MULTISTAGE DEPLOYMENT OF THE ARMY THEATER HOSPITAL

**Trisha Cobb, Major, United States Army**
**Master of Science in Operations Research**
**Advisor: Ned Dimitrov, Department of Operations Research**
**Second Reader: Lawrence Fulton, Texas State University**

We will never know the operational battle space of the future, so medical assets need to be flexible and agile to conform to a variety of environments and threats. We utilize a multistage optimization model and data from past contingency operations to analyze potential configurations of a robust theater-deployable hospital. The current Army theater-deployable hospital has 248 beds, and our analysis shows that it is over-capacitated for the current brigade-centric force structure. Based on our analysis, the optimal role-3 medical treatment facility is between 44 beds and 124 beds, with smaller wards and the ability to combine hospitals to create larger hospitals. The smaller role-3 medical treatment facility better suits the tactical and operational employment of medical assets and supports the strategic plans for regionally aligned forces. Full text

**Keywords:** combat support hospital, Army Medical Department, AMEDD, multistage, optimization

## A BUSINESS CASE ANALYSIS OF PRE-POSITIONED EXPEDITIONARY ASSISTANCE KIT JOINT CAPABILITY TECHNOLOGY DEMONSTRATION

**Hui Hyang Lee, ,Lieutenant Commander, Supply Corps, United States Navy**
**Master of Science in Operations Research**
**Advisor: Daniel Nussbaum, Department of Operations Research**
**Second Reader: Kevin Maher, Department of Operations Research**

The Pre-Positioned Expeditionary Assistance Kit (PEAK) is a Joint Capability Technology Demonstration initiative that is being managed by the Office of the Secretary of Defense, developed in partnership with the National Defense University, and is sponsored by United States Southern Command. This study analyzes the costs and benefits of implementing the PEAK as a new capability into the Humanitarian Assistance/Disaster Relief Operational community with the objective of building key capacity in partner nations to promote security and stability and focusing on providing effective, low-cost and sustainable capabilities. This thesis conducts a business case analysis (BCA), including a base case analysis and sensitivity analyses focusing on the return on investment (ROI) of investing in, operating and maintaining the PEAK. The BCA compares the life-cycle cost estimate of the PEAK with that of the status quo (existing) systems in operational scenarios for a 10-year period. When compared against the estimated investment over the system life-cycle, the results show positive ROI and net present value after the first year. The savings come from the cost of water and transportation. Full text

**Keywords:** business case analysis, BCA, Pre-Positioned Expeditionary Assistance Kit, PEAK, return of investment, ROI, net present value, NPV, life-cycle cost estimate, LCCE

## FUZZY COMPREHENSIVE EVALUATION (FCE) IN MILITARY DECISION SUPPORT PROCESSES

**Karen Teague, Lieutenant, United States Navy**
**Master of Science in Operations Research**
**Advisor: Dashi Singham, Department of Operations Research**
**Second Reader: Michael Atkinson, Department of Operations Research**

The United States has a tradition of military analysis using a federated or combined suite of models. However, these are not the only methods of modeling military problems. We consider the application and implications of foreign modeling approaches. The particular alternate technique we focus on is fuzzy comprehensive evaluation (FCE). FCE makes use of fuzzy mathematics, alone and in partnership with analytic hierarchy process (AHP) models, to inform strategic and operational decisions. It is designed to aid leaders in capturing the complicated and sometimes fuzzy nature of multi-criteria decision problems through human knowledge and evaluations. These subjective inputs invite criticisms regarding FCE solutions. FCE results are only as valid as the consistency of the subject matter experts' opinions. Therefore, this thesis analyzes the FCE approach through a case study and evaluates the implications of FCE results when there is high variance in expert opinions. Full text

**Keywords:** analytical hierarchy process, AHP, fuzzy logic, fuzzy comprehensive evaluation, FCE, decision making, simulation

# MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

## MULTI-DECADAL VARIABILITY IN THE BERING SEA: A SYNTHESIS OF MODEL RESULTS AND OBSERVATIONS FROM 1948 TO THE PRESENT

**James Scianna, Lieutenant, United States Navy**
**Master of Science in Physical Oceanography**
**Advisor: Wieslaw Maslowski, Department of Oceanography**
**Co-Advisor: Jaclyn Kinney, Department of Oceanography**

The northern Pacific Ocean is a highly dynamic region characterized by strong decadal signals, as evident in climate regime shifts. A regime shift marks when the climate exhibits an abrupt modification from one physical environment to another. The mesoscale variability seen in regime shifts is poorly represented in earth system models. To best understand the changes in the Arctic Ocean, we must analyze the Pacific Ocean's influence on the Arctic through regional models. This study synthesizes multi-decadal results in the Pacific Ocean from the regional Arctic system model (RASM): a high-resolution, pan-Arctic, coupled model forced with atmospheric data from the Common Ocean Reference Experiment, version 2 (CORE2), 1948–2009 reanalysis to identify climate regime shifts. Analyzed results are validated with observational data and compared to output from the community climate system model, version 4 (CCSM4). RASM demonstrated skill in identifying climate regime shifts. RASM-based correlations with the Pacific decadal oscillation (PDO) can explain 40–60 percent of the total variability in the northern North Pacific and Bering Sea region. Limited comparisons of RASM to CCSM4 suggest that there is added value in regional climate simulations and better understanding of climate regime shifts. Full text

**Keywords:** oceanography, modeling, regime shifts, Pacific decadal oscillation, PDO, climate change, Bering Sea, ice, Gulf of Alaska

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# MASTER OF SCIENCE IN PROGRAM MANAGEMENT

## WHITE SANDS MISSILE RANGE NON-TRACK OPTICS: STREAMLINING THE PROCESS OF CONDUCTING BUSINESS FOR IMPROVED CUSTOMER SUPPORT

**Abel Moreno, Civilian, Department of the Army**
**Antonio Marquez, Civilian, Department of the Army**
**Juan Brun, Civilian, Department of the Army**
**Richard Chandler, Civilian, Department of the Army**
**Master of Science in Program Management**
**Advisor: Michael Boudreau, Graduate School of Business and Public Policy**
**Co-Advisor: Filemon Aragon, White Sands Missile Range**

Budget overruns and scheduling difficulties within the White Sands Missile Range (WSMR) test community have become more prevalent of late. Two of the biggest customer complaints have been that WSMR is too expensive and that the scheduling process is slow and inflexible; the WSMR Non-track Optics organization has been suggested as the main contributor to these problems. WSMR Non-track Optics manages multiple types of specialized static cameras, networking instrumentation, and vehicles to transport and control its equipment but has shown itself unable to support numerous test activities scheduled during the same timeframe. The focus of this thesis is to define the process whereby requirements for Non-track Optics support are routed, identify process inefficiencies within the organization, and recommend solutions for the Non-track Optics organization to successfully adopt the pull method, where the ability to set-up instrumentation and support exactly what the customers want, when they need it, is achieved within budget. In identifying and addressing these inefficiencies, solutions can be applied, resulting in WSMR becoming a more affordable and customer-oriented test range. Full text

**Keywords:** business process improvement, Non-Track Optics, White Sands Missile Range, WSMR

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# MASTER OF SCIENCE IN SYSTEMS ENGINEERING

## EXPLORING THE REDUCTION OF FUEL CONSUMPTION FOR SHIP-TO-SHORE CONNECTORS OF THE MARINE EXPEDITIONARY BRIGADE

**Stephen Skahen, Michael Brookhart, Michael Boyett, Steven Benner, Josue Kure, and Jason Maier**
**Master of Science in Systems Engineering and Master of Science in Engineering Systems**
**Advisor: Eugene Paulo, Department of Systems Engineering**
**Co-Advisor: Paul Beery, Department of Systems Engineering**

At the beginning of the 21st century, the United States Marine Corps (USMC) took a leading role in the war on terror. The traditionally amphibious force deployed massive amounts of troops and supplies in two major land wars of occupation. Now, as the USMC winds down its participation in the conflicts, it must seek to return to its roots as a primarily amphibious force without the benefits of a land-based operation. Tomorrow's battles will likely begin from the littorals in and around the coastal regions of the developing world. The Marine Corps must prepare itself to operate without the benefit of readily available fossil fuels and supplies shipped in by trucks or home-based supply lines. As demonstrated in the current conflicts, the threats of IEDs and the expenses of obtaining fossils fuels make it imperative that the Marine Expeditionary Brigade (MEB) of the future must be able to bring its supplies with them or have them delivered by readily available and close-by alternate means. This research will evaluate the current landing doctrine of a notional MEB and its associated ship-to-shore connectors. It will analyze potential changes in doctrine with the goal of reducing energy footprint while maintaining mission effectiveness. Full text

**Keywords:** U.S. Marine Corps, amphibious warfare, Expeditionary Energy Office, fuel efficiency, discrete event modeling, modeling and simulation

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