Compilation of Abstracts, December 2016

Monterey, California; Naval Postgraduate School

http://hdl.handle.net/10945/52410
COMPILATION OF

ABSTRACTS

Unrestricted Dissertations,
Theses, and Final Projects

NPS Class of December 2016
PREFACE

This publication, Compilation of Abstracts, contains abstracts of unrestricted dissertations, theses, and capstone project reports submitted for the doctor of philosophy, master of arts, master of business administration, and master of science degrees for the Naval Postgraduate School’s December 2016 graduating class. A digital copy of this publication can be found at http://calhoun.nps.edu/handle/10945/52410 while the corresponding metadata for December 2016 abstracts can be found at http://calhoun.nps.edu/handle/10945/51738.

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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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

The Naval Postgraduate School is pleased to present the dissertation, thesis, and capstone project report abstracts for unrestricted research completed in December 2016 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)

Graduate School of Operational and Information Sciences (GSOIS)

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, and special operations and related defense analysis.

- 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
- Software Engineering (residential and DL)
- Special Operations
- Systems Analysis (DL)
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.

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 status. All curricula lead to a master of science or art or a master of business administration; additional study may yield an engineer or doctoral degree. Below is a listing of degrees offered at the Naval Postgraduate School.

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

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

Source: NPS Public Affairs Office
DECEMBER 2016 DEGREES CONFERRED

The December 2016 graduating class produced 183 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 2016 (unrestricted theses)](image)

- **29%** Graduate School of Operational and Information Sciences (GSOIS)
- **26%** Graduate School of Business and Public Policy (GSBPP)
- **22%** School of International Graduate Studies (SIGS)
- **23%** Graduate School of Engineering and Applied Sciences (GSEAS)

Source: NPS Public Affairs Office
ACADEMIC AWARDS ANNOUNCED DECEMBER 2016

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 Awards
• Monterey Council Navy League Award for Highest Academic Achievement: Lieutenant Nicholas J. Sharpe, USCG
• Naval Postgraduate School Outstanding Academic Achievement Award for Department of Defense Student: Mr. Wayne Thomas Walker, Program Manager, Headquarters, Department of the Army
• Naval Postgraduate School Outstanding Academic Achievement Award for International Students: Captain Woosok Lee, South Korean Army
• Association of the United States Army, General Joseph W. Stilwell Chapter, Award for Outstanding Army Student: Major Zachary Hoover, USA
• Monterey Kiwanis Club Outstanding International Student Award: Captain Mehmet Celiktas, Turkish Army

Graduate School of Business and Public Policy (GSBPP)
• The Louis D. Liskin Award for Excellence in Business and Public Policy: Lieutenant Commander Melissa Gonzales, SC, USN—Outstanding Thesis: Resilience among Students at the Basic Enlisted Submarine School (co-authors listed on the following page)
• The Graduate School of Business and Public Policy Faculty Outstanding International Student Award: First Lieutenant Mustafa Canbolat, Turkish Army
• RADM Donald R. Eaton Logistics Award for Outstanding Achievement: Lieutenant Commander Kevin Peters, SC, USN
• Rear Admiral Thomas R. McClellan Award for Academic Excellence in the Graduate School of Business and Public Policy: Commander Nathaniel Robbins, USN

Graduate School of Engineering and Applied Sciences (GSEAS)
• Naval Sea Systems Command Award for Excellence in Combat Systems: Lieutenant Commander Tom Pilkerton, USN
• The Space Systems Engineering Award for Academic Excellence: Mr. Rob Vannice, Civilian, Boeing Space & Intelligence Systems, FJ Segundo, California
• Astronaut Michael J. Smith, CAPT, USN, and Astronaut William C. McCool, CDR, USN, Astronautics Award: Lieutenant Commander Colin Monk, USN—Outstanding Thesis: Closed-Loop Optimal Control Implementations for Space Applications
• The Johns Hopkins Applied Physics Laboratory Award for Excellence in Applied Physics Research: Lieutenant William Swan, USN
• Meyer Award for Outstanding Student in Systems Engineering (Distance Learning): Mr. Jeremy Richard Hoff and Ms. Jennifer Erin Kays

Graduate School of Operational and Information Sciences (GSOIS)
• AFCFA John McReynolds Wozencraft Electrical and Computer Engineering Academic Honor Award: Lieutenant Commander Richard Thompson, USN
• The Hans Jones Award for Excellence in Thesis Research in Special Operations and Irregular Warfare or Security, Stabilization, Transition and Reconstruction: Major Frie Roles, USA; Major Christopher Thielenhaus, USA; Major David Yu, USA; Major James Self, USA; and Major Zack Hoover, USA
• The Pat Tillman Leadership Award: Major Matt Piosa, USA; and Commander Brian Bourgeois, USN

School of International Graduate Studies (SIGS)
• The Louis D. Liskin Award for Excellence in Regional Security Studies: Lieutenant Geoffrey A. Ellis, USN
• The International Student Award for Excellence in Regional or Security Studies: Lieutenant Colonel Muhammad Waqar Khalid Khan, Pakistan Army
• The Outstanding United States Air Force Graduate Award, Department of National Security Affairs: Captain Reid Touchberry, USAF
• Foreign Area Officer Association Award for Excellence in International Affairs: Major Phil Sakamoto, USAF
• The Curtis H. "Butch" Straub Achievement Award: Commander Brian R. Lee, U.S. Immigration and Customs Enforcement, Dallas, Texas

Outstanding Thesis Recognition
• Captain Dayton Gilbreath, USAF; Captain Carrie Moore, USAF: A Collection of JPME Operational Contract Support Case Studies and Vignettes
• Major Badura A. Hakimu, Tanzanian Army: Insecurity in the DRC: The Obstacle to Peace and Stability
• Lieutenant Commander Benjamin K. Grossi, Royal Australian Navy: A Variable Flow Modelling Approach to Military End Strength Planning
• Lieutenant Commander Jeffrey A. Drewiske, USN: The Muted Voice of the Catholic Church in Angola
• Lieutenant Colonel Christopher R. Laird, USAF: Volunteer Flying Organizations: Law Enforcement's Untapped Resource
• Captain Johnathan R. Fergenson, USMC: The Effect of Active Duty Presence on High Quality Enlisted Accessions in the Marine Corps
• Major Shane A. Bladen, USMC: Do Military Personnel Patent?
• Lieutenant Commander Cassandra M. Sisti, USN: Dynamics, Stability, and Evolutionary Patterns of Mesoscale Intrathermocline Vortices
• Major AliceMary Trivette, USA; Lieutenant Commander Dominic Raigoza, USN; and Lieutenant Commander Melissa Gonzales, USN: Resilience among Students at the Basic Enlisted Submarine School
ADVANCED DEGREES

Doctor of Philosophy
DOCTOR OF PHILOSOPHY

EFFICIENT ORCHESTRATION OF DATA CENTERS VIA COMPREHENSIVE AND APPLICATION-AWARE TRADE-OFF EXPLORATION

Alan Bairley—Major, United States Army
Doctor of Philosophy in Computer Science
Supervisor: Geoffrey Xie, Department of Computer Science

Software-defined network (SDN) orchestration, the problem of integrating and deploying multiple network control functions (NCFs) while minimizing suboptimal network states that can result from competing NCF proposals, is a challenging open problem. In this work, we formulate SDN orchestration as a multiobjective optimization problem, present an evolutionary algorithm designed to explore the NCF tradeoff space comprehensively and avoid local optima, and propose a new application-aware approach that explicitly models resource preferences of individual application workloads. In addition, we propose a new logical application workload (LAW) abstraction to enable precomputation of the required relative positioning of an application’s virtual machines (VMs) and allocation of these VMs in a single atomic step, leading to online algorithms that are one order of magnitude faster than existing solutions for placing data center workloads. For an instance of the SDN orchestration problem subject to four independent NCFs attempting to optimize network survivability, bandwidth efficiency, power conservation, and computational contention, we demonstrate that our approach enumerates a wider range of, and potentially better, solutions than current orchestrators, for data centers with hundreds of switches, thousands of servers, and tens of thousands of VM slots. 

Keywords: software-defined networking, network state, data center network, genetic algorithms, virtual machine placement

ANALYSIS AND AUGMENTATION OF TIMING ADVANCE-BASED GEOLOCATION IN LTE CELLULAR NETWORKS

John Roth—Major, United States Marine Corps
Doctor of Philosophy in Electrical Engineering
Supervisor: Murali Tummala, Department of Electrical and Computer Engineering
Co-Supervisor: John McEachen, Department of Electrical and Computer Engineering

The ubiquity of cellular technology has woven a variety of services, now axiomatic, into the modern social fabric. Among those services is the ability to provide mobile user location. Applications of these location-based services include providing directions, emergency services, fraud protection, and direct marketing. This work provides in-depth analysis of cellular positioning, which leverages the Long Term Evolution (LTE) signaling plane timing advance (TA) parameter for the end of user geolocation. Additionally, we propose a novel method of augmenting TA-based positioning, Cellular Synchronization Assisted Refinement (CeSAR). We simultaneously show CeSAR to be a network performance multiplier and security vulnerability vis-à-vis the method’s electromagnetically passive nature. Furthermore, we demonstrate how CeSAR improves positioning by adding system information and mitigating the effects of poor network infrastructure geometry. Through robust statistical analysis, we derive a theoretical lower bound on TA-based positioning and demonstrate that a statistically efficient estimator is possible in this context. Furthermore, numerical studies are conducted with synthetic and empirical data. The real-world data are observed in actual network deployments found in geographically diverse environments, such as Maryland and California. The results not only demonstrate the
efficiency of the estimator but show that accuracy on the order of tens of meters is possible. Indeed, TA-based positioning is shown to be accurate on the order of 40 m in some scenarios. Additionally, we demonstrate that CeSAR is able to passively provide improvements ranging from 10 to 254 m over TA-only positioning. Full Text

Keywords: geolocation, Long Term Evolution (LTE), cellular networks, privacy, Cramer-Rao Lower Bound, quantization, maximum-likelihood estimation, timing advance

HYBRID HIGH-FIDELITY MODELING OF RADAR SCENARIOS USING ATEMPORAL, DISCRETE-EVENT, AND TIME-STEP SIMULATION
Yuan-Pin Cheng—Major, Republic of China Army
Doctor of Philosophy in Modeling, Virtual Environments, and Simulation
Supervisor: Donald Brutzman, Department of Information Sciences
Co-Supervisor: Phillip Pace, Department of Electrical and Computer Engineering

Many simulation scenarios attempt to seek a balance between model fidelity and computational efficiency. Unfortunately, scenario realism and model level of detail are often reduced or eliminated due to the complexity of experimental design and corresponding limitations of computational power. Such simplifications can produce misleading results. For example, Radar Cross Section (RCS) effects in response to time-varying target aspect angle are dominant yet often ignored. This work investigates a new approach. A hybrid, high-fidelity sensor model can be achieved by using a Time-Step (TS) approach with precomputed atemporal response factors (such as RCS), each situated on active simulation entities that interact within an overall Discrete Event Simulation (DES) framework. This work further applies regression analysis to the cumulative results of 1,281 design points multiplied by 100 replications each to provide additional insight from massive results. Through a rigorous cross-validation (CV) for ensuring proper model selection, this new methodology adapts the best aspects of temporal control by each simulation approach, integrating multiple high-fidelity physically based models in a variety of tactical scenarios with tractable computational complexity. The meta-model generates statistically identical results as the baseline hybrid sensor model in mean with higher variation. This outcome sensor model performs in an efficient DES architecture by predicting only probability of detection (Pd) and time-to-detect (TTD) of the targets with the consideration of the range and the aspect relationship between the sensor and the target. The range and the aspect factors were ignored in current existing DES sensor models due to the overly simplified detection algorithm and the constraint of modeling complexity. Full Text

Keywords: Discrete Event Simulation (DES), radar range equation, Simkit, Visual Simkit, atemporal model, hybrid sensor model, DES event graph, Nearly Orthogonal Latin Hypercube (NOLH), regression analysis, cross-validation

OBSERVATIONS AND MODELING OF UPPER OCEAN HYDROGRAPHY IN THE WESTERN ARCTIC WITH IMPLICATIONS FOR ACOUSTIC PROPAGATION
Dominic DiMaggio—Lieutenant Commander, United States Navy
Doctor of Philosophy in Physical Oceanography
Supervisor: Wieslaw Maslowski, Department of Oceanography
Co-Supervisor: John Colosi, Department of Oceanography

Observational and modeling studies are conducted to explore the changing physical environment of the western Arctic Ocean and its significance to upper-ocean hydrography and acoustic energy propagation. In-situ observations of temperature and salinity were made as part of the Canada Basin Acoustic Propagation Experiment (CANAPE) pilot study in summer 2015. Sound-speed fluctuations due to internal waves and spice were analyzed to describe spatio-temporal variability. Internal-wave frequency spectra show a spectral slope lower than the Garrett-Munk (GM) model, and the energy level is 4% of the standard GM value. Frequency spectra
of spice show a form similar to the internal-wave spectra but with a steeper spectral slope. Several global climate models were evaluated against historical and recent hydrographic observations and found to inadequately represent key upper-ocean hydrographic features. The Regional Arctic System Model (RASM) was used to investigate sensitivity of the simulated upper ocean to various configurations and showed that sub-grid scale brine rejection parameterization, appropriately tuned surface momentum coupling, and increased vertical and horizontal resolution improved model simulation. In both observational and model data sets, a near-surface sound channel is present, the significance and variability of which warrant further in-situ investigations and model improvements. Full Text

Keywords: Arctic Ocean, oceanography, acoustics, Canada Basin, climate system model

MATERIAL TRANSPORT IN THE INNER SHELF OF THE NORTHERN GULF OF MEXICO
Mathias Roth–Lieutenant Commander, United States Navy
Doctor of Philosophy in Physical Oceanography
Supervisor: Jamie MacMahan, Department of Oceanography

Material transport is investigated in the northern Gulf of Mexico with field observations obtained within the inner shelf, offshore of a beach where oil washed ashore following the Deepwater Horizon oil spill. In the fall, winter, and spring, extratropical cold air outbreaks frequently pass from the north-northwest across the nearly latitudinal coastline and experiment site, bringing winds that are stronger in the cross-shore than alongshore. Cross-shore winds drive depth-averaged along-shelf currents through an ageostrophic balance with the cross-shelf pressure gradient force and Coriolis force. Eulerian Acoustic Doppler Current Profiler and Lagrangian GPS-drifter-measured surface (< 1 m) currents differ from depth-averaged subsurface currents, and are 4–7 times larger than theoretical estimates of wind and wave-driven surface flow. Differences in surface flow are attributed to the presence of a buoyant river plume. Plume boundary fronts are sources of horizontal velocity and density gradients where drifters converge, slow, and are redirected. When the plume extended along the coast, 100% of drifters deployed offshore of the plume were barred from the beach. Plume kinematics and thickness, expected to be important for sustainment of the barrier, are examined with a one-year record of velocity observations in 10 m water depth. Full Text

Keywords: material transport, inner shelf, cold air outbreak, coastline curvature, river plume, coastal barrier, HYCOM
The purpose of this study is to provide a clear understanding of the nexus of crime and terrorism, using the Abu Sayyaf Group (ASG) as a case study. This terrorist group in the southern part of the Philippines has evolved as a hybrid organization, combining terrorist and criminal activities to achieve its objectives. Moreover, as a terrorist organization, ASG effectively employs criminal tactics for its survival. This group draws its strength and resilience from collusion with various lawless elements and other criminal groups in Mindanao. This paper examines the theoretical framework of Makarenko’s Crime-Terror (CT) Continuum to provide compelling explanations of the interaction and interoperability of crime and terrorism in the case of the ASG. It also highlights the Philippine CT strategy and approach to counter terrorism and discusses some notable gaps and problems, particularly its failure to recognize the ASG as a hybrid organization. This thesis concludes that the current Philippine counterterrorism strategy, although effective and in good shape, seems inadequate against hybrid organizations. Thus, this paper proposes that the Philippines reexamine its current CT strategy to be more appropriate, effective, and responsive against hybrid terrorist organizations. Full Text

Keywords: Abu Sayyaf, terrorism, crime, Philippines

This thesis examines Albania, one of the newest Alliance members, as a case study in the debate as to whether small states serve as security importers or providers in the North Atlantic Treaty Organization (NATO). It investigates the hypothesis that the benefits for NATO as a whole associated with Albania’s NATO membership outweigh the costs. Albania’s accession to NATO, the evolution of its roles, and its potential for expanded contributions are evaluated to assess the advantages and costs of Albania’s membership in the Alliance. This project places Albania’s NATO membership since 2009 in the context of its independence since 1912 in order to provide insight regarding Albania’s decision making and motivations. It also analyzes Albania’s contributions to NATO during its Partnership for Peace (PfP) membership in 1994–2009 and as an Alliance member since 2009. This thesis concludes that despite its weak economy, domestic issues, and numerically small military forces, Albania is a valued member of the Alliance that provides important capabilities in support of NATO’s core tasks. Full Text

Keywords: Albania, NATO, partnership, membership, PfP, small states, enlargement, North Atlantic Treaty, military reforms
Unmanned aerial systems (UAS) and their meteoric rise in popularity among hobbyists and commercial users have created a sense of urgency among lawmakers to develop a strategic policy to facilitate domestic UAS integration into the national airspace. Local municipalities and state agencies are initiating legislative efforts to develop best practices, ordinances, and policies in the absence of a structured legal framework for UAS expansion. The city of Phoenix is among those seeking solutions to the question of how the city and police department can develop and implement a strategic guidance policy governing UAS integration to best serve the interests of government and community. This research effort utilizes the five-step process contained within the multi-goal policy analysis research design method. This process is ideal for conducting policy analysis in which there are multiple policy outcomes or when these outcomes cannot be comparatively quantified equally. This academic effort constructs the identified alternative outcome solution within a specified problem segment to present a solution compliant with industry standards and directed toward the intelligent non-specialist end user. The product deliverable results in a strategic policy guidance strategy that is transparent and falls within an accountability framework.

Keywords: drones, unmanned aerial systems (UAS), unmanned aerial vehicles (UAV), strategic policy guidance, legislation, policy analysis, Eugene Bardach, threat, cyber, law enforcement, public safety, military, privacy, Fourth Amendment, intelligence, surveillance, reconnaissance (ISR)

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A DHS SKUNKWORKS PROJECT: DEFINING AND ADDRESSING HOMELAND SECURITY GRAND CHALLENGES

Calvin Bowman–Senior Policy Advisor, Mayor's Office of Emergency Management, Baltimore, MD
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs
Co-Advisor: Jack Thorpe, Worldwide Incident Command Services

What global grand challenges do we face today that will have an impact on the homeland security landscape 25 years from now? Today, a grand challenge is intended as a call-to-action for a given field, to find the potential solution for a moonshot problem. This thesis recommends potential methods and organizational capacity requirements for Department of Homeland Security (DHS) science and technology (S&T) based on a focused comparison of three cases: XPRIZE, Defense Advanced Research Projects Agency (DARPA), and DHS S&T. This research shows that both XPRIZE and DARPA have a consistent record of innovation and disruption that have transformed contemporary life through, for example, the Internet, space travel, cloud computing, GPS, artificial intelligence, virtual reality, and satellite imagery. However, DHS S&T has an uneven history and uninspiring track record of using research and development to deliver results. Through a contemporary application of smart practices used by XPRIZE and DARPA, DHS can better prepare for today's shifting technological threat environment. DHS's current approach to grand challenges is local and linear when it should be global and innovative. Better defining moonshot problems will lay the foundation for S&T to adopt pioneering strategies and to harness the massive potential of the crowd. These strategies will further drive innovation, the cornerstone to solving tomorrow’s grand challenges.

Keywords: grand challenge, moonshot, DARPA, XPRIZE, Skunkworks, innovation, global, science and technology, homeland security, Department of Homeland Security, exponential, visioneering, visioneers, use-inspired, crowdsourcing, prize competition, Massive Transformational Purpose, Archon XPRIZE, Human
Genome Project, Moore’s Law, research and development, Peter Diamandis, Ansari XPRIZE, market failure, technology, stealth technologies, Pasteur’s quadrant, Heilmeier Catechism, Homeland Security Advanced Research Projects Agency, HSARPA, DHS, strategic planning, disruptive technology, Strategic Foresight Initiative, FEMA, project management triangle, triple constraint

FRACKING: UNINTENDED CONSEQUENCES FOR LOCAL COMMUNITIES
Chad David Stangeland–Assistant Chief, Moorhead Fire Department, Moorhead, MN
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Thomas Mackin, Center for Homeland Defense and Security
Co-Advisor: Rudolph Darken, Department of Computer Science

The advent of hydraulic fracturing and the ability to bore horizontal wells have changed the energy industry for better and worse since 2005. Advancements have dramatically increased the extraction of oil from shale, but the controversial process, commonly known as fracking, has transformed North Dakota’s Bakken into a major producer of oil that has affected global oil markets. The questions asked in this thesis are as follows: What are the effects of unconventional shale oil exploration on local communities? How can they prepare for, prevent, mitigate, and recover from the socioeconomic impacts associated with shale oil exploration? What happened at the Bakken served as a case study to evaluate the holistic impact of fracking on the environment and socioeconomics of local communities at the epicenter of shale oil production. This study included an evaluation of crucial environmental issues: water consumption, water quality, air quality, wastewater disposal, and seismic activity in western North Dakota. Socioeconomic concerns comprised population growth, housing availability, employment rate, community growth, taxes, infrastructure needs, and crime rate. An analysis of these impacts leads this thesis to offer six recommendations that local decision makers should consider as they strive to implement risk-reduction strategies and policies for their communities. Full Text

Keywords: fracking, shale oil, hydraulic fracturing, Bakken

BRIDGING THE GAP: PROSPECTS FOR REFORM AND RECONCILIATION IN POST-CONFLICT SRI LANKA
Chaminda Arjuna Bandara Tennakoon–Lieutenant Colonel, Sri Lanka Army
Master of Arts in Security Studies (Civil-Military Relations)
Advisor: Carolyn Halladay, Center for Civil-Military Relations
Co-Advisor: Cristiana Matei, Center for Civil-Military Relations

Seven years into the peace following Sri Lanka’s civil war between the Sinhalese and Tamils, society remains divided. Yet a permanent peace between both communities is essential to the nation. This thesis examines the prospects for a post-conflict durable reconciliation process in Sri Lanka that can create a lasting solution to the Sinhalese-Tamil dispute. It argues that if the joint leadership of the Sinhalese and Tamils embrace accommodation, tolerance, and compromise, then a meaningful reconciliation may follow in Sri Lanka. Similarly, by establishing an internationally engineered Truth and Reconciliation Commission to examine the alleged human rights violations at the last stage of the conflict, Sri Lanka may complicate the reconciliation process and may even further polarize the Sinhalese and Tamils. To support these arguments, this study evaluates the core issues and the past reconciliation efforts by different stakeholders in the conflict. Additionally, this thesis explores the South African Truth and Reconciliation Commission as a case study to find its relevance in the Sri Lankan context. Subsequently, the study identifies the prevailing obstacles to the reconciliation process after analyzing the perceptions of the Sinhalese, the Tamils, the Muslims, and the international community.
Finally, it reveals that a degree of uncertainty overshadows the ongoing reconciliation process mainly due to the absence of a meaningful dialogue among the Sinhalese and the Tamils in the country. Full Text

Keywords: reconciliation, government of Sri Lanka, Sinhalese, Tamils, Muslims, LTTE, international community, transitional justice

VOLUNTEER FLYING ORGANIZATIONS: LAW ENFORCEMENT’S UNTAPPED RESOURCE

The following paper has been recognized as outstanding by its department.
Christopher Laird–Lieutenant Colonel, United States Air Force
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Erik Dahl, Department of National Security Affairs
Second Reader: Laura Adame, Department of Defense Analysis

Given the fiscal constraints of today’s law enforcement environment, many local police and sheriff agencies are unable to fully implement an aviation division due to the inherent costs to operate aircraft and pay professional law enforcement pilots. To cope with the extreme costs, some smaller police forces around the country have relied on the help of volunteer civilian pilots to augment law enforcement based aviation operations. This thesis uses recommendations of the Public Safety Aviation Accreditation Commission (PSAAC) to provide a foundational understanding of the critical aspects of running a law enforcement aviation division. By using PSAAC as the foundation, this thesis compares the aviation divisions of the following agencies: California Highway Patrol (CHP), Monterey County Aero Squadron (MCAS), and Lane County Sheriff’s Office (LCSO). Comparing the all-volunteer divisions of MCAS and LCSO to the professional force of CHP yielded a list of best practices for the law enforcement aviation community. Full Text

Keywords: Public Safety Aviation Accreditation Commission, California Highway Patrol, Monterey County Aero Squadron, Lane County Sheriff’s Office, Civil Air Patrol, volunteer flying organizations, law enforcement aviation, law enforcement volunteers

CRIMINAL VIOLENCE AND STATE RESPONSES IN THE NORTHERN TRIANGLE

Clinton Cabe–Lieutenant, United States Navy
Master of Arts in Security Studies (Western Hemisphere)
Advisor: Diego Esparza, Department of National Security Affairs
Second Reader: Thomas Bruneau, Department of National Security Affairs

This thesis analyzes the effect of high levels of criminal violence on military missions and civil–military relations. Specifically, it examines how the criminal violence in El Salvador, Guatemala, and Honduras changed the militaries and subsequently altered the civil–military relations in each country. In order to determine the change, each country is evaluated in terms of military missions immediately after transitioning to a civilian democracy and then again in the present day. Similarly, each country is then evaluated for the state of civil–military relations at the end of military authoritarianism, and then again in the present day. The results of the research show that the militaries have changed in three distinct ways: (1) the overall missions have shifted from traditional to internal, (2) the equipment used and procured is best suited for internal missions, and (3) the doctrine and training of the militaries supports an internal role. The civil–military relations research shows that there is an imbalance as a result of the criminal violence. The violence minimized the time for civilians to fully establish defense knowledge and civilian-controlled institutions, such as the Ministry of Defense, resulting in a heavily involved and politicized military. Full Text

Keywords: military missions, civil–military relations, El Salvador, Guatemala, Honduras, criminal violence
Employing a theory from the natural sciences to analyze a topic of social sciences is a procedure that can benefit decision makers, who can avoid mistakes by testing their decisions with the help of mathematical models. This thesis provides an overview of Chaos Theory—why it has been accepted in the natural sciences, specifically in physics—and whether it can be relevant for the international relations domain of social sciences. The applicability of Chaos Theory to the physics domain is examined through the OGY (Ott, Grebogi, Yoke) method and its applications. For the international relations domain, Chaos Theory is modeled in two specific international relations puzzles, bipolarity and democratic peace, to show the utility of the theory in this social science field. The results of the model are compared with the conventional international theories of Liberalism and Realism. The comparative analysis between the use of Chaos Theory in physics and in international relations issues, respectively, shows that for the former we have controllability of chaotic phenomena, and for the latter, it is applicable and helpful. This thesis concludes that the theory of Chaos is a universal theory that is applicable to both natural and political sciences. 

Keywords: Chaos theory, international relations, social sciences, physics, driven damped pendulum, intelligence, post-structuralism

Japanese Prime Minister Shinzo Abe’s two premierships were different from one another, with his second tenure proving to be relatively successful. This study compares the two Abe administrations, focusing on agenda setting, economic policy, election tactics, and security policy. It provides relevant explanations for Abe’s political success in his second administration. Abe’s pragmatism in statecraft mainly originated from his own political experiences and was crucial for accumulating his political capital and realizing security policy. At the domestic level, political influence from former administrations, Abe’s unrivaled political performance within the Liberal Democratic Party (LDP), the weakness of opposition parties, and an economic downturn influenced his political dominance. Regionally, the stronger U.S.-Japan alliance and an increase in Japan’s security concerns about China and North Korea supported the development of Abe’s security agenda. This analysis has implications for the future of Abe’s normalization trajectory. Abe’s dominance may continue; weak domestic checks and balances and the regional political situation are likely to remain the same. Abe’s further success will ultimately depend on the outcome of his economic policy, which, in turn, may enable his efforts to amend the constitution so that Japan can maintain its own armed forces rather than a Self-Defense Force.

Keywords: Abe, first Abe administration, second Abe administration, political success and failure, domestic policy, security policy, pragmatism, political environment, normalization, Liberal Democratic Party (LDP)
ANALYSIS OF A MULTI-DISCIPLINARY APPROACH TO GUN MISUSE AND THE NEED FOR A PARADIGM SHIFT IN TERMINOLOGY
Damon Arnold–Colonel, United States Army National Guard (Ret.)
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Christopher Bellavita, Department of National Security Affairs
Second Reader: Lauren Wollman, Center for Homeland Defense and Security

The threat of gun misuse occurs against the backdrop of historical, cultural, and legal perspectives within which guns are immersed. This thesis explores the potential for collaboration among the medical, legal, and homeland security disciplines when confronting a commonly held threat, such as gun misuse. Currently, each discipline has a unique and sometimes conflicting definitional view of what the term gun control actually means, as well as how it is to be operationally approached. What emerges within this thesis is the position that gun control is not even the correct term to use and should be avoided when addressing issues involving gun misuse. Rather, the use of the term gun misuse prevention appears to be more appropriate. Such a shift in perspective is not only more consistent with the gun misuse data presented, but also serves to dampen the polarization imposed by the use of the term control. Further, it provides a clearer path for stakeholders from both the public and private sectors to approach and make recommendations when confronting the issue of gun misuse that includes legislative, policy, and technological approaches. This type of approach may pave the way for addressing other issues of common interdisciplinary concern. Full Text

Keywords: interdisciplinary approach integration, collaboration, common disciplinary approach levels, paradigm shift from gun control to gun misuse prevention, conceptual framework analysis, technological approaches to gun misuse prevention, historical immersion of guns in American culture, constitutional rights, preservation and protection of gun owner rights

A VISUAL LANGUAGE FOR SITUATIONAL AWARENESS
David DeMarco–Captain, Everett Fire Department, Everett, WA
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs
Second Reader: John Rollins, Center for Homeland Defense and Security

What is the best way for the various responder silos to communicate situational awareness information across complex homeland security incidents? With the advent of wireless data networks, homeland security responders have the opportunity to instantly communicate vast volumes of information across myriad local, state, and federal resources. Finding a common, interoperable language for a network-centric response environment is essential to avoid duplicating the patchwork of communication techniques in place today. A comparative analysis between the Department of Defense and the Department of Homeland Security finds the agencies have very similar situational awareness needs. The Department of Defense is more advanced in its development of networked situational awareness communication. The humble map lies at the heart of situational awareness tools and requires a common visual language to be interoperable. This thesis recommends a common national symbols set that visually communicates situational awareness across a network. Applying semiotic principles to symbols creates a visual metalanguage that answers not only What? and Where? questions, but also provides essential operational context by incorporating the attributes of incident resources into the symbols themselves. Full Text

Keywords: geographic information systems, emergency management symbols, visual communication, situational awareness, network-centric response, interoperability
A NEW MODEL FOR UNDERSTANDING INCIDENT MANAGEMENT
David Flamm–Deputy Director, Santa Clara County Office of Emergency Services, San Jose, CA
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Glen Woodbury, Department of National Security Affairs
Co-Advisor: Lauren Fernandez, Center for Homeland Defense and Security

The various sources of doctrine that practitioners use to conceptualize incident management result in inefficiencies, conflict, and misinterpretation. They can hinder or reduce operational success for incident management agencies and practitioners. Existing difficulties were validated through practitioner interviews and an in-depth literature review. Taking a more comprehensive and unified approach, a new incident management conceptual model is proposed and applied to several case examples. Conclusions, findings, and possible corrective measures are proposed to improve incident management doctrine. Full Text

Keywords: incident management, emergency management, crisis management, incident management model, incident management framework, incident management conceptual model

EVALUATING THE SUCCESS OF THE COMMANDER'S EMERGENCY RESPONSE PROGRAM IN HERAT PROVINCE, AFGHANISTAN
David Williams–Lieutenant Commander, United States Navy
Master of Arts in Security Studies (Strategic Studies)
Advisor: James Russell, Department of National Security Affairs
Second Reader: Zachary Davis, Department of National Security Affairs

The purpose of this thesis is to determine if the Commander’s Emergency Response Program (CERP) achieved its intended goals in Herat Province, Afghanistan. The thesis uses a qualitative approach, gathering information and observations from CERP projects completed in Herat Province, Afghanistan. Satellite images of projects initiated in 2008 and 2009 were investigated to determine if they have produced long term, positive effects for the people of Herat province. Utilizing a list of 52 projects, it was determined that 54% of the projects had been successful while 6% were judged to be failures; the results of 40% of the projects are unknown. The program was effective at achieving its short-term goals; however, the long-term results will not be known until the Afghan government becomes self-sustaining. In future conflicts utilizing CERP-like systems, it is recommended that commanders and managers receive more thorough training prior to administering the program. Full Text

Keywords: Commander’s Emergency Response Program, Herat, Afghanistan

ONE-PARTY DOMINANCE: FUTURE POLITICAL IMPLICATIONS FOR THE CONSERVATIVES IN SOUTH KOREA
David Yu–Captain, United States Air Force
Master of Arts In Security Studies (Far East, Southeast Asia, The Pacific)
Advisor: Robert Weiner, Department of National Security Affairs
Second Reader: Jessica Piombo, Department of National Security Affairs

This thesis poses three questions: What is one-party dominance? What factors have been identified as encouraging the development of dominant parties in genuinely democratic systems? Do these characteristics apply to the conservative party in South Korea? This thesis focuses on pork barrel politics, fragmentation of opposition parties, and partisan control of the media as possible factors encouraging one-party dominance. To what extent are these structural advantages that the conservatives might hold in government and society, and could these lead to dominance by the conservative party? The thesis finds that the conservatives and progressives...
both take part in pork barrel politics and both influence the media; the progressive party is more fragmented than the conservatives and this gives the conservatives an advantage, but only a weak one. Full Text

Keywords: one-party dominance, Korean politics, Korean government

DEPLOYMENT OF THE MILITARY IN POST-CONFLICT RECONSTRUCTION: IMPLICATION FOR DEMOCRATIZATION IN SRI LANKA
Don Kapila Sarath Kumara Dolage–Lieutenant Colonel, Sri Lanka Army
Master of Arts in Security Studies (Civil-Military Relations)
Advisor: Anshu Chatterjee, Department of National Security Affairs
Co-Advisor: Cristiana Matei, Center for Civil-Military Relations

How does post-conflict militarization affect democratization in Sri Lanka? In 2009, Sri Lanka ended three decades of counter-insurgency action with the separatist LTTE. Yet the military remains active in the reconstruction processes. Critics describe the deployment of the military in post-conflict reconstruction as an impediment to democratization. This thesis, however, argues that the deployment of the military in post-conflict reconstruction both positively and negatively affects democratization processes in Sri Lanka. This thesis also studies the political developments from 1948 to 2016 that resulted in the deployment of the military internally. Then, it analyzes the effects of such military roles toward democratic consolidation and civil-military relations within the frameworks of analysis provided by Juan J. Linz and Alfred Stepan, and Thomas C. Bruneau and Florina Cristiana Matei. This thesis finds that post-conflict militarization positively affects democratic consolidation in the short term but negatively in the long term. It also finds both positive and negative effects toward democratic civil-military relations. Sri Lanka presents a unique case because militarization helped the economic growth of the country during the conflict. Hence, this research will contribute to the studies on the effects of post-conflict militarization toward democratization theoretically, and in the South Asian context. Full Text

Keywords: Democratization, democratic consolidation, civil-military relations, militarization, post-conflict reconstruction, effectiveness of the military, democratic civilian control of the military

INCREASING ROAD INFRASTRUCTURE CAPACITY THROUGH THE USE OF AUTONOMOUS VEHICLES
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Thomas Mackin, Center for Homeland Defense and Security
Co-Advisor: Rudy Darken, Department of Computer Science

Roadway infrastructure is a critical component to U.S. homeland security. Overland transportation affects the national economy, emergency services, defense, and communication systems. This thesis illustrates the capacity increases to roadways enabled by autonomous vehicle technology. Public policy can enhance the adoption rate of autonomous vehicles to maximize the benefit of this emergent technology on the roadway system. A policy analysis provides a comparison of options and outlines regulations that will be needed to ensure the safe adoption of autonomous vehicle technology nationally. Full Text

Keywords: autonomous vehicles, driverless vehicles, road infrastructure

Dongwoo Kim–Major, Republic of Korea Air Force

Master of Arts In Security Studies (Far East, Southeast Asia, The Pacific)

Advisor: Wade Huntley, Department of National Security Affairs

Second Reader: Michael Glosny, Department of National Security Affairs

The ROK-U.S. alliance is facing a new security circumstance due to the rise of China and the deepening nuclear ambition of the DPRK, along with U.S. military spending reduction by the sequestration. The research question of this thesis is this: How has U.S. military spending affected the cohesion of the ROK-U.S. alliance since 1953? No studies have researched the cohesion of the ROK-U.S. alliance through robust empirical analysis. To answer this question empirically, this thesis examines three indicators for measuring the cohesion of the ROK-U.S. alliance: institutionalization, capacity of the USFK, and the ROK-U.S. combined exercises. In addition, this thesis analyzes three categories of the U.S. military spending to determine whether a certain relation exists between the cohesion of the ROK-U.S. alliance and U.S. military spending. Through empirical analysis, this thesis concludes that there is no certain relationship between the cohesion of the ROK-U.S. alliance and U.S. military spending. Comparing two variables, the cohesion of the ROK-U.S. alliance and U.S. military spending, this thesis found a striking difference between the Cold War and the Post-Cold War. Based on the variable findings, this thesis explores the implications for future tasks for the ROK-U.S. alliance under new security circumstances. Full Text

Keywords: ROK-U.S. alliance, cohesion of the ROK-U.S. alliance, institutionalization, USFK, ROK-U.S. combined exercise, U.S. military spending

REDUCING THE THREAT OF NUCLEAR TERRORISM—A REPORT CARD ON THE OBAMA ADMINISTRATION’S EFFORTS

Drew Hargraves–Captain, United States Army

Master of Arts in Security Studies (Combating Terrorism: Policy & Strategy)

Advisor: James Moltz, Department of National Security Affairs

Second Reader: Zachary Davis, Department of National Security Affairs

This thesis seeks to explain if President Barack Obama’s efforts to reduce nuclear terrorism have had a meaningful impact. Key areas of observation include how well efforts have been implemented and how effectively the president has fostered domestic and international support. Early in his presidency, President Obama declared to the world that the United States would lead a concerted effort to reduce the threat of nuclear terrorism. Combined with the Nuclear Security Summits, the president’s efforts quickly established reducing the threat of nuclear terrorism as a top priority for his administration. Over the ensuing eight years, President Obama diligently supported nonproliferation measures by enhancing the domestic and international nonproliferation architecture. The president’s integrative approach wove nonproliferation efforts together that had, traditionally, not been used to reduce the threat of nuclear terrorism. The findings of this thesis indicate that most of the programs were successful but problems remain, particularly in areas linked to further arms reductions and international nonproliferation. The next president can further these efforts by continuing the integrative approach, crafting a more cooperative relationship with Congress and expanding threat reduction activities beyond Russia. Full Text

Keywords: nonproliferation, proliferation, nuclear terrorism, nuclear, nuclear weapon, fissile materials, nuclear security summit, Barack Obama, cooperative threat reduction, Russia, Four-Year Effort, Congress
RECYCLED BRICKS: EXPLORING OPPORTUNITIES TO REINTEGRATE RETURNING AMERICAN FOREIGN FIGHTERS USING EXISTING MODELS
Edward Scott III–Supervisory Federal Air Marshal, Federal Air Marshal Service, Atlantic City, NJ
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Lauren Wollman, Center for Homeland Defense and Security
Co-Advisor: Carolyn Halladay, Center for Civil-Military Relations

Foreign fighters have been engaged in conflicts for hundreds of years, but the sheer number of foreign fighters who have traveled to Iraq and Syria during the last five years is unprecedented. The United States is not sure what to do with American ex-foreign fighters who leave their group and want to return to the States and peacefully reintegrate back into society, since there is currently no reintegration program for ex-foreign fighters. This thesis explores how the United States can develop an ex-foreign fighter reintegration strategy using existing, analogous models. This study identifies two groups that possess similar characteristics to foreign fighters: U.S. street gangs and the U.S. military. Utilizing the conceptual frameworks of street gangs and the military, the conceptual life cycle of foreign fighters is detailed to ascertain the practicality of developing a foreign-fighter reintegration program utilizing the existing reintegration programs of street gangs and the military. Based on the findings that foreign fighters, street gang members, and formerly deployed service members are very similar, I recommend the development of a multidisciplinary reintegration program for retuning ex-foreign fighters using specific aspects of each previously referenced reintegration program. Full Text

MISSING THE MARK: IS ICS TRAINING ACHIEVING ITS GOAL?
Eric Seibel–Assistant Chief, Point Pleasant Fire Protection District, Boone County, KY
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: David Brannan, Center for Homeland Defense and Security
Co-Advisor: Carolyn Halladay, Center for Civil-Military Relations

The Incident Command System (ICS) was originally adopted in the 1970s as a fire service emergency management system. Following the events of September 11, 2001, the National Response Plan adopted ICS across all hazards and disciplines in order to unite responders under the same management system during emergencies. However, creating one system to service so many disparate agencies and response types was a massive undertaking, and the system’s effectiveness has since been questioned. To operate in ICS, responders must engage in the adult learning process, which requires social interaction with an engaged instructor and active peers. Before the system can be judged properly, we must ensure personnel have been trained and are implementing the system adequately. This thesis examines the adult learning process and the keys to ensuring that learning and behavior change actually occur. It further examines ICS courses’ current online delivery system and recommends evaluating this system to engage the social learning required for successful cultural change. The thesis also critiques the ICS training measurement method and recommends changes to better measure system learning and utilization. Full Text

Keywords: ICS, NIMS, training
EVALUATING COMMON HYPOTHESES FOR VIOLENCE IN CENTRAL AMERICA
Geoffrey Ellis–Lieutenant, United States Navy
Master of Arts in Security Studies (Western Hemisphere)
Advisor: Diego Esparza, Department of National Security Affairs
Second Reader: Thomas Bruneau, Department of National Security Affairs

This thesis endeavors to bring analytical clarity to the assumptions that inform proposed policy solutions to the alarming rise in violence in Central America. The thesis evaluates three of the most common hypotheses for citizen insecurity in the region: the impact of structural economic problems like poverty and inequality, the efficacy of state criminological approaches, and the effectiveness of internal security institutions. To evaluate each hypothesis, the thesis uses a comparative case analysis of Nicaragua and El Salvador. In spite of dramatic divergence in violence outcomes, the two countries share many variables, including geographical proximity, economic development challenges, a history of civil conflict, and democratic transition in the 1990s. Using homicide rates as the most reliable indicator of violence, the findings reveal that structural economic problems like poverty and inequality have only an imperfect correlation with citizen security. On the contrary, variables that correlate more closely with peaceful security outcomes include the effectiveness of security institutions—characterized by sophisticated plans, sound structures, and adequate resources—and rigorous criminological approaches as characterized by community involvement, efficient intelligence-gathering mechanisms, and recidivism reduction programs. The thesis’s implications pertain not only to Central America but also to troubled regions throughout the world. Full Text

Keywords: Nicaragua, El Salvador, Central America, violence, homicide, police, military, intelligence, citizen security, insecurity, poverty, inequality, criminology, rational choice theory, institutionalism, effectiveness, foreign assistance, CARSI

THE MUTED VOICE OF THE CATHOLIC CHURCH IN ANGOLA

The following paper has been recognized as outstanding by its department.
Jeffrey Drewiske–Lieutenant Commander, United States Navy
Master of Arts in Security Studies (Middle East, South Asia, Sub-Saharan Africa)
Advisor: Rachel Sigman, Department of National Security Affairs
Second Reader: Diego Esparza, Department of National Security Affairs

This thesis explores the role of the Catholic Church in Angola and compares it to the influence of the Church in two other former Portuguese colonies: Mozambique and Brazil. More specifically, this thesis asks how the Catholic Church has permeated each society and spread the values and rights pronounced by the Second Vatican Council. Using a comparative case study methodology, this thesis investigates why the influence of the Church, specifically with respect to the development of rights and freedoms, was weaker in Angola than in Brazil and Mozambique despite a common colonial and religious heritage. The analysis suggests that state resistance to international influence, or gatekeeping, is a significant factor in understanding the relationship between transnational actors and civil society, as suggested by the boomerang pattern. Rents from resource revenue enabled the Angolan elite to sustain their gatekeeping efforts longer than others. This argument suggests the need to bring together theories of transnational advocacy and the resource curse to better understand when and why transnational actors influence domestic politics. These insights offer potential lessons to policy makers as they search for opportunities to effectively promote liberal democracy and constructively engage states in the developing world. Full Text

Keywords: Catholic Church, Second Vatican Council, boomerang pattern, gatekeeper, human rights
**DISASTER THREAT AND THE DUNNING-KRUGER EFFECT**

Jeffrey Siems—Fire Marshal, City of Edina, MN

Master of Arts in Security Studies (Homeland Security and Defense)

Advisor: Lauren Fernandez, Center for Homeland Defense and Security

Co-Advisor: Glen Woodbury, Department of National Security Affairs

Decision making is a cognitive process of selecting a course of action or belief among multiple alternative choices. However, pressures of time, circumstance or unappreciated wickedness can create a situation where an ostensibly illogical choice overtakes rational decision making. Sometimes, when evaluated by those considered experts, decisions made in disasters seem irrational, harmful, or iniquitous in nature. A cognitive bias known as the Dunning-Kruger effect posits that individuals who lack the necessary skills to make rational decisions can also lack the metacognitive ability to realize that their decision making is flawed. The Dunning-Kruger theory theorizes this can result in the individual exhibiting overconfidence to adequately address the threat. Essentially, the unskilled are unaware and overconfident. This thesis investigates the occurrence of the Dunning-Kruger effect in individual decision making during disasters. The author analyzed 12 indicators by coding interview transcripts of disaster survivors. This thesis includes two case studies: Hurricane Katrina, representing a natural disaster, and the World Trade Center attacks, exemplifying a human-caused disaster. In each case, 30 transcripts of survivors were reviewed, and Dunning-Kruger indicators were present in both case studies. How individuals process realized or perceived threat is important for homeland security policy makers. Future research should be conducted to better understand how Dunning-Kruger effects influence disaster decision making. Full Text

Keywords: Dunning-Kruger theory, Dunning-Kruger effects, disaster threat, human behavior, World Trade Center, Hurricane Katrina, natural disaster, human caused disaster, cognitive bias, decision making, disaster survivors

**RULES AND A RUBRIC COULD BE USED TO ASSESS THE OPENNESS OF A HOMELAND SECURITY ENTERPRISE SOCIAL NETWORK**


Master of Arts in Security Studies (Homeland Security and Defense)

Advisor: Nadav Morag, Center for Homeland Defense and Security

Co-Advisor: Paul Smith, Department of National Security Affairs

The Homeland Security Enterprise (HSE) lacks a process to create a body of knowledge to unify its stakeholders. This thesis asked if a set of rules and an assessment methodology could be applied to three wikis to illustrate how the rules can improve the quality of information-sharing across the HSE. The research for this thesis applied a set of rules and an assessment methodology to case studies testing the hypothesis that wikis are a good example of an enterprise social network (ESN) and could serve to meet the information needs of the HSE. The methodology will apply Bloom's Taxonomy to a rubric and establish a current status, as well as plan a path ahead for development. This thesis investigated the demand for improved information sharing and some existing platforms, and developed an assessment rule set and rubric. It then discovered the openness strengths and weaknesses of three case studies using the rules and rubric. Our conclusions are that the rules and rubric are adequate to develop paths to improvement for existing platforms, as well as to aid in the planning of future ESNs with the intention of developing a wiki-based homeland security-centric ESN designed to create an HSE body of knowledge. Full Text

Keywords: information sharing, crowdsourcing, collective intelligence, wiki, enterprise social network, and rubric
In 2010, North Korea launched an artillery bombardment of South Korea’s Yeonpyeong Island, killing four, wounding 18, and damaging over 100 buildings. Despite conventional military superiority, the Republic of Korea-United States (ROK-U.S.) alliance failed to deter this significant North Korean low-intensity provocation (LIP). This thesis examines the Yeonpyeong deterrence failure to ask how the ROK-U.S. alliance can deter North Korean LIP in the future. It examines the requirements for conventional deterrence, identifies traits that distinguish conventional and nuclear deterrence, and develops an original matrix of conventional deterrence criteria that can be applied to specific cases. The thesis then utilizes this matrix for a structured case study of the Yeonpyeong bombardment. The thesis finds that most of the criteria for successful conventional deterrence were absent prior to the Yeonpyeong bombardment, indicating multiple reasons for deterrence failure. Among other factors, the alliance ignored intelligence regarding increased North Korean military deployments near the island and had not demonstrated a likelihood of response in similar incidents in the past. The conclusions provide numerous lessons applying to both future studies of conventional deterrence effectiveness and the policy requirements for the ROK-U.S. alliance to successfully deter LIP by an increasingly dangerous North Korean regime.

Keywords: conventional deterrence, ROK-U.S. alliance, bombardment of Yeonpyeong in 2010, denial capability, punishment capability, credibility, military balance, past actions theory, red line, North Korea, low intensity provocation, counter provocation plan, extended deterrence

This thesis sought to analyze why the Homeland Security Enterprise (HSE) disregards practices that conform to the scientific understanding of human fatigue and to identify the effective human-error mitigation practices of two other high-consequence fields that may be useful to the HSE. Using the constant comparative method, the command center work environments of the HSE, nuclear power, and air traffic control were analyzed with regard to fatigue-mitigation practices and policies. Despite remarkable similarities in their public safety function and human-technology interface, the resulting grounded theory highlights key differences. In contrast to nuclear power and air traffic control, the HSE has yet to record a serious fatigue incident to serve as a catalyst for change, and unlike those two industries’ strong safety cultures, the HSE command centers continue to operate in a deeply rooted bravery culture that prevents the focus on fatigue issues. This thesis brings attention to a clear safety gap and makes practical recommendations that would facilitate the HSE’s intentional movement toward a safety culture through the implementation of comprehensive fitness-for-duty programs, multilevel fatigue mitigation training, and the gathering and continual review of human-error data in its command-center work environments.

Keywords: fatigue, sleep deprivation, human factors, human error, catastrophe, ergonomics, circadian rhythms, cognitive ergonomics, accidents
This thesis analyzes the motivations behind China’s decision to conduct extensive land reclamation and outpost construction projects at seven locations in the Spratlys beginning in late 2013. I examined two hypotheses: first, China’s actions were mainly undertaken in reaction to the actions of rival claimants and the United States; and second, China acted primarily to extend its power projection capabilities. The evidence shows that China’s decision to commence reclamation projects was ultimately driven by a desire to increase its power projection capabilities in the South China Sea. This desire predates the internationalization of the South China Sea dispute in 2009 and was a result of China’s military growth and its enhancements to its own power projection capabilities. The proximate cause of China’s decision to begin these activities in late 2013 was a perceived need to react to its rivals, which from China’s perception had grown increasingly willing to confront China on its South China Sea sovereignty claims. Ultimately, whether China continues pursuit of enhanced power projection capabilities will be determined by how China perceives the threat environment and the actions of others. Continued perceived provocations from China’s rivals may drive China toward further enhancement of its military power projection capabilities. Full Text

Keywords: China, Spratly Islands, Spratlys, reclamation, reclaimed islands, artificial islands, outpost expansion, PLA, power projection, reactionary, reactive assertiveness

AN ONTOLOGY OF POWER: PERCEPTION AND REALITY IN CONFLICT
Jonathan Gaddy–Director, Calhoun County Emergency Management Agency, Jacksonville, AL
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Anders Strindberg, Center for Homeland Defense and Security
Second Reader: Lauren Wollman, Center for Homeland Defense and Security

Strategy is a problematic yet often-invoked concept. This thesis explores the 2015 U.S. National Security Strategy (NSS), philosophy, and social theory to develop an alternative framework for the formulation of strategy in the security domain. The 2015 NSS is analyzed for consistency in its concepts and categories. A model of strategic agency is proposed as an alternative framework for developing security strategy. The strategic agency model draws upon actor-network theory and utilizes a novel approach whereby ontology is conceived as a network of power relations. Strategic agency provides a mechanism whereby a perceiving self-observer (Strategos, the strategic agent) may identify, describe, and explain the behavior of other actors in the strategic environment. This thesis relates how the perspective of Strategos moves along a continuum of ontology and epistemology in framing its world, with implications for accurate modeling of social systems. A model for analytical use in strategy development is presented along with insights into how such a model might be employed for analytical, planning, and operational purposes. Full Text

Keywords: strategic agency, national security, strategy, power, international relations, actor network theory, agencement, identity, behavior, governmentality, ontological security, policy, translation, anti-history, philosophical pluralism, instrumentalism
FROM TRAGEDY TO STRATEGY: ASSESSING THE FDNY’S POST-9/11 STRATEGIC PLANNING PROCESS
Jonathan Pistilli—Division Chief, Fire Department of New York
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs
Second Reader: Lauren Wollman, Center for Homeland Defense and Security

All Fire Department of the city of New York (FDNY) strategic plans have been formulated using the same process, implemented in the post-9/11 environment. The process must be assessed to ensure it supports the FDNY’s mission in an environment that has significantly changed and continues to evolve. Since September 11, 2001, significant weather events, including blizzards, hurricanes, and Superstorm Sandy, have challenged the FDNY’s capabilities and magnified the threat of global climate change. Terrorism keeps evolving; the use of fire as a weapon and active shooter tactics push the boundaries of the FDNY’s response paradigms. Its core responsibilities are changing, with fire-related incidents dropping steadily and medical incidents rising significantly. The FDNY has risen to all these challenges, analyzing and adapting to threats, innovating and adopting new technology, improvising and adjusting tactics, and modifying and amending operations. However, in the 12 years since its first strategic plan, strategic planning at the FDNY has not evolved to include a long-term perspective with future-oriented goals and effective performance metrics to stay ahead of the evolving environment. Implementing the recommendations in this thesis will realign and update the process, incorporating current concepts that will improve FDNY strategic planning now and in the future. Full Text

Keywords: strategic plan, strategic planning, strategic planning process, strategic management, strategic thinking, Fire Department of the City of New York, FDNY, Project Axiom

CHARTING A PATH TOWARD A SUSTAINABLE ROK SPACE PROGRAM
Jung Hun Jang—Major, Republic of Korea Air Force
Master of Arts in Security Studies (Far East, Southeast Asia, The Pacific)
Advisor: James Moltz, Department of National Security Affairs
Second Reader: Wade Huntley, Department of National Security Affairs

This thesis seeks to trace the origins of the Republic of Korea (ROK)'s initial strategy in space policy and to analyze the prospects and challenges of building effective and sustainable civil, commercial, and military space capabilities. To better understand the factors involved in developing a sustainable ROK space program, two sets of comparative case studies, both internal and external cases, are examined. The internal case studies consist of the ROK automobile and semiconductor industries, and the external case studies are of Israel’s and Australia’s space programs. The ROK space program exhibits considerable differences from the internal and external case studies in terms of policy direction, R&D investment, and human resources. Based on these findings, this thesis derives several conclusions. In order to take a path toward a sustainable space program, the ROK should redefine national needs and aspirations for its space activities; plan to expand private investment, especially in space R&D; invest in the space sector with a long-term vision; and continue to strengthen ties with international partners, especially its main ally, the United States. Full Text

Keywords: ROK space programs, space sustainability, catch up strategy, latecomer, Space Technology Ladder, space policy, space R&D investment, space human resources, ROK automobile industry, ROK semiconductor industry, Israeli space program, Australian space activity
CONNECTIONS AMONG COMMUNITIES: PREVENTING RADICALIZATION AND VIOLENT EXTREMISM THROUGH SOCIAL NETWORK ANALYSIS IN THE THREAT AND HAZARD IDENTIFICATION AND RISK ASSESSMENT FRAMEWORK
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Wayne Porter, Global Public Policy Academic Group
Co-Advisor: Glen Woodbury, Department of National Security Affairs

The evolution of socially connected networks of influence has created new ideological dimensions that motivate an individual to radicalize and to commit acts of violent extremism and terrorism. This thesis explored the viability of using social network analysis (SNA) as a tool in the nation's Threat and Hazard Identification Risk Assessment (THIRA) framework to determine whether factors (such as relationships and motivations) can be used to reduce the vulnerability of a community at risk of radicalization and violent extremism and to build resilience. Using literature that described core SNA principles and related fields of study, a theoretical framework was developed to illustrate how extremist ideologies and motivations are socialized within a particular network. This theoretical framework is assessed through a multi-case study analysis, examining an individual's radicalization process and programs to counter violent extremism in Australia and Scotland. This analysis ultimately suggested that incorporating the SNA methodology could be beneficial if included in the THIRA process. This thesis illustrates how a community could be provided the opportunity to mitigate against the process of radicalization by developing and targeting core capabilities that may help them build social capital and trust and to increase efficiency and availability of information sharing and social support intended to improve individual and community resilience. Full Text

Keywords: social network analysis, radicalization, violent extremism, terrorism, threat and hazard identification and risk assessment, countering violent extremism, prevention, social capital, resilience

POLICY SAFEGUARDS AND THE LEGITIMACY OF HIGHWAY INTERDICTION
Kevin Hood–Lieutenant, Virginia State Police
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Lauren Fernandez, Center for Homeland Defense and Security
Co-Advisor: Carolyn Halladay, Center for Civil-Military Relations

The strategy of highway interdiction was created to counter the negative consequences of drug trafficking organizations using highways to distribute contraband. Although there have been tangible results, the strategy has also resulted in the unintended consequences of racial profiling and illegal searches. This thesis addresses whether policy safeguards could help minimize improper practices of personnel conducting highway interdiction operations. This project convened a series of focus groups consisting of 11 state police organizations that provided information on policy safeguards and their purposes. This thesis examines seven major categories of policy safeguards to determine the level of implementation by the state police organizations. In addition, this thesis includes a comparative analysis of the implementation of policy safeguards and the number of personnel complaints filed to determine whether there is any correlation. Although the findings are not conclusive, the analysis identified potential benefits of implementing policy safeguards. Full Text

Keywords: complaints, effectiveness, implementation, interdiction, legitimacy, profiling, safeguards, strategy, trust, law enforcement
MORAL HAZARD: HOW THE NATIONAL FLOOD INSURANCE PROGRAM IS LIMITING RISK REDUCTION

Kevin Starbuck–Emergency Management Coordinator, Amarillo/Potter/Randall,
Office of Emergency Management, City of Amarillo, TX
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Glen Woodbury, Department of National Security Affairs
Second Reader: Christopher Bellavita, Department of National Security Affairs

Moral hazard occurs when people do not assume the full risk of an action or decision; they are not inclined to make a fully responsible or moral choice. Over the course of the last half century, federal government involvement in providing disaster assistance has greatly expanded. With this expansion, many believe that in providing disaster assistance, the federal involvement limits risk reduction and contributes to the rise of a moral hazard. Flooding and flood-related hazards are the most prominent and significant hazards in the United States, accounting for the highest percentage of major disaster declarations and direct economic losses. The National Flood Insurance Program (NFIP) aims to reduce the impact of flooding through hazard identification and risk assessment, floodplain management, and flood insurance. A study of the NFIP concludes that aspects of the program limit risk reduction, specifically the continued coverage of repetitive loss properties and use of subsidies to desensitize risk. Furthermore, the long-term sustainment and resilience of the program are compromised by failures of policymakers to adjust for catastrophic losses. Identification of these issues provides a framework for consideration of the unintended consequences of federal government involvement in providing disaster assistance. Full Text

Keywords: moral hazard, flood, National Flood Insurance Program (NFIP), repetitive loss, insurance subsidies, significant loss events, disaster assistance, floodplain management, risk assessment, disaster recovery, flood insurance claim, pre-flood insurance rate map

SOURCES OF EVOLUTION OF THE JAPAN AIR SELF-DEFENSE FORCE’S STRATEGY

Kisung Nam–Captain, Republic of Korea Air Force
Master of Arts in Security Studies (Far East, Southeast Asia, The Pacific)
Advisor: Wade Huntley, Department of National Security Affairs
Co-Advisor: Robert Weiner, Department of National Security Affairs

The Japan Air Self-Defense Force’s (JASDF) activities, training, and weapons after the first decade of this century seem to deviate from an exclusively defense-oriented policy. This thesis investigates what is driving the evolution of JASDF’s strategy behind this behavior and what is the most influential driver of that evolving strategy. This thesis first examines the JASDF’s strategic changes in terms of ends, ways, and means, and assesses these changes through the concepts of defensive defense and offensive defense to illuminate the JASDF’s strategy. Then, this thesis analyzes four possible drivers of the JASDF’s strategic evolution: the People’s Liberation Army’s (PLA) air power, the North Korean threat, the conservative swing of Japanese domestic politics, and the offensive nature of the air strategy. This thesis argues that the JASDF’s strategy has evolved from the defensive defense strategy to the offensive defense strategy after the early 2000s. In addition, even though the evolution of the JASDF’s strategy is a combined result of the four independent variables, the strongest driver is the modernization of the PLA’s air power. Therefore, the improvement of the relationship between Japan and China is the most important factor in curtailing an arms race in Northeast Asia. Full Text

Keywords: Japan Air Self-Defense Force (JASDF), strategy, defensive defense, offensive defense, People’s Liberation Army (PLA), North Korea’s nuclear, North Korea’s missiles, conservative swing, air strategy, air power
IMPROVING RESOURCE ALLOCATION DECISIONS TO REDUCE THE RISK OF TERRORIST ATTACKS ON PASSENGER RAIL SYSTEMS
Lawrence King–Supervisory Transportation Security Inspector, Department of Homeland Security, Transportation Security Administration, New York, NY
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Thomas Mackin, Center for Homeland Defense and Security
Co-Advisor: Rudy Darken, Department of Computer Science

Passenger rail systems continue to be a prime target for terrorists. Since 1995, there have been hundreds of attacks targeting assets worldwide that have resulted in almost 1,000 deaths and more than 1,500 injuries. As evidenced by the March 2016 attack in Brussels, Belgium, the openness and accessibility of passenger rail facilities are attractive to adversaries. This thesis reviews the current approach to risk assessment used by system operators to counter threats and proposes a new model to improve resource allocation decisions, which is intended to reduce the risk of terrorist attacks on passenger rail. The use of the game theory attacker-defender methodology in deciding where to allocate security improvements will increase the security of systems in defending against attacks. Changing tactics require security professionals to continually enhance the security posture of rail systems to deter terrorists. Limited resources make the job of securing a passenger rail system more of a challenge today than ever before. Full Text

Keywords: passenger rail security, decision making, risk assessment, rail systems, metro, mass transit, subway, risk management, game theory, passenger rail bombing, attacker-defender methodology

IMPLEMENTING COMPSTAT PRINCIPLES INTO CRITICAL INFRASTRUCTURE PROTECTION AND IMPROVEMENT
Mark Molinari–Captain, New York City Police Department
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Erik Dahl, Department of National Security Affairs
Co-Advisor: Patrick Miller, Center for Homeland Defense and Security

Roads and bridges, as aspects of transportation that are at the center of critical infrastructure (CI), are central to evacuation and to emergency response. New York City CI needs an accountability and communication model to ensure future progress, focusing on maintenance and prioritized improvement. This thesis focuses on how a performance measurement system, such as the New York City Police Department's (NYPD) CompStat model, will improve and protect the critical infrastructure of New York City’s roads and bridges. The author uses over 20 years of NYPD managerial experience to demonstrate the successes of the NYPD’s CompStat program through its 22-year history and how those successes can be translated to improvement in accountability and communications in road and bridge construction and reconstruction. This thesis investigates CI issues, and multiple sample events demonstrate how using the CompStat model would have resulted in a different outcome. I make the recommendation to create a New York City Mayor’s Office of Infrastructure using New York City Emergency Management’s Emergency Support Functions (ESF) as a method of grouping agencies and private companies together to engage in pre-event non-emergency multi-agency conversations. Full Text

Keywords: CompStat, NYPD, Critical Infrastructure, CI, New York City Police Department, roads, streets
IN HARMONY WITH THE POPULATION: ETHNOMUSICOLOGY AS A FRAMEWORK FOR COUNTERING VIOLENT EXTREMISM IN THE SAHEL

Mathew Wenthe—Chief, Personnel Recovery and Special Operations, Air National Guard
Master of Arts in Security Studies (Homeland Security and Defense)
Advisor: Kathleen Kiernan, Center for Homeland Defense and Security
Second Reader: Lauren Wollman, Center for Homeland Defense and Security

Through continued efforts like the Pan-Sahel Initiative of 2002 and subsequent Trans-Saharan Counterterrorism Partnership initiated in 2005, the State Department and Department of Defense struggle to leverage interagency partnerships and multinational cooperation within the Sahel region to wage war on terrorism and enhance regional peace and security. While these programs have made modest progress through mil-to-mil engagements and U.S.-led military exercises in the region, they fail to understand and address the full scope of regional security issues in the Sahel to include transnational organized crime and centuries-old regional sovereignty disputes. If policy makers hope to achieve and maintain true situational awareness in such a dynamic environment, they must leverage all available tools. In a region like the Sahel, where music is a foundational component of the cultural heritage and modern communication channels, ethnomusicology becomes a valuable tool with which to build situational awareness and enhance engagement with the population. This thesis draws from ethnomusicology research theory, intergroup psychology principles, and network convergence and communications theory to create a framework for regional security studies in order to better understand intergroup dynamics in the Sahel, and works as a tool to map networks in the region. Using Mali as a case study, it recommends the application of ethnomusicological analysis to identify and address legitimate grievances within the population that provide exploitable leverage points for regional bad actors. Further, it suggests using the existing peer-to-peer cell phone music sharing network in the Sahel to identify convergence nodes to target illicit networks in the region. [Full Text]

Keywords: ethnomusicology, counter violent extremism, Trans-Saharan Counterterrorism Partnership, Mali, Sahel, Maghreb, psychology, Tuareg, music, digital media, art, multiculturalism, communication flow theory

SEEING EYE DRONES: HOW THE DOD CAN TRANSFORM CBRN AND DISASTER RESPONSE IN THE HOMELAND

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The threat of chemical, biological, radiological, and nuclear (CBRN) disasters is one of the most dangerous threats to the homeland. The United States has an opportunity to harness emerging technology to increase responder safety and improve situational awareness for civil authorities during response to natural or manmade CBRN disasters. This thesis explores the possibility of integrating small unmanned aircraft systems (sUAS) with video capability and CBRN detection and identification sensors for use by National Guard civil support teams. Existing policy and doctrine are insufficient to accommodate the fielding of such a capability. This thesis identifies and discusses these gaps. This thesis also conducts an analysis of similar Department of Defense and other national UAS policy and programs and offers recommendations to implement a new domestic sUAS policy. The recommendations provide the framework for implementing an innovative technology while addressing complicated issues, such as national airspace system integration, intelligence oversight, and training programs. [Full Text]

Keywords: DOD drones, chemical, biological, radiological, nuclear (CBRN), CBRN drones, drones in natural disasters, National Guard, civil support team, unmanned aircraft systems (UAS), small unmanned aircraft systems (sUAS), privacy, intelligence oversight, defense support of civil authorities
ORGANIZATIONAL IDENTITY: POSITIONING THE COAST GUARD FOR FUTURE SUCCESS IN AN EVOLVING ENVIRONMENT
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Co-Advisor: Glen Woodbury, Department of National Security Affairs

The Coast Guard is an organization entrusted with significant responsibilities in the maritime environment. Concerns about large numbers of aging assets scheduled to reach the end of their design service life has prompted the Coast Guard to initiate the replacement and modernization of its offshore maritime and aviation fleet. Due to an initial lack of acquisition expertise and less than adequate funding, the Coast Guard has been faced with making tradeoffs. The primary goal of this thesis is to determine how the Coast Guard’s organizational identity and strategic vision have impacted its ability to obtain necessary capabilities to satisfy mission requirements. This research also explores the Coast Guard’s social identity and the organization's current performance measures. This research employed historical analysis, social network analysis, program analysis, and social identity theory methods. This research concludes is that changing patronage lines and in-group characterization may have negatively impacted the Coast Guard’s ability to satisfy mission requirements. This thesis recommends that the Coast Guard reevaluate performance measurements that do not directly translate to the overarching strategic goals of the organization or of the Department of Homeland Security. Communication resources should focus on key figures associated with the budgetary and acquisitions processes. Full Text

Keywords: USCG, United States Coast Guard, DHS, Department of Homeland Security, missions, social identity, organizational identity, social network analysis, social structure, social categorization, social comparison, program analysis, performance measure, program analysis

THE IMPACT OF “DUTY TO WARN” (AND OTHER LEGAL THEORIES) ON COUNTERING VIOLENT EXTREMISM INTERVENTION PROGRAMS
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Countering violent extremism (CVE) programs are moving into the realm of intervention, diversion, and deflection. These programs require mental health professionals to conduct assessments, construct treatment plans, and provide the treatment. How can practitioners treat or divert individuals from the path to radicalization but also communicate when an individual remains a threat? An understanding of the laws that facilitate or restrict disclosure of confidential health information, combined with a structure to oversee the process, is critical. Research for this thesis has focused on federal and Maryland state laws pertaining to medical record confidentiality and the duty to warn. This legal analysis has determined that exceptions exist within medical confidentiality laws, enabling mental health practitioners to disclose when a threat exists, and that Maryland's duty-to-warn laws mandate that mental health practitioners have a duty to protect third parties from the actions of patients. Due to the varied disciplines involved in CVE, collaborative group models are suggested to structure the process. Full Text

Keywords: countering violent extremism, radicalization, intervention, diversion, deflection, duty to warn, duty to protect, multi-disciplinary team
UNCOMMON LAW: UNDERSTANDING AND QUANTIFYING THE SOVEREIGN CITIZEN MOVEMENT
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This thesis examines possible reasons why some organizations overuse the term “sovereign citizen.” To do so, the thesis discusses various behaviors that sovereign citizens typically undertake, describes activities that the law enforcement community and researchers classify as sovereign citizen-related, and demonstrates the incongruity in some of those attributions. This thesis also explores how various organizations at times incorrectly apply the domestic terrorist label to sovereign citizens, at variance with both state and federal law. The conclusion proposes behavioral markers as a common language for identifying and quantifying anti-government behavior. The conclusion also demonstrates ways in which organizations should apply the markers to better calculate and assess the sovereign citizen movement. Full Text

Keywords: sovereign citizen, domestic terrorism, terrorism statute, social identity theory, behavioral markers, common law, Posse Comitatus, militia, Patriot Movement, redemption theory, Bundy ranch, paper terrorism, uniform commercial code, false lien, Moors

A KEY TO ENDURING PEACE: REFORMS IN FEDERALLY ADMINISTERED TRIBAL AREAS OF PAKISTAN
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Co-Advisor: Robert Looney, Department of National Security Affairs

During the Cold War and the ongoing Global War On Terrorism, the Federally Administered Tribal Areas (FATA) of Pakistan formed the strongholds of mujahedeen-turned-terrorists. For the last four decades, the tribespeople of FATA have been the victims of terror and socioeconomic deprivation. The tribal traditions and the semi-autonomous status of FATA—in accordance with the constitution of Pakistan—barred Pakistan’s administration from imposing any order in the FATA. In the absence of any real law enforcement and governance mechanism in FATA, the Taliban thrived—and exported terror to the outside world. After 9/11, amid international pressure, Pakistan’s government endeavored to establish its writ in FATA. As part of this process, Pakistan’s army drove the Taliban from FATA through a decade-long military campaign. Now, to ensure peace, stability, and prosperity in the region, Pakistan must integrate FATA into the national mainstream by imposing the full constitutional framework on the lawless region. This thesis examines the integration options available to Pakistan to absorb FATA into its national system and examines the possibility of merging FATA with Khyber Pakhtun Khw province, which has significant ethnic, religious, and cultural similarities, though it has been part of Pakistan’s federal system for 70 years. Specifically, this thesis highlights the administrative and economic reforms necessary to establish effective state control and to bring the FATA to equal status with Pakistan’s other provinces. Full Text

Keywords: Federally Administered Tribal Areas (FATA) of Pakistan, integration in Pakistan’s state system, constitutional amendments, administrative, political, judicial and economic reforms
THE COUNTERINSURGENCY POLICIES OF THE HINDU NATIONALIST BHARATIYA JANATA PARTY OF INDIA AND THE NAXALITE INSURGENCY

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Over the last six decades, the Naxalite insurgency has spread to over 40 percent of India and survived multiple administrations. The Naxalites adopted a flexible approach, using the government’s neglect of Dalits and tribal peoples to its advantage. By 2006, the Indian National Congress (INC) government declared the insurgency a great threat to national security but implemented only half-hearted counterinsurgency efforts. In 2014, the Hindu nationalist party (Bharatiya Janata Party or BJP) came to power with the promise of aggressively dealing with the Naxalites. This thesis examines the BJP’s counterinsurgency policies and practice in comparison to its election rhetoric. Since 2014, the BJP has implemented a holistic and balanced approach in its multipronged counterinsurgency strategies by using security, good governance, development, peace talks, and amnesty. The government is allocating needed resources to implement its strategy effectively. In the last two years, Naxalite violence has decreased, although the government still faces many challenges such as coordinating efforts and controlling corruption and other unlawful activities. However, in comparison to the INC, the BJP’s counterinsurgency approach is more pragmatic and resourceful. It is attempting to solve the underlying causes of discontent among the indigenous people by supporting political, economic, and social justice. Full Text

Keywords: Bharatiya Janata Party, BJP, Hindu, nationalism, Hinduism, Hindutva, Indian National Congress, INC, Naxalite insurgency, Communist, Maoist, policies, counterinsurgency, insurgency, Andhra Pradesh, Chhattisgarh, Jharkhand, Odisha, West Bengal, hawkish

MIDDLE GROUND ON GUN CONTROL

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Each tragic shooting incident that the American news media covers highlights the problem of gun violence in the United States. However, the focus of this reporting is rarely on the largest component of total gun deaths: suicides. Suicides make up two-thirds of all gun deaths. Limiting access to firearms for individuals with suicidal tendencies could cause a significant reduction in the total number of casualties included in gun violence statistics. This thesis examines the efficacy of adding more mental health information to the FBI’s database of persons who are prohibited from gun purchases, and also compares U.S. gun laws to the National Firearms Agreement in Australia, which is widely accepted as an effective gun control measure. This research finds that mental health information on clinical depression and schizophrenia can be a strong predictor of suicidal tendencies, and reporting of this information could be improved in order to reduce overall gun violence. Improved mental health reporting must be a matter of federal law, because current state laws on guns vary widely and have limited effectiveness. Full Text

Keywords: gun control, mental health, background checks, depression, schizophrenia, suicide, gun violence
SECURITY STUDIES

GERMAN ENERGY SECURITY AND ITS IMPLICATIONS ON REGIONAL SECURITY
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This thesis considers three notable developments in German energy policy: the Nord Stream 2 natural gas pipeline project between Russia and Germany, the decision to phase out nuclear energy, and European Union (EU) and German renewable energy policy agendas. The thesis uses EU and German policy pronouncements, press reports, and third-party analysis to understand the three policy developments and assess their effects. It establishes a trilemma framework that relates energy security with other energy objectives as well as a liberal international relations (IR) theory framework to relate energy policy to broader security and stability objectives. Through an analysis of the three policy measures, the thesis depicts the challenges associated with pursuing energy objectives and highlights contradictions where measures intended to increase energy security can actually act to undermine it. Furthermore, it explores the complex relationship between energy security and overall regional security and stability. Using a liberal framework, it illustrates how policies established to improve energy security may act to undermine broader regional stability and security objectives. Full Text

Keywords: Germany, energy, security, stability, natural gas, nuclear energy, renewable energy, European Union

SMALL ARMS PROLIFERATION AND HOMEGROWN TERRORISM IN THE GREAT LAKES REGION: UGANDA'S EXPERIENCE
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Illicit arms are responsible for high death rates in the Great Lakes region. The phenomenon of small arms and light weapons (SALW) proliferation owes to historical factors, porous borders, and the prevalence of regional armed conflicts that offer markets for illicit arms and is compounded by poor arms management and control measures within the region. The effects of SALW on the social, economic, and political arenas in Uganda and in other states in the region are enormous. Ad hoc measures and the lack of regional consensus in implementation allow illicit arms to flow to homegrown terrorists. Although not the only cause of homegrown terrorism, SALW have remained a significant driver in creating a fragile security environment in which homegrown terrorism thrives. This thesis addresses the causes and effects of SALW proliferation in Uganda and the Great Lakes region. Specifically, it explores the nexus between homegrown terrorism and SALW proliferation. The study concludes by providing policy recommendations to combat homegrown terrorism and the effects of SALW proliferation in Uganda and the Great Lakes region. Full Text

Keywords: Uganda, small arms and light weapons proliferation, homegrown terrorism, anti-terrorism measures, Great Lakes regional security, National and Regional legal framework
AUTHORITARIANISM AS A DRIVER OF U.S. FOREIGN POLICY: THE CASES OF MYANMAR, VIETNAM, AND NORTH KOREA

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What is the significance of authoritarianism to U.S. foreign policy? Promoting democracy is a key element of U.S. foreign policy, and Washington conventionally criticizes authoritarian regimes. At the same time, the United States traditionally praises authoritarian regimes that allow pluralism. But these attitudes may or may not correlate with improved foreign relations. To what extent is the softening of authoritarian rule responsible for improved foreign relations as opposed to other factors? This thesis compares U.S. foreign relations with three authoritarian states: Myanmar, Vietnam, and North Korea. The cases represent varying degrees of authoritarian rule and varying levels of cooperation with Washington. Findings from this thesis highlight the significance of authoritarian rule as a driver of U.S. foreign policy. [Full Text]

Keywords: authoritarianism, U.S. foreign policy, Myanmar, Vietnam, North Korea, U.S.-Myanmar relations, U.S.-Vietnam relations, U.S.-North Korea relations, Freedom House, strategic interest

IMMIGRATION AND ITS EFFECTS ON THE NATIONAL SECURITY OF SRI LANKA

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Immigration has social, political, economic, and security significance in Sri Lanka. Immigrants bring economic potential to the countries receiving them but also pose many security threats that may include criminal, terrorist, and extremist activities, as well as ethnic tensions and sectarian violence. This study identifies some of the potential threats posed by immigration, both legal and illegal, and examines the underdeveloped framework of Sri Lankan immigration law. A comparative analysis of Sri Lanka, its neighbor India, and the island nation of Bahamas serves to identify possible measures for revising the existing counterterrorism approaches and introducing new strategies to Sri Lanka. Furthermore, an analysis of these countries demonstrates that reform of comprehensive policies, the practice of immigration control, and effectively coordinated counterterrorism strategies to monitor immigrants may enhance the national security of Sri Lanka. [Full Text]

Keywords: immigration, securitization, rural-urban migration, push-pull, nexus, criminalization, conceptualization, post-conflict, counter-terrorism, border security management, diaspora, census, ideologies, refugees, human smuggling, trafficking, trans-border terrorism

TURKEY AND STABILITY IN EAST ASIA

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East Asia is an important region for global stability. Major economies—China, Japan, and South Korea—are located in the region. The phenomenon of a rising China, the response of the United States to a rising China, and the interaction of these two major powers in the area, as well as the relations among the principal actors of the region—the United States, China, Japan, and South Korea—will determine the stability of the region.
Realists maintain a pessimistic view regarding a rising China and East Asia; liberals are optimistic and contend that because of the greater economic interdependency of nations in the region, the prospect of a conflict is not likely. However, the long-standing distrust, resentment, and territorial disputes among these nations are drivers of bilateral relations of China, South Korea, and Japan, and these problems may undermine the long-term stability of the region. Turkey is also a growing economy, and stability in East Asia is important for Turkey. Turkey historically has had good relations with China, South Korea, and Japan. Turkey, as a responsible member of the international community, could play a more active role and could contribute to the stability of the region by actively engaging with the three principal actors of East Asia to resolve their problems.

Keywords: Turkey, East Asia, China, South Korea, Japan, history, stability, IR theories

THE DRONE COURT AND DUE PROCESS
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Co-Advisor: Lynda Peters, Center for Homeland Defense and Security

In the aftermath of 9/11, the U.S. Congress passed the Authorized Use of Military Force (AUMF), which established the authority of the president to use force to protect the United States from threats against the homeland. This authority allowed the president to use drones, even against U.S. citizens on foreign soil who have been deemed terrorists and placed on the kill list. The current process lacks procedural due process. These flaws have prompted critics to argue that a drone court should be created to address this concern. This thesis explores the issue of the drone court and asks: if one were created, what form should it take? How should it look? The thesis employs a policy options analysis to review three possible judicial forums for hearing these cases: the Foreign Surveillance Court (FISC), Guiora and Brand’s hypothetical Operational Security Court (OSC), and the Combatant Status Review Tribunal (CSRT). Five criteria were evaluated: oversight of the executive branch, transparency, timeliness, judges and legal representation, and legal/procedural review. The OSC had the best evaluation because it supported procedural due process. However, policies will need to be implemented to ensure that OSC legal procedures are timely.

Keywords: drone court, drones, due process, Foreign Intelligence Surveillance Court

A BUSINESS OF SECURITY: APPLYING AN ECONOMIC MODEL TO HUMAN TRAFFICKING IN OREGON
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Second Reader: Thomas Young, Center for Civil-Military Relations

Human trafficking is the second-largest criminal industry in the world and has become the fastest-growing crime today, according to the U.S. Department of Health and Human Services. Many policies have attempted to reduce human trafficking through under-resourced initiatives and social services. This thesis explores whether applying an economic supply and demand model to human trafficking at the state level would reduce the prevalence of human trafficking. Using an economic supply and demand model, the research evaluates current literature and existing national and state policies within Oregon, analyzing weaknesses and gaps. The thesis presents policy analysis under a qualitative cost-benefit lens to assess economic model variables applied to state level policies. The conclusion is that existing anti-human trafficking policies in Oregon are lacking in instilling risks and costs associated with conducting the criminal behavior. Supply and demand actors in human trafficking are operating relatively unhindered in Oregon, which has led to a growth of the problem in the state. Thus, a three-pronged approach built around an applied economic supply and demand model is
recommended to help reduce human trafficking in Oregon: reduce costs to victims, increase costs to suppliers, and increase costs to buyers. Full Text

Keywords: human trafficking, trafficking in persons, modern slavery, sex trafficking, labor trafficking, Oregon, supply and demand, cost-benefit analysis

INTEGRATION OF BEHAVIORAL THREAT MANAGEMENT INTO FUSION CENTER OPERATIONS TO PREVENT MASS OR TARGETED VIOLENCE

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Incidents of mass or targeted violence seem to occur without warning and lead us to conclude that nothing may be done to prevent them. These incidents may take the forms of mass shootings, stabbings, vehicular attacks, and other methods designed to kill or injure many people. Opportunities to detect and interdict potential attackers may exist. The literature identifies a host of warning behaviors that may be useful in detecting and disrupting acts of violence. This thesis examines the opportunities available to the nation’s 78 fusion centers to help prevent mass or targeted violence by learning to conduct behavioral threat assessments and management activities. Analysis of four police agencies that conduct behavioral threat assessments is conducted. Also, the National Network of Fusion Centers is explored to determine whether behavioral threat assessment and management may be a good tool to incorporate into current violence prevention efforts. It was found that fusion centers already perform basic behavioral analysis through the vetting of suspicious activity reports as part of the Nationwide Suspicious Activity Reporting Initiative. Preventive efforts may be more successful should principles of behavioral threat assessment and management be incorporated into fusion center operations. Full Text

Keywords: threat assessment, behavioral threat assessment, behavioral threat management, warning behaviors, violence prevention, suspicious activity reporting, fusion centers

ENHANCING PUBLIC HELICOPTER SAFETY AS A COMPONENT OF HOMELAND SECURITY

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The wide range of missions performed by public safety helicopters makes them a valuable asset for the public and to the homeland security environment. The high-risk missions, lack of regulatory oversight, and minimal standards of safety put public-safety helicopter aviation in the crosshairs of the National Transportation Safety Board. This study addresses how public safety aviation units’ exemption from Federal Aviation Administration regulations is a contributing factor to helicopter accidents. The study uses a qualitative analysis called coding to identify the common traits among accidents and then makes recommendations to prevent future accidents. There is currently no industry research identifying the commonalities among accidents in the way this research does. This thesis also identified the safety culture in the public safety units as a contributing factor to the accidents. The nature of public safety personnel is to accept high levels of risk to help those in need. When this attitude is applied to aviation, it leads to unnecessary accidents. The recommendations provided in the
last chapter of the thesis provide techniques and solutions to help reduce the risk in public safety aviation. The recommendations, if adequately implemented, may help save lives by preventing future accidents. **Full Text**

Keywords: public helicopter safety, law enforcement helicopter safety, public helicopter risk management, public safety aviation, National Transportation Safety Board (NTSB), Federal Aviation Administration (FAA), safety culture, New Mexico State Police, Alaska State Troopers, Maryland State Police
ANALYSIS OF THE MARINE CORPS SUPPLY MANAGEMENT UNIT'S INTERNAL OPERATIONS AND EFFECT ON THE WARFIGHTER

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The primary mission of the Marine Corps' Supply Management Unit (SMU) is to act as the intermediate supply activity by providing requisitioning support between the wholesale and consumer levels of supply within the established Marine Corps supply chain. The SMU stockpiles supplies close to the warfighter in order to decrease requisitioning cycle time and, in essence, has become a natural bottleneck between the wholesale and consumer levels of supply. The speed at which the SMU can effectively fulfill and ship a requisition has a direct impact on the supply, maintenance, and sustainability levels of its supported units. This project centers on determining and analyzing the internal processes of the SMU's requisition management cycle and its distribution capabilities in order to identify potential areas of improvement. The objectives of this project include an analysis of current SMU requisitioning procedures and protocols, the Marine Corps continuous process improvement program, and the incentives within the logistics contracts supporting SMU operations.

Keywords: contracting, continuous process improvement, and logistics support

COST–BENEFIT ANALYSIS OF IMPLEMENTING A CAR-SHARING MODEL TO THE NAVY'S PASSENGER VEHICLE FLEET

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Master of Business Administration
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The Navy leases more than 3,300 vehicles annually to commands and bases throughout the United States; however, the management model is antiquated, and there are now new fleet management options available. The purpose of this study is to examine the costs and benefits of utilizing a commercial car-sharing model or implementing a Fleet-Sharing solution to replace the current ownership model administered by Naval Facilities Engineering Command (NAVFAC). We will use a cost–benefit analysis (CBA) framework to analyze a data set provided by NAVFAC for the Naval Air Station (NAS) Jacksonville (JAX) locality and compare the net benefit of three available alternatives. The first alternative is continued operation with the current model (status quo). The second alternative is replacement of the current model with a contractor operated commercial car-sharing model. The third alternative involves integrating a fleet management hardware/software solution (fleet-sharing). The goal of this CBA is to compare alternatives in order to identify the one with the highest net benefit. The data set conclusively supports alternative three, which provides a reduced initial cost.
in lieu of the status quo and a cumulative net present value. Therefore, we recommend implementing a fleet-sharing solution to the existing fleet at NAS JAX. Full Text

Keywords: cost–benefit analysis, car-sharing, fleet-sharing

FREEWARE VERSUS COMMERCIAL OFFICE PRODUCTIVITY SOFTWARE
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In 1998, the Department of Defense (DOD) Enterprise Software Initiative (ESI) was created as an official DOD initiative sponsored by the DOD chief information officer (CIO) to lead in the establishment and management of enterprise commercial off-the-shelf (COTS) information technology agreements, assets, and policies. This included software products such as Microsoft, Oracle, VMWare, and multiple others. In July 2010, Google announced the launch of Google Apps for Government, adapting Google’s widely popular freeware for government agency usage. This study analyzes the proposed benefits of using freeware, specifically Google Apps, in the DOD in relation to reliability, cost, and security. The results of our analysis supported our recommendation to the DOD ESI to begin complete integration of Google Apps within DOD commands. Full Text

Keywords: Google, freeware, commercial, productivity software, Microsoft, cloud computing, ESI

NON-TACTICAL VEHICLE REPLACEMENT FOR THE DEPARTMENT OF THE NAVY’S MEDIUM- AND HEAVY-DUTY VEHICLE FLEET
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Co-Advisor: Alan Howard, USPTC Program
Co-Advisor: Daniel Temple, Energy Academic Group

The purpose of this project is to evaluate the Navy’s medium- and heavy-duty non-tactical vehicles, and to determine if a business case could be made for replacing them with alternative fuel vehicles. This project analyzed Marine Corps Installation Command’s Southwest Region telematics data from its non-tactical vehicles to provide the operational characteristics necessary for any proposed alternative. Through market analysis, this project identified three primary alternative fuel vehicle technologies that potentially could be used to replace the existing medium- and heavy-duty non-tactical vehicle fleet. These technologies were electric, hybrid-electric, and compressed natural gas. All relevant costs were gathered to conduct a net present value analysis to determine whether a proposed alternative provided savings. While many of these technologies offered the benefit of greenhouse gas reduction for the Department of the Navy, all three technologies resulted in increased costs for the medium- and heavy-duty vehicle fleet. The primary reasons that these technologies failed to provide savings was high purchase costs and a persistent depression in world oil prices. However, this project illustrates a methodology that transportation officials can use to make future decisions based on changing variable inputs. It also provides insight into market trends in the alternative fuel market. Full Text

Keywords: energy; alternative fuel vehicles; net present value; non-tactical vehicles
Street to Navy Enlisted Sailor Costing is a project to identify and analyze current total costs associated with the process of recruitment, entrance processing, and recruit training for transforming a civilian prospect into an enlisted Navy Sailor. Navy Recruiting Command (NAVCRUITCOM), United States Military Entrance Processing Command (USMEPCOM), and Recruit Training Command (RTC) represent the command entities responsible for this transformation. These organizations track costs independently from other organizations. The team identified the individual process within each organization, and then created a swimlane to track an individual through the process. The team identified comprehensive Navy cost activities at NAVCRUITCOM, USMEPCOM, and RTC, and then identified the fixed and variable costs to provide an estimated average cost per Sailor. The team analyzed the transformation process through the prospecting, applicant, and recruit phases. Full Text

Keywords: process analysis, average costing

THE GOLDWATER-NICHOLS ACT OF 1986: 30 YEARS OF ACQUISITION REFORM
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Thirty years after the implementation of the Goldwater-Nichols Act of 1986, congressional and military leaders are calling for a revision of the act that will position the Department of Defense (DOD) to meet uncertain and increasingly challenging threats. This project researched the environment leading up to Goldwater-Nichols, the impacts of implementing the act, and the acquisition reform efforts over the past 30 years in order to understand the current calls for acquisition reform, and the potential impacts of proposed legislation. Many consider Goldwater-Nichols to be the most significant contribution to defense acquisition reform in modern history. Goldwater-Nichols attempted to target big A acquisition by considering all three components of the system: Planning, Programming, Budgeting, and Execution (PPBE), Defense Acquisition System (DAS), and requirements generation. However, research shows the Packard Commission was significantly more influential in affecting long-term improvement efforts. In 1985, the Packard Commission made nine categorical recommendations to improve defense acquisition. These recommendations, if fully applied by Goldwater-Nichols, would have generated a legitimately revolutionary reform to big A acquisition. Instead, 30 years of legislative acts and DOD policies have incrementally addressed the recommendations. Legislators and senior DOD leaders are again seeking revolutionary acquisition reform, calling for a Goldwater-Nichols II with significant restructuring and realignment of priorities. Research indicates that in order to conduct a legitimate overhaul, DOD and Congress must target all three components of big A acquisition in a holistic and integrated effort. Full Text

Keywords: Goldwater-Nichols, acquisition reform, Packard Commission
This study was initiated to identify and illustrate with a visual model the key student learning competencies that most fundamentally contribute to a student’s ability to achieve desired learning outcomes in a synchronous, dispersed virtual learning environment. We answered the following research questions: (1) which learning competencies can best be leveraged to support learning in a synchronous virtual-learning environment? (2) how can relevant learning competencies be transmitted to students during learning events? (3) which, if any, individual-level cognitive factors can be extracted during the pre-training phase that positively influence students’ learning processes? and (4) which learning competencies can be added to existing models on learning in virtual environments? By surveying students participating in the U.S. Navy’s Virtual Schoolhouse, we were able to attain and analyze quantitative data. We discovered that virtual world efficacy is a meta-competency composed of autonomous learning, multiple level operation, and collaborative adaptability. Our research findings suggest that a student's capability to understand and learn in the virtual world is a broad competency and is a significant predictor of his/her success in the virtual environment. Based on our findings, we recommend a familiarity period to allow students to develop these competencies prior to their participation in virtual learning. 

Keywords: synchronous, dispersed learning, Submarine Learning Center, Virtual Schoolhouse, virtual learning, student learning competencies

AN ANALYSIS OF THE U.S. ARMY'S T-11 ADVANCED TACTICAL PARACHUTE SYSTEM AND POTENTIAL PATH FORWARD

Since the fielding of the T-11 Advanced Tactical Parachute System (ATPS) in 2009, nine paratroopers have died utilizing this parachute and its reserve, causing several senior military officials to question the design, safety, and effectiveness of the new parachute system. Several tests and studies were commissioned in response, subsequently concluding that the T-11 parachute has a reduced number of paratrooper jump-related injuries compared to the legacy T-10 parachute. Despite these findings, leaders within the Army Airborne community have requested continued assessments, modifications, and even a new parachute. The T-11 ATPS has been fully fielded, reaching full operational capability (FOC) in 2014. Using a case study approach, this report reviews the user community’s request to assess, modify, or develop a new parachute against potential acquisition approaches. To inform the recommendation, data is collected from stakeholders, and the advantages and disadvantages of acquisition approaches are compared and analyzed. This report concluded that one acquisition approach cannot address all of the issues and concerns identified by the airborne community and recommended that a combination of approaches be used for the T-11 ATPS program path forward.

Keywords: T-11 ATPS; parachute; airborne operations
This MBA research project is an extension and replication of recent diagnostic utility studies to determine if
the methods used are (a) generalizable to a new population and (b) useful in identifying specific questioning
strategies relevant to international military officers. Research conducted by Charles Bond and Bella DePaulo
in 2006 indicated that, on average, people are slightly better than fifty-fifty at detecting deception, as seen in a
published Personality and Social Psychology Review article. Modern research ideology favors using diagnostic
utility, which is the use of comprehensive questioning methods. In the past, a clear majority of researchers
relies solely on verbal and nonverbal indicators to aid in deception detection. This new research uses spe-
cific questioning techniques that have been proven more reliable in determining deceptive behavior. Results
from the quantitative analysis conducted in Study 1 exhibited that international military officers considered
non-experts outperformed experts in their ability to detect deception. In addition, those considered experts
performed better than previous research indicated, and the accuracy rate improved as content and contextual
questioning methods were implemented. Results from the qualitative analysis conducted in Study 2 established
that international military officers combined information obtained from other sources along with physical
observations when detecting deception. Full Text

Keywords: international, international military officers, deception, deception detection

USE CASE ANALYSIS: THE AMBULATORY EEG IN NAVY
MEDICINE FOR TRAUMATIC BRAIN INJURIES
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Advisor: Robert Eger, Graduate School of Business and Public Policy
Co-Advisor: Bryan Hudgens, Graduate School of Business and Public Policy

Implementing the ambulatory electroencephalograph (EEG) system can expedite potentially emergent re-
sults, reduce patients' time spent in the hospital, eliminate the need for specialized technicians to administer
the electrodes, reduce the bulky EEG equipment that takes up space and limited resources, and eliminate the
need for a specialized physician to be present at the site to read the EEG report. This use case analysis details
the processes involved with the ambulatory EEG concerning traumatic brain injuries and advises on the best
uses of the device for naval medicine. Full Text

Keywords: traumatic brain injuries, electroencephalography, EEG, use case study
PERFORMANCE ANALYSIS OF THE UNITED STATES MARINE CORPS WAR RESERVE MATERIEL PROGRAM PROCESS FLOW

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Spencer Sweet—Captain, United States Marine Corps

Master of Business Administration

Advisor: Eddine Dahel, Graduate School of Business and Public Policy
Co-Advisor: Kenneth Doerr, Graduate School of Business and Public Policy

This MBA professional report explores the historical performance of the United States Marine Corps (USMC) War Reserve Materiel (WRM) Process Flow, specifically during the time building up to the initial invasion of Iraq (2003) in support of Operation Iraqi Freedom. Managed by USMC Logistics Command (LOGCOM), the ability of the WRM Program to rapidly deliver equipment and supplies in support of major contingency operations is critical to the given USMC mission. Using historical data from January through March 2003, this project is specifically focused on the processes and procedures that take place within LOGCOM to identify, procure, package and ship when an item is requested but not maintained in the WRM inventory. By conducting a process analysis and using computer modeling, our recommendations are focused on improving efficiency and reducing lead time in an effort to better support future contingencies. Full Text

Keywords: LOGCOM, process flow analysis, Six Sigma, Program Evaluation and Review Technique, war reserve

IS NATO READY FOR A CYBERWAR?

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Emrah Sezgin—First Lieutenant, Turkish Air Force

Master of Business Administration

Advisor: Bryan Hudgens, First Lieutenant, Turkish Army
Second Reader: Dorothy Denning, Department of Defense Analysis

This thesis analyzes the sufficiency and effectiveness of the North Atlantic Treaty Organization’s (NATO) cyber policies against cyber threats, considering the recent cyber cases and incidents that could be related to NATO’s cyber defense. The authors use analytical and descriptive approaches to answer the research questions by examining the categories of cyber threats facing NATO and the policies implemented to fight against cyber operations and attacks. Finally, the authors make policy recommendations in order to respond to cyber threats more effectively in regard to eight specific areas: cooperation with the European Union; relations with business enterprises; information sharing among members; education, training, and exercises; capabilities of NATO Communications and Information Agency (NCIA); critical infrastructure protection; cyber law and legislature; and collective cyber defense. The cyber domain is a challenging arena in which to carry out operations and develop policies. NATO can be considered successful in cyberspace; however, the alliance should be aware that there is no limit to the development of capabilities, especially in cyber defense issues. Full Text

Keywords: NATO, cyberwar, cyber policy, cyber threats, cyber cases, cyber law
RELATIONSHIP BETWEEN TIMING OF MULTIPLE RETENTION BONUSES AND THE QUALITY OF OFFICERS RETAINED ON THE COST SAVINGS FOR THE NAVY

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The surface warfare community has recently increased bonus amounts in an attempt to reward quality performance and retain superior officers. Simultaneously, the community has started to offer alternative programs and incentives that might appeal to those officers who desire a flexible career. We used survey information to determine which of these were the most appealing to the community in a way that might provide cost savings to the military when provided in conjunction with an auction bonus system. Using the standard bonus system compared to the uniform price auction, the Quality Adjusted Discount (QUAD) auction, and Combinatorial Retention Auction Mechanism (CRAM), we determined which would be most effective for maintaining quality officers in the community while meeting retention objectives and providing cost savings. We found that a quality auction system could provide cost savings as much as $1,850,000 or could increase costs by as much as $2,081,250, depending on community retention levels, even with increased individual bonus amounts. Additionally, from survey responses we were able to discern additional non-monetary incentives that surface warfare officers desire, which could be used to improve retention of quality officers in the future. Full Text

Keywords: Surface Warfare Officer, SWO, officer retention, DHRB, RJCSRB, SWO bonus, continuation pay, QUAD, CRAM

REAL OPTIONS IN DEFENSE R&D: A DECISION TREE ANALYSIS APPROACH FOR OPTIONS TO DEFER, ABANDON, AND EXPAND

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Master of Business Administration
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Second Reader: Steven Landry, Graduate School of Business and Public Policy

The purpose of this thesis is to demonstrate the benefits of using real options in defense research and development (R&D) projects. To this end, the primary research question, how can real options be used in defense R&D?, is addressed. The thesis provides a comprehensive literature review to substantiate that, in evaluating real options in defense R&D projects, the decision tree analysis (DTA) should be used rather than the real option valuation (ROV). Accordingly, this thesis employs the DTA approach along with the case study method to evaluate the options to defer, abandon, and expand in three simple defense R&D cases. These cases are analyzed first without, and then with, the respective option to demonstrate the increase in the net present value (NPV) of the R&D projects when the real options are used strategically. The results suggest that incorporating real options into defense R&D projects provides decision makers with flexibility, thus improving the project value, and that the value of real options can practically be calculated with the DTA approach. In this regard, the thesis closes an important gap in the literature and provides practitioners with valuable insights. Full Text

Keywords: real options, decision tree analysis, DTA, real option valuation, ROV, real options thinking, defense research and development, R&D, defer, deferment, abandon, abandonment, expand, expansion
Naval Aviation Depot Level Repairables (AVDLRs) are repairable subassemblies for Naval aircraft weapon systems. The Fleet Readiness Centers’ primary task is to repair non-functional AVDLRs. Such repairs usually require replacement of components, known as bit-piece parts or consumables. Technicians requisition any bit-piece parts not on hand through the Defense Logistics Agency (DLA). As weapon systems age, sources for bit-piece parts become more difficult to identify. As a result, as of July 2016, DLA has approximately 15,000 bit-piece part requisitions backordered. Naval Supply Systems Command (NAVSUP) Weapon Systems Support (WSS), the organization responsible for managing AVDLRs, is concerned that the significant quantity of bit-piece part backorders is negatively affecting aviation operational readiness. A potential alternative source for acquiring bit-piece parts is Navy excess material. Excess material is inventory designated by Navy organizations as meeting excess classification criteria. Since the Navy has already purchased the excess material, it represents a cost-effective sourcing option. The goals of this project are to determine if existing excess material can fulfill any current bit-piece part backorders, and if excess material represents a sustainable source of bit-piece parts for future requisitions. Full Text

Keywords: naval aviation AVDLRs, backorder, excess, DLA, WSS, FRC, Python, piece part

The Joint Strike Fighter (JSF) is the largest and the most expensive multinational development and acquisition program in history. The purpose of this MBA project is to analyze the probable rationale behind Turkey’s decision to participate in the JSF program using Graham T. Allison’s conceptual models for foreign policy analysis. After providing background information, including a brief history of Turkish military aviation history and the JSF program, and reviewing literature that outlines Allison’s rational actor, organizational behavior, and governmental politics models, this thesis analyzes Turkey’s decision to participate in the JSF program rather than the Eurofighter program. From a rational actor point of view, each program had its own advantages and disadvantages in terms of Turkey’s plausible objectives. The organizational behavior model sheds light on the decision from the perspective of an organization’s routines, outputs, and culture. Full Text

Keywords: Joint Strike Fighter, JSF, Eurofighter, acquisition, Turkey, conceptual models, rational actor, organizational behavior, governmental politics
UNMANNED MARITIME SYSTEMS INCREMENTAL ACQUISITION APPROACH
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Jason Richesin–Lieutenant, United States Navy
Master of Business Administration
Advisor: Ray Jones, Graduate School of Business and Public Policy
Co-Advisor: Chad Seagren, Graduate School of Business and Public Policy

The purpose of this MBA report is to explore and understand the issues involved in the DOD's acquisition process for Unmanned Maritime Systems (UMS) in order to recommend a new acquisition approach or solutions that would allow the military to keep pace with the rapid unmanned technology development cycle found in the commercial industry. We find that current UMS acquisitions are utilizing previous acquisition reforms but could benefit from additional contractor peer competition and peer review. Additional cost and schedule benefits could result from contractor competition during build processes in each incremental process. We recommend that further analysis be performed to alleviate funding issues associated with evolutionary acquisition. Full Text

Keywords: acquisition strategy, Unmanned Maritime Systems

AMERICAN RED CROSS: A HISTORY AND ANALYSIS
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Thanousone Pravongviengkham–Major, United States Marine Corps
Master of Business Administration
Advisor: Latika Hartmann, Graduate School of Business and Public Policy
Co-Advisor: Bryan Hudgens, Graduate School of Business and Public Policy
Co-Advisor: Aruna Apte, Graduate School of Business and Public Policy

We, in this research, provide a detailed history and highlight current operations of the American National Red Cross (ANRC). We analyze the organization's mission, purpose, structure, and relationship with the U.S. government and provide an analysis of its financial status and capabilities and competencies based on the Sphere Project standards in order to inform government organizations and disaster planners. We find that the ANRC generates sufficient revenue to execute relief operations and other services and is efficient and competent in all essential services and capabilities for disaster response. We also find that its fundraising efficiencies are directly tied to the size of domestic disasters the organization responds to in any given year. However, the ANRC is struggling to break even in its biomedical services program. Full Text

Keywords: American Red Cross, American National Red Cross, competencies, capabilities, collaboration, non-governmental organizations, NGO, humanitarian assistance, disaster relief, HADR

ANALYSIS OF UNMANNED SYSTEMS IN MILITARY LOGISTICS
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Co-Advisor: Douglas Brinkley, Graduate School of Business and Public Policy

The purpose of this thesis is to analyze the current and potential applications of unmanned systems in military logistics. In seeking to evaluate uses of unmanned systems, we initially aimed to define current and proposed unmanned applications in civilian-sector logistics and current military logistics challenges. Then, justifying uses of unmanned systems in the commercial sector and military, we analyzed the potential advantages and risks of these systems by using archival analysis and case studies. Finally, we addressed recommendations on the current and future uses of unmanned systems in military logistics. Unmanned technology is an area open
to development. There has been extensive use of unmanned vehicles in military operations such as reconnais-
sance, surveillance, and armed attacks. Changing economic conditions and advances in technology indicate
that there may also be opportunities to employ unmanned systems to support logistic operations. Full Text

Keywords: unmanned systems, robotics, UAVs, UGVs, USVs, UUVs, military logistics, civilian sector logistics,
logistics

DETERMINING THE OPTIMAL INVENTORY MANAGEMENT POLICY
FOR NAVAL MEDICAL CENTER SAN DIEGO'S PHARMACY
Jason Galka–Lieutenant Commander, United States Navy
Master of Business Administration
Advisor: Eddine Dahel, Graduate School of Business and Public Policy
Second Reader: Bryan Hudgens, Graduate School of Business and Public Policy

Inventory management in Navy pharmacies uses outdated technologies and strategies and desperately needs
updating. The management of inventory should never use a one-size-fits-all approach, and the optimal inven-
tory management system was determined for Naval Medical Center San Diego (NMCSD). This thesis used
demand data gathered from NMCSD to investigate the periodic review and continuous review systems with
single item ordering and joint quantity ordering to determine which was best for NMCSD. The results of this
study are that joint ordering with continuous review is less expensive than single item ordering and periodic
review of inventory. It is recommended that NMCSD begin looking into the costs and how to begin imple-
menting a continuous review system. Full Text

Keywords: pharmacy inventory management policies

A COLLECTION OF JPME OPERATIONAL CONTRACT
SUPPORT CASE STUDIES AND VIGNETTES
The following paper has been recognized as outstanding by its department.
Dayton Gilbreath–Captain, United States Air Force
Carrie Moore–Captain, United States Air Force
Master of Business Administration
Advisor: Karen Landale, Graduate School of Business and Public Policy
Co-Advisor: E. Cory Yoder, Graduate School of Business and Public Policy

The objective of this project is to educate joint senior leaders on the importance of the strategic effects of
operational contract support (OCS). Contracting for goods and services in the contingency operational en-
vironment is a mission-enabling necessity; however, analyzing the strategic effects of contracting is not well
practiced and rarely understood by military leaders, from lieutenants to generals. Commanders in the field are
taught to think of the costs literally, as tax dollars spent to enhance mission effectiveness. However, the less
literal costs and the associated effects of choosing to contract for goods or services are largely ignored. This
project explores the use of OCS in contingency environments, and the positive and negative effects OCS deci-
sions have on the larger, strategic military mission, and on other instruments of power. The case studies and
vignettes developed by this research examine how second- and third-order OCS effects impact the United
States’ military mission and general interests. The products developed during the course of this project consist
of case studies and vignettes for use in Joint Professional Military Education coursework. Full Text

Keywords: Operational Contract Support, Joint Professional Military Education, joint operational planning,
Instruments of National Power, strategic effects
ANALYSIS OF THE EFFECTIVENESS OF THE RETIRE TOOL WHEN DECIDING BETWEEN HIGH-36 RETIREMENT AND BLENDED TSP RETIREMENT

The Department of Defense has enacted military retirement reforms that will change the vested pension system into a hybrid pension and matching Thrift Savings Plan contribution called the Blended Retirement System. The purpose of this research was to evaluate the effectiveness of a previously developed retirement tool (RETIRE Tool) that allows service members to evaluate and compare the net present values (NPV) of the HIGH-36 retirement system (HIGH-36) and the blended Thrift Savings Plan retirement system (BRS) in order to make an informed retirement decision. The effectiveness of the RETIRE Tool was assessed through a before-and-after survey of military personnel at the Naval Postgraduate School. Service members who have less than 12 years of active service by December 31, 2017 can opt into the BRS between January 1, 2018 and December 31, 2018. The RETIRE Tool provides financial value estimates of the old retirement system compared to the new retirement system. The research findings show evidence that the RETIRE Tool has a positive net effect on the confidence levels of service members given the choice between HIGH-36 and the BRS. Participants were able to identify which methods of financial education would best assist them with the decision between HIGH-36 and the BRS. Full Text

Keywords: military retirement, blended retirement, HIGH-36, thrift savings plan, investment risk, retirement taxes, net present value, personal discount rate, retirement risk, annuity, risk tolerance, matching contributions, tsp, retirement reform, time value of money, volatility, pension

FINANCIAL HEALTH INDICATORS: AN ANALYSIS OF FINANCIAL STATEMENT INFORMATION TO DETERMINE THE FINANCIAL HEALTH OF DOD CONTRACTORS

Prior to awarding a contract, government contracting officers must be able to determine the financial health of prospective contractors. In fact, according to the Federal Acquisition Regulation (FAR) 9.104-1(a), the very first general requirement to being considered a responsible prospective contractor is to show adequate financial resources to perform the contract or the ability to obtain financing. The purpose of this research is to identify a financial assessment framework that could assist DOD contracting officers with determining the financial health of potential DOD contractors. This research study may help DOD contracting officers determine the financial health of potential contractors prior to awarding a contract. The findings of this study provide a recommended framework that a contracting officer could follow in order to assess the financial health of a prospective contractor. The framework includes a ratio analysis using selected ratios compiled by this study, as well as a comparative analysis using industry average driven data. The framework also incorporates horizontal and vertical analyses, as well as bankruptcy and fraud analyses. The financial assessment framework created in this study is a comprehensive financial health assessment tool that can be utilized by DOD contracting officers. Full Text

Keywords: financial health, procurement fraud, determinants, financial ratios, Z-score, profitability
TIME ON STATION REQUIREMENTS: COSTS, POLICY CHANGE, AND PERCEPTIONS
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Jose Mireles–Major, United States Marine Corps
Master of Business Administration
Advisor: Jesse Cunha, Graduate School of Business and Public Policy
Co-Advisor: Ryan Sullivan, Defense Resources Management Institute

The Department of Defense (DOD) continuously seeks ways to cut costs, and Congress has directed the DOD to reduce permanent change of station (PCS) expenses. One option that may reduce expenses and improve quality of life without sacrificing readiness is to increase time on station (TOS). Accordingly, this project evaluates how Marines feel about the current TOS policy as well as how they would feel if the requirements increased from three to five years. We developed and fielded a survey to capture attitudes about TOS requirements and analyzed the responses using econometric tools. Our findings show that while 80% reported the current TOS policy adequately supports career development, 67% think longer TOS will improve quality of life and 85% think longer TOS will not sacrifice unit readiness. Moreover, the Marine Corps stands to save $38 million annually by increasing its rotation cycle from three to five years. We take these results as evidence that Marines support longer TOS and a change in policy might be beneficial to the institution.

Keywords: permanent change of station (PCS), permanent change of assignment (PCA), time on station (TOS), cost-benefit analysis (CBA), econometrics, regression

AUDITABILITY IN THE U.S. NAVY: A KNOWLEDGE ASSESSMENT OF THE CONTRACTING WORKFORCE
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Michael McCrory–Captain, United States Army
Master of Business Administration
Advisor: Juanita Rendon, Graduate School of Business and Public Policy
Co-Advisor: Rene Rendon, Graduate School of Business and Public Policy

The Department of Defense (DOD) has some problems in its contracting workforce that make the department susceptible to procurement fraud. In fiscal year (FY) 2014, $285 billion was spent on federal contracts. In FY 2015, the DOD increased its obligation to $290 billion. The DOD committed more money than all other government agencies combined. In total, the U.S. Department of Justice stated in its annual evaluation that there were 4,801 U.S. government–wide fraud investigations in 2015. The purpose of this research was to evaluate the knowledge level of Navy contracting professionals regarding procurement fraud. The research method included a survey that contained questions regarding contract management processes, internal control components, and procurement fraud schemes. The results of this research identified differences in levels of fraud knowledge and perceptions of an organization’s vulnerability to procurement fraud. The other two aspects of auditability are effective internal controls and capable processes. Having strong auditability in an organization would help to identify susceptibilities to procurement and assist in reducing vulnerabilities. Based on the results of the survey, recommendations are provided to the Navy for improvement of organizational auditability related to contracting.

Keywords: procurement fraud, contracting, auditability, internal controls, contract management process
As the Department of Defense (DOD) places increased emphasis on a smaller, skilled workforce, Human Capital and Social Capital (HC and SC) preservation become more important. The revolving door is an efficient but politically charged HC and SC preservation method. How are retired military second careers framed, and how should we understand them? What HC investments does the DOD make in officers, and what use is that investment to second-career employers? How large is the revolving door, and what can we learn by examining it in this officer group? This project uses DOD databases and previously gathered information to sample retired field grade officers and understand the revolving door. It recognizes the revolving door as an efficient way to maximize HC and SC return and the public perception as an unfair practice. Results indicate that the 30–40 percent recaptured retired officer HC tracks DOD civilian hiring trends and represents less than 2 percent of DOD new GS civilian hires annually. Retired officers tend to stay in their second career for at least 10 years. The project concludes that rehiring retired officers allows the DOD to maintain its operational focus. It recommends policy-makers continue the revolving door practice with safeguards in place to maintain transparency, equity, and oversight. Full Text

Keywords: human capital, social capital, social network, human capital investment, human capital exchange, revolving door, double-dipping, officer, field grade officer, public policy, civilian hiring, retiree

AN ANALYSIS OF BID EVALUATION PROCEDURES OF CONTEMPORARY MODELS FOR PROCUREMENT IN PAKISTAN
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Yasin Akkoc–Lieutenant Junior, Turkish Navy
Master of Business Administration
Advisor: E. Cory Yoder, Graduate School of Business and Public Policy
Co-Advisor: Robert Looney, Department of National Security Affairs

Pakistani defense procurement is done in accordance with Pakistan Public Procurement Authority (PPRA) rules. The PPRA rules provide limited scope/detail for the bid evaluation process. The public procurement procedure of Pakistan pertaining to bid evaluation is not defined in detail and has been wholly and solely left at the discretion of the procuring agency. The loophole in the bid evaluation of the public procurement has led to many problems and fraudulent activities. This research project reviews the existing bid evaluation procedures of the United States, the United Kingdom, Turkey, and Australia. This research project analyzes the bid evaluation procedure in the PPRA rules and highlights the relevant deficiencies in the procurement procedures. Then the four contemporary procurement models of the United States, the United Kingdom, Turkey, and Australia are analyzed with particular focus on the bid evaluation procedures. The comparative analysis is carried out for the four existing procurement models of various countries, and, based on this comparative analysis, five components of bid evaluation are recommended for incorporation in the PPRA rules to serve as a guide for Pakistani defense contracting. We recommend that a comparative analysis of all the relevant/best practices of the bid evaluation processes for public procurement in Turkey, the United States, the United Kingdom, and Australia be undertaken and be used to develop a guide for Pakistani defense contracting. Full Text

Keywords: Pakistan, procurement, PPRA, bid evaluation, procurement models, corporate sector
Over the last six years, the Department of the Defense (DOD) and Department of the Navy (DON) have ramped up efforts toward achieving financial audit readiness by dedicating additional resources and implementing new process changes in support of the DOD Financial Improvement Audit Readiness (FIAR) program. Despite increased emphasis on ensuring key supporting documentation availability during an audit, the DON still has issues regarding poor-quality document submissions from lower-level units, which can ultimately lead to poor audit results. This project attempts to identify and improve upon root causes of quality defects in audit-related key supporting documentation onboard U.S. ships in the Pacific Surface Fleet using a Lean Six Sigma analysis. The recommendations provided in this study augment improvement processes currently in progress, and are sequenced to build momentum before addressing higher-risk priorities. The objective of this research is to develop a case study for use by DON FIAR that examines audit-related areas of improvement and the implementation of additional process changes at the unit level. The case study is meant to spur discussion on how the DON can benefit from Lean Six Sigma analysis to improve quality and mitigate the risk of audit failure.

Keywords: audit, audit readiness, FIAR, financial improvement, failure analysis, lean six sigma, process improvement

The purpose of this study is to examine challenges and opportunities facing industry and the Department of Defense (DOD) in utilizing additive manufacturing (AM). This research focuses on the challenges and opportunities identified in a June 2015 Government Accountability Office report pertaining to supply chain issues and to advance research methods used to obtain intellectual property and patent rights. Specifically, this research examines supply chain and intellectual property rights methods used in government and private industry to maximize AM capabilities for the benefit of the DOD. Research was conducted by analyzing current technology and processes used in both cradle-to-grave logistics of AM material and private sector approaches to obtaining intellectual property rights for continuous internal use. These methods are analyzed for compatibility with government operations. This report is the final result of our research. This report determined potential solutions the DOD can adopt to effectively resolve challenges faced in producing and obtaining intellectual property rights for DOD-required material.

Keywords: additive manufacturing, supply chain management, intellectual property rights
IMPACT OF THE ACQUISITION CORPS MEMBERSHIP REQUIREMENT “24 BUSINESS-CREDIT HOURS” ON THE NAVY ACQUISITION WORKFORCE

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Master of Business Administration
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Co-Advisor: Raymond Jones, Graduate School of Business and Public Policy

This research paper determines whether there is a negative impact on the Acquisition Workforce regarding the 24 business-credit hour requirement for membership into the Acquisition Corps (AC). This paper discusses the Defense Acquisition Workforce history in regard to key legislation and why the 24 business-credit hour requirement was enacted. The research analyzes Acquisition Workforce survey data from DAWIA level II and III program managers (PM) assigned to NAVAIR and NAVSEA and previous fiscal year AC board results to determine whether there is an impact to the workforce because of this requirement. Survey and AC board data shows that among the four primary AC membership requirements, the 24 business-credit hour requirement contributes to the highest number of AC non-selection. Survey data collected from PMs at NAVAIR and NAVSEA showed no effect on officer promotion due to any requirement for AC membership. Further analysis of DAWIA certification regarding formal business education for each acquisition career field and the 24 business-credit hour requirement for AC membership did present a disconnect. The majority of acquisition career fields do not require business education as a DAWIA certification core standard, but they require 24 business credits for AC membership. This is causing an impact, specifically on the engineering duty officer (EDO) community for AC selection. The results and conclusion of this research provide a concise and achievable remedy to minimize the impact of this requirement by tailoring the formal business credit requirement to each career field and/or identifying the business education requirement earlier in the officer’s DAWIA certification process. Full Text

Keywords: acquisition workforce, acquisition corps

AN ANALYSIS OF PERSONALIZED LEARNING SYSTEMS FOR NAVY TRAINING AND EDUCATION SETTINGS

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Co-Advisor: Marigee Bacolod, Graduate School of Business and Public Policy

The U.S. Navy employs a single approach to education and training in virtually all of its schoolhouses and learning environments. This one-size-fits-all system is dated and inefficient, and the Navy could potentially benefit from an individualized approach. Personalized learning is a methodology that enables the individual student to learn in a manner that best suits his or her aptitude, background, and learning style. This approach, while complex and expensive to implement, is quickly gaining traction as educational technology improves. The benefits of such a methodology to student outcomes and organizational efficiency could be substantial. In analyzing cost structures of three fundamental instructional models, long-run average total costs for each were found to be most sensitive to delivery of instruction, not content development or school infrastructure. Fewer human teachers, less travel time, more cost-effective delivery of training, and a higher level of student performance make personalized learning an attractive alternative to the industrial model. The Navy’s Digital Tutor program is one such example, and although there are mixed results for its effectiveness and cost savings, evaluating this program provides lessons for continued efforts in embracing technology to develop revolutionary training and education programs for the future. Full Text

Keywords: personalized learning, intelligent tutoring system, individualized instruction, cost-effectiveness analysis, digital tutor
THE USE OF REVERSE AUCTION WITHIN THE U.S. ARMY

Amy Saal–Major, United States Army
Stephen Settembre–Major, United States Army
Master of Business Administration

Advisor: E. Cory Yoder, Graduate School of Business and Public Policy
Co-Advisor: Douglas Brinkley, Graduate School of Business and Public Policy

The purpose of this research project is to analyze the effectiveness and efficiency of the U.S. Army’s use of reverse auctions (RAs) in regard to contracting. RAs are powerful procurement tools that leverage the power of fluid market conditions through a dynamic pricing environment. This project examines the use of RAs within the Army Contracting Command (ACC) using E. Cory Yoder’s Three Integrative Pillars for Success. Research questions focus on identifying best practices currently used within the contracting field. Data gathered through personal interviews with subject matter experts and practitioners of RA tools identifies whether current RA platforms deliver best value procurements and generate true cost savings. Interview questions target three key focus areas: personnel, platforms, and protocols. If the ACC is to utilize RAs in the most effective and efficient manner, it is essential to select the appropriate RA type, field the best platform, and implement the correct protocols to maximize the use of RAs. These three factors together will yield maximum savings while generating new process improvements that will enable the ACC to become a more efficient and lean organization. Conclusions and recommendations provide suggestions for improving the Army’s future use and application of RAs. Full Text

Keywords: reverse auctions, FedBid, Army Contracting Command, Mission and Installation Contracting Command

ANALYSIS OF EXPEDITED DEFENSE CONTRACTING METHODS IN THE ACQUISITION OF EMERGING TECHNOLOGY

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Mark Zakner–Captain, United States Air Force
Master of Business Administration

Advisor: Karen Landale, Graduate School of Business and Public Policy
Co-Advisor: Robert Mortlock, Graduate School of Business and Public Policy

The future of national security rests on more than nuclear weapons, heavy equipment, and conventional forces. Increasingly, security depends on technological advantage, innovation, and asymmetric technology exploitation. Future conflicts will share limited semblance with historical conflicts due to the technology exploitation that characterizes modern warfare. As the U.S. government’s share of research and development (R&D) funding shrinks and defense budgets continue to decline, the Department of Defense (DOD) will increasingly depend on new innovative firms to maintain a technological advantage. Such firms inherently differ from traditional defense acquisition in process and culture. They also enjoy demand from broader domestic and international markets. R&D funding sources affect rights to intellectual property—a major concern for technology firms. The DOD has authority to apply non-traditional contracting methods to better adapt to this competitive marketplace. This project studied non-traditional contracting tools at the DOD’s disposal and their merits, with an analysis of how the DOD can effectively leverage its existing and potential authorities to be a competitive buyer in the emerging technology market. Practitioners in the field provided firsthand accounts of their awareness and experience with non-traditional contracting. Findings include the benefits and limitations of non-traditional methods with recommendations for their selective application. Full Text

Keywords: emerging technology, expedited procurement, non-traditional contracting, other transactions, intellectual property
ANALYSIS OF OTHER TRANSACTION AGREEMENTS TO ACQUIRE INNOVATIVE RENEWABLE ENERGY SOLUTIONS FOR THE DEPARTMENT OF THE NAVY

Ryan Tobin–Lieutenant Commander, United States Navy
Josh Millner–Lieutenant Commander, United States Navy
Casey Gillette–Lieutenant, United States Navy

Master of Business Administration

Advisor: Daniel Nussbaum, Department of Operations Research
Co-Advisor: E. Cory Yoder, Graduate School of Business and Public Policy

The purpose of this project is to use a case-study approach to analyze the effectiveness and efficiency of other transaction (OT) agreements and the OT Consortium Model to acquire innovative renewable energy solutions. OTs are typically used for prototypes; however, the fiscal year (FY) 2016 National Defense Authorization Act (NDAA) expands the use of OT authority per statute 10 U.S.C. § 2371. Our research includes interviews with Defense Innovative Unit–Experimental personnel to highlight their experience with innovative businesses previously reluctant to pursue federal contracts. Additionally, our research leverages best practices from the Army Contracting Command–New Jersey, as well as industry partners, such as the Consortium for Energy, Environment, and Demilitarization and the National Security Technology Accelerator consortium, to compile recommendations for the Department of the Navy’s acquisition strategy for renewable energy. The results of this case study include recommendations on the best use of OT agreements to drive innovation into the procurement of renewable energy solutions in accordance with Better Buying Power 3.0 initiatives.

Keywords: other transaction authority, renewable energy acquisition strategy

RESILIENCE AMONG STUDENTS AT THE BASIC ENLISTED SUBMARINE SCHOOL

The following paper has been recognized as outstanding by its department.

AliceMary Trivette–Major, United States Army
Dominic Raigoza–Lieutenant Commander, United States Navy
Melissa Gonzales–Lieutenant Commander, United States Navy

Master of Business Administration

Advisor: Edward Powley, Graduate School of Business and Public Policy
Co-Advisor: Frank Barrett, Graduate School of Business and Public Policy

This study assesses resilience among Sailors at Basic Enlisted Submarine School (BESS), analyzing the effects of positive framing and how changes in resilience affect subjective well-being and perceived stress. An appreciative inquiry-based intervention was administered at two intervals to measure changes according to various scales (e.g., positive framing, perceived-stress scale, resilience, and subjective well-being). Surveys of BESS Sailors were collected at four intervals to examine relationships, trends, and measure changes in scales and self-reported resilience. The Hayes’ Macro in the Statistical Package for the Social Sciences (SPSS) was used to uncover factors relevant to mediation analysis. Findings suggest that the encouragement of social resilience helps buffer against stress and explains subjective well-being. Improvement of Sailor resilience may improve fleet readiness, productivity, retention, and morale. It is recommended that this study be expanded in scope from BESS to the entire submarine fleet to target and reduce unplanned attrition in the submarine community.

Keywords: Basic Enlisted Submarine School, students, resilience, leadership, identification, positive framing, stress, subjective well-being
IMPLEMENTATION OF FLU (INFLUENZA) VACCINATION INTO ARMENIAN ARMED FORCES PRE-EMPTIVE VACCINATION PLAN
Manvel Vardanyan–Lieutenant Colonel, Ministry of Defense, Armenia
Master of Business Administration
Advisor: Chad Seagren, Graduate School of Business and Public Policy
Co-Advisor: Spencer Brien, Graduate School of Business and Public Policy

This project measures the influence of influenza vaccinations on Armenian Armed Forces personnel readiness. In the Republic of Armenia, neither the Ministry of Health nor the Military Medical Service of the Armed Forces conducts flu vaccinations. The flu is always highly prevalent in the Armenian Armed Forces personnel morbidity ranking. An analysis of flu morbidity data from 2006 to 2014 reveals how Armed Forces personnel readiness was affected. Preventive activities are likely beneficial in countries such as Armenia that have low economic development, where inpatient treatment costs are relatively low, where insurance companies and healthcare providers are still under development, and where population healthcare expenditures impose a heavy burden on the government. A cost-benefit analysis of flu vaccination would assess whether conducting flu vaccination is expedient. Full Text

Keywords: Armenian Armed Forces, personnel readiness, flu morbidity, flu vaccination, preemptive vaccination plan, cost-benefit analysis

USING ADDITIVE MANUFACTURING TO MITIGATE THE RISKS OF LIMITED KEY SHIP COMPONENTS OF THE ZUMWALT-CLASS DESTROYER
Xiao Wang–Lieutenant, United States Navy
James Whitworth–Lieutenant Commander, United States Navy
Master of Business Administration
Advisor: Charles Pickar, Graduate School of Business and Public Policy
Co-Advisor: Raymond Jones, Graduate School of Business and Public Policy

The purpose of this project was to explore the benefits of using a combination of additive manufacturing (AM), Performance-Based Logistics (PBL), and Open Systems Architecture (OSA) to mitigate the risks of limited key ship components for the Zumwalt-class destroyer (DDG 1000) program. Specifically, this project was focused on current industry’s capability for AM and the implementation of AM in the near future. Research was conducted in three phases. First, this research reviewed the problems and challenges within the defense industry. Next, this research reviewed the previous research on intellectual property (IP) concerns with AM (particularly, insourcing versus outsourcing) and the latest AM applications in the marketplace and defense industry. Finally, this research focused on DDG 1000 program documents, including the Acquisition Strategy (AS), the Life-Cycle Sustainment Plan (LCSP), and a Diminishing Manufacturing Sources and Material Shortages (DMSMS) analysis. By conducting a comparison of DDG 51 and DDG 1000 and analyzing an AM arrangement among Airbus, Systemanalyse and Programmentwicklung (SAP), and United Parcel Service (UPS), this research concludes that the government can use AM, with a properly structured PBL arrangement and OSA, to substantially mitigate risks, lower operation and support (O&S) costs, and effectively improve system readiness. Full Text

Keywords: additive manufacturing, Zumwalt-Class Destroyer, ship components, performance based logistics, open system architecture, obsolescence management
THE CHARITABLE TRUST MODEL: AN ALTERNATIVE APPROACH FOR DEPARTMENT OF DEFENSE ACCOUNTING

Gerald Weers Jr.—Lieutenant Commander, United States Navy
Master of Business Administration
Advisor: Philip Candreva, Graduate School of Business and Public Policy
Second Reader: Robert Eger, Graduate School of Business and Public Policy

The purpose of this project is to identify logical weaknesses in the financial statements of the Department of Defense (DOD) and to propose an alternative approach to accounting to supplant the current corporate-style financial management and reporting practices mandated by federal law. First, the researcher identifies the influences, statutes, and organization bodies that form the framework for contemporary federal financial reporting. Second, the researcher identifies the fundamental differences between the private and public sectors and divergent purposes of financial reporting in both domains. Next, the researcher presents evidence from stakeholders, indicating the current corporate-style financial statements are less useful than intended in government administration. The researcher then analyzes how the misapplied logic of private sector accounting creates weakness and inconsistencies in federal reporting. The researcher discusses alternative approaches from accounting literature that recognize the differences between sectors and introduces the trust arrangement. Finally, the trust model is overlaid onto the administration of the DOD and recommended as a more useful accounting system for the agency. Full Text

Keywords: Chief Financial Officer’s Act (CFO Act), accounting, Government Management Reform Act (GMRA), financial reporting, Department of Defense, charitable trust, financial statements, balance sheet, financial management, financial accountability, new public management (NPM), Federal Accounting Standards Advisory Board (FASAB), Financial Accounting Standards Board (FASB), enterprise resource planning (ERP)

GSBPP CAPSTONE REVIEW

Mathis Wright—Major, United States Army
Christopher Williams—Major, United States Army
Mark Toner—Lieutenant, United States Navy
Master of Business Administration
Advisor: Kathryn Aten, Graduate School of Business and Public Policy
Co-Advisor: Keith Snider, Graduate School of Business and Public Policy

The Naval Postgraduate School’s Graduate School of Business and Public Policy (GSBPP) is committed to a process of continuous improvement throughout all business practices, including its present approach to facilitating student capstones (i.e., projects and theses). The first step in any process improvement effort is to accurately depict the existing, as-is state of the process to be improved. The project team seeks to describe the existing GSBPP approach to facilitating student capstones through careful data collection and analysis from multiple sources, including the GSBPP exit survey, archived GSBPP capstones, faculty advisement data, faculty interviews, and a new GSBPP student survey in order to detail the capstone’s process, content, and value to multiple stakeholders. The project team also employs the Plan-Do-Study-Act framework for continuous process improvement throughout. It is not within the scope of this report to understand, control, or improve the current GSBPP approach to facilitating student capstones. Rather, this report only collects and presents data about the current approach so that GSBPP can understand it, control it, and improve it insofar as GSBPP finds it advantageous to do so. Full Text

Keywords: continuous process improvement, lean six sigma, Plan-Do-Study-Act model, GSBPP capstone, GSBPP project, GSBPP thesis, existing as-is state
MASTER OF SCIENCE

Applied Mathematics
Applied Physics
Astronautical Engineering
Computer Science
Cyber Systems and Operations
Defense Analysis
Electrical Engineering
Information Strategy and Political Warfare
Information Technology Management
Management
Mechanical Engineering
Meteorology and Physical Oceanography
Network Operations and Technology
Operations Research
Physical Oceanography
Physics
Systems Engineering
Cryptography forms the backbone of modern secure communication. Many different methods are available for encrypting and decrypting data, each with advantages and disadvantages. If communicating parties require speed of encryption more than incredibly robust security, they may use a stream cipher, which is based on generating long strings of bits with linear feedback shift registers (LFSRs), then making those strings cryptographically secure by combining them with a nonlinear Boolean function called a combiner. In this thesis, we investigate a modification to the classical combiner method by introducing a (nonsecure) probabilistic randomization to the order in which the LFSRs are input into the combiner function at each bit. We implemented two different designs for the probabilistic combiner: one that randomly ordered four LFSRs and put them into a four-variable Boolean function, and another that selected only three out of four LFSRs to use as inputs in a three-variable function. Our tests on the resulting output strings show that they increase drastically in complexity while passing the stringent randomness tests required by the National Institute of Standards and Technology for pseudorandom numbers. Full Text

Keywords: cryptography, pseudorandom number generation, linear feedback shift register, combiner, linear complexity
MASTER OF SCIENCE
IN
APPLIED PHYSICS

UNMANNED SYSTEMS: A LAB-BASED ROBOTIC ARM FOR GRASPING PHASE II
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Master of Science in Applied Physics
Advisor: Richard Harkins, Department of Physics
Second Reader: Gamani Karunasiri, Department of Physics

A 6 Degrees of Freedom (DOF) Leap Motion Controller (LMC) was characterized in position and accuracy for robotic arm control. Tests were conducted with linear and planar trajectories for input into the Kinova Jaco interface. The objective was to produce an intuitive and adaptive system that mimicked natural hand motion. Algorithms in C++ were produced to translate the LMC Cartesian position information to the Jaco Arm reference frame. Data showed that the LMC detector was quite sensitive to human hand jitter. Post-processing low-pass Fast Fourier Transform (FFT) filter techniques were employed to mitigate this problem. The LMC hand motion volume parameters were empirically scaled, in the Cartesian frame, to match Jaco motion operational requirements. It was determined that the LMC can be successfully used as an input device for the Jaco robotic arm control. Robotic arm trajectory latency issues were negligible when the Jaco Arm parameters for displacement trajectory rates were not violated, and this was successfully managed in program code and user visual input. Full Text

Keywords: robotics, 6 DOF Jaco Arm, Leap Motion Controller, inverse kinematics, DH parameters.

MODELING OF PLUTONIUM IONIZATION PROBABILITIES FOR USE IN NUCLEAR FORENSIC ANALYSIS BY RESONANCE IONIZATION MASS SPECTROMETRY
Steven Hutchinson–Lieutenant, United States Navy
Master of Science in Applied Physics
Advisor: Craig Smith, Department of Physics
Co-Advisor: Brett Isselhardt, Lawrence Livermore National Laboratory

Recent advancements in nuclear forensics have enabled the use of lasers via resonance ionization mass spectrometry (RIMS) to determine the isotopic composition ratios of U-235 and U-238. These technological advancements aid the field of nuclear forensics by establishing a known database and modeling approach for quantifying uranium isotope ionization probabilities. In order to further enhance the data and modeling capability necessary for nuclear forensics, numerical simulations must be analyzed and compared to experimental results conducted at Lawrence Livermore National Laboratory (LLNL). This research extends previous RIMS data simulation analysis conducted at the Naval Postgraduate School (NPS) and LLNL. The modeling framework collaborates with the experimental data to empirically derive the ionization cross sections for plutonium, furthering the confidence in the use of RIMS for nuclear forensic analysis. By implementing the experimental data into the modeling framework, we are able to provide the Department of Defense with a more rapid nuclear forensics process. Full Text

Keywords: plutonium, RIMS, nuclear forensics, laser ionization, resonance laser
METALLOID ALUMINUM CLUSTERS WITH FLUORINE
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Master of Science in Applied Physics
Advisor: Joseph Hooper, Department of Physics
Second Reader: James Luscombe, Department of Physics

Metals have a very high energy density compared to explosives, but they typically release this energy slowly via diffusion-limited combustion. There is recent interest in using molecular-scale metalloid clusters as a way to achieve very rapid rates of metal combustion. These clusters contain a mixture of low-valence metals as well as organic ligands. Here we investigate a prototypical aluminum metalloid cluster to determine system stability if the organic ligand contains significant amounts of fluorine. The fluorine can, in principle, oxidize the metallic elements, resulting in a system much like organic explosives, where the fuel and oxidizer components are mere angstroms apart. We performed density functional theory calculations within the SIESTA code to examine the cluster binding energy and electronic structure. Partial fluorine substitution in a prototypical aluminum-cyclopentadienyl cluster results in increased binding and stability, likely due to weak non-covalent interactions between ligands. Ab initio molecular dynamics simulations confirm that the cluster is structurally stable when subjected to simulated annealing at elevated temperatures.

Keywords: density functional theory, molecular dynamics, binding energy, siesta code, density of states, projected density of states

EXPERIMENTAL DESIGN OF A UCAV-BASED HIGH-ENERGY LASER WEAPON
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Master of Science in Applied Physics and Master of Science in Systems Engineering
Advisor: Keith Cohn, Department of Physics
Co-Advisor: Eugene Paulo, Department of Systems Engineering

The deployment of a High Energy Laser (HEL) weapon in an airborne platform is a challenging task due to size, weight, and power (SWaP) constraints. Recent technology innovations, however, promise that such HEL development may be a reality in the near future. This study models an Unmanned Combat Aerial Vehicle (UCAV) armed with a HEL weapon and simulates the laser beam’s atmospheric propagation. The Design of Experiments (DOE) methodology is then applied to determine the significance of the UCAV-HEL design parameters and their effect on the lethality of the weapon. The weight and energy requirements of two design alternatives are estimated, and the HEL output power is tabulated in relation to the UCAV endurance. Additional simulation shows the effects that platform jitter and beam quality have on the weapon lethality.

Keywords: directed energy weapons, high energy lasers, atmospheric propagation, unmanned combat aerial vehicle, system architecture, design of experiments
MASTER OF SCIENCE
IN
ASTRONAUTICAL ENGINEERING

EXPERIMENTAL TEST RIG FOR OPTIMAL CONTROL
OF FLEXIBLE SPACE ROBOTIC ARMS
Martin Griggs–Commander, United States Navy
Master of Science in Astronautical Engineering
Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering
Second Reader: I. Michael Ross, Mechanical and Aerospace Engineering

The goal of this thesis was to build an experimental test rig for demonstrations on flexible space systems control. Specifically, an air-bearing test bed incorporated a two-degree of freedom (2DOF) rigid robotic arm and an appendage with flexible joints to test the effects of movement of the robotic arm on the appendage. The two-link, 2DOF rigid robotic arm can be used to simulate a moving space antenna or other movable appendages. Optimal trajectories of the two-link arm to simulate a conventional antenna slewing maneuver were investigated to illustrate the type of flexible motion that may be produced in the laboratory. An iterative process was used to refine the test bed design and experimental workflow. Three concepts incorporated various strategies to design a robust flexible link. Inertia measurement units (IMU), a central processor for data analysis, power distribution, and robotics software, were all integrated as part of the test bed design. A single link arm with a torsional, helical spring at the base was finalized to investigate the effects of coupling due to movement of the rigid two-link arm. The torsional spring allowed the vibrating arm to displace sufficiently to have a high signal-to-noise ratio compared to earlier concepts in which IMU noise dominated the response. The test bed was designed to accommodate further testing that may require increased loading due to, for example, the incorporation of reaction wheels or additional instrumentation. Full Text

Keywords: degree of freedom, optimal control, optimal trajectory, vibration analysis, satellite, flexible space systems, air-bearing, slew rates

CLOSED-LOOP OPTIMAL CONTROL IMPLEMENTATIONS FOR SPACE APPLICATIONS
The following paper has been recognized as outstanding by its department.
Colin Monk–Lieutenant Commander, United States Navy
Master of Science in Astronautical Engineering
Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering
Second Reader: I. Michael Ross, Department of Mechanical and Aerospace Engineering

This thesis explores concepts for a closed-loop optimal control implementation of minimum-time attitude maneuvers of spacecraft. The most common implementation of optimal control solutions is via open-loop commands. However, ignorance of the true system parameters can undermine the open-loop optimal control solution. While traditional closed-loop control methods can compensate for significant levels of uncertainty, this comes at the cost of optimality. This work focuses on optimization of eigenaxis maneuvers, but the concepts are not limited to this constraint. The study begins with an examination of candidate control architectures, weighing the advantages of various closed-loop feedback architectures. A control architecture consisting of a traditional proportional-derivative (or quaternion error) feedback loop and a feed-forward control torque signal is deemed to have the best performance and is then selected for further study. Next, through the analyses of a series of optimal control problems, several real-time optimal control algorithms are developed that continuously adapt to feedback on the system’s actual states throughout the maneuver. These algorithms
demonstrate significant performance improvements over conventional open-loop implementations—most notably, shorter overall maneuver times. The results of this work, therefore, provide an algorithmic enhancement of spacecraft agility. **Full Text**

Keywords: optimal control, closed-loop control, real-time optimal control, eigenaxis, state prediction

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**OPTICAL CORRECTION OF SPACE-BASED TELESCOPES USING A DEFORMABLE MIRROR SYSTEM**

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Master of Science in Astronautical Engineering
Advisor: Brij Agrawal, Department of Mechanical and Aerospace Engineering
Co-Advisor: Jae Kim, Department of Mechanical and Aerospace Engineering

Adaptive optics offer the potential to reduce the high cost and long lead time associated with manufacturing mirrors for spaced-based telescopes by allowing lighter materials to be substituted. These lighter materials lack the optical performance of traditional space-based mirrors. Deformable mirrors could be used to correct for surface aberrations in order to improve the optical quality by altering their surface to adjust the wavefront. Research focused on placing a deformable mirror at the exit pupil of a simulated telescope. Experimental work first studied a severely degraded one-meter carbon fiber reinforced polymer mirror to establish a baseline. Simulations were conducted to see how a notional deformable mirror would be able to negate the optical effects due to a distorted mirror in combination with field angle effects. Results from the investigation showed that a deformable mirror yielded the greatest benefit when applied to a distorted mirror surface. Increasing the actuator count on the deformable mirror boosted the root mean square performance across all field angles. Increasing the actuator stroke yielded minimal benefits after a certain reduction in wavefront had already been achieved. Further research is recommended to focus on using a continuous deformable mirror to account for field angle effects. **Full Text**

Keywords: adaptive optics, deformable mirror
Marine Corps Manpower Plans and Policy Division, Manpower & Reserve Affairs, is responsible for formulating Marine Corps force manpower plans. Accomplishing this mission requires extensive knowledge of the Human Resource Development Process (HRDP) for controlling future personnel attrition, retention, and accession quantities to ensure that appropriate quantities of its various Military Occupational Specialties (MOS) and overall end strength are maintained. To assist their mission, an agent-based computer simulation model was developed in the Java computer language. This thesis investigates that simulation model, titled Manpower Simulation Model (MSM). This thesis provides documentation of MSM’s architecture and processes, tests the sensitivity of its inputs through the use of an experimental design, and validates MSM’s output measures by calculating the relative error for five successive forecast years for various HRDP categories. This thesis found that MSM’s structure and output measurement responses aligned with HRDP practices. With respect to validation, on average the HRDP categories losses and accessions underestimated by 17 and 18 percent, respectively, while gains overestimated by 36 percent. The category promotions generally underestimated but lessened in magnitude as grade increased. The category retention consistently overestimated for all grades. Lastly, the MSM showed biasness toward retaining Marines over backfilling vacancies through accessions.

Keywords: computer simulation, agent-based simulation, sensitivity analysis, design of experiments, U.S. Marine Corps, manpower model, verification, validation, modeling
The Navy must employ the talented programmers and developers required to build and maintain its software systems. The establishment of a Navy community of practice (CoP) for programmers and developers can significantly increase knowledge sharing, provide mentorship opportunities, increase cybersecurity of computer-dependent systems, and expose the Navy and industry to each other’s cybersecurity needs and requirements, as well as best practices, tools, and techniques. The design for a Navy CoP should be human-centered and should reflect the key characteristics shared among successful communities of practice. Through the use of surveys, interviews, and observations conducted at the June 2016 HACKtheSKY Navy hackathon, it was discovered that there is a need and want for such a Navy CoP. CoP design and specific Tenth Fleet recommendations were drafted with focus on social interactions, operational structure, and lifecycle characteristics. In conclusion, there is high confidence that the Navy will benefit long term from expanding its boundaries in the cyber domain and practice of programming and development. 

Keywords: community of practice, design thinking
Stabilization Operations through Military Capacity Building—Integration Between Danish Conventional Forces and Special Operations Forces

Jesper Andreassen—Danish Air Force
Kenneth Boesgaard—Danish Special Operations
Anders Svendsen—Danish Army

Master of Science in Defense Analysis
Advisor: Kalev Sepp, Department of Defense Analysis
Co-Advisor: Anna Simons, Department of Defense Analysis

Due to instability in Africa and the Middle East, Denmark’s political commitment to deploying troops to stabilize fragile regions is not expected to decrease in the near future. The political ambition for Denmark is to conduct stabilization efforts through military capacity building under the framework of shape-secure-develop. This requires targeting both the physical and cognitive domains. For Denmark to sustain long-term stabilization operations, different approaches to integrate and synchronize the efforts of both conventional forces and special operations forces must be explored. This capstone makes use of two different conceptual scenarios: one of conflict prevention and one of conflict intervention. With conflict prevention, we contend that conventional forces and special operations forces should be fully integrated across doctrine, organization, and technology, and predominantly advise, mentor, and train local forces. With conflict intervention, military forces should predominantly partner with and assist local forces through operational mentoring liaison teams and village stability operations. This capstone makes additional recommendations related to doctrine, organization, and technology, as well as education and training. Full Text

Keywords: Danish Defence, military capacity building, stabilization operations, integration, synchronization, conventional forces, special operations forces, task assignment, full integration, conflict prevention, conflict intervention, doctrine, organization, technology, partner, assist, advise, mentor, train, shape-secure-develop, operational mentoring and liaison teams, village stability operations, Africa, Middle East

Strategic Utility of the Russian Spetsnaz

Abdullah Atay—First Lieutenant, Turkish Special Forces

Master of Science in Defense Analysis
Advisor: Hy Rothstein, Department of Defense Analysis
Second Reader: Douglas Borer, Department of Defense Analysis

The Russian annexation of Crimea stimulated the author’s interest in researching the little green men (allegedly the Russian Spetsnaz) who appeared at a decisive point in the coup de main. The intent here is to understand the capabilities and limitations of the Russian special operations forces (SOF) and the level of threat they present to North Atlantic Treaty Organization (NATO) members and Russia’s neighbors. This study uses Colin Gray’s strategic utility theory to understand why Russian leaders choose unconventional warfare over conventional warfare, and how well the Spetsnaz execute assigned missions. Soviet and Russian military doctrines constitute a baseline for the evolution of Russian strategy and of Spetsnaz in parallel. Three case studies—Operation Danube in Czechoslovakia, the First and Second Chechen Wars, and the annexation of Crimea—contribute to this research. Russian Spetsnaz are competent enough to fulfill their duties; however,
they do not make up for poor planning, weak strategy, and general incompetence. When Russia has vigorous plans and a strong strategy, the Spetsnaz become an indispensable element. Thus, it behooves the decision makers of concerned countries to remain vigilant and take precautions and countermeasures to ensure that the Spetsnaz will not surface in their nations’ capitals out of the blue. Full Text

Keywords: strategic utility, Spetsnaz, spetsialnogo naznacheniya, special forces, special operations, special operations forces, SOF, Soviet Union, Russia, Prague, Czechoslovakia, operation Danube, First Chechen War, Second Chechen War, Chechnya, annexation of Crimea, Ukraine

THE ROLES OF DECISION MAKERS IN SPECIAL OPERATIONS
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Master of Science in Defense Analysis
Advisor: Hy Rothstein, Department of Defense Analysis
Second Reader: Douglas Borer, Department of Defense Analysis

This thesis examines the roles of decision makers in three phases of a special operation: the approval phase, the preparation phase, and the execution phase. The author argues that the level of decision makers’ involvement should be high in the approval phase, medium in the preparation phase, and low in the execution phase. Four special operations which were conducted by different countries’ Special Forces—Operation Thunderbolt, Operation Nimrod, Operation Eagle Claw, and the Moscow Theater Hostage Crisis—are studied in order to test the argument. Ultimately, this thesis seeks to draw attention to the specific roles that decision makers should perform for a successful special operation. It concludes by offering these specific activities for decision makers: Examining Less Risky Options, Gaining International and Domestic Support, Delegating Authority, Establishing Clear Chain of Command, Selecting Appropriate Units, Gaining Time, Coordinating, and Preserving Secrecy. Full Text

Keywords: special operations, roles of decision makers, approval phase, preparation phase, execution phase, Operation Thunderbolt, Operation Nimrod, Operation Eagle Claw, Moscow Theater Hostage Crisis

FROM SUCCESSFUL DEFENSE TO PROBLEMATIC OFFENSE:
THE DEVOLUTION OF UNCONVENTIONAL WARFARE
Timothy Ball–Major, United States Army
Master of Science in Defense Analysis
Advisor: Anna Simons, Department of Defense Analysis
Second Reader: Michael Richardson, Department of Defense Analysis

Unconventional warfare (UW) originated in World War II as a defensive tactic, utilized to assist an occupied ally during a conventional war. Since then, Special Forces (SF) has changed the definition of UW to include offensive regime change as a strategic option. This type of UW was practiced extensively by the Central Intelligence Agency during the Cold War with poor results. The use of offensive UW by the United States is problematic for a variety of reasons, ranging from unreliable proxy forces to unpredictable results and negative international perception. The use of defensive UW under certain conditions remains justified and practical but retains many of the same issues. After examining the history of the United States’ use of UW, this thesis concludes that Special Forces better serves the nation’s interests by promoting itself as the premier combined force of the United States military. Full Text

Keywords: Special Forces, unconventional warfare, covert action, nation-building, irregular forces, proxy forces, partner forces, foreign internal defense, security force assistance, Jedburgh, TPAJAX, PBSUCCESS, BGFIEND, intervention
WHY IRREGULARS WIN: ASYMMETRY OF MOTIVATIONS AND THE OUTCOMES OF IRREGULAR WARFARE
Andrew Ballow–Major, United States Army
Master of Science in Defense Analysis
Advisor: John Arquilla, Department of Defense Analysis
Second Reader: Doowan Lee, Department of Defense Analysis

The U.S. military is first-rate, yet it struggles to fight and win irregular wars. Surprisingly, throughout the course of history, great powers have had difficulty with small wars. One must ask, then, why and how do irregulars win as often as they do? The answer to this question will enable the United States to support irregulars more effectively and defeat irregulars more efficiently. This thesis considers 17 irregular conflicts between World War II and the present day to determine why irregulars win when they do and how asymmetries of motivation can affect the outcome of irregular wars. A mixed methodology, including heuristics, process tracing, and comparison of case studies, is used to evaluate irregular wars and the motivations of the combatants. The findings suggest that asymmetries of motivation only partially explain why irregulars succeed. Irregulars can succeed when motivations are symmetric or asymmetric. Internal conflicts that exhibited symmetrical motivation were often long, bloody, and costly affairs resolved primarily by negotiations. Alternatively, when asymmetries of motivation have existed, the weak were able to influence intrinsic and extrinsic motivations to coerce their adversaries to quit. Ultimately, the findings from this thesis indicate that opinion and public support significantly influence an actor’s motivation and will to fight. In light of this, this thesis suggests that Special Operations Forces (SOF) should focus on advising irregulars to shape opinions and perceptions to undermine their opponents’ will to fight. Furthermore, the U.S. government should focus more on the application of political and psychological warfare to enable U.S. SOF operations in support of both counterinsurgency and unconventional warfare operations. Full Text

Keywords: insurgents, guerrillas, irregulars, insurgencies, civil war, asymmetric warfare, gray zone, strategy, counterinsurgency, guerrilla warfare, special operations, pseudo operations, World War II, Cold War, post-Cold War, unconventional warfare, conventional warfare, motivation, external support, safe havens, Vietnam War, Algerian War of Independence, Arreguin-Toft, Jeffery Record, Gil Merom, Andrew Mack

ASSESSING SENTIMENT IN CONFLICT ZONES THROUGH SOCIAL MEDIA
Andrew Bourret–Lieutenant Commander, United States Navy
Joshua Wines–Major, United States Army
Jason Mendes–Chief Petty Officer, United States Navy
Master of Science in Defense Analysis
Advisor: Camber Warren, Department of Defense Analysis
Second Reader: Robert Burks, Department of Defense Analysis

While it is widely accepted that polling can assess levels of popular support in a geographic area by surveying a cross-segment of its population, it is less well accepted that analysts can use social media analysis to assess sentiment or popular support within the same space. We examine this question by comparing geographically anchored polling and social media data, utilizing over 1.4 million georeferenced messages sent through the Twitter network from Yemen over the period from October 2013 to January 2014, to assess both support for extremist groups and support for the Yemeni government. From our research, we conclude that social media data, when combined with polling, has a positive impact on analysis. It can also be a reliable source of stand-alone data for evaluating popular support under certain conditions. Therefore, we recommend future research projects focus on improving the quality of social media data and on operational changes to improve the integration of social media analysis into assessment plans. Full Text

Keywords: social media, data, polling, surveys, sentiment, Twitter, Yemen, regression analysis, defense
Many members of the U.S. government seem to misunderstand one of the most important concepts of social competition and politics—the interpretation of ideology. This qualitative study provides an explanation of how ideologies go to war armed with unique profiles for social movements. In a connected world, which includes prisons and other grievance breeding grounds, the spectrum of strategic to grassroots ideological warfare will never go away. Knowing how to fight influentially in the information domain requires a communication pathway with resonant messages for the intended audiences. After studying ideologies and social movements as domestic and international phenomena, my recommendation is an initial attempt to modify Special Operations organization and expectations and to improve their effectiveness in information warfare.

Full Text

Keywords: ideology, ideologies, idea, social movement, organization, network, resonance, resonate, narrative, frame, meme, harmonic, antenna, influence, communication, information, pathway, consciousness, interpretation, bias, fallacy, violence, war

What are the impacts of airstrikes on civilian sentiment and political violence? With increased air campaigns and technology proliferation in the Middle East and Africa, there exists a significant gap exploring airstrike associations within irregular warfare. In response, this thesis uses new geospatial measurements to map civilian sentiment in Yemen. Then, spatiotemporal windows are utilized to assess associations between airstrikes, sentiments, and political violence. The findings imply that airstrikes are associated with an increase in extreme sentiment for both states and insurgencies, suggesting that airstrike effects mobilize bystanders to participate in the political process. Furthermore, the findings indicate that airstrikes raise the level of post-strike political violence in Yemen and Pakistan but may decrease post-strike political violence in Afghanistan and Somalia. This gives credence to the theory that narrative distribution may be a critical link that connects secondary airstrike effects with policy goals within the human domain. In addition, information asymmetry between competing narrative campaigns and civilians may be a viable theory to connect extreme sentiment and political violence. Full Text

Keywords: airstrikes, sentiment, political violence, public opinion, survey experiment, political process model, information asymmetry
In 2014, the Royal Norwegian Air Force (RNoAF) became the Executive Agent Office of Primary Responsibility (EA OPR) for Personnel Recovery (PR) for the Norwegian Armed Forces. This capstone project is sponsored by the commander RNoAF PR and SERE School to support the development of a whole-of-department approach to PR by answering this question: How can we design a Personnel Recovery (PR) system for the Norwegian Armed Forces that enables Norwegian commanders and staffs, forces and isolated personnel to collaborate and operate in a combined joint PR mission environment? This capstone project explores PR for the Norwegian Armed Forces through an inquiry of design and design thinking. As an initiation of the design process, the capstone begins the discovery phase with an examination of archival records centered on PR from World War II to the present and in-depth discussions with national and international PR subject-matter experts. This capstone describes the results from the design thinking process, its prototypes, and recommendations to the RNoAF. In brief, the capstone project recommends that the Norwegian Armed Forces, with the RNoAF as the EA OPR for PR, develop a network organization that coordinates the main actors in the PR system into well-functioning communities of practice. Full Text

Keywords: personnel recovery, design, design thinking, network, network design, network governance, network administrative organization, lead organization, shared governance, community of practice, PR

REEXAMINING GROUND SOF COMMAND AND CONTROL: DOES ONE SIZE FIT ALL?
Thomas Cogan—Major, United States Marine Corps
Master of Science in Defense Analysis
Advisor: Kalev Sepp, Department of Defense Analysis
Co-Advisor: Robert Burks, Department of Defense Analysis

The current designs employed by the U.S. Department of Defense for the command and control of special operations forces (SOF) in limited contingency environments require reexamination to see whether they are sufficient or can be improved to meet the needs of the current operational environment. Joint Special Operations Task Force (JSOTF) and Special Operations Command-Forward (SOC-FWD) structures provide a scalable response to identified problems but still primarily operate as closed organizations in complex turbulent environments that would be better influenced by an open organizational design. This research examines how existing Marine Special Operations Forces, Army Special Operations Forces, and Naval Special Operations Forces organizations can meet the demands of complex operational environments at the task force level more efficiently. JSOTFs and SOC-FWDs provide adaptive organizations when employed with clear unity of effort and command within a Joint Task Force. Performance is increased when homogenous organizations command and control ground SOF during operations, vice using a Theater Special Operations Command, as doctrine prescribes. Full Text

Keywords: special operations forces, command and control, Joint Special Operations Task Force, Special Operations Command-Forward, Marine Special Operations Forces, Army Special Operations Forces, Naval Special Operations Forces, task force, Theater Special Operations Command, Joint Task Force
ASSESSING THE STRATEGIC UTILITY OF THE HIGH NORTH: THE COLDER WAR
Brandon Daigle—Major, United States Air Force
Brian James—Major, United States Army
Master of Science in Defense Analysis
Advisor: Douglas Borer, Department of Defense Analysis
Co-Advisor: Jeffrey Appleget, Department of Operations Research

Russia’s current policy and associated expansion in the High North directly contrast with the United States’ weak Arctic policy. To secure its objectives in the Arctic, the United States—which has constrained diplomatic, military and economic resources for foreign relations—must assess if Arctic investment is truly worthwhile. This thesis examines the military dimension of Arctic expansion in order to assess the risk and overall investment of U.S. militarization against diplomatic agreements. Using Senturion modeling and simulation software via closed-loop capstone wargames, this thesis helps forecast potential implications of various U.S. Arctic policy avenues across the spectrum of known stakeholders and against each stakeholder’s stated or perceived preferences. Full Text

Keywords: Arctic, High North, Russia, policy, resources, trade, environmental Northern Sea Route, Northwest Passage, climate

FINDING THE LIMIT: THE STRATEGIC POTENTIAL OF THE NETWORK-BASED ACTOR
Sean Dixon—Major, United States Army
Master of Science in Defense Analysis
Advisor: Kalev Sepp, Department of Defense Analysis
Second Reader: Sean Everton, Department of Defense Analysis

Non-state, network-based threats are elusive and effective. There is an ongoing discussion about how the U.S. government can best counter these threats. What is lacking in this discussion is a clear understanding and general agreement concerning what these threats are capable of. The potential of these networks should be the primary driver of these discussions. Currently there is a split among researchers concerning the potential of network-based actors. The source of this division is a debate about whether and to what extent decentralized network-based actors can conduct strategic planning. This thesis contributes to the debate through qualitative analysis of two non-state, network-based actors, to show the capacity to plan strategically, evidenced by their ability to acquire and employ agents of influence. Full Text

Keywords: agents of influence, Soviet KGB, the Trust, Pierre-Charles Pathé, Al-Kifah Refugee Center, Al-Qaeda, Holy Land Foundation for Relief and Development

MILITARY FREE FALL SCHEDULING AND MANIFEST OPTIMIZATION MODEL
Anthony Fera—Major, United States Army
Master of Science in Defense Analysis
Advisor: Paul Ewing, Department of Operations Research
Co-Advisor: William Fox, Department of Defense Analysis

The United States Army Special Operations Command mandate to have all Green Berets be military free fall–qualified essentially doubled the number of students in the course. This thesis uses an optimization tool for the manifest station to streamline airborne operations and reduce aircraft dwell time, thus saving money and enhancing use of resources. The military free fall scheduling and manifest optimization model is based on the existing scheduling dilemma model with original parameters. This model prescribes the number of jumpers
per pass, depicts planned aircraft dwell time, and predicts duty day length. This information will help the command team make validated decisions regarding future class sizes and methods of training execution. Full Text

Keywords: military free fall school, manifest, optimization

MILITARY RETENTION: A HOLISTIC APPROACH TO UNDERSTANDING OFFICER SEPARATION IN THE NAVY EXPLOSIVE ORDNANCE DISPOSAL COMMUNITY

Mark Gutierrez–Lieutenant, United States Navy
Master of Science in Defense Analysis
Advisor: Sean Everton, Department of Defense Analysis
Second Reader: George Lober, Department of Defense Analysis

This thesis explores and identifies trends in officer separation within the Navy Explosive Ordnance Disposal (EOD) officer community. It blends analyses of a survey conducted on active duty EOD officers with interviews of former EOD officers to better understand why the community struggles to meet manning requirements at the eight- to ten-year mark. Analysis of the data indicates that family stability, leadership, military bureaucracy, and limited operational time each are factors in the community’s retention problem. Of those, this thesis proposes that leadership focus on a factor it can influence—operational time. In particular, it proposes that longer tours and extending operational time for junior officers may mitigate officer separation. Full Text

Keywords: military retention, explosive ordnance disposal, officer retention

INSECURITY IN THE DRC: THE OBSTACLE TO PEACE AND STABILITY

The following paper has been recognized as outstanding by its department.

Badura Hakimu–Major, Tanzanian Army
Master of Science in Defense Analysis
Advisor: Heather Gregg, Department of Defense Analysis
Second Reader: Anna Simons, Department of Defense Analysis

The Democratic Republic of Congo (DRC) has experienced complex warfare that has involved various neighboring nations since the mid-1990s. In particular, the protected presence of armed groups has been a major obstacle to peace. Based on the best practices in Disarmament, Demobilization, Reintegration (DDR) programs, this thesis constructs an analytical framework and uses a longitudinal case study of the DRC to analyze four DDR programs initiated in the DRC from 2002 to 2009, with the goal of better understanding why they failed. The thesis finds that an unrealistically short timeline, insufficient funds, an overemphasis on disarmament, and the failure to include all key warring parties in the DDR process created major obstacles to success in short-term DDR efforts in the DRC. Long-term reintegration efforts have been hindered by poor linkages between the DDR and security sector reform (SSR), a lack of government capacity to implement and oversee reintegration programs, a chronically weak economic sector, and continued tensions with DRC’s neighbors, particularly Rwanda. Given these findings, implementing a viable DDR program should require a minimum of 15 years of commitment; this would allow for comprehensive SSR, jobs programs, community-based activism, an improved economy, and better relations with neighboring countries. Full Text

Keywords: Democratic Republic of Congo, disarmament, demobilization, repatriation, resettlement, reintegration, MONUC, DRC, DDR, DCR, FARDC, FDLR, SRR
ROOTS OF RUSSIAN IRREGULAR WARFARE
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Master of Science in Defense Analysis
Advisor: John Arquilla, Department of Defense Analysis
Second Reader: Laura Adame, Department of Defense Analysis

The Russian experience with irregular warfare runs deep. Russian forces used irregular warfare to defeat Napoleon's army in 1812. Russia conquered vast territory in the latter half of the 19th century, defeating irregulars with impressive economy of force. The Soviets employed partisan guerrillas with increasing skill during the Bolshevik Revolution and the Great Patriotic War. In Afghanistan, the Soviets avoided a Vietnam-like collapse while employing irregular tactics fighting against the Mujahedeen. Russia was at first defeated by, then learned from and turned the tables on, insurgents and irregulars in Chechnya. The experience Russia gained across the past two centuries of irregular warfare left an indelible mark on and shaped Russian forces for their invasion of Ukraine in 2014. Understanding the roots of Russian irregular warfare—their experiences and how they adapted to unique challenges—could prove invaluable to understanding the future of it. Full Text

Keywords: Russian irregular warfare, hybrid warfare, non-linear warfare, new-generation warfare, unconventional warfare, Gerasimov Doctrine, Russian irregular warfare against Napoleon, Russian irregular warfare and economy of force during the Great Game in Central Asia, Russian irregular warfare and partisan operations in the Great Patriotic War, Russian irregular warfare and counterinsurgency in Afghanistan, Russian irregular warfare against Chechnya and in the Caucasus, Russian irregular warfare in Ukraine and the Crimea

BUILDING PARTNER CAPACITY: THE SCIENCE BEHIND THE ART
Zachary Hoover–Major, United States Army
James Self–Major, United States Army
David Yu–Major, United States Army
Master of Science in Defense Analysis
Advisor: Heather Gregg, Department of Defense Analysis
Co-Advisor: Robert Burks, Department of Defense Analysis

Building Partner Capacity (BPC) is a key mission for special operations forces (SOF), yet there is a lack of consensus on which variables most significantly impact BPC success. This thesis uses quantitative and qualitative methods to explore the effects of cultural, economic, and support conditions on the outcome of BPC programs. It first constructs and analyzes a quantitative model that uses several preexisting conflict datasets. It then provides a qualitative case study, the Dhofar Rebellion (1965–1975) in Oman, to give real-life context to the model's findings. This thesis finds that cultural differences between BPC sponsor and client, the number of sponsors per client, the length of a BPC relationship, and the types of support provided are all critical factors for BPC mission success. From these findings, the thesis offers five recommendations for sponsors to improve BPC mission success: manage personal relationships to overcome cultural differences; front-load support to their clients; consider allowing clients increased access to the sponsor's military and intelligence infrastructure; recognize the importance of funding support; and shield clients from the complexities of multilateral BPC efforts. In short, sponsors should build intimate sponsor-client relationships to succeed at BPC efforts. Full Text

Keywords: building partner capacity, culture, special operations forces, Dhofar Rebellion
DEPTH VS. BREADTH: TALENT MANAGEMENT FOR SPECIAL WARFARE  
William Krebs Jr.–Major, United States Army  
Master of Science in Defense Analysis  
Advisor: Anna Simons, Department of Defense Analysis  
Second Reader: Kalev Sepp, Department of Defense Analysis

This thesis presents recommendations for improving officer talent management for Special Warfare units. Success in this complex human domain demands that key planners and commanders of a Special Warfare campaign operate with a long-term perspective, a depth of expertise, and a strong network of relationships. However, on any given day in a U.S. Army Special Forces Group, the preponderance of field grade officers are in their first year on the job. With a particular focus on what constitutes adequate time in key leadership positions, this thesis examines talent management in Nordic SOF units, the Intelligence Community, Google, and elite college basketball teams. Based on how these exceptional organizations balance breadth vs. depth—and grounded in interviews with former four-star commanders and Defense Department leadership—the research determines that the current method of rotating field grade officers through key jobs every 12–24 months is antithetical to the needs of Special Warfare. The thesis concludes with three recommendations to improve talent management for field grade Special Forces officers. Full Text

Keywords: special warfare, talent management, leadership, special operations forces, irregular warfare, succession, leader rotation, manager tenure, managing complexity, leader development

USING CROWDSOURCED GEOSPATIAL DATA TO AID IN NUCLEAR PROLIFERATION MONITORING  
Kenyon Leno–Major, United States Army  
Steven Miller–Major, United States Army  
Master of Science in Defense Analysis  
Advisor: Leo Blanken, Department of Defense Analysis  
Co-Advisor: Zachary Davis, Department of National Security Affairs

In 2014, a Defense Science Board Task Force was convened in order to assess and explore new technologies that would aid in nuclear proliferation monitoring. One of their recommendations was for the director of National Intelligence to explore ways that crowdsourced geospatial imagery technologies could aid existing governmental efforts. Our research builds directly on this recommendation and provides feedback on some of the most successful examples of crowdsourced geospatial data (CGD). As of 2016, Special Operations Command (SOCOM) has assumed the new role of becoming the primary U.S. agency responsible for counterproliferation. Historically, this institution has always been reliant upon other organizations for the execution of its myriad of mission sets. SOCOM’s unique ability to build relationships makes it particularly suited to the task of harnessing CGD technologies and employing them in the capacity that our research recommends. Furthermore, CGD is a low-cost, high-impact tool that is already being employed by commercial companies and nonprofit groups around the world. By employing CGD, a wider whole-of-government effort can be created that provides a long-term, cohesive engagement plan for facilitating a multifaceted nuclear proliferation monitoring process. Full Text

Keywords: counterproliferation, crowdsourcing, CGD, social networks, recursive incentive structure, query incentive structure
DO VILLAGES STILL MATTER?
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Advisor: Kalev Sepp, Department of Defense Analysis
Second Reader: Camber Warren, Department of Defense Analysis

In 2014, the United Nations reported that there were 28 cities in the world with populations of over 10 million. In 2016, there were 34 of these megacities, and, by the year 2030, the UN estimates that there will be 41. As a result, concerns over rapid megacity growth have become the focus of U.S. military planners and strategists attempting to determine how to best operate in the future megacity environment. In light of these demographic shifts and in the face of rapid megacity growth, this research asks the question: Do villages still matter? Three case studies were chosen that cover a wide geographic range, including two contemporary cases in areas with some of the highest rates of urbanization. The historic case broadens the geographic scope of the study but also provides historical insights into how each variable influenced success or failure once an insurgency occupied the urban terrain. Ultimately, this thesis concludes that in spite of megacity growth, if in tomorrow’s conflict the state chooses to take the fight to where the insurgent seeks refuge, it will likely occur in the mountains, jungles and deserts for control of villages. Full Text

Keywords: megacities, urbanization, counterinsurgency, villages, safe havens, relative deprivation, polarization, urban, rural

ASSESSING ANTI-AMERICAN SENTIMENT THROUGH SOCIAL MEDIA ANALYSIS
David Morales–Lieutenant Colonel, United States Air Force
Master of Science in Defense Analysis
Advisor: Camber Warren, Department of Defense Analysis
Second Reader: Sean Everton, Department of Defense Analysis

This thesis examines the history of anti-Americanism as both a passing sentiment and an enduring ideology and how both can be detrimental to American security and future prosperity. It further explores the analytical methods for studying anti-Americanism, including classic polling and social media analysis, in an attempt to determine the reliability of each. This work attempts to bring to light the underlying motives for anti-American beliefs by examining relationships between explicit American actions in Pakistan and Japan and variations in anti-American sentiment. The results show that drone strikes in Pakistan and large-scale military exercises involving U.S. and Japanese forces can both cause significant fluctuations in the number of positive and negative tweets directed toward America. I argue that the mixed and negative messages represented in Twitter are due in large part to a lack of U.S. transparency while conducting both drone strikes in Pakistan and military shows of force in and around Japan. Full Text

Keywords: anti-Americanism, Twitter, social media analysis, drone strike, Pakistan, UAV, sentiment analysis, Japan, sentiment dictionary

THE IMMERSION EFFECT
Andrew Potts–Major, United States Army
Master of Science in Defense Analysis
Advisor: Hy Rothstein, Department of Defense Analysis
Second Reader: Doowan Lee, Department of Defense Analysis

This project seeks to improve foreign language and cultural acquisition methods for active component (AC) psychological operations (PSYOP) personnel. This project leverages official documents and empirical evidence, as well as data, to determine the requisite levels of foreign language and cultural proficiency. Various
methods of foreign language and cultural acquisition are reviewed to determine a method suitable for PSYOP personnel. These methods are then compared against those used by the Church of Jesus Christ of Latter-Day Saints, Foreign Area Officer, and the U.S. Army Special Warfare Center and School language and culture acquisition programs to determine the effectiveness of each. This research concludes that immersion is a critical and necessary element of foreign language acquisition. Immersion replicates natural language acquisition, similar to the process by which children learn to speak. This research offers methods by which advanced language and culture proficiency can be achieved through an immersion-based language acquisition program. Full Text

Keywords: language, culture, region, PSYOP, SOF, ARSOF, SOCOM, DLPT, DLI, BSOLT

THE FUNDING OF BOKO HARAM AND NIGERIA'S ACTIONS TO STOP IT
Jason Rock–Major, United States Army
Master of Science in Defense Analysis
Advisor: Michael Freeman, Department of Defense Analysis
Second Reader: Doowan Lee, Department of Defense Analysis

Since 9/11, the United States and the international community have taken numerous steps to combat the financing of terrorism. Terrorist organizations have adapted and become innovative to ensure their monetary funds are secure and undetectable. Boko Haram is one organization that has found ways to ensure its finances are almost undetectable. Over the past 12 years, Boko Haram has become a powerful and destructive violent extremist organization while obtaining millions of dollars in funding. The United States and the international community must look for ways to disrupt Boko Haram’s financial apparatus outside conventional counter-threat finance measures. The goal of this paper is to examine Boko Haram’s finances and the steps that have been taken to stop its funding, including identifying what new approaches, if any, can be used to prevent the ongoing funding of Boko Haram. Full Text

Keywords: Boko Haram, funding, Nigeria

CONSEQUENCES OF CHINESE AID IN SUB-SAHARAN AFRICA
Phillip Sauls–Major, United States Army
Neal Heaton–Lieutenant Commander, United States Navy
Master of Science in Defense Analysis
Advisor: Glenn Robinson, Department of Defense Analysis
Co-Advisor: Jessica Piombo, Department of National Security Affairs
Second Reader: Camber Warren, Department of Defense Analysis

China’s position of noninterference in foreign governments’ affairs, while currently good for Chinese business, may threaten to increase international terrorism, deepen regime corruption, and erode U.S. political relevance in sub-Saharan Africa. China has empowered private enterprises, which can monopolize African market sectors, marginalize African businesses, and exacerbate local social conditions. Using nonviolent uprising and violent resistance events from Social Conflict Analysis Database (SCAD), World Governmental Indicators (WGI), and World Development Indicators (WDI) databases, this study seeks to determine to what extent China’s long-term economic goals may challenge U.S. security objectives in Africa. Observations from African states will form the base for analysis to establish a fundamental correlation between Chinese direct investment and Beijing’s foreign policy in Africa. This study illustrates that China’s foreign policy is not reflected in the actions of its state-owned enterprises and non-governmental organizations, increasing the potential for friction and conflict, and that China’s investment approach inherently requires the support of the host nation.
and may affect our African partners’ alignment with U.S. policy objectives. This study also highlights a significant gap in data regarding the state of our partners in Africa. Full Text

Keywords: Chinese aid and investment, sub-Saharan Africa, foreign policy, civil unrest, stability, AFRICOM, SOCAF

SPECIAL OPERATIONS AND CYBER WARFARE
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Master of Science in Defense Analysis
Advisor: Dorothy Denning, Department of Defense Analysis
Second Reader: Duane Davis, Cyber Academic Group

As the United States Special Operations Command (USSOCOM) prepares for future conflicts, some have questioned its ability to conduct Special Warfare and Surgical Strike in all domains of warfare, including the cyber domain. This thesis examines the applicability of cyber operations to U.S. special operations and whether the cyber support provided by the United States Cyber Command (USCYBERCOM) is sufficient to meet USSOCOM’s potential cyber requirements. It explores USSOCOM’s congressionally mandated core activities and how cyber operations could promote such activities. Finally, the thesis provides a decision theory and operational design analysis of how USSOCOM could build its own internal cyber capability if USSOCOM determines USCYBERCOM cannot meet the cyber requirements of the special operations community. The researcher was unable to conclude whether USCYBERCOM’s cyber support to USSOCOM was sufficient. USCYBERCOM’s cyber support structure is still too immature for analysis and therefore necessitates future research by USSOCOM. The thesis does conclude USSOCOM can improve their special operation’s efficacy by incorporating the cyber domain. Finally, the research concludes, if USSOCOM were to build a cyber capacity, the reflagging of the 95th Civil Affairs Brigade would be the best course of action. Full Text

Keywords: cyber domain, cyber warfare, special operations, core activities, Special Warfare, Surgical Strike, future warfare, technology, low intensity conflict, Internet, networks, non-state actors, state actors, Russia, China, Ukraine, cyber command, Duggan, direct action, unconventional warfare

ENABLING PERSISTENT PEACE AFTER NEGOTIATED SETTLEMENTS
Evert Andres Mejia—Lieutenant Colonel, Colombian Marines
Jason Christopher Green—Captain, United States Army
Master of Science in Defense Analysis and
Master of Science in Information Strategy and Political Warfare
Advisor: Kalev Sepp, Department of Defense Analysis
Second Reader: Diego Esparza, Department of National Security Affairs

This thesis examines the theory and practice of sustaining peace after an intrastate conflict. After an agreed-upon peace settlement is signed, certain factors support sustaining the peace. In this study, those factors are analyzed to develop recommendations for implementation in Colombia. Drawing from literature on peace settlements and case studies, the thesis posits that the positive factors for sustainable peace be employed to function as a plan to deter a recurrence of intrastate conflict. The thesis tests these factors through analysis of the period following civil wars in Angola and Mozambique and finds that political inclusion and public security are particularly important. In Colombia, the Marines, along with the backing of the United States Armed Forces, will aim to sustain the peace through collaboration. Building on these findings, this thesis recommends ensuring that disarmament, demobilization, and reintegration (DDR) and security sector reforms (SSR) are the foundations for sustaining the peace. Full Text

Keywords: negotiated settlement, recurrence of war, post conflict, Colombian Marines
A PERSONAL INERTIAL-NAVIGATION SYSTEM BASED ON MULTIPLE DISTRIBUTED, NINE-DEGREES-OF-FREEDOM, INERTIAL MEASUREMENT UNITS
Cole Johnson—Civilian, Department of the Air Force
Master of Science in Electrical Engineering
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: James Calusdian, Department of Electrical and Computer Engineering

The use of inertial-measurement units (IMUs) for personal navigation is investigated in this thesis. IMUs lack a position-finding algorithm that optimally blends sensor data to achieve high accuracy in a GPS-denied environment. In this research, software and a methodology for tracking position using body-mounted IMUs, building on a gait-phase detection algorithm and quaternion-based complementary filter developed at the Naval Postgraduate School, is developed. The performance of a consumer-grade nine-degrees-of-freedom IMU is characterized and alternative sensor placements evaluated to determine optimal mounting location or locations. Measurements were fused from gyroscope, accelerometer, and magnetometer sensors to create a single, virtual IMU. In addition, measurements from a distributed system of IMUs, as well as multiple co-located IMUs, were averaged to find performance enhancements. Software was developed to streamline and integrate position solutions into a larger network of capabilities. Results show that the foot is the optimal mounting location, and other placements degrade performance. Averaging measurements from multiple IMUs at one location improves performance but with diminishing returns as the number of IMUs increase. We recommend that multiple IMUs be printed on the same MEMS circuit board to achieve accuracy by fusing the measurements of co-located sensors. Full Text

Keywords: personal navigation, inertial sensor, gyroscope, magnetometer, accelerometer, attitude heading and reference system, quaternion algorithm, inertial measurement unit, complementary filter, gait phase detection, zero velocity update, MEMS, IMU, AHRS, GPS denied, distributed sensor, virtual sensor, fusion, network-centric warfare, navigation warfare, electronic warfare, jamming, reticle

DYNAMIC ACCURACY OF INERTIAL MAGNETIC SENSOR MODULES
Heather Pelachick—Captain, United States Marine Corps
Master of Science in Electrical Engineering
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Co-Advisor: Zachary Staples, Department of Electrical and Computer Engineering
Second Reader: James Calusdian, Department of Electrical and Computer Engineering

Magnetic, angular rate, and gravity (MARG) sensor modules have extensive applications in inertial navigation and motion tracking. A wide assortment of these sensor modules exist at varying cost points. In the current fiscal environment, affordable devices are needed; however, performance cannot be sacrificed. The main purpose of the study is to devise a series of tests to evaluate the dynamic accuracy of the LORD MicroStrain® 3DM-GX4-25 Attitude Heading Reference System (AHRS). Previous NPS theses have been constrained to static tests and dynamic, rotational tests in a single axis of motion. Utilizing the OptiTrack Motion Capture System, we examine the dynamic accuracy of the 3DM-GX4-25 for rotations in a single axis of motion and arbitrary motions in three-dimensional space, compare the dynamic accuracy against other MARG sensor modules used in previous NPS theses, and provide a cost analysis of the 3DM-GX4-25. Although the dynamic
accuracy of the 3DM-GX4-25 met performance specifications for most cases, another MARG sensor module existed with better performance and lower cost. Full Text

Keywords: magnetic, angular rate, and gravity, MARG, micro-electro-mechanical systems, MEMS, quaternion

CONFIDENTIAL AND AUTHENTICATED COMMUNICATIONS IN A LARGE FIXED-WING UAV SWARM
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Master of Science in Electrical Engineering
Advisor: Preetha Thulasiraman, Department of Electrical and Computer Engineering
Second Reader: John McEachen, Department of Electrical and Computer Engineering

Large unmanned aerial vehicle (UAV) swarms are a nascent technology promising useful military and civilian solutions to difficult problems. Securing data communications within the swarm is essential to accomplishing swarm objectives. The Naval Postgraduate School has successfully demonstrated the launch, flight and landing of 50 UAVs. The communications architecture to support a UAV swarm is unique. The practical challenges of creating a secure communications channel in the swarm are detailed in this thesis. The Advanced Encryption Standard (AES) was chosen as one of the encryption algorithms for testing, as it is authorized by the National Security Agency (NSA). Various modes of AES, including Galois/Counter Mode and Counter with Cipher Block Chaining Message Authentication Code, were analyzed within the swarm architecture. The impact of these authenticated encryption algorithms on network throughput and processor performance is presented. In addition to AES, ChaCha20-Poly1305, another type of authenticated encryption scheme, was studied. It was found to be the better solution for securing the swarm if classified data is not being handled or created. Full Text

Keywords: unmanned aerial vehicle, UAV, security, swarm, communications, encryption, authentication
Contemporary Russia has shown an increasing preference for using Cold War–era political warfare techniques, which are deeply rooted in its doctrine and foreign policies. To date, the U.S. response comprises the conventional military aspects of the Cold War–era deterrence and containment rather than political warfare strategies. Exploring previous U.S. experience in political warfare activities—under the broad categories of strategic influence, support to political, social, and counter-government groups, and special warfare—provides insight into determining a contemporary political warfare strategy. This thesis tests three hypotheses regarding U.S. political warfare experience during the Cold War. The exploration of these hypotheses shows that a strategic influence narrative centered on a full and fair strategy may produce better results rather than one centered on delegitimizing the enemy. Additionally, it was found that the United States should continue to support political, social, and countergovernment groups but should also take into consideration the type of support being provided while ensuring the group already has certain characteristics and enjoys public support. Finally, Cold War experience indicates that special warfare has the capacity to support and synchronize interagency political warfare activities. This analysis illuminates a path forward for a comprehensive political warfare policy to counter a reinvigorated Russian political warfare strategy. Full Text

Keywords: political warfare, containment, deterrence, Russia, United States, covert action, special warfare, strategic influence, policy, democracy assistance

Israel's preventive attacks against Iraq's Osirak nuclear reactor in 1981 and Syria's Al-Kibar nuclear site in 2007 are often used to illustrate a fundamental precept of realism—that states will use military force to halt the rise of a rival state, especially if that rival attempts to gain a nuclear weapons capability. However, this approach does not fully explain the timing of such attacks, nor does it account for the consequences of violating another state's sovereignty. In contrast to realism's emphasis on the material balance of power, constructivism focuses on how ideational factors, such as norms of appropriate behavior, shape and constrain a state's behavior. By process tracing the events surrounding the attacks at Osirak and Al-Kibar, this thesis finds that the international norms of sovereignty, intervention, and nonproliferation had a strong influence over Israel's behavior. It builds a normative theory of preventive attack that highlights the role that national identity, sanctions, and
ethics play in counterproliferation strategies. Finally, it concludes by offering policy recommendations for predicting future preventive attacks and leveraging international norms to halt nuclear proliferation. 

Keywords: counterproliferation, preventive attack, international norms, nuclear proliferation, constructivism, realism

**WHY DO MILITANT GROUPS EXPERIENCE INTRA-ORGANIZATIONAL CONFLICT?**

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Master of Science in Information Strategy and Political Warfare  
Advisor: Camber Warren, Department of Defense Analysis  
Second Reader: Erik Jansen, Department of Information Sciences

Under what conditions are militant groups more likely to experience intra-organizational conflict? This paper seeks to contribute to the rebel group and political violence literature by drawing upon the insights of previous scholarship in these areas, and from organizational theory and social identity theory, to identify these conditions. These factors are then tested using a sample of militant ethnopolitical groups in the Middle East and North Africa (MENA) collected within the Minorities at Risk Organizational Behavior (MAROB) Database. The results of multiple regression analyses indicate that these groups experience a systematic increase in the likelihood of intra-organizational conflict when they experience a loss of unified leadership, when they attempt to govern territory, when they obtain legal recognition from the state, when they receive foreign assistance, and when they promote authoritarian views. The results also demonstrate that state violence against these groups had no consistent influence on their likelihood of experiencing intra-organizational conflict. These findings point the way for additional research on the interactions between ethnic identity and state violence. They also hold important implications for policymakers and military planners, as events, policies, or actions which affect the above factors can be expected to affect levels of intra-organizational conflict. In contrast, the direct use of state violence appears unlikely to generate systematic increases or decreases in group intra-organizational conflict. 

Keywords: intra-organizational conflict, internal violence, insurgent groups, ethnic groups, militant groups, political violence, insurgency, counterinsurgency, minorities at risk, MAR, minorities at risk organizational behavior, MAROB, rebel groups, Middle East and North Africa, MENA

**UNDERSTANDING THE DRIVERS OF CHINESE PUBLIC DIPLOMACY IN THE INFORMATION ENVIRONMENT**

Michael Barry—Major, United States Army  
Master of Science in Information Strategy and Political Warfare  
Advisor: Camber Warren, Department of Defense Analysis  
Second Reader: Robert Burks, Department of Defense Analysis

As a rising state, China has embraced, adapted, and increased the use of public diplomacy to influence foreign audiences in support of its strategic objectives. China's public diplomacy program is the cornerstone of its effort to rebrand the country’s image as a responsible international power and an attractive economic partner. The quantitative analysis of this thesis explores which types of events tend to drive China's public diplomacy volume and whether China uses public diplomacy to shape the online global discussion prior to or after domestic and foreign events. Using data derived from website monitoring tools, combined with machine-generated international events data, this analysis demonstrates that it is possible to analyze the relationship between China’s public diplomacy volume and event data to enable assessment of the drivers of China’s public diplomacy. In addition to the statistical results, this project also seeks to provide useful lessons for how the
INFORMATION STRATEGY AND POLITICAL WARFARE

U.S. Department of Defense can take advantage of Internet monitoring tools to better understand the information environment. **Full Text**

Keywords: public diplomacy, information operations, China, Internet-monitoring, event data, information environment, GDELT Project, Crimson Hexagon

FOREIGN AID: ARE WE INCREASING STABILITY?

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Chad Thibodeau—Major, United States Army
Master of Science in Information Strategy and Political Warfare
Advisor: Robert Burks, Department of Defense Analysis
Co-Advisor: Timothy Warren, Department of Defense Analysis

In the contemporary environment, in which fiscal responsibility is a priority, each United States government (USG) organization must do more with less. The Department of Defense (DOD) is compelled to conduct military operations across the globe with fewer service members, and the Department of State (DOS) and the U.S. Agency for International Development (USAID) are both being asked to conduct interventions with less capital, fewer foreign service officers, and fewer field representatives. Expectations concerning positive results have not been commensurately adjusted. This research has identified which sectors of U.S. foreign aid monies were allocated between 2011 and 2015 and what effect aid is having on creating stable sovereign nations and ultimately avoiding the onset of conflict. First, using multivariate regression models, the researchers analyzed which World Development Indicators have the strongest negative correlation with the onset of state internal conflict around the world. Following this analysis, the researchers examined which sectors of foreign aid in DOD, DOS, and USAID have had the most significant correlation to the onset of internal conflict. The models considered the level of violence as well as the cost and number of projects performed in a given country to determine the probability of internal conflict. The results of the research show that the USG is not increasing stability through reducing internal conflict. In fact, it appears the USG is provoking internal conflict through foreign aid. Therefore, it is incumbent on the USG to thoroughly analyze which areas and types of foreign aid should be disbursed to achieve desired stability and reduced internal conflict. **Full Text**

Keywords: foreign aid, foreign aid effectiveness, regression, Department of Defense (DOD), Department of State (DOS), U.S. Agency for International Development (USAID), World Development Indicators, internal conflict, stability indicators

ENABLING PERSISTENT PEACE AFTER NEGOTIATED SETTLEMENTS

Evert Andres Mejia—Lieutenant Colonel, Colombian Marines
Jason Christopher Green—Captain, United States Army
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Master of Science in Information Strategy and Political Warfare
Advisor: Kalev Sepp, Department of Defense Analysis
Second Reader: Diego Esparza, Department of National Security Affairs

This thesis examines the theory and practice of sustaining peace after an intrastate conflict. After an agreed-upon peace settlement is signed, certain factors support sustaining the peace. In this study, those factors are analyzed to develop recommendations for implementation in Colombia. Drawing from literature on peace settlements and case studies, the thesis posits that the positive factors for sustainable peace be employed to function as a plan to deter a recurrence of intrastate conflict. The thesis tests these factors through analysis of the period following civil wars in Angola and Mozambique and finds that political inclusion and public security are particularly important. In Colombia, the Marines, along with the backing of the United States Armed Forces, will aim to sustain the peace through collaboration. Building on these findings, this thesis rec-
ommends ensuring that disarmament, demobilization, and reintegration (DDR) and security sector reforms (SSR) are the foundations for sustaining the peace. Full Text

Keywords: negotiated settlement, recurrence of war, post conflict, Colombian Marines

RETHINKING PSYOP: HOW DOD COULD RESTRUCTURE TO COMPETE IN THE INFORMATION ENVIRONMENT

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Shawn Stangle–Major, United States Army

Master of Science in Information Strategy and Political Warfare
Advisor: Anna Simons, Department of Defense Analysis
Second Reader: Bruce Sweeney, Department of National Security Affairs

This thesis focuses on the strategic usefulness and proper employment of Psychological Operations (PSYOP). Numerous political and military leaders speak about the importance of competing in the information environment in the struggle against violent extremism, as well as against the United States’ near-peer rivals. A capability gap exists between what U.S. Army PSYOP could do and how it is currently employed. This gap reflects the lack of consistent attention and resources provided for the conduct of influence operations when U.S. forces are deployed. The authors make the case for how the relevance of Army PSYOP could and should be enhanced. Full Text

Keywords: psychological warfare, information warfare, psychological operations, psyop, military information support operations, miso, influence operations, public diplomacy, strategic communications, information environment
The models for providing computing services have changed over the recent years, thereby allowing many lab-computing options. However, at the Naval Postgraduate School (NPS), thick client computers provide computing services to students in the learning and resource centers (LRC). Due to various budget restrictions, decreased manpower, and the directives set forth by the Navy, the existing LRC solution at NPS has become increasingly difficult to maintain efficiently. These reasons allow the following research questions to be asked: (1) what viable options are available to provide the same level of capabilities in the LRCs at NPS, and (2) for the viable options, does a cost comparison show which solution would be preferable for the labs and classrooms at NPS? To answer these questions, the NPS Cloudlab virtual desktop infrastructure (VDI) solution, as well as the computing solutions at three universities, was selected as the basis for comparison. The research method used includes a qualitative methods approach that utilizes case studies to perform the analysis. Analysis performed in the research looks to find the most effective solution in terms of cost, manpower, and availability of the systems in question. The results showed that Stanford University has the most cost-effective solution provided by their private cloud solution in terms of hardware and software costs and manpower. In regard to availability, the greatest system availability was at the Naval War College, California State University, Monterey Bay, and Stanford University. All three solutions were available 99.9% of the time. The recommendations made were to implement a private cloud computing solution similar to the technology used at Stanford University, implement a bring your own device (BYOD) policy at NPS, and to expand the NPS Cloudlab solution both in terms of licensing and into the LRCs using BYOD and thin clients. 

Keywords: lab, classroom, thick client computer, LRC, Cloudlab, virtual desktop infrastructure, VDI, hardware cost, software cost, manpower, availability, cloud computing, private cloud, bring your own device, BYOD, thin client, software as a service, SaaS, virtualization, personal computer, information technology, IT, client-server architecture
The objective of this research is to analyze the impact of increased annual training requirements on the reserve component—specifically, the 4th Assault Amphibian Battalion. Time is a persistent constraint that the reserve force contends with to accomplish annual general military training requirements and mission essential tasks. Currently, there are 18 annual general military training requirements the reserve component must accomplish. Previous studies have attempted to reduce and combine annual training requirements to give time back to the commander. This research will not identify ways to reduce requirements; rather, it will identify ways that the reserve component can more efficiently and effectively accomplish annual training requirements based on feedback from Marines assigned to 4th Assault Amphibian Battalion. The study analyzes methods that 4th Assault Amphibian Battalion uses to accomplish annual training requirements. Command chronology analysis and interviews provide exploratory insight to the unit’s annual training model. Using command chronology data and interview transcripts, we develop a training model that can be used to improve training effectiveness and efficiency. We believe that adjusting how reserve units conduct 11 of the 18 annual general military training tasks will provide commanders additional time to focus on mission-essential task training.
a proxy for unobserved ability that is correlated with patenting. We recommend the study be expanded beyond the initial scope to identify more officer inventors and other correlates of patenting. Full Text

Keywords: innovation, creativity, patent, patents, inventor

THE EFFECT OF ACTIVE DUTY PRESENCE ON HIGH QUALITY ENLISTED ACESSIONS IN THE MARINE CORPS

Johnathan Fergerson—Captain, United States Marine Corps
Master of Science in Management
Advisor: Latika Hartmann, Graduate School of Business and Public Policy
Co-Advisor: Marigee Bacolod, Graduate School of Business and Public Policy

This study examines the relationship between active duty Marine Corps locations and the accession of high quality enlisted personnel from 2000–2014. The population includes all individuals who accessed into the Marine Corps between 2000 and 2014. Information on their home of record at time of enlistment is merged with Marine Corps location data using geographic information system (GIS) models. The GIS models construct measures of distance between individual enlistees and active duty Marine Corps locations. Using the distance measures from the GIS models as key independent variables, we estimate the correlation between proximity to Marine Corps locations and test scores of enlisted personnel using multivariate linear regression and logit models. The results suggest that women, African Americans and high school graduates receive lower scores on the Armed Forces Qualification Test compared to men, whites and college graduates. Furthermore, the quality of personnel typically declines as distance increases, except for enlisted accessions located beyond the 100-mile radius, suggesting that the majority of high quality accessions come from rural regions. We also find that there is a greater probability of accessing exceptionally high quality enlistees if an individual’s home of record is located beyond a 100-mile radius from an active duty location. Full Text

Keywords: Marine Corps enlisted accessions, enlisted accessions, high quality accessions, Marine Corps recruiting, recruiting, geographic information system, geospatial analysis

WHAT ARE WE WAITING FOR? CUSTOMER WAIT TIME, FILL-RATE, AND MARINE CORPS EQUIPMENT OPERATIONAL AVAILABILITY

Jason Fincher—Major, United States Marine Corps
Master of Science in Management
Advisor: Kenneth Doerr, Graduate School of Business and Public Policy
Co-Advisor: Chad Seagren, Graduate School of Business and Public Policy

This research explores the effects of customer wait time (CWT) and fill-rate on equipment operational availability (AO) using consumable repair parts requisition data from Marine Corps mechanized units to determine (1) the relationship between CWT, fill-rate, and AO; and (2) if the system’s reliance on fill-rate as the primary indicator of supply chain performance adversely affects AO. This study also captures observations on the quality and scope of Ground Combat Support System–Marine Corps (GCSS–MC) data. Analysis methods include linear regression techniques and a categorization model developed specifically to compare supply chain outcomes reported by CWT versus those reported by fill-rate. This study concludes that both fill-rate and CWT are important measures, but neither is sufficient as a single indicator of supply chain performance. The reliance on fill-rate alone currently results in misreporting of supply chain outcomes 20–40% of the time. These findings support policies that balance inventory performance with supply chain responsiveness, focusing efforts on items with long CWTs. The data also suggests logical CWT standards that differ from current
policy. The scope and quality of the GCSS–MC data indicate that data collection processes could be further automated and focused on the drivers of days dead-lined. Full Text

Keywords: Fill-rate, customer wait time, operational availability, days dead-lined, Ground Combat Support System–Marine Corps, consumable repair parts

A VARIABLE FLOW MODELLING APPROACH TO MILITARY END STRENGTH PLANNING

The following paper has been recognized as outstanding by its department.

Benjamin Grossi—Lieutenant Commander, Royal Australian Navy
Master of Science in Management
Advisor: Kenneth Doerr, Graduate School of Business and Public Policy
Second Reader: Chad Seagren, Graduate School of Business and Public Policy

The purpose of this thesis is to develop a model to assist military manpower planners in meeting prescribed end strength requirements. To achieve this, I have developed a variable flow model capable of both optimizing accessions and also optimizing transition probabilities. I use the Marine Technician category of the Royal Australian Navy as the subject of the thesis, as it is currently facing large manpower deficits and could benefit from the recommendations. I compare forecasts using current and optimized parameters against each other, and the results show that optimizing transition probabilities is the most efficient way of meeting manpower targets—while maintaining the current hiring policy—for the Marine Technician category. I also conduct a risk analysis by simulating the effect of changes in the transition rate on the differential between the forecast and desired end strengths. Again, the transition probability optimization model performs better than the status quo situation. Recommendations are made for future research to improve the implementation of optimized transition probabilities and also for ways of limiting the attrition rate, which is the only variable not under the control of the Royal Australian Navy. Full Text

Keywords: Markov model, linear programming optimization, risk analysis, variable flow model, accession optimization, transition rate optimization, end strength planning, risk analysis

30 BRIGADE COMBAT TEAMS: IS THE ARMY TOO SMALL?

Asfandyar Khan—Major, United States Army
Master of Science in Management
Advisor: Chad Seagren, Graduate School of Business and Public Policy
Second Reader: Casey Connors, TRAC-Monterey

The purpose of this thesis is to determine the impact of a contingency operation on Army dwell time. The Department of Defense (DOD) has the following goal for the active Army: for every one year a unit is deployed, the unit gets two years at home. We use a simulation to model the number of times a Brigade Combat Team (BCT) deploys in support of a contingency operation over a specified period of time. This enables us to estimate the amount of time a unit was deployed and its dwell time. The results of the simulation show that the current force structure is not sufficient to sustain a prolonged contingency operation and support existing requirements. To meet the dwell time goal established by DOD, the Army must increase its capacity. In order to increase the number of BCTs, the Army will have to increase its end strength. Full Text

Keywords: simulation, Army brigade combat teams, Army end strength, boots on the ground to dwell time ratio
MANPOWER SYSTEMS INTEGRATION FACTORS FOR FRIGATE DESIGN IN THE TURKISH NAVY
Ismail Kilicaslan–Lieutenant Junior Grade, Turkish Navy
Master of Science in Management
Advisor: William Hatch, Graduate School of Business and Public Policy
Co-Advisor: Chad Seagren, Graduate School of Business and Public Policy

This research examines the manpower systems integration factors for frigate design in the Turkish Navy. The qualitative and quantitative analyses of the correlation between ship design specifications and manpower requirements play a pivotal role in this research. Information about 45 frigate classes from 29 countries is collected from the Information Handling Services Jane's Fighting Ships database and varying approaches of different nations in manning of the frigates in their navies are discussed in detail. Furthermore, a regression analysis is conducted by fitting a model using the sample data to examine the variance in crew complements of those frigates. The correlation between the ship design characteristics and the manpower requirements is supported by the quantitative analysis. This research supports the importance of using Human Systems Integration in the Turkish frigate design. Adoption of a standard workweek by the Turkish Navy to measure the man-hours required to develop a Ship Manpower Document for the Turkish Frigate–2000 project is recommended. This research also recommends expanding the Human Systems Integration domains in frigate procurement. Full Text

Keywords: Manpower requirements/determination, human systems integration (HSI), optimal personnel planning, ship/frigate design, TF-2000 class frigate

HOW CAN A MARINE AVIATION LOGISTICS SQUADRON BE MEASURED FOR EFFECTIVENESS?
Patrick Millikin–Captain, United States Marine Corps
Master of Science in Management
Advisor: Chad Seagren, Graduate School of Business and Public Policy
Second Reader: Kenneth Doerr, Graduate School of Business and Public Policy

This thesis examines current metrics used by a Marines Aviation Logistics Squadron (MALS) and how a MALS can be measured for overall performance in regard to supporting flight-line squadrons. Currently used primary metrics are analyzed for their ability to reflect the level of support a MALS provides, the behavior that those metrics incentivize, metrics that should be adopted, and how standardized metrics can be used to compare performance between various MALS. Supply shelf items with a critically low physical buffer status, supply chain response time, and supply effectiveness for high-priority parts are found to be the best metrics for overall performance measurement. These metrics, when measured specifically according to the various type/model/series of aircraft a MALS supports, constitute a performance measurement system that can be used by aviation logistics leaders to compare various MALS. Full Text

Keywords: Marine Aviation Logistics Squadron, supply chain, logistics, performance measurement, aircraft maintenance
This thesis developed a concept design and prototype system capable of increasing and improving the main energy constraints the Department of Defense must overcome to meet future mission requirements, energy availability and resiliency. The prototype system will reduce the dependency on fossil fuels by generating specific amounts of power using hydrogen produced with only renewable sources. To achieve this, the prototype system relies on the integration of various commercially available components: solar panels, dehumidification units, an electrolytic cell, a diaphragm pump and a proton exchange membrane (PEM) fuel cell. Experimental results were obtained for each of the components. The solar panels were found to generate sufficient power to operate all the components in the system. The dehumidification units showed lower capacity for water extraction from ambient moisture than expected. The electrolytic cell was found to use less power than anticipated to produce the hydrogen flow required. The PEM fuel cell presented an exponential decrease in power generated halfway through the tested operational cycle that can be attributed to low hydrogen mass flow and low hydrogen pressure. Even though the prototype system was found to operate at lower efficiencies than other established power generating systems, the main objectives for this thesis were achieved, and the system showed great capacity for further improvements toward increasing and improving energy availability and resiliency. Recommendations are given to increase the water extraction from ambient moisture, increase the mass flow of hydrogen to improve the power quality generated by the PEM fuel cell, increase the pressure for the hydrogen prior to the PEM fuel cell, and implementation of an automated data collection method.

Keywords: renewable energy, renewable source, water, dehumidification unit, electrolytic cell, electrolyzer, HydroTube, hydrogen, PEM fuel cell, fuel cell
the heat transfer coefficients within turbomachinery obtained from experimental studies. The effectiveness of an integrated heat exchange system was found to be 4.5%. Using this integrated heat exchange system for recuperation in gas turbine cycles improves efficiency at pressure ratios less than 22. Using this heat exchange system for intercooling improves efficiency from 1% to 2% and increases engine power output by 1% to 7%, depending on pressure ratio. Cycle improvements of more than 1% in efficiency can lead to significant fuel savings for both the Navy and Marine Corps. Full Text

Keywords: heat transfer, recuperation, regeneration, gas turbine, heat pipe, cycle improvements

HYDRODYNAMIC DRAG FORCE MEASUREMENT OF A FUNCTIONALIZED SURFACE EXHIBITING SUPERHYDROPHOBIC PROPERTIES

The following paper has been recognized as outstanding by its department.

James Ley–Lieutenant, United States Navy
Master of Science in Mechanical Engineering
Advisor: Young Kwon, Department of Mechanical and Aerospace Engineering
Second Reader: Jarema Didoszak, Department of Mechanical and Aerospace Engineering

With superhydrophobic properties being extended to a variety of metallic substrates through the process of ablation due to femtosecond laser surface processing (FLSP), it is important to understand the hydrodynamic benefits of such a material, as well as its resiliency. This research will focus on the skin friction drag effects of a superhydrophobic flat plate compared to an untreated flat plate of the same material and geometry. The resiliency of this material will also be tested through the use of an accelerated corrosion fog chamber using both treated and untreated aluminum samples. During complete submersion water channel testing, the velocity of the water was varied to yield a range of Reynolds numbers between 20,000 and 70,000 with respect to the test specimen. In this range, the FLSP-treated plate showed consistently lower skin friction drag than that of the untreated plate. However, during the accelerated corrosion testing, the FLSP treated sample suffered from pitting corrosion at a rate faster than the untreated sample, effectively removing the surface treatment. While there are significant hydrodynamic benefits to this material, the elevated corrosion rates raise concerns about the resiliency of this surface treatment. Full Text

Keywords: superhydrophobic, superhydrophilic, femtosecond laser surface processing, skin friction drag

SMALL-SCALE AIR-DRIVEN GENERATOR

Cory McLaughlin–Lieutenant, United States Navy
Master of Science in Mechanical Engineering
Advisor: Anthony Gannon, Department of Mechanical and Aerospace Engineering
Co-Advisor: Andrea Holmes, Department of Physics

The purpose of this thesis was to demonstrate the concept of generating electrical energy using only compressed air as a working fluid. Compressed air systems are common on naval installations, posing an enticing opportunity for small-scale electrical generation. The use of a small turbine, in this case a turbocharger, provided a constant source of shaft power, which was used to spin a small permanent magnet motor. With the permanent magnet motor generating alternating current (AC) voltage, a bridge rectifier integrated circuit (IC) was used to rectify the voltage to direct current (DC). The electricity generated was then stored in a 16-volt supercapacitor. While testing the system, it was discovered that more shaft power could be produced if atmospheric air was entrained into the turbine housing inlet. The effect was similar to an ejector, which is commonly used on aircraft engines to increase thrust. This research demonstrated the feasibility of combining commercially available components to harness compressed air in order to generate electricity on a small
scale. This system could be utilized to offset power spikes associated with heavy equipment startup, or as an always-on emergency backup system for critical components. Full Text

Keywords: compressed air, energy storage, turbocharger, permanent magnet motor, small scale, electrical generation, supercapacitor

DESIGN AND ANALYSIS OF A SOLAR-POWERED COMPRESSED AIR ENERGY STORAGE SYSTEM

Thomas Prinsen–Lieutenant, United States Navy
Master of Science in Mechanical Engineering
Advisor: Anthony Gannon, Department of Mechanical and Aerospace Engineering
Co-Advisor: Andrea Holmes, Department of Physics

This thesis is a two-party study that analyzed a compressed air storage system using fundamental thermodynamic principles and designed the compression phase using commercial-off-the-shelf components. The analysis for this system used a novel control-mass methodology that allowed both isentropic and isothermal work and heat transfer processes to be calculated using end states. The resulting formulas provide a rigorously derived yet straightforward benchmark for the upper limits of efficiency in such systems. The design portion of this study lays the groundwork for building the compression phase of a solar-powered compressed air energy storage system that will integrate a rotary compressor, ultracapacitors, and a turbocharger to serve as proof-of-concept for an environmentally friendly energy storage system that can effectively utilize energy provided by solar radiation. Once implemented, this system’s practicality has the potential to spur the use of solar panels on Department of Defense shore installations without the side effect of relying on rare-earth materials for energy storage. Full Text

Keywords: compressed air, benchmark, efficiency, solar, energy storage

TRANSONIC AXIAL SPLITTERED ROTOR TANDEM STATOR STAGE

Aaron Terrell–Lieutenant, United States Navy
Master of Science in Mechanical Engineering
Advisor: Anthony Gannon, Department of Mechanical and Aerospace Engineering
Second Reader: Garth Hobson, Department of Mechanical and Aerospace Engineering

Development of a procedure to model the hot shape of a rotor blade and a comparison analysis of the transonic axial splittered rotor (TASR), tandem stator (TS) stage has been investigated. The ability to implement this procedure into the current Naval Postgraduate School (NPS) Turbopropulsion Lab (TPL) design procedure that uses commercial off the shelf software has been documented. The TS stage was tested at multiple clocking positions over the full speed range of the rotor. The best performance was observed at a negative 10 percent clocking position relative to the design configuration. Numerical simulations were conducted of both hot and cold rotor shapes and compared. This study advanced the understanding of simulating the hot shape of a rotor to better match the results of experimental data. The hot shape results closely resembled that of the cold shape results; however, the hot shape achieved a greater mass flow range. The procedure developed is easily implemented, utilizing a fluid-structure interaction. Rotational forces as well as gas loading forces were observed as an influence on blade deformation. Utilizing the procedure to model the hot shape of the rotor will be essential in deriving numerical results for a comparative analysis. Full Text

Keywords: Turbomachinery, splittered rotor, tandem stator, transonic compressor, blade deformation, fluid-structure interaction
VISION-BASED POSITION ESTIMATION UTILIZING AN EXTENDED KALMAN FILTER
Joseph Testa III–Lieutenant, United States Navy
Master of Science in Mechanical Engineering
Advisor: Vladimir Dobrokhodov, Department of Mechanical and Aerospace Engineering
Co-Advisor: Brian Bingham, Department of Mechanical and Aerospace Engineering

The purpose of this project is to develop and integrate a prototype multicopter Unmanned Aerial Vehicle (UAV) with a vision-based algorithm to enable a relative position hold capability. The resulting solution will enable automatic operation of a UAV with respect to another visually detectable object without use of GPS receiver or when GPS signal is not available. Navigating a robot in a GPS-denied environment is a desired feature in many applications, including Maritime Interdiction Operations. While automatically maintaining its relative position with respect to a given target, the onboard system will also provide video coverage of blind spots and network relay between the boarding team and ship.

Keywords: UAV, ROS, extended Kalman filter, Matlab, Simulink, position estimation

ENERGY EFFICIENT WASTE HEAT RECOVERY FROM AN ENGINE EXHAUST SYSTEM
Aaron VanDenBerg–Lieutenant, United States Navy
Master of Science in Mechanical Engineering
Advisor: Garth Hobson, Department of Mechanical and Aerospace Engineering
Co-Advisor: Anthony Gannon, Department of Mechanical and Aerospace Engineering

The purpose of this thesis was to design and demonstrate the effectiveness of a new style of heat exchanger for waste heat recovery. The new design sought to optimize heat recovery from a gas turbine engine exhaust as well as assist with flow turning through a bend in the exhaust duct in order to minimize back-pressure increases. The analysis of the design was based around the use of the Allison 250 gas turbine engine. An analysis of the engine was performed to determine baseline operating parameters to be used in ANSYS CFD models. The research for this thesis also included a comparative analysis of three different waste heat recovery cycles to determine which cycle would function best on U.S. Navy ships. The analysis compared the three cycles while assuming the exhaust flow is from an LM2500 gas turbine engine, similar to the engines currently powering Navy ships. The design of a new heat exchanger with the intent of minimizing any gains to back-pressure as well as the analysis of the various waste heat recovery cycles allowed this thesis to make recommendations to the Navy about which cycle should be used on its ships through the new heat exchanger.

Keywords: waste heat recovery, turning vanes, heat transfer, computational fluid dynamics, back-pressure
Low-level jets (LLJ) occur in many regions around the world and exhibit a diverse range of impacts across a variety of climate and weather-related applications, including U.S. Department of Defense assets and operations. A team from the Naval Postgraduate School participated in the 2015 Plains Elevated Convection at Night (PECAN) research project and collected high-resolution stable boundary layer data as it evolved through the night. The objective of this study was to use this dataset to identify the impact of LLJ presence on surface layer properties, such as thermal stability, dynamic stability, surface fluxes, and turbulence. Additionally, this study investigated pre-LLJ daytime surface layer conditions that might promote LLJ development and intensification. The subsequent analysis found that both nocturnal thermal stability and dynamic stability, while in the presence of a LLJ, were only marginally stable, a result consistent with previous literature that related LLJ development primarily to boundary layer properties above the surface layer. This study also found that nocturnal surface fluxes of momentum, sensible heat, and latent heat were significantly enhanced during LLJ events, owing mostly to larger-than-normal generation of shear-driven turbulence. Interestingly, this research also found that the presence of the nocturnal LLJ was highly correlated with values of thermal and dynamic stability that were close to neutral. This result appears to be inconsistent with previous literature in that LLJ presence is suggested to occur under clear, cloud-free conditions; this finding warrants further analysis. Finally, after examining the relationship between daytime turbulence and subsequent LLJ presence, jet development appeared to be well-correlated to higher levels of turbulence during the preceding daytime. 

Keywords: Low-level jet, nocturnal boundary layer, stable boundary layer, convective boundary layer, surface layer, ageostrophic wind, thermal stability, dynamic stability, surface flux, turbulence, turbulence kinetic energy, Richardson number, wind shear, buoyancy
and a 3-m scaler tripod, giving 17 levels of measurement from 25 cm below the surface to 16 m above. To supplement the tower-based measurements, a Leosphere Doppler LIDAR and a sonic detection and ranging (SODAR) device were used to obtain vertical profiles of mean wind and turbulence up to approximately 250 m and 6,000 m, respectively. The primary focus of this thesis is to characterize the transitional period with the presence of convective events. This thesis also used the observed surface fluxes to evaluate the fluxes calculated from the bulk parameterization scheme. The surface layer stability functions in the Coupled Air Ocean Response Experiment (COARE) surface flux algorithm will be used. The surface roughness used in the Navy’s Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) model will also be examined. **Full Text**

Keywords: boundary layer transition afternoon-to-evening transition, field campaign PECAN 2015, convective boundary layer decay, multi-platform surface fluxes, COARE, COAMPS

### EFFECTS OF MIXED LAYER SHEAR ON VERTICAL HEAT FLUX

**Stephen Fleet–Lieutenant Commander, United States Navy**  
**Master of Science in Meteorology and Physical Oceanography**  
**Advisor: Tim Stanton, Department of Oceanography**  
**Second Reader: Timour Radko, Department of Oceanography**

Measurements of salinity, temperature, and velocity shear profile time series were calculated from collocated AOFB and ITP buoys deployed in the Beaufort Sea from 2014 to 2015. Of interest was the effect ice speed has on MLD shear generation, Richardson number, and heat flux. The inertial components were also considered, as a large inertial event was present during the beginning of the data set. Data from the buoys show turbulent activity in the ocean during inertial wind events contributes to enhanced mixing in the mixed layer and entrainment of heat from the pycnocline. Data during non-inertial events has a much weaker correlation. Results demonstrated that during inertial events, ice speed was moderately correlated with heat flux ($r = .56$, $p < .001$). Non-inertial events saw a lower correlation of ice speed to heat flux ($r = .312$, $p < .001$). Relationships between ice speed and shear ($r = .107$, $p < .001$), ice speed and inverse Richardson number ($r = .035$, $p = .256$), inverse Richardson number and heat flux ($r = .3$, $p < .001$), heat content and heat flux ($r = .084$, $p < .001$) were also explored. **Full Text**

Keywords: inertial oscillations, inertial motion, arctic, heat flux, entrainment, Richardson number, ice-tethered profiler, autonomous ocean flux buoy, acoustic Doppler current profiler

### ASSESSING EVAPORATION DUCT VARIABILITY IN THE EASTERN MEDITERRANEAN SEA IN SUPPORT OF RADAR AND RADIO COMMUNICATIONS

**Suleyman Gurbuz–Lieutenant Junior Grade, Turkish Navy**  
**Master of Science in Meteorology and Physical Oceanography**  
**Advisor: Qing Wang, Department of Meteorology**  
**Second Reader: Wendell Nuss, Department of Meteorology**

Electromagnetic (EM) propagation is greatly affected by atmospheric conditions. Although this subject has been an active area of research, a comprehensive evaporation ducting study for the Eastern Mediterranean Sea does not exist. The main objective of this thesis is to make detailed analyses of evaporation ducts in the Eastern Mediterranean Sea in support of Navy and civilian activities in the region. In this thesis, the European Center for Medium-Range Weather Forecasts (ECMWF) surface reanalysis data from 1990 to 2015 are used. The Coupled Ocean-Atmosphere Response Experiment (COARE) bulk surface flux algorithm is modified to output vertical profiles of temperature and humidity with input from the ECMWF reanalysis data. The vertical profiles are then used to derive the associated evaporation duct height (EDH) and evaporation duct strength (EDS). The temporal and spatial variations of EDH and EDS are analyzed to provide an evaporation ducting climatology for the Eastern Mediterranean Sea. The sensitivity of EDH and EDS to certain atmo-
spheric factors is further analyzed to develop a more comprehensive understanding of atmospheric effects on EM propagation. The results show that EDHs are highest in summer, between 1200 and 1500 UTC (coordinated universal time), and that EDHs are greatest in the Aegean Sea. Full Text

Keywords: evaporation ducts, ducting, Mediterranean Sea, EM propagation, atmospheric effects on EM propagation

THE IMPACTS OF MULTIPLE SIMULTANEOUS CLIMATE VARIATIONS
Richard Ilczuk Jr.—Lieutenant Commander, United States Navy
Master of Science in Meteorology and Physical Oceanography
Advisor: Tom Murphree, Department of Meteorology
Co-Advisor: Megan Hutchins, Fleet Numerical Meteorology and Oceanography Center

Climate variations such as El Niño—La Niña (ENLN), the Madden-Julian Oscillation (MJO), and the Arctic Oscillation (AO) have significant impacts on environmental conditions and operating environments around the globe. However, relatively little is known about how climate variations interact and alter each other’s impacts. We used several multidecadal reanalysis data sets to investigate the interactions between ENLN and MJO events. We analyzed the interactions by season, and by event amplitude and phase. We found substantial constructive and destructive interference between the tropical convection and subsidence centers of ENLN and MJO events, and the tropical and extratropical low-frequency wave responses to the events. This interference causes large differences in the anomalies that are commonly thought to characterize the events—for example, changes in the patterns, locations, magnitudes, and even signs of the wind, precipitation, and ocean surface wave anomalies associated with ENLN and the eight MJO phases. Our results indicate that analyses and forecasts of one type of climate variation need to account for the simultaneous occurrence of other types of climate variations. The data sets, methods, and results of this study will be used to improve operational climate and long range support products. Full Text

Keywords: climate, climate variations, El Niño, El Nino, La Niña, La Nina, long range forecasting, Madden-Julian Oscillation, operational climate support

INTER-ANNUAL VARIABILITY OF THE ACOUSTIC PROPAGATION IN THE MEDITERRANEAN SEA IDENTIFIED FROM A SYNOPTIC MONTHLY GRIDDED DATABASE AS COMPARED WITH GDEM
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Master of Science in Meteorology and Physical Oceanography
Advisor: Peter Chu, Department of Oceanography
Co-Advisor: Tetyana Margolina, Department of Oceanography

The primary purpose of this research is to identify inter-annual variability of acoustic propagation in the Mediterranean Sea through comparison of sound speed profiles obtained from the synoptic monthly gridded World Ocean Database (SMD-WOD) and Generalized Digital Environmental Model (GDEM) temperature (T) and salinity (S) data. The SMD-WOD for the region of interest in this study has 0.25°×0.25° horizontal resolutions, 28 vertical levels from the surface to 3000-meter depth, one-month temporal increment from January 1960 to December 2014. It provides the long-term spatial and temporal variability of the (T, S) and sound speed profile data. However, the GDEM offers climatological monthly mean (T, S) data with 0.25 horizontal resolution and 78 vertical depths from the surface to 6600 meters. Five distinct points were chosen in order to model acoustic propagation to account for significant differences in mean salinity, temperature vertical profiles and bottom sediments between sub-basins. Overall, we found that the Levantine Surface Water (LSW) has the highest spiciness among the all water masses. We analyzed that transmission loss (TL) for each decade, and we found that there are inter-annual TL variabilities. TL does not show high inter-annual vari-
abilities over convergence zone paths; however, it shows high inter-annual variability on surface duct, bottom bounce and sound channels. Full Text

Keywords: Mediterranean Sea

AN OBSERVATIONAL AND ANALYTICAL STUDY OF MARGINAL ICE ZONE ATMOSPHERIC JETS
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Master of Science in Meteorology and Physical Oceanography
Advisor: Peter Guest, Department of Meteorology
Second Reader: Wendell Nuss, Department of Meteorology

Low-level atmospheric jets have been observed to occur frequently in marginal ice zones (MIZs), but little research has been done on the dynamics of these features. In the fall of 2015, during the Office of Naval Research Sea State cruise in the Beaufort Sea, the research team used radiosondes and shipboard instrumentation to detect several atmospheric jets in the atmospheric boundary layer or in the capping temperature inversion just above. The three strongest jets had maximum wind speeds at elevations near 350 m to 400 m elevation; one of these jets had a secondary maximum wind height at 900 m. Different theories have been suggested as reasons for the existence of MIZ jets, but in all the cases examined, it appeared that the primary cause of the low-level jets was a thermal wind effect where the thermal wind opposes the geostrophic wind due to horizontal temperature changes in the atmospheric boundary layer and capping inversion. The jets were detected using rawinsonde measurements, complemented by daily runs of the ECMWF model. By comparing soundings that were perpendicular to the thermal gradients, it was possible to calculate how the geostrophic wind would vary with elevation. In most cases, the comparisons of the calculated thermal wind matched well with the observed winds in the upper part of the boundary layer, thus indicating that the low-level jets were primarily a result of a thermal wind opposing the background geostrophic wind. At the lowest levels, the observed wind speeds were less than the calculated geostrophic wind, as expected, due to friction. Full Text

Keywords: low level jet, Arctic, marginal ice zone

DYNAMICS, STABILITY, AND EVOLUTIONARY PATTERNS OF MESOSCALE INTRATHERMOCLINE VORTICES
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Master of Science in Meteorology and Physical Oceanography
Advisor: Timour Radko, Department of Oceanography
Second Reader: Erick Edwards, Fleet Numerical Meteorology and Oceanography Center

Mesoscale intrathermocline eddies play an important role in transferring heat, salinity, and momentum in large-scale flows, actively influencing the general circulation of the ocean. Nevertheless, the factors controlling the longevity and coherence of mesoscale eddies are much debated. One of the key questions is the relative significance of double diffusion and turbulence in the dispersion of mesoscale variability. Several observational studies have implicated the lateral intrusions, driven by double-diffusive mixing, in the ultimate disintegration of eddies. However, observational limitations precluded unambiguous quantification of the impact of interleaving on the basis of field measurements. To the best of our knowledge, this research presents the first intrusion-resolving numerical simulation of a mesoscale eddy. This study is focused on the dynamics of a Mediterranean eddy (meddy). Double diffusion and turbulence of various strengths are applied to both static and dynamic (rotating) eddies in order to isolate the effects and determine the dominant players. The prominent findings of this study are threefold: (1) Double diffusion is a key process in dissipating an eddy. (2) Lateral diffusivity values calculated from the numerical simulations fall within the range of observed values.
(3) A static eddy dissipates in a very different manner from a dynamic eddy, which underscores inherent limitations of intrusion modeling in quiescent background states. Finally, it should be emphasized that while the key physical processes at play are illustrated here on a specific example of meddies, the broader implications of our findings are much more fundamental and far-reaching. It is our belief that this study provides a clue to one of the long-standing problems in physical oceanography—namely, the link between the basin-scale forcing of the ocean by air-sea fluxes and the dissipation of energy and thermal variance at the microscale. Full Text

Keywords: meddy, intrathermocline, double diffusion, energy cascade, eddy, MITgcm, numerical simulation, interleaving, lateral intrusions, lateral diffusivity, heat flux
This thesis explores the Defense Health Agency’s (DHA) implementation and sustainment of the newly acquired electronic health record (EHR). The Military Health System (MHS) is utilizing a disjointed taxonomy of patient health record systems to deliver health services that are cumbersome to both the end users and the health information technology specialists in its use and delivery. The acquisition of the new commercial off-the-shelf EHR in 2016 from Cerner-Leidos-Accenture offers an enterprise solution to the MHS. This advanced IT solution requires detailed, deliberate implementation and deployment planning by the DHA, which will result in the effective, efficient, and economical delivery of healthcare services to Department of Defense personnel. Utilizing a case study approach, the authors conducted interviews at two sites within the DHA EHR deployment footprint and correlated results with the application and research of Kates and Galbraith’s star model. The authors conclude that with appropriate change management efforts, communication of strategy and structure, measurement of metrics, and investment in people, the DHA has the ability to implement MHS GENESIS within reasonable schedule parameters and achieve equitable sustainment. Full Text

Keywords: Defense Health Agency, Department of Defense, military treatment facility, Military Health System, healthcare, health information technology, information management, information system, chief information officer, electronic health record, enterprise resource planning, strategy, structure, process, rewards, people, MHS GENESIS
THE EFFECTS OF DISRUPTIVE TECHNOLOGY ON PROJECT INTERDICTION
Timothy Adduce–Lieutenant, United States Navy
Master of Science in Operations Research
Advisor: Matthew Carlyle, Department of Operations Research
Second Reader: Gerald Brown, Department of Operations Research

We model a project network that uses common methods of improvised explosives and metallic liner manufacture for the purposes of constructing anti-armor IEDs. Separately, we model a network utilizing advanced 3D printing technology for the same ends. We then introduce an interdiction extension to both project models. By utilizing decision critical path method models, we examine the differences in the critical paths of both project networks. Our finding of note is that the length of the network employing advanced 3D printing technology is significantly shorter, even after the attacker’s interdiction efforts. Because the length of the critical path of this network remains significantly shorter, advanced 3D printing technology can be considered to be a disruptive technology. This flexible modeling can be rapidly implemented when future technological black swans appear. This modeling provides decision makers with clear, quantitative analysis and can be used to drive future intelligence and capability requirements, as well as to inform potential policy responses.

Keywords: disruptive technology, critical path method, PERT, IED, optimization, defender-attacker

OPTIMIZING GLOBAL FORCE MANAGEMENT FOR SPECIAL OPERATIONS FORCES
Emily LaCaille–Major, United States Army
Master of Science in Operations Research
Advisor: Paul Ewing, Department of Operations Research
Second Reader: Jeffrey House, Department of Operations Research

In light of increasing Special Operations Forces (SOF) mission requirements, United States Special Operations Command (USSOCOM) requires a tool for planning to fulfill force requirements of the most valuable missions while sustaining SOF capabilities within operations tempo constraints. Currently, USSOCOM stakeholders attend numerous meetings throughout the year to qualitatively determine which missions will be fulfilled with available units. For this cycle, USSOCOM has implemented an additional meeting to create a prioritized mission list from which analysts can allocate units. This research introduces an optimization model to provide USSOCOM with insights to improve the current process for the allocation of unit resources to annual mission priorities by using a multi-period inventory model to optimize the allocation of units to missions by maximizing mission prioritization subject to unit availability. This model automates the allocation process and provides analysts a tool that efficiently analyzes unit to mission allocations. With an analyst’s interpretation of our model, the stakeholders and decision makers are equipped with the knowledge of specific resource limitations prohibiting the fulfillment of missions to make better-informed decisions about which missions require the same limited resources to fulfill and how to obtain the necessary resources.

Keywords: Special Operations Forces, United States Special Operations Command, linear programming, optimization, multi-period inventory model, value-based decision making, SOF, USSOCOM
To ensure sufficient capacity to handle unexpected demands for electric power, decision makers often overestimate expeditionary power requirements. Therefore, we often use limited resources inefficiently by purchasing more generators and investing in more renewable energy sources than needed to run power systems on the battlefield. Improvement of the efficiency of expeditionary power units requires better managing of load requirements on the power grids and, where possible, shifting those loads to a more economical time of day. We analyze the performance of a previously developed optimization model for scheduling time-shiftable electrical loads in an expeditionary power grids model in two experiments. One experiment uses model data similar to the original baseline data, in which expected demand and expected renewable production remain constant throughout the day. The second experiment introduces unscheduled demand and realistic fluctuations in the power production and the demand distributions data that more closely reflect actual data. Our major findings show that energy grid power production composition affects which uncertain factor(s) influence fuel consumption, and that uncertainty in the energy grid system does not always increase fuel consumption by a large amount. We also discover that the generators running the most do not always have the best load factor on the grid, even when optimally scheduled. Full Text

Keywords: expeditionary, energy, optimization, robust optimization, Parameter Uncertainty, deferrable, fuel, mixed integer linear program, design of experiment, Latin hypercube, fuel consumption, robust designs
A three-step approach has been developed for detecting and classifying the foraging calls of the blue whale, *Balaenoptera musculus*, and fin whale, *Balaenoptera physalus*, in passive acoustic recordings. This approach includes a pattern recognition algorithm to reduce the effects of ambient noise and to detect the foraging calls. The detected calls are then classified as blue whale D-calls or fin whale 40-Hz calls using a machine learning technique, a logistic regression classifier. These algorithms have been trained and evaluated using the Detection, Classification, Localization, and Density Estimation (DCLDE) annotated passive acoustic data, which were recorded off the Central and Southern California coast from 2009 to 2013. By using the cross-validation method and DCLDE scoring tool, this research shows high out-of-sample performance for these algorithms—namely, 96% recall with 92% precision for pattern recognition and 96% accuracy for the logistic regression classifier. The result was published by the Institute of Electrical and Electronics Engineers (2016).

The advantages of this automated approach over traditional manual methods are reproducibility, known performance, cost-efficiency, and automation. This approach has the potential to conquer the challenges of detecting and classifying the foraging calls, including the analysis of large acoustic data sets and real-time acoustic data processing.

**Keywords:** blue whale, fin whale, foraging call, pattern recognition, machine learning, logistic regression classifier, detection, classification
MASTER OF SCIENCE
IN
PHYSICS

CHAOS THEORY AND INTERNATIONAL RELATIONS
Dimitrios Kanemnidis–Lieutenant, Hellenic Navy
Master of Science in Physics and Master of Arts in Security Studies (Civil-Military Relations)
Advisor: James Luscombe, Department of Physics
Co-Advisor: Cristiana Matei, Center for Civil-Military Relations

Employing a theory from the natural sciences to analyze a topic of social sciences is a procedure that can benefit decision makers, who can avoid mistakes by testing their decisions with the help of mathematical models. This thesis provides an overview of Chaos Theory—why it has been accepted in the natural sciences, specifically in physics—and whether it can be relevant for the international relations domain of social sciences. The applicability of Chaos Theory to the physics domain is examined through the OGY (Ott, Grebogi, Yoke) method and its applications. For the international relations domain, Chaos Theory is modeled in two specific international relations puzzles, bipolarity and democratic peace, to show the utility of the theory in this social science field. The results of the model are compared with the conventional international theories of Liberalism and Realism. The comparative analysis between the use of Chaos Theory in physics and in international relations issues, respectively, shows that for the former we have controllability of chaotic phenomena, and for the latter, it is applicable and helpful. This thesis concludes that the theory of Chaos is a universal theory that is applicable to both natural and political sciences. Full Text

Keywords: Chaos theory, international relations, social sciences, physics, driven damped pendulum, intelligence, post-structuralism.
MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

The following theses and capstone project reports were produced by residential or distance-learning students in the systems-engineering curriculum. The degrees awarded include Masters of Science in Systems Engineering, Systems Engineering Management, and Engineering Systems.

ANALYSIS AND DESIGN OF A WATER PURIFICATION SYSTEM FOR THE WEST AFRICAN AREA OF OPERATION
Jude Ezedike–Lieutenant, United States Navy
Master of Science in Systems Engineering
Advisor: Ronald Giachetti, Department of Systems Engineering
Co-Advisor: Ronald Carlson, Department of Systems Engineering
Second Reader: Matthew Boensel, Department of Systems Engineering

The borehole water system (BWS) in West Africa has capability gaps in the area of detection and monitoring of chemical compounds, filtration, and disinfection of potable water. As a result, there is not enough potable water in West Africa to support a large-scale U.S. forces operation. This research focuses on the analysis of BWS and its ability to deliver potable water to meet U.S. standards in West Africa. The intent of this research is to design and test a feasible and cost-effective prototype of a purification system to the BWS for improved capability. This study uses a design-based and analytic research method with emphasis on basic systems engineering process. The Pugh Matrix was used in the feasibility study to determine the alternative water-purification system selection. The feasibility study confirmed that in terms of cost and operating efficiency, the Modified Reverse Osmosis System (MROS) met all operational requirements. A prototype model of the selected system was tested and evaluated to determine feasibility of the design. The prototype test results showed that the water-purification system performed effectively and efficiently in accordance with the operational requirements. The water-purification system’s reliability was modeled and estimated to show overall reliability of 0.9064.

Keywords: borehole water system, capability gaps, functional analysis, functional requirements, improved borehole water system, need analysis, operational analysis, operational concept, operational model, operational and technical feasibility, prototype model, system reliability analysis

DEVELOPING A DECISION SUPPORT TOOL FOR WASTE-TO-ENERGY CALCULATIONS USING ENERGY RETURN ON INVESTMENT
Adam Haag–Lieutenant, United States Navy
Master of Science in Systems Engineering
Advisor: Alejandro Hernandez, Department of Systems Engineering
Co-Advisor: Matthew Boensel, Department of Systems Engineering
Second Reader: Joseph Klamo, Department of Systems Engineering

Using systems engineering methodology, we build a decision support tool that enhances the Navy’s ability to evaluate the economic viability of sites for waste-to-energy technologies, mirroring the current tool’s capabilities and expanding its use. This tool returns recommendations about investing in waste-to-energy technology for a given facility or site. The recommendations are actionable results for the user in an easily digestible for-
mat in Microsoft Excel. The team has examined current Navy systems that evaluate waste-to-energy technologies and identified their shortfalls. These gaps directed the team’s focus toward the critical areas that required improvement and/or development, including specifying required data and data sources. The team conducted stakeholder analysis and functional decomposition of the requisite model before constructing its additional module to the tool. This study shows the viability of waste-to-energy technologies to the Navy and Department of Defense. It supports the development of renewable power sources for a green Navy. Full Text

**FEASIBILITY OF TACTICAL AIR DELIVERY RESUPPLY USING GLIDERS**

Chaz Henderson–Lieutenant, United States Navy  
Master of Science in Systems Engineering  
Advisor: Oleg Yakimenko, Department of Systems Engineering  
Second Reader: Fotis Papoulias, Department of Systems Engineering

Due to the high cost and logistical burden placed on deployed units by the Joint Precision Aerial Delivery System (JPADS), the U.S. Marine Corps has requested proposals for a single-use tactical resupply glider that can resupply squads with 500 pounds of essential food and gear while costing less than $3,000 per unit and using commercial-off-the-shelf (COTS) electronics. The feasibility of this request was determined by designing, constructing, and testing two prototype gliding aerial delivery systems, Pun-Jet and Sparrow, using modern design and manufacturing techniques including AutoCAD, 3D printing, laser cutting and CorelDraw, and conducting field testing and subsequent analysis using MATLAB. It was determined that a low-cost, glider-based precision aerial delivery system utilizing COTS electronic components is likely a viable alternative to the parachute-based systems currently in use and can be constructed using modern manufacturing techniques. Further research should include an enlarged design, logistics, improvement of landing algorithms and navigation in GPS-degraded environments. Full Text

Keywords: TACAD, Tactical Air Delivery Supply Glider, aerial delivery, autonomous aerial delivery, precision aerial delivery, Joint Precision Aerial Delivery System, JPADS, AADS, ADS, PADS, commercial-off-the-shelf, COTS, modern manufacturing, glider

**USING A FUNCTIONAL ARCHITECTURE TO IDENTIFY HUMAN-AUTOMATION TRUST NEEDS AND DESIGN REQUIREMENTS**

Bradley Johnson–Lieutenant, United States Navy  
Master of Science in Systems Engineering  
Advisor: Joseph Sweeney, Department of Systems Engineering  
Second Reader: Karen Holness, Department of Systems Engineering

This thesis develops and analyzes the functional architecture for an autonomous unmanned aerial system performing an Intelligence, Surveillance, and Reconnaissance (ISR) mission without a continuous communication link to human operators for trust needs. The factors that affect human trust are developed from a literature review covering theory and empirical studies that have investigated the importance of human trust in human-automation interactions. The identified factors are applied to the functional architecture, and the system functions are categorized as Reasoning functions and Non-reasoning functions. Each functional category is analyzed for trust needs by describing how the function’s purpose, process, and performance link to human knowledge, perception and beliefs. From the analysis, automation design requirements that link to the
identified trust needs are developed. This work highlights the importance of applying human factors analyses in the early stages of the Systems Engineering process for autonomous systems. Full Text

Keywords: automation, autonomy, autonomous, trust, human systems integration, human factors, systems engineering, systems engineering process

EXPERIMENTAL DESIGN OF A UCAV-BASED HIGH-ENERGY LASER WEAPON
Antonios Lionis–Lieutenant, Hellenic Navy
Master of Science in Applied Physics and Master of Science in Systems Engineering
Advisor: Keith Cohn, Department of Physics
Co-Advisor: Eugene Paulo, Department of Systems Engineering

The deployment of a High Energy Laser (HEL) weapon in an airborne platform is a challenging task due to size, weight, and power (SWaP) constraints. Recent technology innovations, however, promise that such HEL development may be a reality in the near future. This study models an Unmanned Combat Aerial Vehicle (UCAV) armed with a HEL weapon and simulates the laser beam’s atmospheric propagation. The Design of Experiments (DOE) methodology is then applied to determine the significance of the UCAV-HEL design parameters and their effect on the lethality of the weapon. The weight and energy requirements of two design alternatives are estimated, and the HEL output power is tabulated in relation to the UCAV endurance. Additional simulation shows the effects that platform jitter and beam quality have on the weapon lethality. Full Text

Keywords: directed energy weapons, high energy lasers, atmospheric propagation, unmanned combat aerial vehicle, system architecture, design of experiments

A SOCIOTECHNICAL SYSTEMS APPROACH TO COASTAL MARINE SPATIAL PLANNING
Tyler McDonald–Lieutenant Commander, United States Navy
Master of Science in Systems Engineering
Advisor: Karen Holness, Department of Systems Engineering
Co-Advisor: Tom Murphree, Department of Meteorology
Second Reader: Arlene Guest, Department of Oceanography

This thesis conducted a requirements analysis of the planning and permitting process for ocean aquaculture operations in the state of Hawaii, which is applicable to the other Pacific Islands within the jurisdiction of the Pacific Islands Regional Planning Body (PIRPB). The aim of the analysis was to form the basis for and generation of a set of capability requirement recommendations for a future Coastal Marine Spatial Planning (CMSP) decision-support system. All research, data collection, modeling, analysis, and recommendations were conducted from a systems engineering perspective and specifically used a sociotechnical systems approach. The research investigated aquaculture permitting from the perspective of the aquaculture companies that must navigate the process. Personnel from three Hawaiian aquaculture companies were interviewed. These interviews provided the bulk of the raw data that was used in subsequent analysis. This raw data was then honed by way of content analysis. From there the macroergonomic analysis and design methodology was adapted for use in analysis and generation of capability requirements for a decision-support system. The study resulted in the generation of 16 recommended requirements for the design of a coastal and marine spatial planning decision support tool. Full Text

Keywords: sociotechnical systems, coastal marine spatial planning, systems engineering, macroergonomic analysis and design, marine aquaculture, Pacific Islands, regional planning
EVALUATION OF THE OPERATIONAL BENEFITS VERSUS COSTS OF AN AUTOMATED CARGO MOVER
Team ACME, Systems Engineering
Master of Science in Systems Engineering
Advisor: Gregory Miller, Department of Systems Engineering

This report examines the use of an automated robotic pallet mover during resupply missions in support of forward-deployed Marine units. The pallet mover is capable of loading and unloading itself and its cargo from MV-22 and CH-53 aircraft and subsequently transporting that cargo 3,281 feet over unimproved terrain. In order to determine whether the pallet mover is beneficial, the report explores the operationally relevant scenarios where it could be used. The scenarios are used to quantify the different performance measures using the pallet mover compared to traditional methods of working parties composed of available Marines and material handling equipment such as forklifts. The pallet mover’s logistics footprint and life-cycle cost are presented as part of this report. Analysis of modeling and simulation results identified statistically significant differences between the three methods (robotic pallet mover, working parties, material handling equipment) for loading and unloading, and impacts on logistical footprints, number of sorties, and cost. The benefit of the eXpeditionary Robo-Pallet is its ability to quickly embark and debark from aircraft, reducing the time aircraft spend on the ground waiting for cargo to be loaded or unloaded. This report recommends additional investigation of other potential benefits or drawbacks.

Keywords: autonomous cargo mover, cost analysis, operational logistics, life-cycle cost, modeling and simulation, unmanned cargo mover, resupply, EFSS, MV-22, CH-53, XRP

ANALYSIS OF ENERGY EFFICIENCIES AND SOURCE TRADESPACE IN AN A2/AD SEABASE-TO-SHORE OPERATION WITH AN ASYMMETRIC THREAT
Team East, Systems Engineering
Master of Science in Systems Engineering and Master of Science in Engineering Systems
Advisor: Eugene Paulo, Department of Systems Engineering
Co-Advisor: Joseph Sweeney, Department of Systems Engineering
Co-Advisor: Paul Beery, Department of Systems Engineering

This capstone project supported the mission of the United States Marine Corps (USMC) Expeditionary Energy Office (E2O) for development and assessment of solutions that increase the energy efficiency of USMC operations in an antiaccess/area denial (A2/AD) mission. Primarily, this study analyzed energy efficiency during USMC seabase-to-shore operations by developing an operational model to determine the best combination of connectors among all feasible combinations within the selected seabase. This capstone concluded that mission objectives for throughput and fuel consumption during operations could not be met in all scenarios by all connector combinations, and identified why certain combinations of connectors had better broad utility and operational effectiveness. The secondary objective of this study was the exploration of new and alternative energy generation methods that are employable by the USMC, which maximize energy efficiency of Marine air-ground task force (MAGTF) operations at the shore site. Evaluation criteria were used to investigate feasible alternative energy sources that could support the power generation of the MAGTF operations. This capstone concluded that alternative energy technologies, when combined with diesel-electric generators, helped reduce fuel consumption of the MAGTF operations, and identified their availability and effectiveness for meeting energy goals.

Keywords: MBSE, systems analysis, seabasing, employ, assembly, seabase, MAGTF, seabase-to-shore, MEU, E2O, A2/AD, Asymmetric, ARG, MPF, DOE, statistical analysis, LCAC, LCAT, LCU, STOM
**EFFICACY EVALUATION OF CURRENT AND FUTURE NAVAL MINE WARFARE NEUTRALIZATION METHOD**

Team MIW, Systems Engineering  
Master of Science in Systems Engineering and Master of Science in Engineering Systems  
Advisor: Eugene Paulo, Department of Systems Engineering  
Co-Advisor: Joseph Sweeney, Department of Systems Engineering  
Co-Advisor: Paul Beery, Department of Systems Engineering

This capstone report analyzes the expected mine countermeasures (MCM) performance of legacy and emerging mine neutralization systems on multiple platforms. The systems evaluated are the SLQ-48 Mine Neutralizing System, the SLQ-60 SeaFox, the AN/AQS-235 Airborne Mine Neutralization System/Archerfish, and the Improved Mine Neutralization System—Barracuda currently being developed by Raytheon. The platforms in which these systems are to be supported on are the Avenger MCM ship, the MH60S Knighthawk helicopter, and the littoral combat ship (LCS). The study focused on three measures of effectiveness (MOEs): mission time, weapon expenditures, and mission effectiveness. Using an operational simulation and design of experiments (DOE), our team determined which configuration variations of these systems on supported platforms appeared to be the most effective. The study found that the performance of the Improved Mine Neutralization System—Barracuda presented an increase in capability over legacy systems. In addition, the simulation analysis results depicted a significant performance increase from aerial-deployed neutralizers and neutralizers deployed simultaneously in parallel configurations. This report suggests that, when possible, mine neutralization should be conducted in a parallel configuration from multiple platforms with the most capable neutralizer available. [Full Text]

Keywords: model based systems engineering, design of experiments, requirements analysis, mine warfare, MIW, mine countermeasures, MCM, littoral combat ship, LCS, Avenger, MCM 1, MCM-1, ACRS, remote mine hunting system, RMS, mine neutralization

**IMPLEMENTING SET BASED DESIGN INTO DEPARTMENT OF DEFENSE ACQUISITION**

Team SBD, Systems Engineering  
Master of Science in Systems Engineering and Master of Science in Engineering Systems  
Advisor: Gregory Miller, Department of Systems Engineering  
Second Reader: Clifford Whitcomb, Department of Systems Engineering

This report provides guidance to implement the Set Based Design (SBD) methodology into the Department of Defense (DOD) acquisition framework. Deferring requirements and design decisions is the essence of SBD, which in turn defers cost commitments, allowing more flexibility to management than traditional design methodologies. This reduces the risk for cost and schedule overruns, both of which are perennial challenges for the DOD. This report identifies the original SBD principles and characteristics based on Toyota Motor Corporation’s Set Based Concurrent Engineering Model. Additionally, the team reviewed DOD case studies that implemented SBD. The SBD principles, along with the common themes from the case studies, are then analyzed, and guidance is presented for implementing SBD into the Navy’s 2-pass/6-gate acquisition governance process as dictated by the Secretary of the Navy’s acquisition instructions. Recommendations are provided on the system factors, such as program type and tool infrastructure, that provide a good fit for utilizing SBD. The cost and schedule differences between SBD and a typical point-based design approach are discussed. Finally, this report summarizes the findings and provides program managers and systems engineers with an implementation method for SBD in DOD acquisition. [Full Text]

Keywords: set based design, set based thinking, model based systems engineering, concurrent engineering, defense acquisition, ship to shore connector, amphibious combat vehicle, small surface combatant, large displacement unmanned underwater vehicle
To resupply the International Space Station (ISS) with the items to support continuous human occupation and hardware to maintain system functionality, scientific experiments are necessary to maximize its potential as a world-class research laboratory. The transition of this function to the commercial sector under Firm Fixed-Price contracting has forced both NASA and commercial providers to adjust to make this effort successful. Improving bag-level cargo launch manifests delivered from NASA to the provider more than a year in advance is an area where significant gains can be realized by reducing, if not eliminating, costly and time-consuming analysis and/or physical rework during the launch campaign. The current process for developing these early manifests relies heavily on the experience and judgment of subject-matter experts to hand-build them for every flight. This research investigates the application of Monte Carlo simulation based on historical launch cargo data as a proof-of-concept demonstration for improving these manifest deliverables. The Monte Carlo simulation–derived manifests were checked against two dedicated ISS resupply missions, yielding promising results proving the concept. With further development, this methodology will be particularly useful in designing and implementing new cargo spacecraft.

Keywords: National Aeronautics and Space Administration, International Space Station, Commercial Resupply Services, Monte Carlo simulation
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