COMPILATION OF
ABSTRACTS

Unrestricted Theses,
Dissertations, and Final Projects

NPS Class of June 2012
PREFACE

This publication, *Compilation of Abstracts*, contains abstracts of unrestricted theses, capstone project reports, and dissertations submitted for the degrees doctor of philosophy, engineer, master of business administration, master of science, and master of arts for the Naval Postgraduate School’s June 2012 graduating class.

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 publication can be found at [http://www.nps.edu/Research/MoreThesisAbst.html](http://www.nps.edu/Research/MoreThesisAbst.html). Calhoun, the institutional archive of NPS, provides a convenient way to search the content of unrestricted theses. Access Calhoun at [http://calhoun.nps.edu/public/handle/10945/6](http://calhoun.nps.edu/public/handle/10945/6). Restricted theses are available for viewing on the NPS SIPRNET and through the Defense Technical Information Center at [http://www.dtic.mil/dtic/customer/](http://www.dtic.mil/dtic/customer/).

Guidelines for obtaining printed copies of *Compilation of Abstracts* are outlined on the last page of this volume.

Additional Information on NPS Research and Academic Programs

*Summary of Research*, an annual compilation of research projects and publications, is also available online, at [http://www.nps.edu/Research/SummaryRes.html](http://www.nps.edu/Research/SummaryRes.html). “Research News,” a monthly newsletter highlighting some of the newest developments in NPS research, can be found at [http://www.nps.edu/Research/Newsletters.html](http://www.nps.edu/Research/Newsletters.html).

For other inquiries about student and faculty research at the School, please contact the Vice President and 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](http://www.nps.edu/Academics/GeneralCatalog/Layout.html). The admissions website is at [http://www.nps.edu/Academics/Admissions/Index.html](http://www.nps.edu/Academics/Admissions/Index.html).
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INTRODUCTION
The Naval Postgraduate School is pleased to present the thesis, capstone-project report, and dissertation abstracts (hereafter thesis or terminal project) for unclassified research completed in June 2012 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:

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

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

The research program at NPS supports the primary 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 programs at the cutting edge;
- provides the opportunity for students to demonstrate independent graduate-level scholarship in their area 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.

ACADEMIC PROGRAMS
To meet its educational requirements, the Navy has developed a unique academic institution at NPS 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) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) research programs that focus on the integration of education and research in support of current and emerging national security technologies and operations, and of education and research in support of current and emerging national security needs and operations, and 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer’s career.

Programs of graduate studies are grouped as follows. Most programs are offered in the four graduate schools. Programs available through distance learning venues (DL) are so indicated.

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 and arms control to counterinsurgency and counterterrorism; from the history of war to emerging biological and cyber threats; 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, and Sub-Saharan Africa
  - Far East, Southeast Asia, and Pacific
  - Europe and Eurasia
  - Western Hemisphere
Graduate School of Business and Public Policy (GSBPP)

GSBPP reflects the need to manage the business side of national defense to support operational requirements, with programs open to the U.S. uniformed services, DoD and federal employees, international officers and government employees, and DoD contractors. 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's mission is to deliver graduate-level education and conduct 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)

Office of the Provost

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

- Systems Engineering Analysis
STUDENT POPULATION

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government, and foreign military officers and government civilians. The resident degree/subspecialty student population for June 2012 is shown at right.

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

STUDENT RESEARCH

Independent scholarly work in the form of a dissertation (PhD), thesis or (Masters/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 that is required to sustain long-term superiority of the Navy/DoD. Guided by faculty advisors, NPS students represent a vital resource within the DoD for addressing warfighting problems and maintaining cutting edge expertise, particularly in a time when technology and information operations in are changing rapidly. Naval Postgraduate School alumni think innovatively and possess the knowledge and skill to apply nascent technologies in the commercial and military sectors. Their firsthand grasp of operations, when combined with a challenging capstone project that requires them to apply their focused graduate coursework, is one of the most effective elements in solving fleet/joint-force/regional problems. NPS graduate education encourages a lifelong capacity for applying basic principles to the creative solution of complex problems. NPS is also unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.
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; 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

Engineer
• Astronautical
• Electrical
• Mechanical

Master of Arts
• Identity Management and Cyber Security
• Security Studies

Master of Business Administration

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
**JUNE 2012 DEGREES CONFERRED**

In June 2012, 217 theses, capstone reports, and dissertations were submitted as part of the graduation requirement. Figure 2 indicates degrees awarded to the June 2012 graduating class.

*Advanced degrees include:*
- Ph.D. Physics
- Ph.D. Software Engineering
- Electrical Engineer

**Other master’s degrees include:**
- Applied Mathematics
- Computer Science
- Electrical Engineering
- Human Systems Integration
- Information Operations
- Information Sciences
- Information Technology Management
- Information Warfare Systems Engineering
- Management
- Meteorology and Physical Oceanography
- Physical Oceanography
- Physics
- Program Management
- Software Engineering
- Space Systems Operations
- Systems Engineering Management

*Figure 2. Distribution of degrees conferred in June 2012 (Restricted and Unrestricted Theses)*
ACADEMIC AWARDS ANNOUNCED JUNE 2012

The following listing provides recognition to those students selected by NPS faculty or military associations for superior academic achievement. Quite a few departments honor graduating students for the quality and contributions to be made by their thesis, dissertation, or capstone report. Awards are noted with the students’ abstracts as well.

Campus-wide Awards
- Air Force Association Award for Outstanding U.S. Air Force Student: Maj Andrew Jett, USAF
- Naval Postgraduate School Outstanding Academic Achievement Award for International Students: LCDR Meng Hwee Tan, Singapore Navy

Graduate School of Business and Public Policy (GSBPP)
- Rear Admiral Thomas R. McClellan Award for Academic Excellence in the Graduate School of Business and Public Policy: Maj Philip Herschelman, USMC
- The Louis D. Liskin Award for Excellence in Business and Public Policy: LCDR Heather Ray, USN
- Rear Admiral Thomas R. McClellan Award for Academic Excellence in the Graduate School of Business and Public Policy: LT Bradley Henderson, USN
- The Louis D. Liskin Award for Excellence in Business and Public Policy: LT Bradley Henderson, USN

Graduate School of Engineering and Applied Sciences (GSEAS)
- John McReynolds Wozencraft Electrical and Computer Engineering Academic Honor Award: LT Bryan M. Blair, USN
- Space and Naval Warfare Systems Command Award in Electronic Systems Engineering: LT Matthew E. McCay, USN
- Naval Sea Systems Command Award in Naval/Mechanical Engineering: LT Wendell Holmes, USN
- Naval Undersea Warfare Center Division Newport Award for Excellence in Undersea Warfare Technology: MAJ Ng, Chee Wee, Singapore Armed Forces
- Joint Rear Admiral Jack Jarabak/Assistant Secretary of the Navy for Research, Development, and Acquisition/National Defense Industrial Association Award for Excellence in Undersea Warfare Technology: LT John N. Howard, USN
- Meyer Award for Outstanding Student in Systems Engineering (Distance Learning): Matthew Guernsey, Andrew Fowler, and Heather Williams
- Chief of Naval Operations Undersea Warfare Award: LT Jonathan Scobo, USN

Graduate School of Operational and Information Sciences (GSOIS)
- Chief of Naval Operations Award for Excellence in Operations Research: LT Jason Christopher Crews, USN, LCDR Philip J. Mock, USN
- Rear Admiral Grace Murray Hopper Computer Science Award: FLTLT Andre Camenzind, Royal Australian Air Force
- Rear Admiral Grace Murray Hopper Information Technology Management Award: LT Christopher Thomas Schrock, USN
- Commander George L. Phillips Modeling, Virtual Environments, and Simulation Award: LT Ethan Andrew Reber, USN
School of International Graduate Studies (SIGS)

- The International Student Award for Excellence in Regional or Security Studies (previously the Heldman Award): Mr. Maubere Lorosae Da Silva Horta, East Timor
- The Outstanding United States Air Force Graduate Award, Department of National Security Affairs: Lt Col Lindsay C. Droz, USAF, Maj Byron Calhoun, USAF
- The Hans Jones Award for Excellence in Thesis Research in Special Operations and Irregular Warfare or Security, Stabilization, Transition, and Reconstruction (SSTR): LCDR Jeff DeMarco, USN, LTCOL Dave Overton, USMC (Ret.)
- Monterey Council Navy League Award for Highest Academic Achievement: LT Eric J. Blomberg, USN
- The Louis D. Liskin Award for Excellence in Regional Security Studies: LT Eric J. Blomberg, USN, Mr. Lawrence Reeves
ADVANCED DEGREES

Doctor of Philosophy
Engineer
The objective of this research is to advance the development of a micro-analysis technique for characterizing the charge transport properties in bulk semiconductor materials for room temperature nuclear radiation detection. The technique is applied to bulk semi-insulating thallium bromide (TlBr) and cadmium zinc telluride (CZT) and uses a two-dimensional diffusion model and transport imaging to make rapid contact-free measurements of the magnitude and spatial variation in the mobility-lifetime ($\mu\tau$) product at 2-µm resolution. The $\mu\tau$ product is a key measure of charge transport, and a uniform $\mu\tau$ product is critical for optimum energy resolution in gamma ray detectors. Spatial variations in the ambipolar diffusion length are observed in TlBr on a scale of ~10 µm, and the cathodoluminescence (CL) spectrum in TlBr at 5 K is reported. Using CL and photo-induced conductivity transient spectroscopy (PICTS), an empirical energy level diagram for Se and Pb defect levels in TlBr is reported. The $\mu\tau$ product in TlBr is generally found to decrease with increasing impurities/defects. The $\mu\tau$ product in TlBr and CZT is found to decrease with increasing temperature over the ranges of 8–102 K and 5–60 K, respectively. Transport imaging is applied for the first time to investigate the effects of Te inclusions in CZT and the role of photon recycling in TlBr and CZT.

**KEYWORDS:** Transport Imaging, Cathodoluminescence, Mobility-Lifetime ($\mu\tau$) Product, Thallium Bromide, TlBr, Cadmium Zinc Telluride, CZT, Spatial Variation
In this thesis, an optimal estimation algorithm, based on the Kalman filter, is introduced for data recovery of orthogonal frequency-division multiplexed (OFDM) signals transmitted over fading channels. We show that the use of a zero prefix (ZP) along with a fast Fourier transform (FFT) operation zero padded to twice the data length allows for the recovery of subcarriers located next to a deep faded (at low signal-to-noise ratio (SNR)) values, exploiting all other subcarriers with higher SNR. The same approach is also shown to improve demodulation in the presence of signal clipping due to high peak to average power ratio (PAPR), as is often seen in OFDM signals.

The proposed method assumes prior knowledge of the channel, usually estimated using the preamble. Testing was conducted for random channels with zero frequency response at a random frequency $w_0$ and a signal in additive white Gaussian noise for various conditions. Further testing was done with typical Stanford University Interim (SUI) channels.

Additionally, the use of the method to recover OFDM signals based on the IEEE 802.11 and 802.16 standards was examined. Results show that the proposed optimal estimation algorithm has very satisfactory performance compared to the standard OFDM receiver algorithm.

**KEYWORDS:** Wireless Communications, Fading Channels, Kalman Filter, OFDM, PAPR, Zero-Prefix
This thesis explores the causes of the southern Thailand insurgency and the possibility that international terrorist groups have become involved in it. The insurgency began as an ethnic struggle by Malay Muslims for independence from predominantly Buddhist Thailand. But with the advent of the “global war on terrorism,” some scholars believe it has become an increasingly religious one. They fear that if the insurgency has become Islamist, it will attract support from international terrorist groups, which will bring funds, training, and ideology to the already violent conflict. This thesis investigates these possibilities. It finds that Islam has grown in importance, but the struggle remains driven primarily by ethnic separatist, not religious, aims. Since it remains ethnic in nature, international terrorists have not taken a significant role in the movement. The ideological gap between them and the insurgents remains too wide. Nevertheless, it is worth monitoring the situation as the danger of international terrorists becoming involved exists if the insurgency becomes a religious struggle.

**KEYWORDS:** Southern Thailand Insurgency, Ethnic Malay, Malaysia, Islam, Thaksin Shinawatra, Jemaah Islamiyah, Al Qaeda, Pattani, Yala, Narathiwat, Patani

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Foreign aid has been a signal component of United States foreign policy since the creation of the Marshall Plan. Since that time, as new requirements emerged, numerous foreign aid programs and initiatives were created and subsequently piecemealed together under various U.S. agencies. The confluence of programs, initiatives, and agencies has created a confusing and overly bureaucratized environment for expending funds in an effort to support the democratization and modernization of other countries. This study examines U.S. aid provided to Ukraine and Georgia to determine if they have progressed toward Westernized defense and military structures, in accordance with their stated national goals, within the realm of logistics.

The question is whether U.S. security aid in these states has helped to achieve these goals. Addressing this question, this thesis proposes a hierarchal construct with differing assessment criteria based on how and where U.S. aid is applied. In the end, this analysis shows that U.S. aid and assistance programs and funds have assisted both Ukraine and Georgia with their modernization efforts. However, U.S. policy makers and policy...
implementers need to consider alternative and new methods to accurately assess how well those funds are spent in line with U.S. foreign policy goals.

**KEYWORDS:** Security Cooperation, Security Assistance, Foreign Assistance, Foreign Aid, Logistics, Ukraine, Georgia, Partnership for Peace (PFP)

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**ETHNIC VIOLENCE IN SOUTHERN THAILAND: THE ANOMALY OF SATUN**  
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Second Reader: Sandra Leavitt, Research and Sponsored Programs Office

This research uses a historical comparative analysis to investigate the differences between two specific Muslim-majority regions of Thailand: the province of Satun, along the western coast of southern Thailand, and the provinces of Yala, Narathiwat, Pattani, and Songkhla, which border the Malaysian state of Kelantan and the Gulf of Thailand.

The formation of ethnic identities in Satun and Patani has followed different paths over time, and these variations in development have produced dramatically divergent outcomes in relation to observable communal violence and terrorist attacks. Satun has virtually no problem with ethnic or religious conflict when compared to the four other southern provinces that have suffered from multiple rebellions against the state, numerous incidents of violence and terrorism, and a pervading sense of instability and fear.

This pronounced difference in outcomes also reflects the degree to which various ethnic groups within the country have been able to integrate peacefully into the modern Thai state. Finally, an analysis of the Thai government’s effectiveness in managing this integration process in both regions provides insight into providing effective governance throughout the contested regions of southern Thailand and what the potential is for a future resolution of this conflict.

**KEYWORDS:** Satun, Patani, Thailand, Ethnic Violence, Nationalism, Social Inequality, Cultural Identity, Institutional Development, Rational Choice Frameworks, Southeast Asia, Terrorism, Insurgencies, Islam

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**PRIVATELY CONTRACTED MILITARY FIRMS IN THE TWENTY–FIRST CENTURY: RECLASSIFYING, REDEFINING, AND REFORMING THE WAY WE FIGHT**  
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Privately Contracted Military Firms (PCMFs) are in use throughout the globe by the U.S. government. Their role has become so intertwined with the demands of the Department of Defense (DoD) and that of the Department of State (DoS) that it is now hard to imagine operating in support of U.S. national interests without them. But such a relationship is not without its pitfalls. The quantities, costs, and functions of today’s PCMFs have grown at an astounding rate, and so, too, the legal concerns their employment invariably raises. This thesis addresses these pitfalls, the inadequacies of the current legal measures designed to resolve them, and recommend steps to correct them. The author suggests that, once these reforms are met, it will legitimize PCMF utilization, facilitate their integration into national security planning, ease domestic perception regarding their existence, and placate international concerns regarding their use. The author further contends, however, that
until these obstacles are addressed, no realistic reforms can take place, and the PCMFs will continue to operate in shades of gray.

**KEYWORDS:** Privately Contracted Military Firms, Civil–Military Relations, Counterinsurgency, Contractors, Department of Defense, Department of State, Legal Reforms, Status-Based Framework, PUIC International Body

**WHY MONGOLIA HAS CHOSEN TO PARTICIPATE IN PEACE SUPPORT OPERATIONS: AN ANALYSIS OF CURRENT TRENDS AND FUTURE OPPORTUNITIES**

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Since 2002, Mongolia’s commitment to international peace-support operations has dramatically increased and broadened the country’s bilateral and multilateral military engagement throughout the world. By participating in UN peacekeeping and other peace-support operations, Mongolia and its military have gained tremendous experience, learned valuable lessons, and identified challenges in several critical areas that needed improvement. This thesis argues that Mongolia’s commitment to international peace-support operations is based on its national interest of survival between two great powers. Additionally, that commitment to peace-support operations strengthens Mongolia’s position in the world arena and increases its prestige, gaining it international recognition from other countries, international organizations, and international security institutions.

Moreover, active involvement in peace-support operations creates favorable conditions for an independent foreign and defense policy and accelerates military modernization. Mongolia’s participation in peace-support operations influenced the acceleration towards modernization and transformation of its military, helping to identify the vulnerabilities in old military planning, training, equipment, and acquisition processes that desperately required changes. The existing literature on Mongolia’s participation in international peace-support operations is very limited. Therefore, this study contributes a deeper and more detailed analysis and assessment of Mongolia’s commitment to international peace-support operations for scholars.

**KEYWORDS:** Mongolia, National Security, Third Neighbors Policy, Multilateral Policy, Peace Support Operation, Motivation, Military Modernization, Capability Development

**COERCIVE LEVERS IN CHINESE ECONOMIC STATECRAFT: ATTRIBUTED ACROSS EARTH, RARELY APPARENT**

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This study considers the role of coercive lever exercise in Chinese economic statecraft. Whereas the economic statecraft literature presumes larger economic powers dominate smaller economic powers, this study considers cases in which asymmetric interdependence in specific sectors allows relatively less developed states to access coercive levers as viable policy options. It found that coercive lever exercise remains rare relative to inducements in Chinese economic statecraft consistent with evolving Chinese grand strategy and political economy trends. As demonstrated in the case studies, exercise patterns were reactionary and depended on existing conditions of asymmetric interdependence with the target state. Beijing can and will exercise coercive levers in the context of a bilateral trade dispute or during select high-stakes international crises, but only to an extent
that exercise supports achievement of limited political objectives such as signaling resolve, amplifying official protest or altering short-term behavior in the target state. Though reluctant to exercise coercive levers, China's capabilities are evolving and it is becoming a more confident practitioner that selects among an increasingly sophisticated range of policy options in economic statecraft. As China continues to deepen integration with the global economy, coercive levers derived from asymmetric interdependence will likely proliferate.

**KEYWORDS:** China, Japan, Economic Statecraft, Asymmetric Interdependence, Sanctions, Rare Earths, Senkaku Islands, East China Sea

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**REVISITING MODERNIZATION THEORY IN SUB-SAHARAN AFRICA: THE RELATIONSHIP BETWEEN INDUSTRIALIZATION AND DEMOCRATIZATION**

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The relationship between industrialization and democratization in Sub-Saharan Africa is one of interdependence and balance unique to the characteristics and capacity of three critical entities: the state, private capitalists and labor. Case-specific reviews of this critical relationship assist in the general understanding of how industrial characteristics contribute to certain social requisites for democracy. In the cases of South Africa, Gabon, Senegal and Burundi, an increase in industrial diversification roughly correlates to increases in the satisfaction of social requisites for democracy. Senegal, Gabon and Burundi each demonstrate a lack of industrial diversity and a relative imbalance in the power dynamic between the three critical entities. This contributes to divergent degrees of satisfaction of social requisites and autocratic tendencies in lieu of the democratic. In South Africa, diversified industrialization exists and thrives alongside consolidated democracy. In this case, each of the well-developed critical entities is able to exert effective pressure upon the others and social requisites for democracy are largely met.

**KEYWORDS:** Sub-Saharan Africa, Modernization, Industrialization, Democratization, Contingent Democrat Theory, Social Requisites for Democracy, South Africa, Gabon, Senegal, Burundi

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**FRIENDING BRANDEIS: PRIVACY AND GOVERNMENTAL SURVEILLANCE IN THE ERA OF SOCIAL MEDIA**

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Today, individuals network and interact with each other in radically different ways by using social networking sites, such as Facebook and Twitter. Utilizing this new media, individuals are able to share intimate details of their lives, coordinate activities, and exchange ideas with friends, family and others in ways previously accomplished only in person, by telephone, or in written letters stored at home. At the same time, terrorist organizations and other criminal actors are increasingly utilizing social networking sites for recruiting purposes and for the planning, financing, and execution of nefarious acts. As such, social networks have become a valuable source of intelligence for the law enforcement and intelligence communities that enable the collection of information pertaining to individuals in ways not previously possible. However, the law pertaining to surveillance in cyberspace has failed to keep pace with society's adoption of social networking and other cloud computing
technologies. This thesis examines the privacy and civil liberties safeguards inherent in the U.S. Constitution's Fourth Amendment and the need to ensure that an appropriate balance is struck between an individual's reasonable expectation of privacy in online communications and the government's information-gathering requirements necessary to combat emerging criminal and terrorist threats.

KEYWORDS: Privacy and Civil Liberties, Surveillance, Fourth Amendment, Social Media, Social Networking Technologies, Cloud Computing

STATE CAPACITY AND EFFECTIVENESS IN COMBATING CRIME: A COMPARATIVE STUDY OF EL SALVADOR AND GUATEMALA

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Less than two decades after the conclusion of brutal civil wars, El Salvador and Guatemala are once again faced with high levels of violence stemming from drug trafficking, organized crime, corruption, and gangs. Overall, El Salvador was more successful in post-war state building. However, despite having stronger institutions and more capabilities, it is not better off when it comes to public security when compared to Guatemala, a state with weaker institutions and fewer resources. In fact, El Salvador's homicide rates have been consistently higher. According to prevailing conventional wisdom, a country with stronger institutions and more resources should be more capable and effective at maintaining order, but this is not the case. This thesis examines the nature of crime, institutional capacity, and the effectiveness of government responses to reduce violent crime. It argues that decisions made during the transition period set these states on different paths. Furthermore, while strong institutions are important to maintaining order, government policy can strengthen or weaken the effectiveness of the institution. Strong institutions are necessary, but not sufficient.


EXPLAINING HUMANITARIAN INTERVENTION IN LIBYA AND NON-INTERVENTION IN SYRIA

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The emergence of the revolutionary movements of the ‘Arab Spring’ in early 2011 surprised the world. For the western democracies, the often-violent reaction of the ruling regimes in the concerned countries caused political and moral challenges. Different approaches are discernible when for the Libyan case the west was willing to intervene against the regime but for the Syrian case no decisive action was taken. This thesis examines the importance and influence of humanitarian interventions in comparison to national geostrategic interests and the influence of domestic politics. The thesis argues that the three examined Western states—the United States, Germany and France—acknowledge and stress the normative importance of humanitarian interventions but finally prefer geostrategic interests and domestic politics. Next to their own interests, the parameters of the respective conflict are of highest importance, as shown by the comparison of the political, social and military framework of Syria and Libya. The thesis concludes that normative arguments in international politics
are overestimated and dominated by state interests and demands of governments. For western democracies normative reasons are of theoretical importance and part of their own self-awareness but in realpolitik their influence is minuscule.

**KEYWORDS**: Syria, Libya, United States, France, Germany, Humanitarian Intervention, Responsibility to Protect, Qadhafi, al-Assad, Geostrategic Interest, Norms, Domestic Politics, Foreign Policy, Arab Spring

**EVOLUTION IN THE CIVIL–MILITARY RELATIONSHIP IN THE PEOPLE’S REPUBLIC OF CHINA AND THE POTENTIAL IMPACT IN THE RECENT ENDEAVOR TO PROFESSIONALIZE THE PEOPLE’S LIBERATION ARMY**

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This thesis analyzes how civil–military relations in the PRC have evolved during previous efforts to professionalize the military and examines the implications on contemporary analysis of civil–military relations. Current approaches to understanding civil–military relations in the PRC have focused on the professionalization of the military. However, lessons learned from similar episodes of professionalization in the PLA’s past have not been fully incorporated into the current analyses.

Two case studies were selected where there was a prominent shift in the relationship between the CCP and PLA that negatively affected the push toward increased professionalization of the military. The first case study traces the growth and reversal to professionalization in the late 1950s, while the second case study follows the professionalization trend through the 1980s and its dramatic reversal in the aftermath of the 1989 Tiananmen Square incident. By comparing the key linkages between the CCP and PLA that allowed for the previous reversals of professionalization in the military, this thesis highlights the consistencies among the different episodes in the PRC’s civil–military history. Finally, it expands on the implication of these findings on contemporary civil–military relations and its potential impact on current professionalization of the PLA.

**KEYWORDS**: Professionalization, Civil–Military, People’s Republic of China, Chinese Communist Party, People’s Liberation Army, Sino–Soviet, Tiananmen, Politicizing, Factionalism, Symbiosis, Interlocking Directorate, Party Control, Conditional Compliance, State Control, General Political Department, Political Commissar, Party Committee

**THE ALLIANCE DECIDES THE MISSION: MULTILATERAL DECISION MAKING AT THE UN AND NATO ON LIBYA, 2010–2011**

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The UN Security Council quickly authorized the use of force and NATO allies speedily took action in March of 2011 to prevent a potential humanitarian crisis in Libya when it appeared to the international community that civil protest would be met with state-sponsored violence on the level of genocide. How did the multilateral decision-making processes in NATO and the UN, two separate but related organizations, work in this case? What forces led to a slow or fast decision? What factors contributed to international support for intervention, and what was the character of politics that led to action? The underlying multilateral decision-making frame-
work of each organization, a function of structure and original design, is investigated and compared in light of an historical and in-depth study on multilateralism. Within the contemporary crisis management mindset of the last twenty years, it is easily forgotten that these organizations were created for other purposes. Their \textit{raison d’être} was the prevention of catastrophic world war amongst great powers, not the management of small-scale crises or humanitarian interventions. Thus, their decision making in crisis management is blunt. Libya stands out as an exceptional case, with potential future implications on the use of force.

**KEYWORDS:** Libya, Multilateralism, UN, NATO, Alliance, Coalition, Decision Making

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**NATO: MAINTAINING RELEVANCE IN THE TWENTY-FIRST CENTURY**

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This study interprets the political, strategic, and institutional durability of the North Atlantic Treaty Organization (NATO) in the diplomatic revolutions of the past twenty years. In particular, the study seeks to understand the characteristics of statecraft, policy, strategy, and institutional custom and tradition that have allowed NATO as an organization and as a group of democracies to cope with the changes in the international system and the stresses and strains of domestic politics and burden sharing in the inner workings of the alliance, its allies and partners. This study traces the process of transformation and evolution that NATO has endured by analyzing its institutional characteristics, the moral imperatives that guide its actions, and the level of involvement its major players contribute through a comparative case study encompassing such modern operations as Kosovo (KFOR) and Afghanistan (ISAF) in the years from the late 1990s to the present.

**KEYWORDS:** Transformation, Burden Sharing, Moral Imperative, Responsibility to Protect, Responsibility to Rebuild, NATO, Alliance, Trans-Atlantic Community, Institutionalization

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**TAKING A REGIONAL HEALTHCARE COALITION APPROACH TO MITIGATING SURGE CAPACITY NEEDS OF MASS CASUALTY OR PANDEMIC EVENTS**

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Hospitals and healthcare facilities are not able to singularly mitigate the patient surge from a mass-casualty incident or pandemic health event. The potential volume of patients demands that regional healthcare communities be able to respond as a unified body to maintain the resiliency of their healthcare systems. The National Healthcare Preparedness Program advocates the establishment of fully functional, response-ready regional healthcare coalitions to meet this need.

Establishing a regional healthcare coalition requires that an appropriate governance structure be established, a proper level of participation be solicited, and adequate funding mechanisms be put in place. This thesis offers a case study of how these factors influence the ability of three existing and distinctively different healthcare coalitions to prepare for a patient surge from a mass-casualty or pandemic health event. The thesis also shows the influence of each of the factors on a coalition’s sustainability.

The coalitions researched were Palm Beach County, Florida’s, Healthcare Emergency Response Coalition; King County, Washington’s, Healthcare Coalition; and Jacksonville, Florida’s, First Coast Disaster Council. These three coalitions highlight differences and similarities in the governance structure, participation needs,
and funding mechanisms of existing regional healthcare coalitions and show how each influences catastrophic patient surge mitigation in their region.

**KEYWORDS:** Regional Healthcare Coalition, Healthcare, Coalition, Hospital, Preparedness, Mass Casualty, Pandemic, Patient, Surge, Patient Surge, Governance, Participation, Funding, Medical, Catastrophic

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**WHO HAS LEGAL SOVEREIGNTY OVER JERUSALEM AND WHICH PEACE PROPOSAL HAS THE BEST CHANCE FOR SUCCESS?**

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There are four differing schools of thought as to who has legal sovereignty over Jerusalem. This is one of the primary reasons why there has been no resolution to the Israeli–Palestinian conflict. The first is that there was a vacuum of sovereignty in the wake of British withdrawal which was filled by Israel after the first Arab-Israeli War and again as a need for self-defense after the 1967 War. The second is the idea that Palestinians have always held legal sovereignty over Jerusalem and continue to do so today. The third thought is that Jordan still has a legal right to the eastern section of Jerusalem due to the outcome of the first Arab-Israeli War. The fourth is that the United Nations has legal sovereignty due to the mandate that was created by the League of Nations at the conclusion of the First World War. These four claims form the basis behind the legal argument over Jerusalem and are discussed in this thesis in order to determine legal sovereignty over the city and provide the background information necessary to proceed towards a peaceful resolution. The conclusion of this thesis points out that both Israel and the Palestinians have legal sovereignty of Jerusalem and therefore joint control of the city should be pursued in the form of a type of condominium.

**KEYWORDS:** Israel, Palestine, Jerusalem, Legal Sovereignty

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**LESS IS MORE: POOLING AND SHARING OF EUROPEAN MILITARY CAPABILITIES IN THE PAST AND PRESENT**

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This thesis analyzes the policy implications of the pooling and sharing of forces and weapons as a feasible way to strengthen European military power in an era of scarcity. This thesis argues that pooling and sharing is only likely to be successful if states enhance their emphasis on collective defense by mutual aid and self help and reduce particularist and parochial interests of local gain. Pooling and sharing could improve European military capabilities significantly and for the long term if differences in location factors are taken into account and all states concentrate on their respective strengths. Pooling of money in the form of common funding can set incentives and is easier than pooling established military structures. The analysis of NATO’s experiences proves that pooling and sharing is a painstaking process that has to be organized in a way that accounts for national specifics. More competition and less concentration are the keys to ensuring guaranteed access to
By the late 1980s, Colombia had become the world’s leading producer and exporter of cocaine, as well as the most important coca growing country in the Andes. In the context of the “War on Drugs,” U.S. aid to the country increased significantly during this period and, by 1991, Colombia was the leading recipient of U.S. aid in Latin America. Despite the increase in U.S. resources, Colombia’s military suffered a series of important defeats to prominent guerilla groups, which were regarded as major players in the cocaine trade, as well as a serious threat to political stability in the country. In response, a U.S. and Colombian partnership known as Plan Colombia (2000–2005) was initiated and, in accordance with the plan, more coca was eradicated in Colombia than anywhere else in the world. In this context, this thesis asked, what are the unintended consequences of coca eradication as they pertain to Plan Colombia? To answer this question, this thesis elucidates the fundamental linkages between “mainstream” and “deviant” globalization and the unintended consequences of supply-side drug control efforts, such as an eradication policy. It also illuminates how the most important global economic transformations of the past 40 years have profoundly and continuously undermined U.S. efforts to eradicate coca and how strategies that continue to discount the role of globalization (deviant or otherwise) will likely play out in the future.

KEYWORDS: Colombia, Cocaine, War on Drugs, Plan Colombia, Guerilla Groups, Coca, Eradication, Deviant Globalization
MASTER
OF
BUSINESS ADMINISTRATION
The fiscal year 2012 budget resolution forced many agencies to significantly reduce their budget spending and adhere to stricter budgetary policies. The one agency that was hit the hardest was the Department of Defense—it was forced to reduce its budget by $10 trillion over a span of 10 years. With the ongoing War on Terror, the Department of Defense estimated in 2010 that the cost of maintaining a single soldier in a wartime environment grew exponentially—to well over $1 million per soldier.

The U.S. involvement in Iraq and Afghanistan started a major shift, from using manned vehicles to using unmanned vehicles, also known as autonomous vehicles. These autonomous vehicles can be controlled remotely via satellite or radio signals. Currently, the majority of unmanned vehicle usage is in autonomous unmanned aerial vehicles (UAVs) that provide air surveillance, reconnaissance, and assault purposes across all services. This major shift to autonomous vehicles has kept a large number of troops out of dangerous environments such as Iraq and Afghanistan, has reduced the risk of losing soldiers’ lives, and, at the same time, has reduced the costs of keeping soldiers in these dangerous environments for long periods of time.

The purpose of this project is to provide a comparative analysis and operational efficiency evaluation of current and in-development airships, or dirigibles, to expand the UAV’s capability as a viable logistic support platform. This project demonstrates that airships, manned or unmanned, can reduce costs, particularly important with the current budgetary concerns throughout the Department of Defense. The expanded use of airships for logistics could benefit all services due to their flexibility, lift capability, interoperability, and lower cost.

**KEYWORDS:** Dirigible, Airships, Autonomous, Unmanned Aerial Vehicles, Logistics, Transportation, US-TRANSCOM, Comparative Analysis, Operational Efficiency
or manage better. Studies to date indicate that most of the benefits have occurred within the financial management domain: better internal controls, improved financial systems, and more accurate and timely financial information. Additionally, clean audit opinions have resulted in reputational benefits for agency CFOs and their finance departments. To date, however, little has apparently been done to address how these financial statements and audit processes can most effectively be used. Using data obtained from the 24 major CFO agencies, along with three external perspectives, this thesis explores the internal users and uses of financial statements within the federal government to see if there is evidence that higher order benefits are being realized, namely the use of financial statements by executives and managers within the federal government for improved decision making and managing.

**KEYWORDS:** Financial Statements, DoD Financial Improvement and Audit Readiness, FIAR, Audit

**AN EVALUATION OF PRIVATIZED MILITARY FAMILY HOUSING: LESSONS LEARNED**
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Support Advisor: Becky D. Jones, Graduate School of Business and Public Policy

An analysis of previous efforts to privatize military housing and of the current privatization initiative revealed that long-term success requires flexibility to manage the private developers’ and U.S. government’s exposure to various types of risks. The objective of this report is to identify how the Department of Defense has applied the lessons of early privatization efforts to manage risks and to guarantee success of the current military housing privatization initiative. Reviews of government reports, surveys, presentations, journal articles, and congressional testimony were used to trace the progression of these privatization programs in order to highlight key lessons learned and provide a holistic perspective of the evolution of the privatization of military housing.

**KEYWORDS:** Base Housing, Military Housing Privatization Initiative, Wherry, Capehart, Section 801, Section 802, Risk Management

**A COST–BENEFIT ANALYSIS OF THE NAVY FLIGHT DEMONSTRATION TEAM AND THE U.S. NAVY BAND**
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Donald Gardner, Lieutenant Commander, United States Navy  
Master of Business Administration–June 2012  
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This project is a cost–benefit analysis of both the U.S. Navy Flight Demonstration Team and U.S. Navy Band (D.C.). We examined both operations’ associated costs and benefits. Our methodology used established cost–benefit analysis techniques to provide the Navy with information to determine whether the benefits of flight demonstrations to the public in support of recruiting are worth the costs of operating and maintaining all resources. The same analysis techniques were used to determine whether the benefits of musical support to the President of the United States, the Department of Navy, and other senior military and government officials is worth the costs associated with operations of the Navy Band. We found that using the value of the recruiting
leads as a benefit, against all associated costs, that the costs outweighed the benefits for both the Navy Flight Demonstration Team and the U.S. Navy Band (D.C.).

**Keywords:** U.S. Navy Flight Demonstration Team, U.S. Navy Band (D.C.), Cost Benefit

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**TRANSPORTATION CHALLENGES IN THE HAMPTON ROADS, VIRGINIA, REGION**

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Kennis Sigmon, Lieutenant Commander, United States Navy  
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The overall purpose of this MBA project is to provide an overview of all aspects of transportation in the Hampton Roads region to include highways, port traffic, rail, light-rail and tunnels. It also focuses on the importance the transportation system in Hampton Roads is to the military in the region. It includes an analysis and recommendations for potential improvements and future considerations for transit in the Hampton Roads region.

**KEYWORDS:** Hampton Roads Bridge Tunnel, Patriots Crossing, Light Rail, Port Authority

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**A COST ANALYSIS OF THE DEPARTMENT OF THE NAVY HUMANITARIAN ASSISTANCE AND DISASTER RESPONSE TO THE 2011 TOHOKU EARTHQUAKE AND TSUNAMI**

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On March 11, 2011, the Tohoku earthquake and tsunami triggered overwhelming destruction and loss that had global implications. Because of the random nature of disasters, funding for response efforts is not currently included in the budget submitted for the Department of Defense. Thus, when the Department of the Navy responds to a natural disaster and provides humanitarian assistance, great fiscal costs are incurred, which must be accurately tracked and reported for reimbursement.

This project investigates the response of the U.S. Navy following the 2011 Tohoku earthquake and tsunami in Japan. The objective of this research is to analyze the operating costs associated with each DoN vessel and aircraft type. In order to determine the most cost-effective platform(s) the Navy should use when responding to a disaster, an in-depth analysis of all direct and indirect costs associated is provided. As a result, this analysis will provide senior leaders and policy makers with timely operational and financial policy recommendations to better prepare for unforeseen events in the future.

**KEYWORDS:** Humanitarian Assistance, Disaster Relief, Disaster Response, HA/DR, U.S. Navy, Operating Costs, Operational Cost Drivers, Operation TOMODACHI, Tohoku, Japan, OHDACA
SHAPING THE NAVY’S ACQUISITION WORKFORCE
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The Navy’s acquisition workforce is at a crossroads. Force reductions caused the current problems of numerous personnel nearing retirement eligibility, insufficient end-strength to meet the current contracting landscape, and an overreliance on contractors. In response to these challenges, Congress enacted legislation increasing the size of the workforce and emphasizing strategic human capital planning.

The present study seeks to determine how effectively the Navy’s human capital initiatives provide the appropriate end-strength to accomplish the acquisition mission. Researchers utilized the Inventory Projection Model created by RAND to determine the potential effects of selected economic and policy factors on future workforce end-strength. The model relies on a scenario-based approach to predict the impact of such factors by varying input rates for hiring and attrition.

Study results suggest that certain economic or policy changes could have a significant impact on personnel recruitment or attrition behaviors. The Navy’s current initiatives are determined to be effective. However, increased personnel attrition, either through economic improvement or policy shifts, could cause an end-strength shortfall. Expanded use of the model is recommended to assist in estimating the potential effects of various economic and policy factors on the future shape of the acquisition workforce.

KEYWORDS: Acquisition Workforce, Projection Modeling, Acquisition, Human Capital Planning

ANALYZING TRENDS IN FEDERAL GOVERNMENT SURPLUSES AND DEFICITS
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This project consists of an analysis of the federal budget through the years 1990–2020. The key issues to be addressed are (a) average percentage of deficit as a percentage Gross Domestic Product (GDP), (b) interest rate(s) on debt depending on forms of debt, (c) annual interest cost, (d) debt structure, (e) government outlay percentages relating to GDP, and government receipt percentages related to GDP. The objectives are to identify apparent trends in the U.S. federal government’s deficits and implications of annual and total debt.

These data are necessary for the analysis of the federal deficit. The federal budget is a complex formulation of many different inputs used to comprise economic standing. The purpose of this analysis is to identify past, present, and future implications of the federal deficit, e.g., net interest cost. The deficit and interest costs are positively correlated. When the deficit rises, so does the amount of interest paid. This is true assuming interest rates remain constant. Lately, as interest rates have fallen, the debt burden is lighter even though the overall debt is larger. Furthermore, higher interest payments lead to less capital devoted towards programs and the overall budget balance. Conversely, a lower deficit leads to lower interest payments. Therefore, capital can be reallocated to other avenues, such as social programs, infrastructure, and education.

KEYWORDS: Federal Deficit, Net Interest, Public Held Debt, Gross Domestic Product (GDP)
This report creates a financial view of billets at Fleet Readiness Center Mid-Atlantic (FRCMA). FRCMA is the largest Intermediate Maintenance Facility in the U.S. Navy. FRCMA provides maintenance and repair support to aviation squadrons, and is staffed by military, civilian, and contract employees. This report conducts an analysis of direct and indirect costs to build a labor rate comparison between a military, contractor, and civilian wage employee. This analysis uses a single pay grade comparison. All available direct and indirect costs are aggregated, and these costs are traced as accurately as possible to each billet. An analysis of various accounting methods for cost tracing and allocation is conducted, along with the methods for tracing and allocating indirect and direct costs to each comparative pay category. A focus on labor costs and overhead allocation is included, along with an analysis of appropriation categories.

KEYWORDS: Labor Rate, Overhead, Cost Allocation, Cost Distribution, Cost Tracing, Overhead Allocation, Overhead Distribution, Depreciation Distribution, Labor Comparison, Fleet Readiness Center, FRCMA, Direct Cost, Indirect Cost, Accounting Methods, Appropriation

The Department of Defense has engaged in many humanitarian efforts over the years, such as the 2004 Indonesian tsunami and 2010 Haitian earthquake. As military personnel are deployed around the globe, the DoD is in a good position to respond when called upon. The 2011 National Military Strategy focuses on maintaining a global presence to protect our national interest. The strategy stressed the importance of force preparedness to support and respond to humanitarian crises. On March 11, 2011, this ability was tested when Japan was struck by a 9.0-magnitude quake and subsequent tsunami. This project analyzes the U.S. naval response to the humanitarian crisis that resulted from the Tohoku earthquake and tsunami as part of Operation Tomodachi.

KEYWORDS: Humanitarian Assistance; Disaster Relief; Disaster Response; Operation Tomodachi; Military Sealift Command; United States Navy
This study is a business case analysis of a medium altitude global ISR communication (MAGIC) UAV system. The MAGIC platform is analyzed together with three other medium-altitude ISR platforms. A cost model for RDT&E and O&S for the MAGIC is developed based on historical data. A baseline case for MAGIC is then developed with average production unit cost (APUC) of $17M, RDT&E cost of $510M and discount factor of 0.025 for the analysis. A net present value of lifecycle cost (NPVLCC) and a return ratio as defined by the ratio of the NPVLCC of alternative platforms to the NPVLCC of MAGIC are used in the analysis.

Results are presented for 500, 1000, 2000, and 3000-nm ranges. MAGIC outperforms Reaper and Global Hawk, while Predator outperforms MAGIC at the 500 nm. MAGIC outperforms all others in the 1000, 2000 and 3000 nm range. The analysis is extended to cover other payloads for the same ranges. The results show that MAGIC is favored over Reaper for 1000 nm and 2000 nm range, and the return ratio is marginal for 500 nm. MAGIC is favored in all ranges when compared with Global Hawk.

KEYWORDS: Business Case Analysis, MAGIC, UAV, Reaper, Cost Estimation, CER, Global Hawk, Life Cycle Cost, ISR, UAS
In 2005, a U.S.–Japanese security consultative committee agreed to shift the Carrier Air Wing Five (CVW-5) home port from Atsugi Naval Air Station (NAS), Japan, to Marine Corps Air Station Iwakuni (MCASI), Japan, in 2016. Currently the 35-miles distance between Atsugi, where the air wing is based, and Yokosuka, where the carrier is docked, does not significantly burden the supply chain. However, when CVW-5 F/A-18 Hornets are repositioned to MCASI, it will raise transportation costs, due to the additional 542 mile distance to move Tool/IMRL assets to the carrier for air wing embarkation. In the same timeframe of the air wing home port transition, the composition of the air wing will be evolving to become the Navy’s first unit comprised of all Hornet variant aircraft. This analysis tries to determine the cost savings that may be involved with consolidation of Tool/IMRL outfitting allowances. Additionally, the analysis shows that MCAS Iwakuni may bring further asset exploitation opportunities due to the Marine Hornet squadrons already based there, whereas Atsugi has no Hornet presence other than CVW-5.

KEYWORDS: IMRL, Tools, CVW-5, MCAS Iwakuni, Pool Resources, Hornet Variants

The Acquisition Advisory Panel (2007) and Gansler Report (2007) have both expressed concerns that the DoD contracting workforce is not adequate in size to handle the current contracting workload. Core to determining the correct workforce size is establishment of a proven manning model that can be used throughout the DoD to estimate the number of contracting specialists required to handle a given workload.

This project looked at the demand factors that two U.S. Navy systems commands (SYSCOMs) use to signal when they need more contracting full-time equivalents (FTEs). The study applied the Air Force Manning Standard Operational Contracting model to Naval Supply Systems Command’s contracting workload. Results show that the model effectively estimates manning for that SYSCOM. The results suggest that the model could be used to estimate contracting FTE manning in other DoD major commands.

KEYWORDS: Manpower Model, Contracting Workforce
DEFINING AND MEASURING THE SUCCESS OF SERVICE CONTRACTS
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Services acquisition in the U.S. Department of Defense (DoD) has continued to increase in scope and dollars in the past decade. The DoD has spent more on services than on supplies, equipment and goods together, totaling approximately 57% of total acquisition expenditures and nearly a third of the total DoD budget. As a result, the agency must give greater attention to the management of services acquisition. Stakeholder theory illustrates how acquisition team members often have conflicting goals and objectives, leading to differing definitions and measurements of a successful service contact. We used stakeholder theory to address the following questions: (1) how are successful service contracts within the DoD being defined by different stakeholders, (2) how are service contracts being measured within the DoD by different stakeholders, (3) how should service contracts be defined and measured within the DoD. We conducted 41 interviews and surveys of key stakeholders. Our findings reveal no standardized definition or measurements for success of service contracts. However, some salient characteristics of definitions are schedule, maintain costs, and well defined requirements. With respect to measurements, relevant characteristics included performance and cost. Furthermore, we provide recommendations on establishing standardized definitions and measurements of success.

KEYWORDS: Stakeholder Theory, Services Contracting, Service Contract, Scorecard, Defense Acquisition

STANDARDIZING AMMUNITION DISTRIBUTION WITHIN THE UNITED STATES NAVY AS EITHER A PUSH OR PULL METHODOLOGY
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The purpose of this MBA Project is to investigate and provide a comprehensive assessment for standardizing the ammunition distribution system used by the United States Navy. This project was conducted with the sponsorship and assistance of the Naval Supply Systems Command–Global Logistics Support. The goal of this project was to identify and document both the push and pull methods of supply chain distribution and then recommend one of these methods, or possibly a hybrid of the two, to Naval Supply Systems Command for potential implementation. Analysis was performed on requisition information from the eight major Naval Weapons Stations to end users (those ordering particular types of ammunition) in an effort to determine which potential method would have the greatest economic impact for cost savings.

KEYWORDS: Supply Chain Management, Supply Chain Distribution, Push–Pull Methodology
HARNESSING THE TRANSFORMATIVE TSUNAMI:
FLEET-WIDE 360-DEGREE FEEDBACK REVISITED
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Since 1775, the success of the U.S. Navy has been borne of its strong, capable leadership. For generations, seafaring warriors have been cultivated from within, hand-selected, and groomed to fit the roles their fleet demands of them. Unfortunately, the recent firings of a few marquee officers suggest some tarnished organizational practices in need of polish. This thesis highlights obstacles impacting leadership development within the modern United States Navy. It also reflects upon various strategic, cultural, and technological trends that have shaped the twenty-first century naval workplace, as well as key organizational attempts to develop leaders of robust character. Using evidence from scholarly literature, the report champions one specific personnel development system called 360-degree feedback with which the U.S. Navy has enjoyed a storied past. By comparing the force-wide 360-degree feedback trials initiated by the Navy and Army in the mid-2000s, this thesis argues that the abandonment of the initiative by the Navy was a hasty misstep. Finally, this report advocates reintroducing Navy-wide 360-degree feedback because of its unique and timely benefits to today’s fleet and concludes by coining a revised implementation strategy dubbed the “Transformative Tsunami” so as to remediate those weaknesses that befell its predecessor.

KEYWORDS: Leadership Development, Organizational Change Model, 360-Degree Feedback, Multi-Source Feedback, Multi-rater Feedback, SMARTS-360, MSAF

REMITIING THIRD-PARTY SOFTWARE VULNERABILITIES
ON U.S. ARMY INFORMATION SYSTEMS
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Information systems belonging to the DoD and U.S. Army experience cyber attacks on a daily basis. Increasingly, these attacks are targeting popular third-party applications, instead of focusing on vulnerabilities in Microsoft software. The DoD responded to this threat by adopting Citadel Hercules, which did not find a willing audience with the U.S. Army. Instead, the Army adopted Microsoft Systems Management Server (SMS), followed by System Center Configuration Manager (SCCM) 2007 to meet this threat. After more than five years, the rollout of SCCM to all organizations within the U.S. Army is still incomplete. This study provides an overview of the threats facing U.S. Army information systems and looks at how the Army has addressed this challenge in the past. Next, the study takes a system engineering approach to identifying an optimal tool for mitigating third-party vulnerabilities and suggests potential alternatives to SCCM. In addition, the study utilizes a cost benefit analysis approach to aid in evaluating the potential Return on Investment (ROI) pro-
vided by each tool. The purpose of this study is to answer the question: What is the most optimal solution for mitigating vulnerabilities in third-party applications on U.S. Army information systems?

KEYWORDS: Information Assurance Vulnerability Message (IAVM), Patch Management, Third-Party Vulnerability Remediation, System Center Configuration Manager (SCCM), LandWarNet (LWN), Information Assurance Vulnerability Alert (IAVA), Network Operations and Security Center (NOSC), Patching, SysMan

NATIONAL DEFENSE BUDGETING AND CONGRESSIONAL CONTROLS
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In 1992, Jones and Bixler (Mission Financing to Realign National Defense, JAI Press) examined different factors (internalities, externalities) within the federal budget process and identified certain tendencies, trends, and relationships in congressional control over defense through the budget process. This study occurred at the end of the Cold War. The national security situation of the United States has been quite different over the past 20 years. Further, the federal budget context has been different, as mandatory spending has taken a larger share and budget surpluses were achieved and lost. Debates over the right level of spending are increasing now as both fiscal and security issues are driving Congress, Department of Defense (DoD), and the White House to reexamine defense spending. This project examines the assertions in Jones and Bixler to determine if they remain valid through comparisons of their Cold War data with data collected during a relative period of peace (post Cold War to 9/11) and a period of war (post 9/11 to 2011).

KEYWORDS: Budget, Congress, Control, Department of Defense, Hearings, House Armed Services Committee, Micromanagement, Oversight, Patterns, Senate Armed Services Committee, Spending, Trends
In 2012, NAWCWD will spend an estimated $34M providing information-technology (IT) capability to its technical users under the current operating model, which consists of a combination of NMCI and RDT&E network services. The current model has resulted from a combination of contract changes under the continuity of services contract for NMCI and NAVAIR policies related to RDT&E governance and Information Assurance (IA). Cost estimating models were developed that allowed multiple configurations of proposed operating constructs for the technical community under a solely RDT&E environment. A comparative analysis was then performed to identify potential savings to the command by modifying the current IT service model for its technical users to one provided exclusively by the RDT&E network. The research showed that there are two significant cost components of the IT capability under the RDT&E model that must be addressed before significant savings can be achieved. The first is the cost of the IA processes, which include certification, accreditation, and sustainment. The second component is the cost of an email capability within the RDT&E environment. While there are technically feasible solutions for both of these components, policy is preventing affordable solutions from being utilized.

**KEYWORDS:** Information Assurance, NMCI, RDT&E Network, Information Technology, Cost Analysis
specifically designed to measure performance against the U.S. Navy’s Science Technology Engineering and Mathematics (STEM) program portfolio goals, a need exists to develop additional metrics to use to measure program success against goals. The four goals of the U.S. Navy’s STEM program are to inspire, engage, educate, and employ U.S. citizens within the Naval Research Enterprise. This project addresses the current gap in understanding the measurement of qualitative goals in educational outreach programs, specifically in the SEAP and NREIP programs. The concept of five dimensions influencing inspiration in students toward STEM and motivational factors was used to measure performance against the inspire goal. The concept of flow from the positive psychology field was used to measure engagement. The survey developed from this project serves to provide a useful and accurate measure of SEAP and NREIP program success against the four goals of the U.S. Navy’s STEM programs. It has implication in measuring success against the four STEM program goals for other STEM educational outreach programs.

**KEYWORDS:** STEM, Metrics, SEAP, NREIP, Motivation, Flow, Inspire, Engage, Educate, Employ, Educational Outreach

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**NAVAL FACILITIES ENGINEERING COMMAND HEADQUARTERS’ ENTERPRISE-WIDE FEEDBACK TOOL: AGENCY BENEFITS VERSUS INVESTMENT**

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Open dialogue and feedback between employees and management are essential to maintaining a high state of morale within any organization. This communication can also assist leadership in discovering better work practices and ways to improve qualities of life in the workplace. With that said, during a Naval Facilities Engineering Command (NAVFAC) Leadership Board meeting, a senior leader suggested that a feedback tool be implemented across the enterprise. To best accomplish this, NAVFAC Headquarters (HQ) requested an overview of its current suggestion box program to evaluate its success and determine if it could be improved or refined for HQs and/or the enterprise as a whole. The approach used to measure awareness and success of the current program was through the distribution of an internal survey. Additionally, two external commands with specific feedback tools were interviewed and analyzed. Based on this analysis, several recommendations and distinct courses of actions were developed that address potential improvements to the HQs process as well as a potential way ahead to implement an enterprise level tool.

**KEYWORDS:** Feedback Tools, Organizational Climate Assessment
MASTER OF SCIENCE

Applied Mathematics
  Applied Physics
  Computer Science
  Defense Analysis
  Electrical Engineering
  Human Systems Integration
  Information Operations
  Information Technology Management
  Management
  Mechanical Engineering
  Meteorology
  Operations Research
  Physical Oceanography
  Physics
  Software Engineering
  Space Systems Operations
  Systems Engineering
  Systems Engineering Analysis
  System Technology
This thesis explores numerical methods to provide real-time control inputs to achieve an optimal trajectory which minimizes the time required for a Helicopter Unmanned Aerial Vehicle (HUAV) to reorient to a given target. A library of optimal trajectories is populated using a pseudospectral computational algorithm applied to the mathematical model developed by the National University of Singapore and Singapore Department of Defense to simulate flight characteristics for their HeLion small scale HUAV system. The model is a complex system of non-linear differential equations—fifteen state variables and four control variables—used to simulate the aerodynamic forces on the HUAV. Then, using the library of optimal trajectories for known target locations, we apply interpolation methods to provide control inputs in order to intercept an attack heading to a target more quickly than an online, full scale optimization approach. All simulations in this thesis are modeled using the MATLAB program.

**KEYWORDS:** Nonlinear Model, State and Control Variables, Cost Function, Trajectory Optimization, Target Heading Intercept, Bilinear Interpolation
order, single-rate time-integrators: Adams–Bashforth 2 (AB₂), backward differentiation formula 2 (BDF₂), and Runge–Kutta 2 (RK₂).

KEYWORDS: Multirate Method, Runge–Kutta, Finite Difference, Time Integration, Partial Differential Equation
CATHODE STALK COOLING SYSTEM FOR THE MK I QUARTER-WAVE GUN
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The free electron laser (FEL) is of great interest to the United States Navy for shipboard use. The Naval Postgraduate School (NPS) Beam Physics Lab has designed and, in cooperation with other organizations, constructed a superconducting 500 MHz quarter-wave gun and photocathode drive laser system. The cathode of the gun is mounted onto a ~60 cm copper stalk assembly that will position and hold the cathode at the nose cone of the gun. This thesis will explore the necessity to cool the cathode stalk assembly that will have approximately 100W of laser, RF, and radiated heat distributed on it. Based on the operational requirements of the MK I quarter-wave gun a cooling system was designed to run liquid nitrogen internally through the stalk. Simulations were run on COMSOL to determine the effectiveness of the design, followed by the creation of a test stand to physically assess the cryogenic cooling system. Data was found verifying the applicability of the system. Recommendations are made for future experimentation using the cathode stalk cooling system test stand based on the results of this thesis.

KEYWORDS: Free Electron Lasers, FEL, Cathode, Photocathode, Cryomodule, Cryogenics, Electron Gun, Superconducting, Quarter-wave Cavity

INTEGRATION OF AN ACOUSTIC MODEM ONTO A WAVE GLIDER UNMANNED SURFACE VEHICLE
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This thesis examines the possibility of integrating an acoustic modem onto a Wave Glider with the goal of providing a bidirectional communications gateway for submerged sensors, platforms, and networks. The Wave Glider unmanned surface vehicle continuously harvests energy from the environment and is able to hold station without needing to refuel. A unique two-body architecture and wing system directly converts wave motion into thrust, and solar panels provide electricity for sensor payloads. Data messages are transmitted to shore via satellite, and the continuous surface presence means that data can be delivered in real time as it is collected. The objective of this thesis is to identify the best location for an acoustic modem on the Wave Glider considering the factors of hydrodynamic drag on the vehicle and acoustic performance of the modem.

IN SITU RAMAN SPECTROSCOPY STUDY OF THE NANODIAMOND-TO-CARBON ONION TRANSFORMATION DURING THERMAL ANNEALING OF DETONATION NANODIAMOND POWDER
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In this study *in situ* Raman spectroscopy is utilized to investigate the onset of nanodiamond (ND) graphitization, the conversion of diamond (sp$^3$) to graphitic (sp$^2$) carbon, and the subsequent formation of carbon onions. Although the ND-to-carbon onion transformation through thermal annealing of ND in vacuum or inert atmosphere at high temperatures is a well-known phenomenon, the kinetics of the transformation and related structural changes in the nanocrystals are yet not fully understood. Using a high temperature stage under inert atmosphere, the Ultraviolet (UV) Raman spectra of ND were recorded during thermal annealing under isothermal and non-isothermal conditions to monitor the structural transformation of ND crystals at temperatures ranging from 25 to 1100 °C. To complement the UV Raman spectroscopy studies, X-ray diffraction, high-resolution transmission electron microscopy, and thermogravimetric analysis were performed on bulk samples of annealed ND powders.

The results obtained in this study demonstrate that the ND-to-carbon onion transformation starts with the surface graphitization of smaller ND crystals at temperatures as low as 600–700 °C. Between 900–1000 °C, the ND crystals begin to convert to carbon onions from the surface inward. Our study further revealed that the level of surface graphitization and the subsequent transformation of the ND during thermal annealing are strongly dependent on annealing temperature, annealing time, and ND crystal size. The gained knowledge does not only provide better understanding of the ND-to-carbon onion transformation mechanism and therefore allow for an optimization of the carbon onion synthesis process, but also enables the fabrication of ND with various degrees of surface graphitization. These hybrid ND/carbon onion particles have unique physical and chemical properties that are expected to lead to a completely new set of applications, particularly in energy storage.

**KEYWORDS:** Carbon Nanomaterials, Carbon Onion, Raman Spectroscopy, Nanodiamond, X-ray Diffraction, Transmission Electron Microscopy, Thermogravimetric Analysis

NOVEL OUT-COUPLING TECHNIQUES FOR TERAHERTZ FREE-ELECTRON LASERS
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Several issues are encountered in designing a free-electron laser (FEL) oscillator in the terahertz (THz) regime. One such is that there are few inexpensive materials that are suitable for forming a semitransparent out-coupling mirror. To mitigate this particular issue, this presentation explores various out-coupling techniques for a notional FEL oscillator in the THz regime. The advantages and disadvantages of several out-coupling methods will be discussed, including hole out-coupling, and double mesh out-coupling. Simulation results will be presented, showing the effects of these various methods on FEL extraction and optical beam quality.

**KEYWORDS:** Free Electron Laser, FEL, Terahertz, THz, FEL Simulations, Out-Coupling, Mesh Out-coupler, Hole Out-Coupler
UNDERWATER ACOUSTIC NETWORK AS A DEPLOYABLE POSITIONING SYSTEM

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Underwater acoustic communications networks serve to pass data between submerged nodes and a command and control center ashore. Range data recorded incident to regular transmissions between nodes afford the acoustic network an additional use as a navigational aide or tracking system for a vehicle operating in the network domain. Previous studies developed algorithms to solve for the position of the mobile node using node-to-node range data. An alternative localization algorithm is proposed. This study implements the algorithms for experimentation in simulation and an actual maritime environment. Reference nodes are deployed to establish a Seaweb network in Del Monte Lake on the Naval Postgraduate School campus. Experimental range data are recorded and used to plot the path of a surface vehicle towing a network sensor node. GPS fixes are simultaneously recorded for comparison of the calculated track to the true track. This comparison throughout the experiment provides a more definitive measure of the localization algorithms' performance than was possible in previous studies.


NEAR-FIELD IMAGING FOR THE CHARACTERIZATION OF DIFFUSION LENGTH AND WAVEGUIDING IN ZINC OXIDE NANOWIRES

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A novel technique of near field imaging has been advanced and used to measure free carrier diffusion length and study optical waveguiding in ZnO nanowires. The technique employs a near field scanning optical microscope (NSOM) and atomic force microscope (AFM) to optically and spatially map cathodoluminescence generated by a scanning electron microscope (SEM). The technique has been advanced from previous work on nanowires by the use of a higher resolution SEM and filtering approximately 90% of any background luminescent signal directly generated in the AFM/NSOM probe.

For diameters between 250 nm and 800 nm, the diffusion length was found to vary with diameter. For diameters greater than 800 nm, the diffusion length is relatively constant. This is only the second such diameter dependence measurement for ZnO nanowires, and the only measurement for this nanowire diameter range.

The full width at half maximum (FWHM) of the waveguiding output distribution from a single nanowire was found to be uncorrelated with the carrier excitation rate for a 60x increase in excitation rate. Luminescence of \( \lambda \approx 380 \) nm was shown to propagate in the nanowire to a distance of 20-30 \( \mu \)m, indicating an absorption coefficient of \( \sim 2000 \) cm\(^{-1}\).

KEYWORDS: ZnO, Near-Field Scanning Optical Microscopy, NSOM, Diameter Dependence, Waveguiding, Transport Imaging, Diffusion Length
Current approaches to program analysis largely rely on the use of an intermediate language to derive intermediate representations of source code or binaries under evaluation. This can simplify semantics when dealing with a complex instruction set such as the Intel Industry Standard Architecture (ISA) instruction set. However, a question that remains is whether these intermediate languages truly retain semantic fidelity or whether elements of the ISA instruction set get lost in translation. This thesis describes a framework that is being developed at NPS that accomplishes symbolic execution without the use of an intermediate language and symbolically executes ELF and WinPE binary programs over the native x86 ISA instruction set, and specifically discusses an approach to describing state mathematically using a formal algebra.

**KEYWORDS**: Program Analysis, Symbolic Execution, Theorem Proving, x86, SMT, SAT

Communications planning is a key part of the Marine Corps operational planning process. The ability to design and analyze communication network plans efficiently and accurately has a direct impact on the ability of commanders to command and control actions on the battlefield. Portions of the current process of communications network planning for military exercises and operations in the Marine Corps are unnecessarily inefficient and susceptible to human error.

At the heart of network planning is the creation of accurate high-level diagrams that depict the details of the planned network topology for use in network installation, maintenance and operation. These diagrams are referenced at all levels in the planning, installation, operation and maintenance of the resultant communications architecture. Development and iterative refinement of these high-level network diagrams is a fragmented manual process. Despite the heavy reliance on network diagrams in the planning process, no software application currently exists that is designed specifically for their creation.

This thesis proposes a cloud-based application for communications planning. It describes the benefits achievable through automation, collaboration and application interoperability, and provides recommendations.
for development of such a system. It concludes by presenting an implementation of these recommendations via a proof of concept application.

**KEYWORDS:** Communications Planning, Cloud Computing, Real Time Collaboration, Interoperability, Automation
Despite U.S. Special Operations Forces (USSOF) having the most combat experienced units in its history, Naval Special Warfare (NSW) faces a significant mid-grade officer retention problem. This thesis draws on interviews with CEOs and other senior leaders from over 40 private-sector companies. Its overall aim is to help improve NSW’s ability to retain the very best officers—those leaders who have the talent and expertise to keep NSW/USSOF one step ahead of future threats.

Three key findings are: developing and retaining talent is hard work for any organization, and requires substantial effort by senior leaders; organizations use both financial and creative non-financial tools to retain their best people; and a robust human-resources department is critical to preventing retention issues from turning into trends. The thesis offers a number of ways to mitigate current and likely future retention challenges for NSW, USSOF, and the military more broadly.

KEYWORDS: Naval Special Warfare (NSW), U.S. Special Operations Command (SOCOM), Retention, Manning, Talent Leadership Development, Human Resources

The rise in piracy throughout the world in recent years has forced the international community to invest heavily in measures to counter the threat. However, these efforts have had little effect. Lately, the trends in Southeast Asia seem to have turned. In order to counter piracy efficiently, it is critical to fully understand the background and root causes for the phenomenon.

Piracy is blamed by some on poverty, relative deprivation, and the lack of local institutions. This paper investigates piracy in the Caribbean, the Strait of Malacca, and Somalia, and finds that piracy is directly linked to the level of land-based governance. Poverty, relative deprivation, and a lack of local institutions are merely
factors exploitable by organized pirate networks in territories with a low level of governance. By exploring levels of land-based governance in territories close to main shipping routes, possible emerging safe havens for pirates may be found.

**KEYWORDS:** Piracy in the Caribbean, Piracy in the Gulf of Aden, Piracy in the Strait of Malacca, Land based governance, Maritime governance, Poverty, Task Force 151, Malaysia, Singapore, Indonesia, International Maritime Bureau (IMB)

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**TECHNOLOGY STRATEGY INTEGRATION**

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Techno-strategic integration is the process through which militaries integrate technological advances into a strategy that maximizes their advantages. While sheer military might is a function of a variety of factors, technology has taken center stage in the past two centuries. The industrial revolution changed the way war was fought; and the changes had wide ranging effects. The calamity of the First World War was in some ways a failure to techno-strategically integrate industrial age technology. The history of military technology and strategy illustrates many obstacles to the integration of the two. This thesis shows that successful techno-strategic integration is often highly correlated with effective execution of war and improvement of national security. On the other hand, enduring organizational preferences, inter-service rivalry, and commercial self-interest have often undermined new techno-strategic possibilities. However, with the growth and increasing capability of information age technology, this research shows growing indications that the techno-strategic paradigm of the industrial age is shifting. The United States is positioned to capitalize on its lead in informational innovations, and integrating technologies into new concepts of operations. If managed successfully, the United States might emerge with a leaner, more agile force that can keep its strategic competitors at bay.

**KEYWORDS:** Military Technology, Military Doctrine, Innovation, Integration, Diffusion

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**ADAPTIVE COIN IN SRI LANKA: WHAT CONTRIBUTED TO THE DEMISE OF THE LTTE?**

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The Government of Sri Lanka declared victory over the Liberation Tigers of Tamil Eelam (LTTE) in 2009, putting an end to a conflict of thirty years. The sudden demise of the LTTE, one of the most ruthless yet successful insurgent organizations, is worth understanding. This thesis attempts to do this by exploring the internal political dynamics, external influence on the conflict, and the Sri Lankan military’s adaptations in order to determine what contributed to the demise of the LTTE. This thesis will argue that one of the most critical aspects of success for the government and its military was the learning from adversity and the LTTE and adapting the political and military organizations of Sri Lanka. By becoming fast-adapting organizations,
both the government as a whole and the military, in particular, managed to conduct a successful counterinsurgency campaign that eventually ended the LTTE and eliminated its leadership.

**KEYWORDS:** Sri Lanka, Tamil Tigers, Liberation Tigers of Tamil Eelam (LTTE), adaptive counterinsurgency, COIN, South Asia, Eelam War

### DETERMINANTS OF CONFLICT IN THE PHILIPPINES

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Conflict has many causes. Assertions have been made on the relationship of conflict with several factors based on theories, beliefs and principles. Identifying and explaining the determinants of armed conflict in the Philippines is expected to lead to better comprehension and insights on its resolution. Four independent variables are examined as predictors of conflict: ethnicity, poverty, good governance, and literacy. The research primarily utilizes empirical data and projects it in map overlays with the use of the ArcGIS. Bivariate and multivariate statistical models are estimated to derive the relationship between the variables and conflict and to validate the hypothetical claims.

**KEYWORDS:** Determinants, Conflict, Philippines, Poverty, Ethnicity, Ethnic Diversity, Literacy, Good Governance, Mindanao, Bayanihan, IPSP, NISP, Abu Sayyaf Group, ASG, MILF, MNLF, CPP, NPA, Geospatial Analysis, OpenGeoda, Descriptive Statistics, Z-Test, Central Limit Theorem, One-tailed Test, Relative Deprivation, Political Control, Insurgency, Terrorism, Linear Regression, Density Hotspots, STATA, Negative Binomial Regression, Bootstrap, Countfit.

### DEFEATING THE ACTIVE SHOOTER: APPLYING FACILITY UPGRADES IN ORDER TO MITIGATE THE EFFECTS OF ACTIVE SHOOTERS IN HIGH OCCUPANCY FACILITIES

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The average duration of active-shooter incidents in institutions of higher education within the United States is 12.5 minutes. In contrast, the average response time of campus and local law enforcement to these incidents is 18 minutes. In the majority of active-shooter incidents affecting U.S. IHEs, the emergency response time greatly exceeds the incident duration and affords law-enforcement authorities no opportunity to interdict the shooter or prevent further casualties. This stark contrast between response requirements and response capability produces a considerable delta of dead, injured, or potential victims and provides the unfortunate motivation for this project. The primary focus of this project is aimed at reducing the rate of kill of active shooters in U.S. IHEs. This thesis contains fourteen case studies that examine lethal active-shooter incidents that occurred in U.S. IHEs, as well as the Oslo and Utoya Island active-shooter event that occurred in Norway. Data
analysis on each of these incidents revealed facility composition as a critical vulnerability common to all of these incidents. Accordingly, the recommendations included in this thesis suggest a practical implementation of facility upgrades capable of mitigating the deadly effects of active shooters.

**KEYWORDS:** Active Shooter, Mitigation, Facility Upgrades, Victim Initiated, Institution of Higher Education, High Occupancy Facility, Automated Control Measures

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**PROFESSIONAL IRREGULAR DEFENSE FORCES: THE OTHER SIDE OF THE COIN**

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Throughout history, small nation-states have generally organized their militaries and based their homeland-defense strategies on at least one of four conventional models. They have from time to time chosen to imitate large states’ militaries, have joined alliances, assumed neutrality, obtained weapons of mass destruction in more modern times, or implemented some combination of these. A deeper analysis of history, however, unearths other possibilities for defensive postures. The use of irregular strategies and forces, when small nations have faced much bigger and stronger adversaries, has been successful quite a few times. While countries with traditional, orthodox, military mindsets and organizations have spent the last few decades trying to counter irregular forces and strategies, and learning to fight them effectively, the other side of the coin—the adoption of irregular warfare techniques—has been poorly explored. This research was conducted to fill this gap. What can be learned and used at the state level from the strength and historical successes of irregular strategies and forces? Through the analysis of six irregular conflicts, including successful and failed examples, this thesis examines the possible utility and exportability of an irregular strategy as a preferred homeland-defense approach for small states.

**KEYWORDS:** Small States, Homeland Defense, Irregular Strategy, Professional Irregular Defense Force, Asymmetry, Indirect Strategy

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**TARGETED RECRUITMENT FOR NAVAL SPECIAL WARFARE (SEALS): CONNECTING NSW TO RECRUIT POOLS WITH SOCIAL MOVEMENT THEORY**

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The ability to maintain and grow the inventory of sea, air, and land (SEAL) operators depends on the ability of NSW to recruit high probability candidates effectively and increase the retention rates within the existing ranks of SEAL operators. Using data from the BUDs/Pride Database, this thesis draws on logistic multivariate regression models to test the theory that candidates with a prior strong social tie to NSW are more likely to complete the BUDs training successfully than those with no such tie. Geospatial mapping supplements this analysis by providing relatively easy to interpret visualizations of the recruit network. The combination of the logistic models and the geospatial interpretations of the data provide a clearer picture of the entire recruit network. Looking at the results of the logistic regression model, and the ordered logistic regression model, it
can be seen that students with a strong tie either to NSW or another special operations force within the U.S. military are more likely than students without such a tie to make it through the training pipeline.

**KEYWORDS:** Targeted Recruitment, Special Operations, NSW: SEALs, Social Movement Theory, Strong Ties Matter, Multivariable Logistic Regression, Multivariable Ordered Logistic Regression Model, Weak Ties, Strong Ties, Niche Group, Niche Overlap, Niche Centrality, High Risk Activism, Collaborative Network

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**THE REQUIREMENT FOR U.S. ARMY SPECIAL FORCES TO CONDUCT INTERROGATION**

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Waterboarding, rendition, torture: each of these terms provides deeply negative examples of the mishandling of detainees by various entities of the United States government during the prosecution of the wars in Afghanistan and Iraq. In order to rectify these failures of the various systems within the U.S. military’s detention framework, the Department of Defense (DoD) developed and issued Field Manual 2-22.3 *Human Intelligence Collector Operations*. This new doctrine has created restrictions that add unnecessary hours to the process of exploiting detainees through tactical interrogation. Due to the autonomous nature of their missions, the significance for U.S. Army Special Forces is immense.

Tactical interrogation is a legal, viable, and necessary method of information gathering on the battlefield. FM 2-22.3 has taken away USSF’s capability to exploit an immense pool of intelligence that could be critical in the current conflicts. This thesis explores the limitations imposed by current doctrine and discusses changes necessary to provide the skills, training, and legal authorities that will allow Special Forces to use every appropriate resource to be successful on the modern battlefield. Recommendations are provided regarding training and doctrine to provide the proper authorities along with appropriate checks and balances.

**KEYWORDS:** Interrogation, Tactical Questioning, Intelligence, Human Intelligence, Special Forces, Waterboarding, Rendition, Torture, Field Manual 2-22.3 Human Intelligence Collector Operations, Irregular Warfare, Unconventional Warfare, Interrogator

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**PUTTING A PRICE ON STRATEGY: IMPLEMENTING A PREDICTION MARKET IN A MODERN MILITARY UNIT**

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Prediction markets are speculative markets created for aggregating relevant information on some measurable future event. Simply put, prediction markets ask participants to trade ideas as stocks. The “market price” of a particular idea or contract can then be interpreted as the probability that an event will occur, or as a feedback mechanism regarding how well some course of action is working. The application and utility of prediction markets to military strategy and decision-making has yet to be adequately tested in any real or empirical way.
This thesis seeks to understand the conditions under which the application of a prediction market would be both successful and useful to military commanders. To test this, markets were established with three different organizations and included more than 135 participants. Upon the closing of the markets, results and participant surveys were analyzed. The data collected indicate that such a tool could be quite useful if employed and illuminate a variety of challenges that must be addressed in order to implement a prediction market in a military unit.

**KEYWORDS:** Prediction Market, Idea Market, Futures Market, Military Decision Making

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**SPECIAL OPERATIONS FORCES AS A LEARNING ORGANIZATION**

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Special Operations Forces (SOF) units are expected to perform a wide variety of missions under diverse conditions. They are considered a strategic tool, and as such, the price for failure is correspondingly high. The speed of reaction and the degree of flexibility are the key traits of SOF units. As the task environment of SOF units has grown in complexity, the amount of information available has grown too. As a result, the channels and the people could become overloaded, and in unstable and fluid environments, a unit can become less flexible, less capable of learning and ultimately less effective. The ability to learn as an organization is very important in a long-term perspective.

This study analyzes what facilitates a SOF unit as a learning organization characterized by a quick and flexible response to new information. The overarching framework is that “intelligent failure,” framing and reframing, balanced exploitation and exploration, environment of psychological safety, managers’ tasks supportive of organizational learning, learning teams, and mental models, selection of personnel, learning infrastructure, and being organized to learn are procedural and structural elements that facilitate organizational learning. Organizational learning of SOF units is fostered by an environment of psychological safety, and occurs through direct interaction. Establishing the processes that allow for safe reporting, and creating environment that supports open dialogue and discussion that encourage knowledge gain and transfer. SOF members’ ability to cross boundaries helps bring in new ideas and insights, and tolerance of failure in support of learning supports transfer of knowledge, and allows for faster and broader learning.

**KEYWORDS:** SOF, Organizational Learning, Psychological Safety, Intelligent Failure, Learning Teams, Learning Infrastructure, Trust, Knowledge Transfer, Framing, Exploitation, Exploration

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**U.S.–VIETNAMESE MILITARY RELATIONS: GAME-THEORY PERSPECTIVE**

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In recent years, China has been flexing its military power and strengthening its claim to the resource-rich Spratly and Paracel Islands in the South China Sea. These islands are also being claimed by five other countries: Brunei, Malaysia, the Philippines, Taiwan, and Vietnam. Currently China claims the entire South China Sea as its territorial waters. The U.S. has great interest in this issue because its trade routes with the Asia-Pacific
region go through the South China Sea. Throughout history, Vietnam and China have had a contentious relationship. Like China, Vietnam is currently modernizing its military and strengthening its claims to the South China Sea. Of the claimants to the South China Sea, Vietnam seems to be the only country that is willing to challenge Chinese assertiveness in the region. Since the normalization of relations between the United States and Vietnam, the two former enemies have become important trading partners. The United States and Vietnam are conducting yearly high-level military visits; however, the U.S. wants to take this relationship to the next level. This thesis will apply game theory and analyze whether the U.S. can influence Vietnam to open a more formal military relationship to counterbalance the assertiveness of China in the South China Sea. This thesis concludes that, from a game theoretic Strategic Moves perspective, the U.S. currently cannot apply threats, promises, or a combination of thereof to compel or coerce Vietnam toward a more formal military alliance to counterbalance the assertiveness of China in the South China Sea.

**KEYWORDS:** Military Relations, the South China Sea, Game Theory, Strategic Moves, China, the United States, Vietnam

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**FORGING NETHERLANDS MARITIME SPECIAL OPERATIONS FORCES**

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In 2009, the Royal Netherlands Marine Corps started merging its two SOF units into one: The Netherlands Maritime Special Operation Forces (NL MARSOF). This newly formed unit is envisioned as a unique mixture of “traditional” maritime special operations and national counter-terrorism capabilities. Even though the creation of NL MARSOF marks significant progress in the professionalization of Dutch maritime SOF, new challenges in determining its strategic utility and cultural differences between NL MARSOF’s sub-units hamper its optimal development and effectiveness.

Based on an organizational model of unit culture and a theoretical framework based on SOF’s strategic utility, this research explored how NL MARSOF can better unify its culture and clarify its strategic utility. Governing document analysis, survey research, and interviews with key members of NL MARSOF revealed several shortcomings that should be addressed in order to improve NL MARSOF’s effectiveness and ensure its survival during times in which the Dutch Ministry of Defense faces the largest budget cutbacks in its history.

The survey results and interviews indicate that NL MARSOF is experiencing a sort of identity crisis. Even though NL MARSOF leadership has focused on (infra-)structural elements of the reorganization, it failed to define and communicate a clear mission supported by the majority of the community, and thus offered neither a sense of purpose nor sufficient guidance. This lack of a long-term vision set out in strategic direction now negatively affects the overall performance of NL MARSOF. The way forward is to get NL MARSOF members involved in the process of defining the unit’s way ahead.

Strategic management sessions will define the way ahead for NL MARSOF, thereby clarifying its strategic utility. These sessions are the vital first step in improving operational effectiveness. A working group on symbols & traditions will give NL MARSOF its much-needed professional face and provide the symbols (logos, insignias, traditions, and customs) to strengthen the shared system of beliefs and values and thus create a stronger unit culture. Finally, training courses in change management and team-building sessions will help smooth the transition to one NL MARSOF.

**KEYWORDS:** The Netherlands, Dutch, Holland, Special Operations, Special Operations Forces, SOF, Dutch SOF, Dutch Naval SoF, Royal Netherlands Marine Corps, RNLMC, Maritime Special Operations Forces, MARSOF, Unit Intervention Marines, UIM, 7Troop SBS, Dutch Frogmen, Mountain Leaders, National Counter Terrorism Unit, Strategic Utility, Unit Culture, SOF Culture, Merging Units, Reorganization
This thesis observes that in most Afghan villages there is a prominent member who acts as the village leader in the village shura (council of respected leaders) and jirgas (council of elders, tribal leaders, lineage leaders, or heads of families). In all cases, the leader is a man. In some cases, he may be the current tribal elder, or he may be a former mujahedeen fighter. Because these men wield the influence necessary to gain villagers’ general acceptance of the coalition forces fighting in Afghanistan, I assert that they are the most important societal elements to win over. It is upon these leaders, or “local powerbrokers” (LPBs), that this thesis focuses. The same need for allegiance is true for the Afghan government as well: to gain the support of local communities in the current fight against the Taliban, the central government in Kabul must first gain the support and involvement of local leaders. However, as Joel S. Migdal points out, there may be conflicts between the empowering of local strongmen and building a state institution. If local powerbrokers get too strong for the government to handle, it can lead to the state’s demise. In this thesis, I assert that empowering local powerbrokers is a risk that must be taken if peace on terms acceptable to the global community has any chance of success.

KEYWORDS: Afghanistan, Counterinsurgency, Unconventional Warfare, Indirect Support, Local Powerbrokers, Taliban

This thesis explores the history of U.S. Army deception and doctrine, and combines the insights gained with the various works on deception, cognitive psychology, communications, and decision-making in order to distill a concise handbook for deception practitioners. A longitudinal review of U.S. Army doctrine reveals a wide variation in the treatment of deception, from emphasized to ignored. This variation can be primarily explained by the U.S. preference for the cumulative destruction style of war and the perceived balance of power between the U.S. and its adversaries. This thesis strives to fill the current doctrinal gap by distilling the existing body of work to create a theory of deception in the military context. The theory presented provides a cogent structure, taxonomy, and lexicon; as well as, emphasis on how deception functions within the frameworks of communications and decision-making. Next, a synthesis of the practice of deception is presented, with a focus on deception planning and the essential elements of deception practice. Examples of U.S. use of deception from the Revolutionary War to Operation DESERT STORM are presented to provide illumination on the utility and use of deception. Finally, the thesis provides recommendations on how to organize for deception operations.

KEYWORDS: Military Deception, Communications, Decision Making, OODA, Doctrine, Planning
WHY FAILING TERRORIST GROUPS PERSIST: 
THE CASE OF AL-QAEDA IN THE ISLAMIC MAGHREB 
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Al-Qaeda in the Islamic Maghreb (AQIM) is less likely to reach its goal of establishing an Islamic state in Algeria than at any time since its earlier history as the Armed Islamic Group (GIA). Yet the group endures. The apparent resilience of AQIM relies less on its actual organization than the environmental factors that have allowed it to persist. By co-opting local anti-government groups, Algerian jihadists have long been allowed to live among and collaborate with Berber and Tuareg separatists. Turning to international notoriety to augment its local jihad the Salafist Group for Preaching and Combat (GSPC) became AQIM even though an Al-Qaeda link had long since been established. Effective Algerian security measures have pushed portions of AQIM to ungoverned spaces where regional security pressure is less existent and illicit networks are numerous. 

Potential ends for AQIM rely heavily on Algeria to bear the weight of the effort, whereas Sahelian initiatives are peripheral to a complete end. U.S. strategy should subordinate the Sahel focus, as a Sahelian solution is not sufficient, while an Algerian solution is both necessary and sufficient to AQIM’s demise. AQIM represents a lower priority challenge that, if not dealt with properly, can become a major priority or drag on indefinitely, like the FARC in Colombia. The U.S. must strive to meet AQIM with the most appropriate solution with the least force possible to expedite its departure, so that U.S. CT efforts can be engaged elsewhere against remaining Al-Qaeda affiliates.

KEYWORDS: AQIM, OEF-TS, JSOTF-TS, USAFRICOM, Algeria, Sahel, Maghreb, Al-Qaeda, Al-Qaeda in the Islamic Maghreb, GSPC, GIA, Terrorism, Counterterrorism, Mali, Niger, Mauritania, Arab Spring, Salafism, U.S. Policy and Jihad

FLATTENING THE LEARNING CURVE: SOF AS THE SUPPORTED COMMAND IN THE IRREGULAR WARFARE ENVIRONMENT 
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When the United States commits forces to a war, overseas contingency operations, or any other large-scale military effort that centers on conflict with belligerents other than another country’s armed military forces, Special Operations Forces (SOF) should be the supported command. Joint doctrine allows for support of such a concept, but that doctrine has not always been followed in practice. Consequently, this thesis argues for SOF being the supported command in an irregular warfare environment. By selecting the force specifically trained for the task at hand, the United States will dramatically reduce the time lost on the “learning curve” that results from relying predominantly on General Purpose Forces (GPF) commanders in all combat situations. Advocating for SOF being the supported command is not an argument for SOF only, but rather aims
for a synergistic and truly unified approach that makes the best possible use of local national forces, partner nations, and GPF in an irregular warfare environment.

**KEYWORDS:** Special Forces, General Purpose Forces, Integration, SOF, IJC, JFC, VSO, Irregular Warfare, Conventional Warfare, Joint Warfare, Joint Doctrine, Joint Legislation, SOCOM, Human Resource Management, Joint Policy, Us Navy SEALs, Rangers

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**DISRUPTING EMERGING NETWORKS: ANALYZING AND EVALUATING JAMAAT AL-MUSLIMEEN (JAM) AND THE DEVELOPMENT OF AN EXTREMIST THREAT IN THE CARIBBEAN**

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For the last decade, the primary U.S. and global focus has been on combating terrorism and extremist groups in the Middle East and Asia. Limited resources have been directed to the possibility of extremists groups existing in the Western Hemisphere or the threats that could emanate from this region. Knowing that terror organizations exist globally, a closer look at the possibility of a significant terror threat near U.S. borders is warranted.

Recognizing this era of globalization, counter terror efforts must identify and address the reach of extremist organizations with traditional roots in the Middle East. This thesis evaluates and addresses the viability of a terror threat in the Caribbean through the examination of a known extremist organization, Jamaat al-Muslimeen (JAM). Examining this known organization allows for a better understanding of the actual overall threat that may or may not exist.

After assessing JAM, the authors have found that the threat presented by JAM as a terrorist organization has run its course. What began as a social movement with a political message, evolved into a terrorist entity, and has now dissolved with only its political affiliation and history to keep it on life support. The organization has been undermined by splinter groups and dissention. JAM has been unable to grow numerically and it has failed to expand its influence. Although dangerous as a criminal entity and slightly influential in Trinidad and Tobago as a facilitator of government corruption, Jamaat al-Muslimeen should no longer be considered a threat outside of its home country.

**KEYWORDS:** Jamaat al-Muslimeen, JAM, Caribbean, Extremist, Coup, Social Movement Theory, Terrorism, Criminal Threat
In this thesis, an optimal estimation algorithm, based on the Kalman filter, is introduced for data recovery of orthogonal frequency-division multiplexed (OFDM) signals transmitted over fading channels. We show that the use of a zero prefix (ZP) along with a fast Fourier transform (FFT) operation zero padded to twice the data length allows for the recovery of subcarriers located next to a deep faded (at low signal-to-noise ratio (SNR)) values, exploiting all other subcarriers with higher SNR. The same approach is also shown to improve demodulation in the presence of signal clipping due to high peak to average power ratio (PAPR), as is often seen in OFDM signals.

The proposed method assumes prior knowledge of the channel, usually estimated using the preamble. Testing was conducted for random channels with zero frequency response at a random frequency and a signal in additive white Gaussian noise for various conditions. Further testing was done with typical Stanford University Interim (SUI) channels.

Additionally, the use of the method to recover OFDM signals based on the IEEE 802.11 and 802.16 standards was examined. Results show that the proposed optimal estimation algorithm has very satisfactory performance compared to the standard OFDM receiver algorithm.

KEYWORDS: Wireless Communications, Fading Channels, Kalman Filter, OFDM, PAPR, Zero-Prefix
The model for semi-transparent carbon nanotube networks presented in this thesis is incorporated into a solar cell which is simulated in Silvaco ATLAS software. The performance of a cell with and without the carbon nanotube network is compared, taking into account the limitations of the simulation software.

**KEYWORDS:** Carbon Nanotubes, Solar Cells, Photovoltaics, Transparent Contact, Silvaco ATLAS

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Micro-electro-mechanical systems (MEMS) inertial sensors are commonly used in applications such as inertial navigation or human motion tracking. These inertial sensors provide three-dimensional (3D) orientation, acceleration, rate of turn, and magnetic field information. Manufacturers specify both static and dynamic accuracy for the 3D orientation output of MEMS inertial sensors. The dynamic accuracy is in the form of a root-mean-square (RMS) error and is only valid for certain motions, which are not specified. In this thesis, an investigation of the dynamic accuracy of the Xsens Motion Tracker (MTx) inertial sensor was conducted. The yaw or heading dynamic accuracy of the Microstrain DM3-GX3 inertial sensor was also investigated.

A pendulum test apparatus from a previous work was used to test the MTx and GX3. An encoder is installed to the pendulum axis of rotation and provides the reference data needed to calculate the dynamic accuracy of the MTx and GX3.

After a series of motion tests, it was concluded that the MTx was within manufacturer specifications for static accuracy but not for dynamic accuracy. More specifically, the heading or yaw accuracy of the MTx and GX3 did not meet manufacturer specifications under the testing motions chosen in this study.

**KEYWORDS:** Micro-Electro-Mechanical Systems, MEMS, XSENS, MTx, Dynamic Accuracy, Human Motion Tracking, Microstrain, 3DM-GX3-25
Technological advances in ship systems have enhanced the capabilities of United States naval vessels in recent years; however, these changes come with unintended consequences. Only in recent years have we begun to study the effects of motion on the work/rest patterns of human operators in environments.

The purpose of this study was to research the performance issues related to motion in combination with the reduction of staffing onboard naval vessels. This study supports previous findings that increased motion at sea causes a decrease in sleep quality and increase in perceived fatigue. It also confirms that reaction time decreases under motion conditions.

Additionally, this study addressed concerns about the analytical approach used to assess actigraphic data and self-reported work/rest patterns in operational environments. This thesis examined the Fatigue Avoidance Scheduling Tool (FAST) interface, determining that its performance predictions are dependent upon the assumptions used to score and smooth the data before transfer into the interface. The actual performance compared to the FAST performance predictions that uses the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) mathematical model, indicated that the model's reservoir depletion/replenishment rate did not adequately account for the effect of long-term fragmented sleep as seen in the operational maritime environment.

KEYWORDS: Motion Effects on Performance, Reduced Manning, Performance in Maritime Environments, SAFTE Model, FAST Interface Assessment, Sleep Restrictions, Fatigue, Shiftwork
In this thesis, I analyze narratives from a network point of view using social-network analysis (SNA) software and methods. A narrative is a network of semantic meanings that can be coded and analyzed as such. In a competitive environment, such as politics, narratives are a means by which to influence people to act. To analyze a narrative’s effectiveness, I use the 2008 presidential-election campaigns of senators John McCain and Barack Obama as a case study to evaluate their narratives in relation to their success. I generate a series of semantic networks of the two campaigns. I then estimate a series of SNA metrics and compare these to the approval ratings of the two candidates. I hypothesize that the degree of centralization and the cohesiveness of a candidate’s narrative will be positively associated with the candidate’s approval ratings, all else being equal. This hypothesis is confirmed in the analysis.

KEYWORDS: Semantic Network, Narrative, Social Network Analysis, verbal communication, non-verbal communication, AutoMap, ORA
VIRTUALIZATION TECHNOLOGY FOR SYSTEM OF SYSTEMS TEST AND EVALUATION
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Virtualization is the use of a software application to emulate the physical performance of a computer, including the Central Processing Unit (CPU), storage, network device, Random Access Memory (RAM), and Operating System (OS) through executable data files. The virtualization software application allows for multiple virtual machines to exist on a single set of physical hardware. This technology can increase the flexibility of the hardware while reducing hardware configuration time. Virtualization technology will improve the Department of Defense (DoD) system of systems (SoS) Test and Evaluation (T&E) process. The implementation of virtualized systems within SoS will create three primary benefits. First, test personnel can improve configuration management for all component systems. Second, test personnel can reduce test environment setup time. Third, test personnel can improve the scalability of SoS architectures. The success of a DoD information system depends on its ability to meet the established criteria of cost, schedule, and performance. By appropriately integrating virtualization technology into the SoS T&E process, system program managers can improve the likelihood of meeting these criteria.

KEYWORDS: Virtualization, Test and Evaluation, T&E, Virtual Machine, System of Systems

REMEDIATING THIRD-PARTY SOFTWARE VULNERABILITIES ON U.S. ARMY INFORMATION SYSTEMS
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Master of Science in Information Technology Management–June 2012
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Second Reader: Albert Barreto, Department of Information Sciences
Third Reader: Glenn Cook, Department of Information Sciences

Information systems belonging to the DoD and U.S. Army experience cyber attacks on a daily basis. Increasingly, these attacks are targeting popular third-party applications, instead of focusing on vulnerabilities in Microsoft software. The DoD responded to this threat by adopting Citadel Hercules, which did not find a willingness audience with the U.S. Army. Instead, the Army adopted Microsoft Systems Management Server (SMS), followed by System Center Configuration Manager (SCCM) 2007 to meet this threat. After more than five years, the rollout of SCCM to all organizations within the U.S. Army is still incomplete. This study provides an overview of the threats facing U.S. Army information systems and looks at how the Army has addressed this challenge in the past. Next, the study takes a system engineering approach to identifying an optimal tool
for mitigating third-party vulnerabilities and suggests potential alternatives to SCCM. In addition, the study utilizes a cost benefit analysis approach to aid in evaluating the potential Return on Investment (ROI) provided by each tool. The purpose of this study is to answer the question: What is the most optimal solution for mitigating vulnerabilities in third-party applications on U.S. Army information systems?

**KEYWORDS:** Information Assurance Vulnerability Message (IAVM), Patch Management, Third-Party Vulnerability Remediation, System Center Configuration Manager (SCCM), LandWarNet (LWN), Information Assurance Vulnerability Alert (IAVA), Network Operations and Security Center (NOSC), Patching, SysMan

**CRYPTOLOGY MANAGEMENT IN A QUANTUM COMPUTING ERA**

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Today’s most efficient and widely used cryptographic standards such as RSA rely on the difficulty of factoring large numbers to resist cryptanalysis. Asymmetric cryptography is used in a plethora of sensitive operations from online bank transactions to international e-commerce, and the Department of Defense also uses asymmetric cryptography to transmit sensitive data. Quantum computers have the potential to render obsolete widely deployed asymmetric ciphers essential to the secure transfer of information. Despite this, alternatives are not in place.

The goal of this study is to understand the alternatives to classical asymmetric cryptography that can be used as substitutes should quantum computers be realized. This study explores quantum-resistant alternatives to traditional ciphers and involves experimenting with available implementations of ciphers described in the post-quantum literature as well as developing our own implementations based on descriptions of algorithms in the literature. This study provides an original implementation of hash-based digital signature and detailed instructions on its use as well as customization of the NTRU lattice-based cryptography suite, including the use of NTRU and AES together in a hybrid cryptographic protocol. This thesis will make recommendations on future work necessary to prepare for the emergence of large-scale, fault-tolerant quantum computers.

**KEYWORDS:** Quantum Computing, Quantum Key Distribution, Cryptology, RSA, NTRUEncrypt, NTRU, ECCDSA, Elliptic Curve Cryptology, Public Key Cryptography, Symmetric Cryptography, Kerberos
This thesis evaluates Navy policy by comparing elements of fully funded and partially funded graduate-education programs (GEPs). The Navy’s primary goal in offering funded graduate education is to support “requirements for officers with specific subspecialty skills.” Officers are considered funded if they attend graduate school full time for 26 or more weeks, regardless of whether the degree program is partially or fully funded. For a fully funded program, the Navy provides full pay and allowances for the duration of the course of study, plus all tuition costs. For a partially funded program, the Navy generally provides only pay and allowances, and the individual or an organization other than the Navy pays the tuition.

Particular attention was given to researching DoD and Navy policies, a review of stakeholder responsibilities, and management of the Navy’s GEPs. The results identify gaps in the current policy directive (OPNAVINST 1520.23B), which has not been updated in over 20 years. The study proposes policy and program changes to better manage and more effectively execute graduate education in the U.S. Navy. From an equity perspective, the partially funded service obligation needs revision to reflect its actual burden to the individual officer and the Navy. It is further recommended that the Navy review its existing graduate education instructions to confirm that language is current and meets officers’ career milestone objectives.

**KEYWORDS:** Graduate Education, Human Resource Management, Distance Learning, Naval Postgraduate School, Policy

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**A MARKOV MODEL FOR MARINE CORPS ACQUISITION FORCE PLANNING**

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Master of Science in Management—June 2012

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This research is in response to a request by the Marine Aviation Detachment at Naval Air Station Patuxent River, MD. Currently, no manpower planning tools exist for force shaping of the Marine Corps acquisition community. This thesis creates a force-shaping and forecasting tool for Marine Corps manpower planners. The tool assists planners in forecasting inventory levels across rank and military occupational specialty combinations and in determining the most robust force structure for the acquisition officer community. Validation of the model reveals the usefulness of the planning tool for forecasting inventory levels, but also indicates weakness in force structure analysis. This weakness is due to the small size and nascency of the current community; further data collection is required to validate the model for future use in force structure development.

**KEYWORDS:** Manpower Planning, Markov Model, Acquisition Workforce, Marine Corps
THE INFLUENCE OF SHOCK-INDUCED AIR BUBBLE COLLAPSE RESULTING FROM UNDERWATER EXPLOSIVE EVENTS

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Co-Advisor: Jarema Didoszak, Department of Mechanical and Aerospace Engineering

During an underwater explosion (UNDEX) event, a cavitation zone is created which alters the shockwave propagation parameters through this region. A cavitation zone is generally composed of air bubbles whose material properties closely resemble water vapor. Multiple scenarios were created using these properties to simulate the presence of bubble regions during an UNDEX event. Initial simulations involved large rectangular bubble regions which reduced the pressure from the initial shockwave, providing a buffering effect. To better simulate homogeneous air bubbles, additional studies were conducted using circular shapes of varying diameters. For small diameters, the pressure greatly increased in the immediate vicinity of the bubble. These bubbles were studied further using a refined Eulerian mesh. For large diameters, a second pressure peak was encountered, but the pressure magnitude remained roughly the same. Since large homogeneous bubbles are not typically prevalent in nature, a small region of several smaller bubbles was evaluated. This data showed that multiple small bubbles result in an overall lower pressure when compared to a single air bubble of similar area. The pressure increase incurred from the initial shockwave interaction with these air bubbles may be minimized by increasing the distance from the bubble center.

KEYWORDS: UNDEX, Underwater Explosion, Shockwave, Shock-induced Bubble Collapse, Numerical Analysis, DYSMAS Modeling and Simulation, Fluid Dynamics

FLUID STRUCTURE INTERACTION EFFECTS ON COMPOSITES UNDER LOW-VELOCITY IMPACT

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In this study, composite materials were tested in different fluid environments to determine the role of fluid structure interaction with these composites under a lower velocity impact. The purpose of this research is to develop a better understanding of possible marine applications of composite materials. This was done using a low-velocity impact machine and two composite types. The first composite is made from a multi-ply symmetrical plain weave 6 oz. E-glass skin. The test area of the composites is 12” by 12” (30.5 cm by 30.5 cm) with clamped boundary conditions. The testing was done using a drop-weight system to impact the center of the test area. A Plexiglas box in conjunction with the impact machine was used to keep the top of the composite sample dry while it was submerged in approximately 15 inches (38.10 cm) of water.

The second composite type was constructed using the same methods, but was made from a carbon fiber reinforced polymer (CFRP) instead of the E-glass skin. These samples were pre-cracked and tested using the
same impact machine in 15 inches (38.10 cm) of water. The overall size of these samples was 42 cm long and 3 cm wide, forming a long, thin rectangle. The test area of these samples was a 20-cm long section of the sample with the outsides being clamped to achieve the desired boundary conditions. Two variations of these samples were tested. The first was reinforced with multi-walled carbon nanotubes (MWCNTs) and the second had no reinforcements at the interface layer in front of the pre-cracks. Output from both tests was recorded using strain gauges and a force impact sensor. The results show that added mass from the water plays a large role in the fluid–structure interaction with composites, due to the similar densities of water and the composites.

**KEYWORDS:** Composites, Fluid Structure Interaction, FSI, Low Velocity Impact, Carbon Fiber Reinforced Polymers, CFRP, Carbon Nanotubes, CNT, Vacuum Assisted Resin Transfer Molding, VARTM

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**THE EFFECT OF SENSITIZATION ON THE STRESS CORROSION CRACKING OF ALUMINUM ALLOY 5456**

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This work examines the effect of sensitization on the stress-corrosion cracking (SCC) behavior of marine grade aluminum alloys (Al-Mg). These alloys can be sensitized during operation, promoting their susceptibility to intergranular stress corrosion cracking (IGSCC). Aluminum alloy 5456-H116 (also identified as Al-Mg5.1) samples were sensitized at 175ºC for varying durations of time and then mechanically tested in salt water. Mass loss tests quantified the degree of sensitization (DOS) as a function of sensitization time. Dual cantilever beam tests were used to measure the SCC growth rate and cyclic fatigue tests were conducted to determine the corrosion fatigue behavior. DOS increased as sensitization time increased with little difference in mass losses above 336 hours. The SCC growth rate increased as sensitization time increased. Although the sensitization rates for AA5456-H116 were higher than for AA5083, the SCC growth rates were significantly lower. The stress corrosion fracture surfaces showed a clearly intergranular fracture path with extensive crack branching and delamination in the transverse direction.

**KEYWORDS:** Stress Corrosion Cracking, 5456 Aluminum Alloy

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**VIABILITY OF CROSS-FLOW FAN FOR VERTICAL TAKE-OFF AND LANDING AIRCRAFT**

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The present study is focused on determining a housing design that, when paired with an off-the-shelf cross-flow fan rotor, will generate a thrust-to-weight ratio significant enough to allow for vertical take-off. The commercial computational fluid dynamics software, ANSYS CFX, was used to perform a computational analysis of various housing designs until a suitable design was identified to construct for experimentation. Following the analytical phase, the conceptual housing was fabricated and paired with an appropriate rotor to validate the predicted performance. The experimental model was operated at speeds from 4,000 to 8,000 rpm and the actual and projected thrust calculations were found to agree with a maximum difference of less than 7 percent.

**KEYWORDS:** Vertical Take-off, VTOL, Cross-Lan, CFF
PROTECTING THE TURKISH STRAITS FROM MARITIME TERRORISM: 
A SCHEME TO IMPEDE PROPELLER EFFICIENCY

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The protection of the Turkish Straits against maritime terrorism is an important security problem because the straits are highly vulnerable to terrorist attacks. This research is to increase the security of the Turkish Straits against maritime terrorism by designing an underwater system to stop terrorist ships by impeding propeller efficiency. The underwater system wraps ropes and nets around the propeller and hub, decreasing the propeller efficiency. First, the most probable scenario from the point of view of a terrorist organization is determined. Second, all the existing and some non-existent methods to prevent this scenario are analyzed. Finally, an underwater system is designed to impede the propeller efficiency of a ship by wrapping ropes and nets around the propeller and its hub in order to stop the ship before entering the strait. Experimental results of previous researchers and computational methods are used to demonstrate the loss of propeller efficiency after wrapping.

KEYWORDS: Maritime Terrorism, Turkish Straits, Loss of Propeller Efficiency, LNG, LPG and Other Dangerous Cargo Explosions, Piracy, Stopping a Terrorist Ship, Wrapping Ropes and Nets Around Propeller and Hub, Probable Maritime Terrorism Scenario, Underwater System Design

GLOBAL VERSUS REACTIVE NAVIGATION FOR JOINT UAV–UGV MISSIONS IN A CLUTTERED ENVIRONMENT

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Autonomous vehicles have changed the way in which the modern-day military conducts intelligence, surveillance, and reconnaissance missions. The focus of this research is directed towards the coordination of an unmanned, multi-vehicle team that navigates through a congested environment. A novel approach is outlined that enables the control of multiple vehicles based on both computer vision and optimal trajectory algorithms. Various sensors are used to achieve localization in the indoor environment in lieu of global positioning data. Specifically, a Quanser Qball quadrotor is equipped with a downward-looking camera and sonar altimeter, while a Quanser Qbot ground vehicle is outfitted with sonar and infrared range finders. This equipment is complemented by an Optitrack motion capture system.

Using conventional image processing techniques, the bird’s eye images continually supplied by the quadrotor provide information regarding the dynamic environment that surrounds the ground vehicle. The ground vehicle can then produce a global, optimal trajectory, assuring collision-free operations. The optimization problem is addressed by applying the Inverse Dynamics in the Virtual Domain (IDVD) method that utilizes both the inverse kinematics of the ground vehicle and obstacle information. Furthermore, the IDVD method enables the separation of spatial and temporal planning. As verification of the results of this research, the developed approach for path planning is executed in a fully-controlled lab environment and then compared with a sonar-based, reactive obstacle avoidance technique.

KEYWORDS: Quadrotor, Ground Vehicle, Image Processing, Trajectory Generation, Navigation
This thesis used finite element analysis to model a cracked aluminum panel repaired with a bonded composite patch using the minimization of energy release rate in mode I crack growth conditions to determine effectiveness of a patch. The first phase of the study was to understand the mechanics of the effects of asymmetric or one-sided patching for both flat and curved geometries. The out of plane deflection that occurs due to one-sided patching had a significant effect. Phase two studied the relationship between patch and base plate stiffness and patch and base plate thickness using orthotropic patch characteristics. Phase two provides general target patch design guidelines that could be used by technicians performing the repair. The third phase studied the effects of varying specific patch design parameters such as patch length and patch width applied to flat plate and curved geometries to provide specific design parameters to use in achieving general patch requirements determined from phase two of this study.

**KEYWORDS:** Composite Patch, Aluminum Cracking, Numerical Analysis, Curvature

The objective of this research was to generate shock resistant materials based on inorganic fullerene type tungsten disulfide (IF-WS2) and carbon nanocomposite structures for personal protection armor systems. The aim was to develop a new generation of composites that combine the known energy absorbing properties of carbon nanofibers, with the shock absorbing properties reported for IF-WS2 structures. Various methods were explored to generate the desired WS2–carbon fiber composite. Experimentation revealed that in situ growth of carbon fibers from a nickel catalyst with tungsten disulfide particulates had to be performed from particular precursors and fabrication conditions to avoid undesirable byproducts that hinder fiber growth. As a result, tungsten oxide was used as tungsten source, nickel as carbon fiber growth catalyst, ethylene as hydrocarbon and fuel rich oxidative conditions for growth, all followed by a sulfurization process. Fabrication of fibers was performed at moderate temperatures (ca. 550 degrees C) with a sulfurization step at 900 degrees C in a tubular furnace.

Microstructural characterization of the samples was primarily conducted using X-ray diffraction and electron microscopy. In order to determine more properties of the nanocomposites, the samples were dispersed into an epoxy matrix. Nano-indentation was utilized as a method of determining mechanical properties of the composites while a gas gun was used to determine shock propagation effects. The inclusion of WS2/C nanocomposites into epoxy matrixes showed a significant improvement in modulus and hardness values when compared to bare carbon fiber epoxy composites. WS2/C fiber epoxy nanocomposites preserved their integrity during gas gun tests while samples without WS2 fractured.

**KEYWORDS:** Tungsten Sulfide, Nanocomposite, Carbon Nanofiber, Nanoindentation, Shock Testing, Armor
A method for sensing retrieval of Aerosol Optical Depth (AOD) was investigated by Vincent (2006). This technique is known as the Shadow Method. Using high-resolution commercial satellite imagery, Vincent was able to calculate AOD values by measuring the radiance of a scene in and out of a shadow. Over the last five years, several advancements have been made to validate the Shadow Method. Using the MODerate resolution Imaging Spectrometer (MODIS), scenes were analyzed over desert regions to exploit shadows generated by clouds and terrain. The results were quickly compiled using MATLAB. Results confirm that the Shadow Method is capable of producing AOD values.

**KEYWORDS:** Aerosol Optical Depth, Shadow Method, MODIS, AOD, MATLAB, Cloud, Terrain

The skill of individual ensemble prediction systems (EPS) is evaluated in terms of the probability of a tropical cyclone (TC) track forecast being within an expected area. Anisotropic probability ellipses are defined from each EPS to contain 68 percent of the ensemble forecast members. Forecast reliability is based on whether the forecast verifying position is within the ellipse. A sharpness parameter is based on the size of the EPS probability ellipse relative to the main operational forecast probability product, the Goerss Predicted Consensus Error (GPCE). For the 2008-2011 Atlantic TC seasons, the ECMWF ellipses have the highest degree of reliability of the EPSs. Additionally, the ECMWF ellipse has a higher resolution than the GPCE operational product over all forecast intervals. The sizes and shapes of the EPS ellipses varied with TC track types, which suggests that information about the physics of the flow-dependent system is retained compared to isotropic probability circles that may not reflect variability associated with track type. It is concluded that the ECMWF ensemble contributes the most to a combined EPS-based product called the Grand Ensemble (GE), and further modification of the GE to reflect this has a potential for reducing the sizes of warning areas.

**KEYWORDS:** Tropical Cyclone Track Errors, Ensemble Prediction Systems, National Hurricane Center Forecasts
MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

SIMULATING THE SPREAD OF AN OUTBREAK OF FOOT-
AND-MOUTH DISEASE IN CALIFORNIA
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Second Reader: David Alderson, Department of Operations Research
Second Reader: Pam Hullinger, University of California–Davis
Second Reader: Mark Stevenson, Massey University, New Zealand

Foot-and-mouth disease (FMD) is a highly contagious viral disease affecting cloven-hoofed domestic and some wild animals. A hypothetical outbreak of FMD begun in California was recently estimated to have a national impact of up to $55 billion, mostly due to international trade restrictions. Therefore, preparedness for an outbreak is a high priority within the livestock industry, and state and federal government.

We use simulation and a designed experiment to identify robust governmental and industrial surveillance response strategies to control the spread of FMD. A strategy is considered robust if it is effective across a number of outbreak scenarios and a variety of disease spread characteristics.

The main contributions of this thesis are: (1) the development of FMD outbreak scenarios across California that can be used in conjunction with a state-of-the-art, animal disease simulation model, and (2) the development and analysis of an efficient experimental design that allows for the identification of key parameters affecting the spread and containment of an FMD outbreak.

The analysis of over 400,000 simulations in the experimental design indicates two key areas for the control of FMD: (1) surveillance activities at dairy and dairy-like premises are a dominant factor in early identification of the disease and increased surveillance leads to lower impacts of an outbreak, and (2) fast initial responsiveness and capacity of depopulation resources are also key factors in controlling an FMD outbreak, even when no pre-emptive depopulation strategies are considered.

KEYWORDS: Foot-and-Mouth Disease, Disease Modeling, Simulation Analysis, Nearly Orthogonal and Balanced Design, Design of Experiment, California, Interspread Plus

COST BENEFIT ANALYSIS OF A UTILITY SCALE WASTE-TO-ENERGY/
CONCENTRATING SOLAR POWER HYBRID FACILITY AT FORT BLISS
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Second Reader: Eva Regnier, Defense Resources Management Institute

The cost–benefit analysis of a waste-to-energy (WtE)/concentrating solar power (CSP) hybrid facility located on Fort Bliss is a comprehensive analysis of the costs and benefits of a WtE/CSP facility to the Army. Since no capital or operating costs are required from the Army, the increased cost of electricity becomes the overarching cost. This thesis attempts to monetize the benefits of energy security, environmental impact, meeting legislative mandates, and meeting net zero energy goals. Both congressional legislation and executive orders
dictate the increased consumption and production of renewable energy by federal agencies. WtE/CSP presents a strategy toward achieving these mandates, and Fort Bliss is well located to capitalize on this strategy. This thesis estimates those costs and benefits based on available data. Those estimates are discounted for time and adjusted for inflation. The thesis then conducts sensitivity analysis around potential variations in the data to explore changes to the monetized values.


ASSESSING RESILIENCE IN THE GLOBAL UNDERSEA CABLE INFRASTRUCTURE
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This thesis analyzes the global undersea cable infrastructure as it pertains to international telecommunications. This research connects countries, cable landing stations, and undersea cables using a network structure of nodes and edges that closely imitates the real-world system. For a given geographic region, we connect individual networks associated with stand-alone cable systems to create one large network model. We use a “gravity model” to estimate the traffic demand between each pair of countries based on the number of Internet hosts in each country. We formulate and solve an attacker–defender (AD) model to identify the worst-case disruptions, where a “worst-case” disruption corresponds to the greatest shortage in telecommunications traffic even after the system has rebalanced flows as best as possible. Using public sources of data, this thesis compiles information about more than 220 real cable systems, and develops a customized decision support tool that facilitates the analysis of different combinations of countries and cable systems. It demonstrates a modeling technique with an analysis of the undersea cable infrastructure connecting Europe and India. Our analysis provides insight into which components in the system are most vulnerable along with how effectively the system performs in the face of disruptions.

KEYWORDS: Global Undersea Cable Infrastructure, Submarine Optical Fiber Cables, Attacker–Defender

OPTIMIZED LANDING OF AUTONOMOUS UNMANNED AERIAL VEHICLE SWARMS
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Master of Science in Operations Research–June 2012
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Second Reader: Maj Chad Seagren, USMC, Department of Operations Research

This research explores a future concept requiring the efficient and safe landing and recovery of a swarm of unmanned aerial vehicles (UAVs). The presented work involves the use of an overarching (centralized) airspace optimization model, formulated analytically as a network flow problem with side constraints describing a time-expanded network model of the terminal airspace in which the UAVs navigate to one or more (possibly moving) landing zones. This model generates optimal paths in a centralized manner such that the UAVs are properly sequenced into the landing areas. The network model is “grown” using agent-based simulation with simple flocking rules. The resulting solution is compared to another agent-based model which uses similar avoidance rules for the landing of these UAVs, exploring the benefit of distributed computation and decision-making characteristic of swarming models. Relevant measures of performance include, the total time neces-
sary to land the swarm. Extensive simulation studies and sensitivity analyses are conducted to demonstrate the relative effectiveness of the proposed approaches.

KEYWORDS: UAV, Swarm, Automated Landing, Unmanned Aerial Vehicles, Agent Based Models, Network Optimization

ANALYSIS OF HUMANITARIAN ASSISTANCE CARGO TRANSPORTATION
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Second Reader: Javier Salmeron, Department of Operations Research

Humanitarian assistance is of growing importance to the United States and the Department of Defense's strategic objectives. Thus, United States combatant commands increasingly rely on humanitarian assistance cargo transportation programs to deliver material to people in need in their areas of responsibility. This report analyzes the options available to these commands in seeking humanitarian assistance cargo transportation. The report offers a description of current operations, with a specific focus on the European area of responsibility, where these programs have had limited activity.

The analysis reaches the following conclusions: (1) currently no transportation program exists that focuses on providing a quality of service to combatant commands' humanitarian assistance transportation needs; (2) legal, fiscal, and operational mechanisms exist and are outlined to create such a program; and (3) exclusively space-available transportation is generally insufficient for providing the quality of service that may be required for relationship-building through humanitarian assistance cargo transportation, and contract shipping may be necessary. These conclusions are placed in the context of current humanitarian assistance operations, and relevant operational considerations are highlighted throughout the report. The analysis is based on both a quantitative model of transportation, as well as detailed conversations with humanitarian assistance personnel throughout key Department of Defense organizations.

KEYWORDS: Network Model, Stochastic Optimization, Maximum Flow Model

ASSESSING THE RESILIENCY OF GLOBAL SEA ROUTES
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Second Reader: Gerald Brown, Department of Operations Research

This research develops an attacker–defender model of maritime trading. The defender's problem is represented as a minimum cost, multi-commodity network flow model. System cost is measured in terms of total ton-n.m. in the network. Our network contains the 120 most important ports in the world (by volume of cargo), 35 waypoints at sea, and 416 arcs. Port supply and demand have been estimated from different sources. Interdictions represent manmade disruption of the seaways, such as those in the presence of piracy. An interdicted arc is assumed to incur a penalty equivalent to the additional distance that a ship would need to travel in order to avoid the threat, or a total blockade of the arc in the case of straits and canals. We analyze several scenarios with varying assumptions on the defended arcs and the number of simultaneous interdictions. The most disruptive, single interdiction occurs in the Strait of Gibraltar, increasing cost by almost 25 percent, followed by the Straits of Bab el Mandeb (20 percent) and Suez Canal (19 percent). For two simultaneous interdictions, cost
increases to 33 percent, but decreases to 23 percent, 8 percent and 1.5 percent when we defend three, four or five select straits and canals, respectively.

**KEYWORDS:** Maritime Transport, Sea Routes, Piracy, Network Optimization, Attacker–Defender Model

**IMPROVING AIRCRAFT REFUELING PROCEDURES AT NAVAL AIR STATION OCEANA**

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Second Reader: Gerald Brown, Department of Operations Research

This thesis seeks to improve aircraft refueling at Naval Air Station (NAS) Oceana, VA, using aircraft waiting time for fuel as a measure of performance. It develops a computer-assisted discrete-event simulation to model refueling at NAS Oceana using airfield data from October 2011. This study focuses on six factors: the total number of mobile refueling trucks, the rate of fuel flow from each truck, the quality of information sharing, the percentage of aircraft that refuel using hot pits (high-speed, in-ground refueling stations), and the normal operating band (both the upper limit and the lower limit) of jet fuel level that each truck driver maintains. This study uses experimental design and determines the efficiency of various decisions for reducing fuel wait time. It concludes with specific recommendations for NAS Oceana leadership.

**KEYWORDS:** Simulation, Queueing, Aircraft Fuel

**EFFECT OF THE ENVIRONMENT AND ENVIRONMENTAL UNCERTAINTY ON SHIP ROUTES**

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Co-Advisor: Jim Hansen, Naval Research Laboratory  
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The United States Navy (USN) uses Optimal Track Ship Routing (OTSR) provided by ship routing officers (SRO) to aid in the safe transit of its ships. When a ship makes a transit, the ship provides the SRO an origin, a destination, and a date of departure, and the SRO will generate a route for the ship to proceed along. Avoiding severe weather is the most important consideration in determining the route. In addition to safe transit, the USN also focuses on fuel efficiency. In recent years the meteorology and oceanography (METOC) community has been providing more products that estimate the uncertainty in environmental forecasts. However, it is not known how much that uncertainty affects or should affect ship routing. This thesis explores the sensitivity and robustness of optimized ship routes generated by the Ship Track and Routing System (STARS) optimizer to uncertainty in the environment.

**KEYWORDS:** Automated Optimum Track Ship Routing, Environmental Forecast, Robustness, Sensitivity
LIFECYCLE COST ESTIMATE OF DOCK-LANDING SHIP(X)
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Second Reader: Gregory Mislick, Department of Operations Research

In conjunction with OPNAV N8F, the Naval Postgraduate School Systems Engineering Analysis (SEA) Curriculum students have embarked on an effort to conduct a capabilities-based assessment of the U.S. Navy’s dock-landing ship (LSD) fleet. This assessment focuses on filling capability gaps, developing designs that meet amphibious mission performance criteria, and producing lifecycle cost estimates of these proposed designs.

This thesis focuses on developing a model that can be used to provide a credible and reliable rough order magnitude (ROM) Life Cycle Cost Estimate (LCCE) for a newly constructed LSD(X) over the various phases of design, procurement, and operations and support costs. The SEA Curriculum will use this estimate to help establish the costs of the proposed alternatives for LSD(X). This study also includes a cost–benefit analysis through the comparison of LSD(X) to an alternative variant LSD(XB). The comparison examines how the baseline ROM LCCE of LSD(X) is affected by changes in technical parameters such as beam, number of LCACs, troop size, crew size and cargo capacity. Ultimately, this thesis will provide a useful tool to aid decision makers in selecting the most cost effective alternative for the LSD(X) fleet for the expected 30 year operational period.

KEYWORDS: Lifecycle Cost Estimate, LSD(X), Ship Construction Costs, Ship Procurement

UNCERTAINTY QUANTIFICATION USING EPI-SPLINES AND SOFT INFORMATION
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M.S., Florida Institute of Technology, August 2002
Master of Science in Operations Research–June 2012
Advisor: Johannes Royset, Department of Operations Research
Second Reader: COL Scott Nestler, USA, Department of Operations Research

This thesis deals with the problem of measuring system performance in the presence of uncertainty. The system under consideration may be as simple as an Army vehicle subjected to a kinetic attack or as complex as the human cognitive process. Information about the system performance is found in the observed data points, which we call hard information, and may be collected from physical sensors, field test data, and computer simulations. Soft information is available from human sources such as subject-matter experts and analysts, and represents qualitative information about the system performance and the uncertainty present. We propose the use of epi-splines in a nonparametric framework that allows for the systematic integration of hard and soft information for the estimation of system performance density functions in order to quantify uncertainty. We conduct empirical testing of several benchmark analytical examples, where the true probability density functions are known. We compare the performance of the epi-spline estimator to kernel-based estimates and highlight a real-world problem context to illustrate the potential of the framework.

KEYWORDS: Uncertainty Quantification, Epi-Splines, Nonparametric Density Estimation, Soft Information
DEFENDING THE PITTSBURGH WATERWAYS AGAINST CATASTROPHIC DISRUPTION
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Master of Science in Operations Research–June 2012
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Co-Advisor: Gerald Brown, Department of Operations Research
Second Reader: Joseph DiRenzo III, United States Coast Guard

This thesis develops an Operator's Model that mimics the real-world behavior of coal transport in the Port of Pittsburgh and allows for systematic investigation of “what if” disruption scenarios. We model the multi-modal flow of coal using a network of nodes and arcs representing river transport, with support from a surrounding system of rail lines and roads. Each mode of shipment has finite capacities with varying costs. Our model routes flows in order to satisfy contracted supplies and demands at minimum transportation cost. We use 2009 coal shipment data provided by the United States Army Corps of Engineers to drive delivery patterns. We focus our attention on the Monongahela River, which carries a significant amount of coal through our system. We employ defender–attacker–defender techniques to assess critical infrastructure in the context of an intelligent adversary, such as a terrorist, who seeks to damage the system so as to maximally increase its operating cost. This allows us to assess the relative importance of critical system components in order to help the United States Coast Guard identify where to focus its attention.

KEYWORDS: Port of Pittsburgh, Coal Transport, United States Coast Guard, Army Corps of Engineers, Critical Infrastructure, Dams, Locks, Network Interdiction, Attacker–Defender, Defender–Attacker–Defender, Resilience

CASUALTY PROFILE OF UNITED STATES ARMY IN AFGHANISTAN AND IRAQ
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Master of Science in Operations Research–June 2012
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Second Reader: Maj Chad Seagren, USMC, Department of Operations Research

The purpose of this study is to create a profile of U.S. Army troops killed or injured due to hostile incidents in Afghanistan and Iraq between 2003 and 2011. The file used in this study was obtained from the Defense Manpower Data Center (DMDC). It was built from active-duty personnel extract files, covering the period from 2003 to 2011.

Our study shows that pay grades E1 through E3 are more likely to be involved in hostile incidents than other pay-grade groups, and that probability of injury or death decreases as pay grade increases. The findings for gender are not parallel to popular ideas. Male servicemen are less likely to get killed or injured than women after adjusting for other casualties. In terms of the effects of marital status, our study shows that married servicemen are more likely to be involved in hostile incidents. In our model, we found that regular forces have a lower risk of engaging in hostile incidents than guard and reserve forces, which is contrary to general expectation. The results for MOS were as expected. Combat troops are more likely to be killed or injured than other troops.

As a conclusion for our multivariate model, a serviceman who is female, married, in the reserve forces, in a combat troop, between pay grades E1–E3, serving in Iraq, and serving her first deployment is the serviceman with most potential to get injured or killed in the U.S. Army.

KEYWORDS: U.S. Army, Iraq War, Afghanistan War, Casualty, Hostile Incident, Logistic Regression
A visual processing approach developed for analyzing passive acoustic recordings of marine mammal vocalizations collected on a high-frequency acoustic recording package (HARP) is applied to acoustic data collected through three hydrophones at the Southern California Offshore Range (SCORE) on a Naval Postgraduate School recording system. Temporally overlapping datasets collected in proximity to one another are examined with the expectation that vocalizations from species that normally inhabit this region (resident or transient) were recorded on both systems. The analysis process relies on determination of invariant and distinctive features of marine mammal vocal elements to classify mammal sources. Vocalization features used to identify specific sources in the HARP data appear modified in the SCORE data. This thesis examines how the technical components and recording parameters of the SCORE recording system affect the received acoustic signatures of odontocetes to determine how the visual processing protocols applied to HARP data can be adapted for application to SCORE data.

**KEYWORDS:** Oceanography, Marine Mammal Acoustics, SCORE, HARP, Passive Acoustic Monitoring of Marine Mammals, Echolocation Click, Species Identification, Visual Processing, Odontocete
Fourth-generation light sources are pushing the boundaries of high intensity, coherent, short wavelength light sources for the scientific community. In the step from the third generation to the fourth, a free electron laser (FEL) amplifier is used to generate the light over the synchrotron rings of the past. To get to the short wavelengths of an X-ray FEL the emittance of the electron beam must be tightly controlled to match the emittance of the short wavelength photons they are interacting with. The emittance is an intrinsic property of a beam and can only be harmed as it propagates through a beam line. Due to this fact, starting with as low an emittance as possible is ideal. Minimizing the electron beam emittance has the added benefit of decreasing the gain length needed to get up to higher power. For this reason low emittance is important for all types of FEL schemes. Most injector schemes use a photo-cathode as the electron-beam source. A way to keep the emittance low is to shape the laser beam that generates the electrons as it imparts energy into the photo-cathode. Research was done in shaping the drive laser using a set of birefringent crystals for the APEX project at Lawrence Berkeley National Lab. The thesis discusses the light sources as a whole, the physics behind the pulse shaping technique, as well as results obtained.

**KEYWORDS:** Free Electron Laser, Photoinjector, Drive Laser, Laser Pulse Shaping
The U.S government has created and been executing an identity and management (IdM) vision to support a global, robust, trusted, and interoperable identity-management capability that provides the ability to correctly identify individuals and non-personal entities in support of DoD mission operations. Many directives and instructions have been issued to standardize the process to design and redesign new and old systems with the latest available technologies to meet the vision’s requirements. This thesis introduces a cloud-based architecture for the Defense Biometric Identification System (DBIDS), along with a set of DBIDS Cloud Services that supports the proposed architecture. This cloud-based architecture will move DBIDS in the right direction to meet DoD IdM visions and goals by decoupling current DBIDS functions into DBIDS core services to create interoperability and flexibility to expand future DBIDS with new requirements.

The thesis shows how DBIDS cloud services help Defense Manpower Data Center (DMDC) easily expand DBIDS functionalities such as connecting to other DMDC services or federated services for vetting purposes. This thesis will also serve as a recommendation of a blue-print for DBIDS architecture to support a new generation of DBIDS application. This is a step closer in moving DMDC Identity Enterprise Solution toward DoD IdM realizing vision and goals. The thesis also includes a discussion of how to utilize virtualized DBIDS workstations to address software-deployment and maintenance issues to resolve configuration and deployment issues which have been costly problems for DMDC over the years.

**KEYWORDS:** Cloud Computing Technology, Virtualization, SOA, Web Services, PKI
Solar cells are the primary energy-collection agents used on board spacecraft converting energy from the sun into electricity. With solar cells being the main source of power for satellites, it is important to know how they operate and degrade when exposed to the harsh environment of low earth orbit. The objective of this thesis is to estimate the solar cell degradation that will be experienced on orbit due to radiation. This, linked with the mission of the NPS-SCAT providing a quantitative measurement on orbit of how solar cells degrade over time can reduce risk of expensive national satellite by providing real-life solar cell exposure to threats of the space environment.

A secondary goal of this thesis is to build and present a representation of the CONOPs (concept of operations) that describes the functionality expected on orbit. Coordination with the software programmers as well as the staff to set robust functionality is the goal for the CONOPs. This software package will be programmed into the two 1U flight-certified CubeSats as their standard programming once implementation and testing have been completed.

**KEYWORDS:** CubeSat, NPS-SCAT, Solar Cell, CONOPS, Space Program Budget, Solar Cell Tester, Radiation Environment, Program Management
This thesis utilizes principles of the systems engineering process discussed by Dennis Buede in *The Engineering Design of Systems: Models and Methods* (2nd ed., 2009). The systems engineering process is used to create a functional architecture to analyze interagency coordination in support of counterterrorism efforts in the United States European Command area of operation. The resulting functional architectures serve as tools for policymakers as they determine the best ways to create a synchronous whole-government approach to defend United States interests.

**KEYWORDS:** Systems Engineering, Interagency, Counter Trafficking, Counterterrorism

This thesis proposes a model-based systems engineering approach to ship design for the purpose of improving the Navy’s ship design processes. It links capability needs to the end solution by utilizing system architecture development based on capability requirements to allow for enhanced traceability, verification, and validation throughout the design process. Modeling tools are used to explore mission effectiveness against projected threats and create a design space for weighing tradeoffs early in the conceptual design phase.

For demonstration of this approach, a simple design reference mission is created and a functional architecture is described. The capability of a potential design solution (assumed to have the physical architecture of a ship) is modeled to evaluate logical behavior and mission effectiveness. These models aid in the formation of physical design specifications, which are incorporated as inputs to a ship synthesis model. Several alternatives can be created for comparison that reveals the costs associated with various levels of capability giving decision-makers to ample information to consider.

**KEYWORDS:** Model-Based Systems Engineering, Functional Architecture, Capability-Based Design, Ship Design, Tradeoff Analysis
MODEL-BASED SYSTEMS ENGINEERING METHOD FOR ASSESSING APPLICATION OF SYSTEMS ENGINEERING TO UNDERSTAND AND REPLICATE INTERAGENCY COORDINATION IN SUPPORT OF COMBATANT COMMANDS

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Advisor: Eugene Paulo, Department of Systems Engineering
Second Reader: Paul Beery, Department of Systems Engineering

This thesis analyzes interagency coordination from a functional and physical architectural perspective utilizing the Systems Engineering process outlined by Dennis Buede in *The Engineering Design of Systems: Models and Methods*, (2nd ed., 2009). The process of interagency coordination is not fully understood and has proven difficult for various U.S. government agencies to replicate. Two examples of successful interagency coordination are used in this analysis: the Joint Interagency Task Force-South (JIATF-South) and Special Operations Forces (SOF) high-value target teams. These two organizations are individually decomposed into their top-level functions and organized by their major physical components. The results of this analysis are applied in the creation of a notional functional and physical architecture for the U.S. European Command’s new Joint Interagency Counter-Trafficking Center (JICTC).

**KEYWORDS:** Combatant Command, Interagency Coordination, Joint Interagency Counter-Trafficking Center, Joint Interagency Task Force-South, Systems Engineering, United States European Command

A PRELIMINARY INVESTIGATION INTO CNO AVAILABILITY SCHEDULE OVERRUNS

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Advisor: Patricia Jacobs, Department of Operations Research

A naval vessel’s “availability” is a scheduled period of time, normally conducted in a shipyard, to perform maintenance on and modernization of the vessel and its systems. The four public naval shipyards are continually challenged to complete depot-level, CNO availabilities on schedule. A naval vessel’s late return to the fleet results in the decrease in operational readiness due to the reduced number of operational days available for these vessels. Subject-matter experts hypothesize that factors such as inadequate planning for resources, quantity of overtime, and quantity of work stoppages experienced contribute to availability lateness. Data collected by the shipyards are analyzed to investigate factors influencing late completion of availabilities. The analysis suggests that carrier availabilities tend to finish on schedule more often than submarine availabilities; timely availabilities tend to have a higher cost performance ratio than late availabilities; late availabilities tend to charge less for work per month in man-days than the budgeted amount of planned work; and availabilities that finish on schedule tend to have fewer work stoppages prior to start of the availability than the later completing ones.

**KEYWORDS:** CNO Availability, Naval Shipyards, Schedule Overrun, Availability Lateness, Cost Performance, Budgeted Quantity Work Performed, Actual Quantity Work Performed, Availability Delay, Work Stoppages

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IMPLICATIONS OF USING COMPUTER-BASED TRAINING ON THE AN/SQQ-89(V) SONAR SYSTEM: OPERATING AND SUPPORT COSTS
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B.S., State University of New York Maritime College, May 2005
Master of Science in Systems Engineering–June 2012
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Co-Advisor: Lawrence Shattuck, Department of Operations Research
Second Reader: Matthew Boensel, Department of Systems Engineering

The U.S. Navy transitioned to computer-based training in A and C schools in 2003 after a 2001 Revolution in Training report claimed that the Navy would realize savings in cost and training time without negatively affecting the quality of sailors arriving to the Fleet. This thesis analyzes operating and support (O&S) cost data for the AN/SQQ-89(v) sonar system to determine whether the transition to CBT contributed to increased Fleet maintenance costs. Determining how actions to change one aspect of a system affects other areas of the system will provide insight for future decisions affecting O&S cost, system life cycles, and Fleet material readiness.

The results of this thesis show that the conversion to CBT was not the sole contributing factor to increased Fleet maintenance costs or degraded Fleet material readiness. Changes to the Navy’s training, maintenance, and manning programs during the early 2000s were all contributing factors.

KEYWORDS: Training, Maintenance, Cost Analysis, Sonar, Systems Engineering, Operating and Support Cost, Life Cycle, Fleet Material Readiness

DEVELOPMENT AND APPLICATION OF AN APPROACH TO OPTIMIZE RENEWABLE ENERGY SYSTEMS IN AFGHANISTAN
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Master of Science in Systems Engineering–June 2012
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Energy systems in Afghanistan are currently limited to diesel-only solutions. The U.S. Army Corps of Engineers (USACE) does not have means to optimize various energy solutions when designing or modifying Afghanistan National Security Force (ANSF) installations in Afghanistan. The logistics of transporting diesel fuel increases risk to personnel and operations security, and can have a myriad of obscured costs. The purpose of this research is to develop an approach to prioritize multiple stakeholder needs and optimize a power portfolio based on actual environmental conditions. The approach seeks to reduce problems associated with fossil fuel systems by supplementing diesel generators with renewable energy solutions. The approach produces the data necessary to generate a rubric containing optimal combinations of energy systems to include both renewable and diesel power sources. The rubric aids in determining energy system characteristics for any given location in Afghanistan. The results demonstrate millions of dollars in savings while simultaneously reducing risk to operations and personnel in Afghanistan. This approach can be adapted to any region of the globe.

Data in online social networks can be used as a resource to locate persons of interest. The two key issues are the accuracy and length of time to carry out the necessary categorization, correlation, and sifting. Literally millions of data items—most unintentionally prepared to facilitate analysis—are posted and made available through public data feeds. The lack of appropriate tools and schemas inhibit efficient identification and extraction of information. The broad applicability of locating persons of interest extends to humanitarian assistance and disaster-relief efforts, finding missing person(s), reconstructing movements of people, and prognosticating future movement of people. This research defines a method that was shown to be effective in utilizing social network data (Twitter) to locate and track a person of interest. A combination of c# programming language and structured query sequences was integrated with SQL to correlate and sort hundreds of thousands of data items.

**KEYWORDS:** Correlation, Data Mining, Data Manipulation, SQL, Twitter, Tweet
The Capstone Project Reports listed below are produced by cohorts of residential or distance learning students in the systems-engineering curriculum. The degrees awarded are in systems-engineering analysis, systems engineering, and engineering systems.

RECAPITULATION OF AMPHIBIOUS OPERATIONS AND LIFT CAPSTONE PROJECT: COHORT 18A

LT Jon Allmond, USN, LT Karl Hassenftatz, USN, LT Mike McAraw, USN, LT Ryan Birkelbach, USN, LT Andrew Laidler, USN, LT Jac O. Ulman, USN, LT Joe Campbell, USN, LT Todd Lucht, USN, MAJ Robb Witte, USA, LT Will Chapman, USN, LT Matt Martin, USN, CPT Muth Aramugam, RSA, CPT Yong Run Lee, RSA, Yit Peng Tan, MAJ Wen Kai Chan, RSA, CPT Chong Siong Lim, RSA, MAJ Chee Meng Tang, RSA, CPT Bingqiang Chen, RSA, MAJ Tom Lutz, USA, Choon Boon Ting, Kai Ping Chua, LT Joel Marple, USN, Yan Siong Tng, MAJ Eng Kiat Gan, RSA, Fuquan Ng, Huseh Tien Too, Ho Kiat Kok, LT Zak Schwartz, USN, Chun Hong Kelvin Yap, Farn Wei Jason Khong, Kim Hong Tan, Chin Liong Yeo

Co-Advisor: Eugene P. Paulo, Department of Systems Engineering
Co-Advisor: Daniel A. Nussbaum, The Patuxent Partnership

The aging Whidbey Island and Harpers Ferry class ships, LSD-41 and 49 respectively, comprise just over one third of the amphibious Navy. However, a solution to the capability gap created by the loss of these ships is needed to maintain the effectiveness of the amphibious fleet across a broad spectrum of mission areas. This research effort considers future ship designs and fleet architectures to meet the capability gaps left by the decommissioning of the LSD-41 and 49 class ships. With respect to lift capacity, performance capability, cost, and a risk assessment, the analysis showed the LPD-17 or a LSD(X) approximately 30 percent larger than the existing classes to be acceptable replacement classes. The analysis also supports further research to determine the most robust fleet architecture apart from the current eleven LHA or LHD, eleven LPD, and eleven LSD paradigm.

KEYWORDS: LSD(X), LSD(X) Analysis of Alternatives, Recapitalization of Amphibious Operations and Lift

ARMY SCIENCE AND TECHNOLOGY CHALLENGES CAPSTONE PROJECT: COHORT SE311-104G


Master of Science in Systems Engineering Analysis–June 2012
Co-Advisor: Kristin Giammarco, Department of Systems Engineering
Co-Advisor: Brigitte T. Kwinn, Department of Systems Engineering

The U.S. Army’s Research, Development, and Engineering Command (RDECOM) prioritized 24 science and technology (S&T) challenges to represent the capabilities that must be further developed to support the warfighter. In order to better manage their S&T portfolio, RDECOM identified the need to be able to assess
and compare proposed solution sets to meet these challenges. To help RDECOM meet this need, Naval Post-graduate School Capstone Team 311-304G developed a proof-of-concept model-based method focusing on the relationships between the overburdened soldier and force protection S&T challenges, with the intent that this method be extendable to all of the S&T challenges. A systems engineering strategy, including requirements analysis, architecture, modeling, simulation, and risk analysis was used to develop the method. Several aspects of this strategy leveraged derived behavior and attributes from doctrinal sources to define key system interactions and dependencies. The model and associated metrics assess proposed solution configurations against a common solution-neutral baseline describing the desired operational capability. The architecture, model, and simulation together provide the ability to trace complex programs to validated requirements. The method can be used to align S&T objectives, identify common technologies, and identify overlaps and gaps to ensure an efficient distribution of resources.


TAILORABLE REMOTE UNMANNED COMBAT CRAFT
CAPSTONE PROJECT: COHORT 18 TEAM B

LCDR Loren Jacobi, USN, LT Cory Alexander, USN, LT Adam Bush, USN, LT Rick Campbell, USN, LT Christien Edwards, USN, LT Matt Meeks, USN, Chee Nam Chau, Anner Diukman, Kine Yin Tham, Chin Chuan Ong, Sze Yi Ding, Mei Ling Ng, Szu Hau Tan, LT Matthew Hagstette, Ing Khang Yeo, Hock Hin Cher, Howe Leng Kwek, Yew Kok Loke

Master of Science in Systems Engineering Analysis–June 2012
Co-Advisor: Gary O. Langford, Department of Systems Engineering
Co-Advisor: Timothy H. Chung, Department of Systems Engineering

U.S. military and civilian vessels are critically vulnerable to asymmetric threats in littoral environments. Highly proliferated asymmetric weapons such as anti-ship cruise missiles (ASCM), low slow flying (LSF) aircraft and fast attack craft (FAC) / fast inshore attack craft (FIAC) threaten U.S. strategic goals and can produce unacceptable losses of men and material.

The SEA-18B team presents an operational concept for a family of USVs capable of defending ships from air and surface asymmetric swarm attacks. This USV, the Tailorable Remote Unmanned Combat Craft (TRUCC), can operate in concert with the next generation of capital surface vessels to combat this critical threat with maximum efficiency.

Critical performance criteria of the TRUCC family were determined through agent-based simulation of a Straits of Hormuz design reference mission. Additional models addressed ship synthesis and operational availability.

A technology and capability roadmap outlines areas of interest for investment and development of the next-generation USV. Interim technology and capability milestones in the roadmap facilitate incremental USV operational capabilities for missions such as maritime logistics, decoy operations and mine warfare.

The TRUCC operational concept fills a critical vulnerability gap. Its employment will reduce combat risk to our most valuable maritime assets: our ships and sailors.

KEYWORDS: USV, unmanned surface vessel, unmanned surface vehicle, autonomy, systems engineering, surface warfare, mine warfare, logistics, advanced offboard decoy
FIXED WING LIGHT OBSERVATION SQUADRON (VMLO): THE STRATEGIC, OPERATIONAL AND TACTICAL IMPERATIVE FOR A LIGHT OBSERVATION SQUADRON WITHIN THE USMC
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Master of Science in Systems Technology–June 2012
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Second Reader: CDR William J. Robinette, USN, Department of Information Sciences

The military, and the Marines specifically, are experiencing a gap in their light mobility, persistent ISR and CAS/FAC(A) capabilities. Ever changing international and local political and economic realities are impacting the way in which the Marines will continue to act as a force projection of the national strategy. The use of commercial off-the-shelf aircraft, integrated with existing sensors and weapons systems, is a performance and cost-effective augmentation to existing military aircraft and is a discussion centered on placing the right technology, not always high technology, at the right place and time to influence the next battlespace. This thesis considered the future environments these aircraft would operate in and the capabilities that would enhance current aviation capabilities and augment distributed operations. Four aircraft were considered and compared in configuration, performance, cost and commonality on the current commercial market. In addition to the discussion of aircraft, consideration was given to the benefits of the creation of a fixed-wing, light observation squadron within the Marines and its ability to influence operations and augment current aviation capabilities.

KEYWORDS: VMLO, USMC, LAAR, LAS, COTS, SOCOM, JSOC, MARSOC, NSAV, USN, USAF, USA, USASOC, SOCOM, PACOM, CENTCOM, AFRICOM, EUCOM, CESSNA, QUEST, SHERPA, PILATUS, CANOPY, GOTS, COIN, IW, MAGTF, ACE, GCE, MEU, MEF, DO, ECO, Distributed Operations, South China Sea, Philippines, Singapore

UNDERWATER CLOUDS: UTILIZING PRIVATE CLOUD ARCHITECTURE ONBOARD U.S. SUBMARINES
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B.S., Florida State University, April 2006
B.A., Florida State University, April 2006
Master of Science in Systems Technology–June 2012
Advisor: Douglas MacKinnon, Department of Information Sciences
Second Reader: Albert Barreto, Department of Information Sciences

The Consolidated Afloat Network and Enterprise Systems (CANES) program was tasked with replacing computer networks afloat to improve productivity and functionality of the fleet’s information-technology infrastructure. The program, in its first iteration, fails to include half the ships currently in service and is limited to a small number of specific platforms. Upgrading the existing software on the current platforms may pose a useful resolution to this issue. The computer networks on board submarines provide a good opportunity to explore how cloud computing could benefit older platforms. This thesis presents a proof of concept for the use of a private cloud architecture on board U.S. submarines and how improving computer networks may be possible by leveraging the currently installed hardware without requiring a complete system reconfiguration.
This thesis uses the “Ubuntu Server Private Cloud” as a basic example to illustrate and explore potential benefits and limitations of the Platform as a Service (PAAS) model. The revised system is examined in terms of its application aboard a submarine and explores how it compares to previous network architectures, such as the Client/Server model. The Ubuntu model was chosen for its usability and robust features and because it is open source and free.

KEYWORDS: Cloud Computing, Private Cloud, Submarine, CANES, Afloat Network

CLOUD COMPUTING AND VIRTUAL DESKTOP INFRASTRUCTURES IN AFLOAT ENVIRONMENTS
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B.A., University of Washington, June 2006
Master of Science in Systems Technology–June 2012
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Co-Advisor: Rachel Goshorn, Department of Electrical and Computer Engineering
Second Reader: Albert Barreto, Department of Information Sciences

The phenomenon of “cloud computing” has become ubiquitous among users of the Internet and many commercial applications. Yet, the U.S. Navy has conducted limited research in this nascent technology. This thesis explores the application and integration of cloud computing both at the shipboard level and in a multi-ship environment. A virtual desktop infrastructure, mirroring a shipboard environment, was built and analyzed in the Cloud Lab at the Naval Postgraduate School, which offers a potential model for the foundation of a cloud computing infrastructure in a network environment aboard ship. This research develops a concept of operations to propose how a cloud computing infrastructure may be employed and how it might operate in a multi-ship environment. This thesis’ findings indicate that cloud computing, when combined with virtualization technologies, can improve interoperability via the loose coupling of systems, decrease network footprints via server consolidation, and increase elasticity of resources. Additionally, cloud computing may alleviate bandwidth constraints because data and information in a cloud network can be stored, shared, and accessed locally. This could also reduce if not eliminate reachback through satellites. Future efforts in this area of research may involve more rigorous testing and opportunities toward improved security, as well as leveraging ever-improving cloud software.

KEYWORDS: Cloud Computing, Virtualization, Virtual Technology, Virtual Desktop Infrastructure, Afloat Architecture, Consolidated Afloat Network Enterprise Services, Service Oriented Architecture

UAV-TO-UAV TARGET DETECTION AND POSE ESTIMATION
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Systems and Network Engineer, Tunisian Air Force Academy, June 2003
Master of Science in Systems Technology–June 2012
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Second Reader: Raymond Buettner, Department of Information Sciences

The objective of this thesis is to investigate the feasibility of using computer vision to provide robust sensing capabilities suitable for the purpose of UAV-to-UAV detection and pose estimation using affordable CCD cameras and open coding libraries. It accomplishes this by reviewing past literature about UAV detection and pose estimation and exploring comparison of multiple state-of-the-art algorithms. The thesis presents implementation studies of detection approaches including color-based detection and component-based detection. We also present studies of pose estimation methods including the PosIt algorithm, homography-based detection, and the EPFL non-iterative method. The thesis provides a preliminary strategy for detecting small UAVs and for estimating its six degrees of freedom (6DOF) pose from image sequences within the prescribed

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airspace. Discussion of its performance in processing synthetic data is highlighted for future applications using real-life data sets.

**KEYWORDS:** UAV Detection, Pose Estimation, Computer Vision, Obstacle Avoidance, Edge Detection, Morphological Filtering

**THE EFFECT OF SHIPBOARD DESIGN DECISIONS IN AMPHIBIOUS WARFARE**
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Master of Science in Systems Technology–June 2012
Advisor: Steven Iatrou, Department of Information Sciences
Second Reader: LCDR David E. Roberts, USN, Department of Information Sciences

Recently, a major decision was made by the Navy to eliminate a key capability from the future ship of the amphibious fleet. The removal of the well deck from the future LHA (R) amphibious assault ship is attempting to change the way the Navy and Marine Corps have conducted amphibious operations over the past several decades. This thesis will look at the current and future amphibious capabilities in order to develop equations to quantitatively analyze the lift capabilities associated with future design choices to determine the effects of changing the design in the LHA (R) class of amphibious assault ships. A comparative analysis of the trade-offs, capabilities, and limitations associated with and without having a well deck was completed in order to determine the most effective means to operate. By looking at data on the MV-22 Osprey and F-35 Joint Strike Fighter, such as lift capabilities and ranges, and comparing them to the various landing craft data (LCACs, LCUs and AAVs), this thesis determines the effects on mission capabilities of the Navy and Marine Corps.

**KEYWORDS:** Amphibious Warfare, LHA (R) America Class, LHA Tarawa Class, Well Deck, STOM, OMFTS

**NEW NAVY FIGHTING MACHINE IN THE SOUTH CHINA SEA**
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Master of Science in Systems Technology–June 2012
Jimmy A. Harmon–Lieutenant, United States Navy
B.A., University of Arizona, 2006
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Advisor: Raymond Buettner, Department of Information Sciences
Second Reader: CAPT Wayne P. Hughes, Jr., USN, (Ret.), Department of Operations Research

Through the perspective of Wayne P. Hughes’ missile salvo equation, this research examined naval surface forces of the People’s Republic of China (PRC) and the United States in order to demonstrate how American surface combatants can defeat PRC anti-access area denial (A2AD) measures in the South China Sea (SCS). Hughes’ equation reveals that advantages for American surface forces are obtained by increasing fleet numbers, counter-targeting (CT), and increased scouting. This thesis advocates fleet growth as articulated in Hughes’ New Navy Fighting Machine (NNFM) study. Comparisons of the NNFM, the U.S. fleet, and the PRC fleet demonstrate both the disparity facing the American surface forces and the near parity obtained in the NNFM CT through unmanned surface vehicles (USVs) and naval obscurants provide American surface forces increased staying power and tactical advantage. Scouting and communications networking through a theater-wide constellation of airships provide the American fleet with persistent situational awareness of the battle space, tactical communications with subsurface forces, and improved emissions control (EMCON)
measures for surface forces. The distributive properties of the NNFM, combined with this study’s CT and scouting findings, offer American surface combatants success over the PRC Navy in the SCS scenario.

**KEYWORDS:** New Navy Fighting Machine, South China Sea (NNFM), Missile Warfare, Lighter Than Air (LTA), Airships, Counter-Targeting, Unmanned Surface Vehicles (USV), FALCON Laser, Take Charge and Move Out (TACAMO), Missile Boat, Emissions Control (EMCON), Balloon-borne Repeater, Anti-access Area Denial (A2AD)
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