



Calhoun: The NPS Institutional Archive
DSpace Repository

Theses and Dissertations

Compilations of Thesis Abstracts

2016

Compilation of Abstracts -- Surface Warfare:
Theses and Dissertations by Academic Year
2016 Graduates

Monterey, California. Naval Postgraduate School

<https://hdl.handle.net/10945/57655>

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>



Naval Postgraduate School

Compilation of Abstracts – Surface Warfare

Theses and Dissertations by Academic Year 2016 Graduates



Naval Postgraduate School
Monterey, California • www.nps.edu

INTRODUCTION

The Naval Postgraduate School (NPS) is pleased to present the dissertation, thesis, and capstone project report abstracts for Surface Warfare-related research completed throughout Academic Year 2016 by the student body.

The application of interdisciplinary knowledge and research is vital to gaining insight into—and ultimately solving—the numerous challenges, issues and questions facing the Surface Warfare community as we operate and manage our Force in an increasingly complex environment. NPS is uniquely positioned to offer Navy-tailored advanced education in technical, informational, managerial, and policy fields and to integrate research across these disciplinary lines.

To better facilitate the Surface Warfare community's appropriation of this unique academic resource, the Commander, Naval Surface Forces (COMNAVSURFOR) and the President of NPS jointly established a Chair of Surface Warfare at NPS prior to the commencement of Academic Year 2016. This position, filled by a post-Major Command Surface O-6, supports interdisciplinary warfare education and spearheads research in direct support of surface warfighting, including doctrine, capabilities, budgeting and requirements, planning and execution, operations, technology, tactics, manpower systems, and systems engineering.

In support of this overarching objective, the Chair coordinates Surface Warfare-related activity across campus along three lines of effort:

Mentorship: The Chair acts as a professional mentor for all Surface Line (111X) students and helps shape their research toward relevant surface warfare topics of interest. With an 111X student population averaging 105 during AY2016, NPS represents over 20% of the SWO Department Head pool, all concentrated in one place. It is vital that these future leaders retain a connection to their parent community while immersed in the academic environment in order to keep them current in their profession and mentally prepared to become Department Heads.

Advocacy: The Chair serves as a key source of up-to-date data, contacts and concerns regarding surface warfare across campus. With the rapid pace of technological, programmatic and administrative change in the Fleet, it is vital that the on-campus research be informed by a subject matter expert who is current on surface warfare initiatives and tapped in to the relevant sources of community information.

Access: The Chair facilitates access by outside entities to NPS' research programs, centers and institutes for the benefit of surface warfare development. With multiple academic disciplines operating at NPS, spread over four distinct graduate schools, it is vital that the TYCOM staffs, OPNAV requirements directorates, and other surface community activities have an on-campus "conciierge," able to navigate the academic environment to connect community research needs to the faculty and students best equipped to service them.

As part of NPS's overarching Academic Honors and Awards program, the Surface Navy Association Award for Academic Excellence in Surface Warfare recognizes the student thesis or capstone project from each quarter's graduating class that best contributes to the body of knowledge supporting the Surface Warfare community while maintaining the highest standards of academic rigor. The SNA Award winners for AY2016 are:

September 2016 – Lieutenant Kristen Eriksen
Surface Warfare Officer, Operations Research
Thesis: Analyzing Tactics and Techniques within Distributed Lethality Using Agent-Based Simulation

June 2016 – Lieutenant Commander Clay Johnson
Engineering Duty Officer, Systems Engineering
Thesis: A Systems Architecture for Operational Distributed Lethality
and

Lieutenant Travis Harlow
Engineering Duty Officer, Systems Engineering
Thesis: Systems Architecture for Logistics of a Distributed Naval Surface Force

March 2016 – Lieutenant Matt Maupin
Surface Warfare Officer, Network Operations and Technology
Thesis: Management of Cyber-Physical Mobile Ad-Hoc Networks in Support of Distributed Littoral
Operations

December 2015 – Lieutenant Loney Cason, III
Surface Warfare Officer, Undersea Warfare
Thesis: Continuous Acoustic Sensing with an Unmanned Air Vehicle (UAV) System (AquaQuad) for Anti-
Submarine Warfare in a High Threat Area

For more information, please contact the Chair of Surface Warfare:
CAPT Chuck Good, USN
e-mail: cpgood@nps.edu or charles.good@navy.mil
tel: (831) 656-3360

NAVAL POSTGRADUATE SCHOOL MISSION

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

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

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

- advances knowledge in a wide range of disciplines relevant to DON/DOD;
- maintains upper-division course content and cutting-edge programs;
- provides the opportunity for students to demonstrate independent graduate-level scholarship in their areas of study;

- challenges students with creative problem solving experiences on DOD-relevant issues;
- solves warfare problems; and
- attracts and retains quality faculty with state-of-the-art expertise.

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

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

ACADEMIC PROGRAMS

Note: Curriculums typically open to Surface Warfare (111X) students are indicated in **bold font**.

School of International Graduate Studies (SIGS)

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

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

Graduate School of Business and Public Policy (GSBPP)

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

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

Graduate School of Engineering and Applied Sciences (GSEAS)

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

- Applied Mathematics
- **Combat Systems Sciences and Technology**
- **Electronic Systems Engineering (resident 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 (resident and DL)**
- **Systems Engineering (resident and DL)**
- Systems Engineering Management (DL)
- **Undersea Warfare**
- Underwater Acoustic Systems (DL)

Graduate School of Operational and Information Sciences (GSOIS)

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

- Applied Cyber Operations
- **Computer Science (resident 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 (resident 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 (resident and DL)
- Special Operations
- Systems Analysis (DL)
- **Systems Engineering Analysis**

OFFICE OF THE PROVOST

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



STUDENT RESEARCH

Independent scholarly work in the form of a dissertation (PhD), thesis (master's/engineer), or capstone project is required for most academic programs. Student research projects address issues ranging from the current needs of the fleet and joint forces to the science and technology required to sustain long-term superiority of the Navy and DoD. Guided by faculty advisors, including the Chair of Surface Warfare, NPS students represent a vital resource for addressing warfighting problems and maintaining cutting-edge expertise, particularly in a time when technology and information operations are changing rapidly. NPS alumni think innovatively and possess the knowledge and skills to apply nascent technologies within their warfare communities and the broader Joint community. Their firsthand grasp of operations, when combined with challenging projects that require them to apply their focused graduate coursework, is one of the most effective elements in solving fleet, joint-force, and regional problems. NPS graduate education encourages a lifelong capacity for applying basic principles and creative solutions to complex problems. NPS is also unique in its ability to conduct classified research at both the GENSER and SCI levels.



Source: Naval Postgraduate School Public Affairs

Copies of unclassified/unlimited distribution theses and capstone reports are available at the NPS Institutional Archive (aka "Calhoun") <https://calhoun.nps.edu/>.

To obtain Classified and Restricted Distribution reports, please contact the Chair of Surface Warfare.

TABLE OF CONTENTS

MASTER OF ARTS

Master of Arts in Security Studies

The Port Security Grant Program: Good Enough, or Can It Be Made Better?	1
Civil-Military Relations and Sexual Assault	1
Sailing the Calm and Rough Seas: The Influence of Wealth and Sovereignty in Southeast Asian Maritime Disputes	2
Big Missiles and Big Decks: The Viability of Aircraft Carriers in an A2/AD World	2
U.S. Navy Bloodhounds: Establishing a New Maritime Security Combatant.....	3
The Carrier Strike Group: Examining Approaches to Forward Presence	3
Chinese Cyber Espionage: A Complementary Method to Aid PLA Modernization	4
Oil as a Weapon of the 21st Century: Energy Security and the U.S. Pivot to Asia-Pacific.....	4
With Strings Attached: China’s Economic Policy in the South China Sea	5
Mindfulness Training: Worthwhile as a Means to Enhance First-Responder Crisis Decision Making?	5
Nato’s Preparedness for Cyberwar	6
Crimson Tide: Comparing Chinese Naval Expansion with Existing Naval Powers	6
The Pursuit of Economic Strength Has Stabilizing Effects in the South China Sea	7
Maritime Cybersecurity: The Future of National Security	7
A South China Sea Adiz—Vietnam’s Next Challenge	8
A Study on the Decision Factors in the Delay of the ROK–U.S. Wartime OPCON Transfer: Focusing on the Domestic Determinants	8
Indian, Japanese, and U.S. Responses to Chinese Submarine Modernization	9
What Are We Missing? A Call for Red Teaming within the Domestic Maritime Domain for Anti-Terrorism Programs	9
Hacking Your Ride: Is Web 2.0 Creating Vulnerabilities to Surface Transportation?	10
Prospects for Finland and Sweden to Pursue Closer Defense Cooperation with NATO	10
The Advanced Surface Force Fleet: A Proposal for an Alternate Surface Force Structure and Its Impact in the Asian Pacific Theater.....	11
U.S. and NATO Naval Engagement with Russia in the Black Sea: Historical Patterns and Current Prospects.....	11
Chinese and Russian Policies on Climate Change: Implications for U.S. National Security Policy	12
GPS: Public Utility or Software Platform?	12
Building Automation System Cyber Networks: An Unmitigated Risk to Federal Facilities.....	13
China’s Soft Power: Changing the World Perception	13

MASTER OF BUSINESS ADMINISTRATION

Analysis of the Capabilities Supporting Humanitarian Assistance and Disaster Relief Operations of the Indonesian Navy and the United States Marine Corps Marine Expeditionary Unit	15
Navy Advertising: Targeting Generation Z	15
LPTA Versus Tradeoff: Analysis of Contract Source Selection Strategies and Performance Outcomes.....	16
An Inquiry into the Resilience of U.S. Navy Recruits.....	16
A Baseline Analysis of Combat Logistics Force Scheduling Efficiency.....	17
A Cost–Benefit Analysis between the Current Naval Officer Retention Bonus Plan and the Enlisted Retention Bonus Plan	17
Contract Source Selection: an Analysis of Lowest Price Technically Acceptable and Tradeoff Strategies...	18
The Cost of Commonality: Assessing Value in Joint Programs	19
Evaluating the Modernization of Military Retirement.....	19
A Business Process Analysis of the Surface Navy’s Depot Maintenance Program	20
Additive Manufacturing: An Analysis of Intellectual Property Rights on Navy Acquisition	20
U.S. Coast Guard Cutter Procurement Lessons’ Impacts on the Offshore Patrol Cutter Program	

Affordability.....	21
Analysis of Naval Ammunition Stock Positioning.....	21

MASTER OF SCIENCE

Master of Science in Applied Mathematics

Aerial Logistics Management for Carrier Onboard Delivery.....	22
Optimizing Search Patterns for Multiple Searchers Prosecuting a Single Contact in the South China Sea.....	22

Master of Science in Applied Physics

The Design and Implementation of a Prototype Surf-Zone Robot for Waterborne Operations.....	23
Effects of Relative Platform and Target Motion on Propagation of High Energy Lasers.....	23
Design and Analysis of Megawatt Class Free Electron Laser Weapons.....	24
Power and Energy Storage Requirements for Ship Integration of Solid-State Lasers on Naval Platforms ..	24

Master of Science in Computer Science

Rapidly Deployable Mobile Security Solution	25
Software Architecture for Anti-Submarine Warfare Unmanned Surface Vehicles	25
Wireless Sensor Buoys for Perimeter Security of Military Vessels and Seabases	26
Free Space Optical Communication for Tactical Operations	26
Server-Based and Server-Less BYOD Solutions to Support Electronic Learning.....	27
Mesh Networking in the Tactical Environment using White Space Technology	27
An Approach for Detecting Malicious Emails using Runtime Monitoring with Hidden Data	28

Master of Science in Contract Management

An Analysis of the Department of Defense’s Use of Other Transaction Authority (10 U.S.C. 2371)	29
An Analysis of Cybersecurity and How It Is Affecting a Contract Writing System, Seaport	29

Master of Science in Defense Analysis

Multinational Counter-Piracy Operations: How Strategically Significant Is the Gulf of Guinea to the Major Maritime Powers?	30
Toward a Theory of Hybrid Warfare: The Russian Conduct of War during Peace	30
Maritime SOF in the Littorals: Theoretical Principles for Successful Littoral Special Operations	31
Decision Making in Chaos	31
China’s Soft Power: Changing the World Perception	32

Master of Science in Electrical Engineering

Generalized Hough Transform for Object Classification in the Maritime Domain.....	32
Comparison of Two Railgun Power Supply Architectures to Quantify the Energy Dissipated after the Projectile Leaves the Railgun	33

Master of Science in Engineering Acoustics

Resolution of Port/Starboard Ambiguity using a Linear Array of Triplets and a Twin-Line Planar Array.....	33
---	----

Master of Science in Management

Resilience among Naval Recruits: A Quantitative and Qualitative Analysis of Interventions at Recruit Training Command and Implications on Fleet Readiness.....	34
The Effect of Graduate Education Timing on the Retention of Surface Warfare Officers	34
A Validation of the Proposed Royal Australian Navy Standard Work Week and Naval Management Diary using a Simulated Crew of an Armidale Class Patrol Boat	35
Movement of Fuel Ashore: Storage, Capacity, Throughput, and Distribution Analysis.....	35
Are We Hoping for a Bounce? A Study on Resilience and Human Relations in a High Reliability	

Organization	36
The Effect of STEM Degrees on the Performance and Retention of Junior Officers in the U.S. Navy	36
Study of Female Junior Officer Retention and Promotion in the U.S. Navy	37
An Analysis of the Impact of Financial Factors on the Well-Being of Military Officers	37
Role of Social Networks in Resilience of Naval Recruits: A Quantitative Analysis.....	38
 Master of Science in Mechanical Engineering	
Characterization of Aluminum-Magnesium Alloy Reverse Sensitized via Heat Treatment	38
Predicting the Accuracy of Unguided Artillery Projectiles.....	39
Initial Testing for the Recommendation of Improved Gas Metal Arc Welding Procedures for HY-80 Steel Plate Butt Joints at Norfolk Naval Shipyard	39
Evaluation of Composite-Hull Ships Operating in Arctic Ice	40
Feasibility Study on Missile Launch Detection and Trajectory Tracking.....	40
 Master of Science in Meteorology and Physical Oceanography	
Inter-Annual Variability of the Acoustic Propagation in the Yellow Sea Identified from a Synoptic Monthly Gridded Database as Compared with GDEM	41
In-Situ Observation of Undisturbed Surface Layer Scaler Profiles for Characterizing Evaporative Duct Properties.....	42
 Master of Science in Modeling, Virtual Environments, and Simulation	
Discrete Event Simulation Model of the Polaris 2.1 Gamma Ray Imaging Radiation Detection Device	42
Modeling Anti-Air Warfare with Discrete Event Simulation and Analyzing Naval Convoy Operations	43
 Master of Science in Network Operations and Technology	
Development of a Big Data Application Architecture for Navy Manpower, Personnel, Training, and Education.....	43
Fighting the Network: MANET Management in Support of Littoral Operations	44
Field-Deployable Video Cloud Solution.....	44
 Master of Science in Operations Research	
Manned and Unmanned Aircraft Effectiveness in Fast Attack Craft/Fast Inshore Attack Craft ASUW Kill Chain Execution	45
An Exploratory Analysis of Projected Navy Officer Inventory Strength using Data Farming	45
Anti-Submarine Warfare Search Models	46
OTTER: An Optimized Transit Tool and Easy Reference	47
Optimal Repair and Replacement Policy for a System with Multiple Components	47
Aerial Logistics Management for Carrier Onboard Delivery	48
A Brownian Bridge Movement Model to Track Mobile Targets	48
An Exploratory Analysis of Economic Factors in the Navy Total Force Strength Model	49
Linear Optimization of Frequency Spectrum Assignments Across Systems	49
Evaluating Effectiveness of a Frigate in an Anti-Air Warfare (AAW) Environment	50
Heterogeneous Defensive Naval Weapon Assignment to Swarming Threats in Real-Time.....	50
Navy Operational Planner - Undersea Warfare Module.....	51
Modeling Anti-Air Warfare with Discrete Event Simulation and Analyzing Naval Convoy Operations	51
Analysis of Protection Measures for Naval Vessels Berthed at Harbor against Terrorist Attacks	52
 Master of Science in Physical Oceanography	
The Effects of Double Diffusion and Background Turbulence on the Persistence of Submarine Wakes.....	52
Continuous Acoustic Sensing with an Unmanned Aerial Vehicle System for Anti-Submarine Warfare in a High-Threat Area	53
Statistical Analysis of Acoustic Signal Propagating through the South China Sea Basin	53

Master of Science in Program Management

Analysis of Rapid Acquisition Processes to Fulfill Future Urgent Needs 54
Impacts of Transitioning from Firm Fixed Price to Fixed Price Incentive Firm Target Contracts in PEO
Missiles and Space 54
An Analysis of Test and Evaluation in Rapid Acquisition Programs 55
Case Analysis of the Joint High-Speed Vessel Program: Defense Acquisition 55

Master of Science in Systems Engineering

Operational Energy Capability Portfolio Analysis for Protection of Maritime Forces against Small Boat
Swarms 56
System Architecture for Logistics of a Distributed Naval Surface Force 57
A Systems Architecture for Operational Distributed Lethality 57
A Seakeeping Performance and Affordability Tradeoff Study for the Coast Guard Offshore Patrol
Cutter 58
Achieving Ship’s Mission Flexibility through Designing, Printing and Operating Unmanned Systems with
Additive Manufacturing and Delayed Differentiation 58
Evaluation of Littoral Combat Ships for Open-Ocean Anti-Submarine Warfare 59
Transportation Analysis Exploring Alternative Shipping of Marine Expeditionary Brigade Forces to Seabase
in Contingency Response Scenarios 59
A Decision Support System for Evaluating Systems of Undersea Sensors and Weapons 60
Scenario-Based Systems Engineering Application to Mine Warfare 60
Unmanned Systems in Integrating Cross-Domain Naval Fires 61
Technological Evolution of High Temperature Superconductors 61
Modeling of Engine Parameters for Condition-Based Maintenance of The MTU Series 2000 Diesel
Engine 62

Master of Science in Systems Technology (Command, Control & Communications)

Multi-Sensor Image Fusion for Target Recognition in the Environment of Network Decision Support
Systems 62

MASTER OF ARTS

Master of Arts in Security Studies

THE PORT SECURITY GRANT PROGRAM: GOOD ENOUGH, OR CAN IT BE MADE BETTER?

Paul Arnett—Captain, United States Coast Guard

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

Advisor: Rudy Darken, Department of Computer Science

Second Reader: Ryan Ellis, Northeastern University

For almost a decade and a half since the terrorist attacks of September 11, 2001, the Port Security Grant Program (PSGP) has provided funding to project proposals for improving the security and resiliency posture of the nation's ports and waterways. The United States has over 360 coastal and inland ports through which over \$1.3 trillion in cargo moves annually; a safe, secure, and efficient marine transportation system is critical to national security. The PSGP is intended to enhance port security and resiliency by funding proposals to provide increased risk management, measures to mitigate disruptions and facilitate port recovery, and maritime domain awareness capabilities to prevent, respond to, and recover from attacks. The PSGP has matured to include funding for all hazards threatening the ports—natural, accidental, and intentional. This thesis seeks to evaluate how well the PSGP has met those goals and if it should be improved, reorganized, or eliminated. [Full Text](#)

Keywords: Port Security Grant Program, Maritime Transportation Security Act, Area Maritime Security Committee

CIVIL-MILITARY RELATIONS AND SEXUAL ASSAULT

Brandi Bluhm—Civilian, Department of the Navy

Master of Arts in Security Studies (Civil-Military Relations)

Advisor: Carolyn Halladay, Center for Civil-Military Relations

Co-Advisor: Cristiana Matei, Center for Civil-Military Relations

The Bureau of Justice Statistics' Criminal Victimization Survey reported that there were 284,350 rapes or sexual assaults in the United States in 2014. In the same year, the Department of Defense (DOD) Sexual Assault Prevention and Response Office (SAPRO) estimated that 18,900 sexual assaults occurred in the military. In recent years, Congress has been increasing pressure on the military to improve sexual assault prevention and response; some efforts to resolve the sexual assault problem in the military have included proposals to alter the military justice system to resemble its civilian counterpart. Yet, as the numbers suggest, the civilian justice system may not be doing such a good job either. Civil-military relations revolve around who controls what. This thesis addresses the role of civil-military relations in regard to sexual assault prevention and response. Through official statistics, documents from the state of California and the Department of Defense, scholarly research, and reports from the media, this paper describes the experience of the victim as he or she navigates through either system. The comparison of the systems side by side reveals that, if the civilian and military communities work together to capitalize on learning from each other, real progress can occur in serving victims of sexual assault in both systems. The power struggle over who controls what in civil-military relations tends to distract from the root issue of serving victims of sexual assault. The focus must shift from "Who is doing a worse job?" to "How

can both systems learn from each other to improve and best serve the victims of these horrible crimes?”
[Full Text](#)

Keywords: sexual assault, law, justice system, civil–military relations, rape, victim, legal

SAILING THE CALM AND ROUGH SEAS: THE INFLUENCE OF WEALTH AND SOVEREIGNTY IN SOUTHEAST ASIAN MARITIME DISPUTES

Andromeda Ciptadi–Lieutenant, Indonesian Navy

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: Michael Malley, Department of National Security Affairs

Second Reader: Daniel Moran, Department of National Security Affairs

Under what conditions do members of the Association of Southeast Asian Nations use peaceful means to resolve their maritime disputes? Why do they resort to military action in some cases but compromise peacefully in others? This thesis answers these questions by investigating two variables that influence the course of such disputes: the presence of natural resources and disputes over sovereign control of maritime features. This thesis examines four cases of maritime dispute resolution: maritime delimitation in the Singapore Strait by Indonesia and Singapore; joint-development in the Gulf of Thailand; the Pedra Branca dispute between Singapore and Malaysia; and recurring violence in the South China Sea involving multiple states in the region. After analyzing the case studies, this research finds that the presence of natural resources and of conflicting claims of sovereignty over islands or other related features strongly affect the outcome of the maritime disputes. In general, four different outcomes are possible: maritime delimitation, joint development, third-party settlement, or violent conflict. Southeast Asian countries are likely to employ peaceful measures for situations in which at least one of the two variables studied here is absent. If both of them are present, maritime disputes will likely end in violence. [Full Text](#)

Keywords: maritime disputes, TAC, UNCLOS, Southeast Asia, ASEAN, international arbitration, joint development, maritime boundaries, maritime borders, South China Sea

BIG MISSILES AND BIG DECKS: THE VIABILITY OF AIRCRAFT CARRIERS IN AN A2/AD WORLD

Robert Coffman–Lieutenant, United States Navy

Master of Arts in Security Studies (Strategic Studies)

Advisor: Erik Dahl, Department of National Security Affairs

Second Reader: Daniel Moran, Department of National Security Affairs

This thesis analyzes the implications of modern anti-access/area denial (A2/AD) capabilities on the use of aircraft carriers in executing U.S. maritime strategy. The objective is to determine if there are historical lessons from previous U.S. experiences with A2/AD capabilities that bear on the current debate. Additionally, it analyzes several proposed alternatives to the aircraft carrier. It argues that there are several relevant lessons from previous A2/AD challenges with aircraft carriers and the United States’ ability to conduct sea control and power projection, and that none of the aircraft carrier alternatives can sufficiently provide the necessary capabilities across a range of military operations. It concludes that incorporating innovative employment of carrier strike groups in an A2/AD environment, while also pursuing advancements in the air wing’s operating range, provides a viable solution to redressing the A2/AD threat. [Full Text](#)

Keywords: anti-access, area denial, A2/AD, maritime strategy, aircraft carrier, ASBM, air wing, sea control, power projection, technology, innovation, operational experimentation, haystack, uptick

U.S. NAVY BLOODHOUNDS: ESTABLISHING A NEW MARITIME SECURITY COMBATANT

Ryan Donohue—Lieutenant, United States Navy

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

Advisor: Erik Dahl, Department of National Security Affairs

Co-Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs

To protect the United States' 4.5 million miles of Economic Exclusion Zone, maritime forces are directed to conduct homeland defense missions and support civil authorities as far from U.S. shorelines as possible to protect the country from transnational threats. In order to protect the United States from transnational organized crime regimes and their continued maritime narcotics trafficking, the U.S. Navy requires a surface combatant to fulfill these interdiction missions. Therefore, with the Navy's decommissioning of its patrol frigates, should the Navy plan development of a new vessel, rebuild the Oliver Hazard Perry class frigates, or refocus the Littoral Combat Ship (LCS) program to replace the current frigate's capabilities in combating narcotic trafficking? In turn, the Oliver Hazard Perry class was a sound platform that performed well, the LCS is a troubled program facing severe financial, stability, and lethality issues, while the design and construction of a new frigate is entirely too costly and time consuming. With these considerations in mind, this thesis proposes the reconstruction of the Oliver Hazard Perry class frigate for maritime security operations, as a result of its illustrious multirole career, survivability, and relatively cheaper price point than the increasingly expensive and unproven LCS ship class. [Full Text](#)

Keywords: Navy, Coast Guard, maritime security, counternarcotic, drug interdiction, frigate, Littoral Combat Ship, Homeland Security, law enforcement

THE CARRIER STRIKE GROUP: EXAMINING APPROACHES TO FORWARD PRESENCE

Christopher Elliott—Lieutenant Commander, United States Navy

Master of Arts in Security Studies (Strategic Studies)

Advisor: Daniel Moran, Department of National Security Affairs

Second Reader: James Russell, Department of National Security Affairs

With carriers reduced to their lowest number since 1942, maintaining forward presence in regions of U.S. national interest has proven difficult. The current carrier operating concept has resulted in unprecedented deployment lengths, shorter home-cycles and increasing strain on crew members and their families. By examining the Carrier Strike Group (CSG) deployment models and the various techniques for optimizing forward presence, a more efficient approach may be developed. This thesis answers the following question: How will the carrier's ability to protect U.S. national interests through a global strategy centered on forward presence and flexible response be accomplished in the future? The goal is to maximize forward presence based on current and forecast ship-building budgets and resources by identifying the CSG's utility and role in forward presence while assessing various techniques. The predicted carrier force structure of 11 is assumed while determining which technique or combination of techniques produces the appropriate level of forward presence and crisis response to deter current and future global threats. A combined approach incorporating a proportional crew swap concept with the potential to increase overseas-based CSGs will offer more options to policy-makers and leadership and

increased flexibility in employing the CSG in pursuit of U.S. national interests. [Full Text](#)

Keywords: Carrier Strike Group, CSG, carrier, forward presence, extended deployments, overseas-basing, crew rotation, crew swap, Optimized-Fleet Response Plan

CHINESE CYBER ESPIONAGE: A COMPLEMENTARY METHOD TO AID PLA MODERNIZATION

Jamie Ellis—Captain, United States Air Force

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: Wade Huntley, Department of National Security Affairs

Second Reader: Christopher Twomey, Department of National Security Affairs

In 2013, Mandiant published a report linking one People's Liberation Army (PLA) unit to the virtual exploitation of 11 modern U.S. military platforms. In the last two decades, Chinese cyber espionage has cultivated a significant reputation in cyberspace for its high-volume, illicit exploitation of defense technology. At the same time, the PLA has also rapidly modernized its naval, fighter jet, and air defense technologies. This thesis examines trends in Chinese cyber espionage, PLA modernization, and PLA acquisitions methods to determine—from only open-source information—if the categories are related and, if so, the nature of the relationship. Defense reports suggest there is a strong correlation between China's virtual exfiltration of modern U.S. technology and the PLA's rapid advancement; cyber espionage is the principal driver for PLA modernization. This thesis asks: Does cyber espionage really play a central role in PLA modernization, or does it simply complement alternate procurement methods? This thesis draws from case studies of China's overt acquisitions, indigenous research, and physical espionage operations to demonstrate that the majority of the PLA's modernized military platforms were developed from non-cyber acquisition methods. These studies support this thesis's conclusion that cyber espionage is not the critical component driving forward PLA modernization. [Full Text](#)

Keywords: China, Chinese, technology, cyber, espionage, military, modernization, Navy, Air Force, defense, PLA

OIL AS A WEAPON OF THE 21ST CENTURY: ENERGY SECURITY AND THE U.S. PIVOT TO ASIA-PACIFIC

Jay English—Lieutenant, United States Navy

Master of Arts in Security Studies (Middle East, South Asia, Sub-Saharan Africa)

Advisor: James Russell, Department of National Security Affairs

Second Reader: Daniel Moran, Department of National Security Affairs

This thesis examines the U.S. pivot to Asia to determine whether energy security issues are likely to complicate relations and/or lead to friction between the United States and China in the twenty-first century. Drawing on case studies in which energy issues have directly and indirectly driven states decisions to use military force to secure access to energy resources or to leverage access as a means of coercive diplomacy, this research projects how similar scenarios may develop in the twenty-first century. The analysis also supports the notion that mutual interests in Middle Eastern energy resources and centrality of the Sea Lanes of Communication (SLOCs) in its transport could result in cooperative security arrangements in the absence of preferential access to any country. Conflict could result from territorial disputes involving U.S. collective-defense allies. For this reason, it is recommended that the United States pursue a diplomatic solution to territorial disputes and avoid policies that limit China's access to the SLOCs. [Full Text](#)

Keywords: China, PACOM, Asia Pacific, Central Asia, National Security Strategy, Energy Security, Trans Pacific Partnership, Pivot to the Pacific, Strait of Malacca, Strait of Hormuz

WITH STRINGS ATTACHED: CHINA'S ECONOMIC POLICY IN THE SOUTH CHINA SEA

Jarrold Fiecoat–Lieutenant, United States Navy

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: Naazneen Barma, Department of National Security Affairs

Second Reader: David Anderson, Department of National Security Affairs

How has China used economic policy to create leverage in its relationships with its Asian neighbors? Through comparative case studies of China's political and economic relationship with the Philippines and its political and economic relationship with Cambodia, this thesis supports the notion that China uses cooperative economic policy to entice political support from its poorer, lesser developed neighbors while using coercive economic policy to extract political concessions from its more advanced, emerging neighbors. In short, China uses coercive economic policy to extract concessions from Manila while it uses cooperative economic policy to woo Cambodian support in those very disputes. [Full Text](#)

Keywords: People's Republic of China, PRC, South China Sea, political economy, coercive economics, soft power

MINDFULNESS TRAINING: WORTHWHILE AS A MEANS TO ENHANCE FIRST-RESPONDER CRISIS DECISION MAKING?

John Flynn–Assistant Chief, Yonkers Fire Department, Yonkers, NY

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

Advisor: Christopher Bellavita, Department of National Security Affairs

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

This thesis identified a need for improvement in first-responder crisis decision making. The primary research question was, would mindfulness training be worthwhile as a means to enhance first-responder crisis decision making? Qualitative research methods (primarily a thematic analysis of the literature) were utilized to explore the areas of first responder operations, crisis decision making, and mindfulness training to identify key categories in the data relevant to the primary and sub-research questions. Evidence uncovered during this research supports a conclusion that mindfulness training may be one way in which first responders can improve their capacity to make effective decisions during a crisis. It was demonstrated that these improvements to crisis decision making resulting from mindfulness training could very well culminate in significant improvement of outcomes during future emergencies and disasters at which mindful first responders are present. Despite identifying significant implementation challenges, systematic analysis of the literature revealed sufficient evidence to warrant serious consideration for further study and application of this theory in the field, including potential implementation of discipline-specific and culturally relevant mindfulness training systems within first responder organizations. [Full Text](#)

Keywords: mindful, mindfulness, meditation, decision making, crisis decision making, situational awareness, sense-making, attentional control, attentional training, cognitive bias, self-awareness, meta-awareness, neuroplasticity, neuroscience, organic technology, working memory capacity, first

responder, focus, stress management, non-reactivity, mindfulness-based resilience training, mindfulness-based stress reduction, mindfulness-based attention training, mindfulness-based mind fitness training, strength training for attention and resilience in ROTC cadets

NATO'S PREPAREDNESS FOR CYBERWAR

Z'hra Ghavam—Lieutenant Commander, United States Navy

Master of Arts in Security Studies (Europe and Eurasia)

Advisor: David Yost, Department of National Security Affairs

Co-Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs

The advent of cyberspace has created a new, unregulated dimension of warfare, which the North Atlantic Treaty Organization (NATO) has striven to manage. This thesis raises the following question: To what extent is NATO cybernetically, politically, militarily, and economically prepared to respond to a major act of cyberwar against one or more of its members? The thesis evaluates NATO's level of preparedness across seven areas: cyber strategy, cyber cooperation, decision making, political will, crisis management, defense spending, and defense policy prioritization. The thesis concludes that NATO is moderately prepared to respond effectively to a major act of cyberwar launched against one or more of the allies. NATO's implementation of its cyber policies and cooperative partnerships probably make it cybernetically prepared to address major acts of cyberwar; however, challenges with decision making, public support, crisis management, defense spending, and defense policies could make NATO less than optimally effective in responding with force to acts of cyber aggression that rise to the level of a conventional armed attack. The thesis recommends that NATO enhance its efforts in cyber strategy development, cyber cooperation, decisional delegation, strategic messaging, and defense spending to address challenges resulting from the evolving complexity and heterogeneity of cyber incidents.

[Full Text](#)

Keywords: North Atlantic Treaty Organization, NATO, Washington Treaty, North Atlantic Treaty, Article 5, collective defense, consensus, cyber, cyberattack, cyberwar, cybersecurity, hybrid, cyber readiness, conventional armed attack, kinetic attack, Wales Summit, Warsaw Summit

CRIMSON TIDE: COMPARING CHINESE NAVAL EXPANSION WITH EXISTING NAVAL POWERS

Erik Guiremand—Lieutenant, United States Navy

Master of Arts in Security Studies (Near East, Southeast Asia, the Pacific)

Advisor: Christopher Twomey, Department of National Security Affairs

Second Reader: Daniel Moran, Department of National Security Affairs

As China continues its comprehensive military modernization program, the 2015 Annual Report to Congress on Military and Security Developments Involving the PRC, published by the Office of the Secretary of Defense, has expressed concerns that China's military modernization has the potential to reduce core U.S. military technological advantages. In order to put this concern into a broader context, this thesis asks: how does China's navy compare to navies of existing powers? With China's naval expansion in mind, this thesis compares the People's Liberation Army (Navy) (PLAN) to other modern naval powers to determine if China's force structure resembles a regional navy that is built primarily for power projection, sea denial, or sea line of communications (SLOC) defense. Comparative case studies are used to contextualize China's naval modernization by identifying characteristics of archetypal navies built for sea denial, power projection, and SLOC defense. The Royal Swedish Navy is analyzed as a navy

that specializes in sea denial, the French Navy is analyzed as a navy that specializes in power projection, and the Japanese Maritime Self Defense Force is analyzed as a navy that specializes in SLOC defense. This thesis finds that China is primarily pursuing a maritime strategy centered on SLOC defense, but is also capable of employing a sea denial strategy in its near seas. [Full Text](#)

Keywords: Chinese naval modernization, People’s Liberation Army (Navy), sea denial, power projection, SLOC defense, maritime strategy, Royal Swedish Navy, French Navy, Japanese Maritime Self- Defense Force

THE PURSUIT OF ECONOMIC STRENGTH HAS STABILIZING EFFECTS IN THE SOUTH CHINA SEA

Michael Gussenhoven–Commander, United States Navy

Master of Arts in Security Studies (Near East, Southeast Asia, the Pacific)

Advisor: Michael Malley, Department of National Security Affairs

Second Reader: Daniel Moran, Department of National Security Affairs

Are Vietnam and the Philippines trending more toward conflict or cooperation with China over disputed territories and resource claims in the South China Sea? This thesis investigates realist and liberal international relations theories applied to three states involved in South China Sea disputes. It reviews the history of South China Sea disputes between China, Vietnam, and the Philippines since 1988 and reviews the states’ growing economic interconnectedness to determine whether they have trended toward armed conflict or if economic interdependence has led the states toward cooperation to manage their overlapping claims. This thesis concludes that China, Vietnam, and the Philippines have trended neither toward armed conflict nor cooperation to manage their South China Sea territory and resource disputes. Despite increasing tensions over the competition for territory and resources, the states have managed their disputes peacefully and have avoided armed conflict since 1988. Furthermore, despite increasing asymmetric economic interdependence between the smaller states and China correlating to the period of relative peace in the South China Sea, the states have rarely cooperated with one another to manage their disputes. Asymmetric economic interdependence between the smaller states and China, however, has contributed to the relative peace in the South China Sea. [Full Text](#)

Keywords: South China Sea, China, Vietnam, the Philippines, economic interdependence, territory and resource disputes

MARITIME CYBERSECURITY: THE FUTURE OF NATIONAL SECURITY

Christopher Hayes–Lieutenant, United States Navy

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

Advisor: Erik Dahl, Department of National Security Affairs

Second Reader: Wade Huntley, Department of National Security Affairs

Cybersecurity in the 21st century is constantly evolving and changing in order to meet today’s threats. The maritime industry in the United States is no different than any other organization that can fall under a cyberattack. Currently, no major cyber threat has threatened the maritime community in the United States or national security. Recent attempts to disrupt the flow of the maritime industry, however, legitimize fears over maritime cyber-attacks. The United States has significant shortfalls in maritime cybersecurity. This thesis evaluates U.S. ports and strategies against those of the European Union to examine the impact of cyber issues on the United States and its national security. The maritime

community is not cyber resilient and has no specific guidelines or responses in place to deter or prevent a major cyber-attack on the United States. For the United States to maintain its cyber resilience and normal operations at its ports, the global maritime community must address the issues together to maintain global maritime dominance. [Full Text](#)

Keywords: maritime, maritime cybersecurity, national security, ports, terminals, coast guard

A SOUTH CHINA SEA ADIZ—VIETNAM’S NEXT CHALLENGE

Duc Ho—Major, United States Air Force

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: Michael Malley, Department of National Security Affairs

Second Reader: Robert Weiner, Department of National Security Affairs

When China declared its East China Sea (ECS) Air Defense Identification Zone (ADIZ) in November 2013, the declaration sparked fears that it would soon implement similar zones over the South China Sea (SCS), further exacerbating tensions in the region. Since Vietnam is projected to be the country most affected by China’s SCS ADIZ, this thesis focuses on how Vietnam’s leaders might respond. To do so, this thesis reviews reactions from Japan, South Korea, and Taiwan during the 2013 ECS ADIZ crisis to identify a range of possible responses for Vietnam. It then explores how Vietnam has responded to past territorial disputes from China—both land and maritime—to identify similar challenges that an ADIZ might pose. Finally, it analyzes the range of responses within the context of Vietnam’s current strategies toward China. Research reveals that Vietnam has four major policy options: bilateral diplomacy, multilateralization/arbitration, complete defiance, and a mixture of civilian appeasement and military nonrecognition. The policy option Vietnam chooses will depend largely on its leadership preferences as well as domestic and geopolitical factors. [Full Text](#)

Keywords: ADIZ, SCS ADIZ, ECS ADIZ, South China Sea, East China Sea, Vietnam

A STUDY ON THE DECISION FACTORS IN THE DELAY OF THE ROK–U.S. WARTIME OPCON TRANSFER: FOCUSING ON THE DOMESTIC DETERMINANTS

Jinhak Jung—Captain, Republic of Korea Army

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: Wade Huntley, Department of National Security Affairs

Second Reader: Robert Weiner, Department of National Security Affairs

This thesis begins by asking why the wartime OPCON transfer period between the ROK and the United States has continuously been delayed. To answer this question, the author studies how domestic politics have affected the continuous delay. To investigate the influence of domestic politics, this thesis first applied Graham Allison’s Rational Actor Model (security); second, it applied domestic politics from Allison’s bureaucratic politics model; and third, to fill a gap between security (RAM) and domestic politics, this thesis used Robert Putnam’s Two-Level Game theory to clarify interconnectivity of international and domestic levels. The result of this study indicates that the security environment is critical and could affect the continuous delay of the wartime OPCON transfer; however, the key actors of those decisions are policy decision makers. Unless the security environment changes drastically, the ROK conservatives and progressives, and the U.S. neoconservatives and pragmatists, will remain key members. The ROK, with its strong ally—the United States—should meticulously prepare the process of

the wartime OPCON transfer to maintain the peace of the Korean Peninsula under unexpected political and economic situations, mainly focusing on the future-oriented combined ROK–U.S. military structure.

[Full Text](#)

Keywords: wartime OPCON transfer, condition-based wartime OPCON transition, ROK–U.S. alliance

INDIAN, JAPANESE, AND U.S. RESPONSES TO CHINESE SUBMARINE MODERNIZATION

David Kiser–Lieutenant Commander, United States Navy

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: James Moltz, Department of National Security Affairs

Second Reader: Christopher Twomey, Department of National Security Affairs

Nations in the Asia-Pacific region are modernizing their naval fleets, and many are choosing to use submarines as the centerpiece of these plans. China, one of the most influential nations in the region, has upgraded its submarine force, and it is important to analyze the impact this modernization effort will have on the stability of the region. India, Japan, and the United States are closely watching the submarine force of the People’s Liberation Army Navy (PLAN) to better understand China’s intentions writ large and the implications they have for security. All three nations have reacted in response to the PLAN’s modernization goal. This thesis concludes that the most effective policy going forward would be a balanced combination of both hard and soft hedging, including dialogue with the PLAN, to defend allied security interests but also to provide avenues for promoting future regional stability. [Full Text](#)

Keywords: submarines, China military, Japan-military, India-military, U.S. military

WHAT ARE WE MISSING? A CALL FOR RED TEAMING WITHIN THE DOMESTIC MARITIME DOMAIN FOR ANTI-TERRORISM PROGRAMS

Timothy List–Commander, United States Coast Guard

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

Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs

Second Reader: Lauren Wollman, Center for Homeland Defense and Security

As a component of the Department of Homeland Security and the department’s lead for maritime security, the Coast Guard is charged with executing the United States domestic maritime anti-terrorism program. It is critical that Coast Guard policy, plans, and tactics maintain pace with the ever-changing risks associated with terrorism. This thesis examines alternative analysis red teaming and its potential value to the Coast Guard. Specifically, it seeks to answer how red teaming can be leveraged to enhance the value of domestic maritime anti-terrorism activities. The research reviews elements of the maritime domain and principles of red teaming, and proposes and provides implementation recommendations for a terrorism red teaming program for the domestic maritime domain. The study revealed that a red team program would be value added to the Coast Guard for domestic maritime anti-terrorism programs. Leveraging the concept of a minimal viable program, the thesis proposes a red team program and strategy to implement the program within the U.S. Coast Guard. The suggested program would be comprised of three elements: physical red teaming, identification of future attack scenarios, and policy red teaming. The thesis further provides insight into the implementation of these programs and suggests a minimal viable program approach to establishing a terrorism red teaming program for the domestic maritime domain. [Full Text](#)

Keywords: alternative analysis, red teaming, homeland security risk, domestic maritime domain,

maritime terrorism, minimal viable program, social identity theory, port security, Coast Guard

HACKING YOUR RIDE: IS WEB 2.0 CREATING VULNERABILITIES TO SURFACE TRANSPORTATION?

Cedric Novenario—Transportation Services Manager, City of Los Altos, CA

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

Advisor: Wayne Porter, Global Public Policy Academic Group

Second Reader: Robert Schroeder, Department of Defense Analysis

The purpose of this thesis is to determine the threats that social media and social navigation (SMSN) pose to the surface transportation system. The research catalogs the types of threats and SMSN's vulnerabilities, and uncovers terrorists' malign use of social media for intelligence gathering. Academic researchers have already discovered threats in social navigation platforms such as Waze and Google Maps; Sybil and man-in-the-middle attacks allow malicious actors to create traffic congestion and alternate vehicle routing. While this has not yet caused an attributable security concern to the vehicle surface transportation system, in the hands of malicious actors, these vulnerabilities could be exploited to orchestrate an attack that devastates infrastructure and risks human lives. [Full Text](#)

Keywords: social media, social navigation, Web 2.0, surface transportation security, vehicle transportation security, Waze, Google Maps, traffic congestion, traffic management security, transportation security vulnerabilities, transportation security threats

PROSPECTS FOR FINLAND AND SWEDEN TO PURSUE CLOSER DEFENSE COOPERATION WITH NATO

Daniel Pedrotty—Lieutenant, United States Navy

Master of Arts in Security Studies (Europe and Eurasia)

Advisor: David Yost, Department of National Security Affairs

Second Reader: Wayne Porter, Global Public Policy Academic Group

This thesis examines the potential advantages for Finland and Sweden in pursuing closer cooperation with the North Atlantic Treaty Organization (NATO) and possible membership. The security policy objectives of Finland and Sweden have largely been defensive in nature: to ensure national survival and protection of sovereignty. With the exception of Finland's opposition to the Soviet Union's aggression in 1939–1940 and 1941–1944 to defend its national independence, both countries have remained neutral in foreign and security policies. Sweden's geopolitical situation is advantageous in that the Baltic Sea hinders invasion and the country has positive relations with its immediate neighbors. In contrast, Finland shares a lengthy border with Russia and has a complex history of relations with Moscow. In 2009, Sweden pledged a Declaration of Solidarity that protects its neighboring Nordic states as well as European Union (EU) member states in an effort to strengthen and preserve peaceful relations and stability. The thesis concludes that the benefits of closer cooperation with the Alliance and possible membership, notably collective defense protection under Article 5 of the North Atlantic Treaty, are substantial. Russia's recent aggressive behavior may lead Finland and Sweden to seek closer cooperation with NATO and to give greater attention to the option of membership. [Full Text](#)

Keywords: NATO, EU, Finland, Sweden, Russia, defense cooperation, collective defense, deterrence, solidarity, security, neutrality, non-alignment, membership, expansion, SFNTG, EDA, PfP, EMU, OSCE,

NORDAC, NORDCAPS, NORDEFECO, A2/AD, CSDP, CFSP, FCMA, USSR, EDA, EEZ, DDoS, CIS, CCDCOE, C4I, ISR, EU BG, EC, SECGEN, economic interdependence, Lisbon Treaty, Article 42.7, Article 5

THE ADVANCED SURFACE FORCE FLEET: A PROPOSAL FOR AN ALTERNATE SURFACE FORCE STRUCTURE AND ITS IMPACT IN THE ASIAN PACIFIC THEATER

Scott Richards, Jr.—Lieutenant, United States Navy

Master of Arts in Security Studies (Far East, Southeast Asia, the Pacific)

Advisor: Daniel Moran, Department of National Security Affairs

Co-Advisor: Jeff Kline, Department of Operations Research

This thesis addresses how an alternate surface fleet composed of aircraft carriers (CVNs), guided missile destroyers (DDGs), and enhanced San Antonio class amphibious transport dock ships (eLPD 17s) of an equal replacement procurement cost compare in 14 measures of capabilities to the planned 2040 U.S. fleet, and how the two fleets compare in Asian Pacific Theater operations. The estimated procurement costs for the proposed eLPD 17 class ship and for the Navy's planned 2040 fleet, and the composition of the equal procurement cost alternate fleet, the Advanced Surface Force Fleet, are determined. The two fleets are then compared using three different matrices: 14 measures of capabilities, the capability to conduct humanitarian assistance and disaster relief operations, and the capability to defeat an adversary in a maritime conflict. The Advanced Surface Force Fleet has more offensive capability than the Navy's planned 2040 fleet. Furthermore, the eLPD 17 provides the Navy with an amphibious ship that can act autonomously in contested environments, with more surface ships that have offensive capability, and with a warship that can perform conventional surface combatant roles while maintaining the ability to perform traditional amphibious lift capabilities. [Full Text](#)

Keywords: force structure analysis, sea shield, sea strike, naval expeditionary maneuver warfare, ground and sea vehicle, power projection and integrated defense, expeditionary and irregular warfare, bilateral and multilateral security building, modeling future conflicts, U.S. and allied security policies, planning and strategy

U.S. AND NATO NAVAL ENGAGEMENT WITH RUSSIA IN THE BLACK SEA: HISTORICAL PATTERNS AND CURRENT PROSPECTS

Alex Schneider—Lieutenant, United States Navy

Master of Arts in Security Studies (Europe and Eurasia)

Advisor: David Yost, Department of National Security Affairs

Second Reader: Mikhail Tsypkin, Department of National Security Affairs

Since Russia's annexation of Crimea in March 2014, the United States and its NATO Allies have increased their military presence and exercises in the Black Sea focused on deterring Russian aggression or coercion. Russia has also increased the number and magnitude of its exercises in the region. In some interactions in this region, Russia has acted in an unprofessional manner and has engaged in provocative conduct against U.S. and NATO military units to an extent that has placed future U.S.—Russian and NATO—Russian relations into question. This thesis analyzes how Russia's ambitious military maneuvers and the subsequent U.S.—NATO responses have resulted in a security dilemma in the Black Sea region. Russia's Black Sea Fleet buildup and modernization program will generate new economic and security concerns that the United States and NATO will confront as Russia's military capabilities expand in the

region. Despite the NATO Allies' attempts to establish cooperation and open dialogue with Russia, Moscow seems unwilling to reciprocate. Until Russia engages in cooperation and open dialogue with the NATO Allies, the security dilemma will persist, and it may result in a possible flashpoint in the Black Sea region. [Full Text](#)

Keywords: North Atlantic Treaty Organization, European Union, Russia, military exercises and interactions, Black Sea Fleet, Black Sea

CHINESE AND RUSSIAN POLICIES ON CLIMATE CHANGE: IMPLICATIONS FOR U.S. NATIONAL SECURITY POLICY

David Sechrist–Lieutenant Commander, United States Navy

Master of Arts in Security Studies (Europe and Eurasia)

Advisor: David Yost, Department of National Security Affairs

Second Reader: Naazneen Barma, Department of National Security Affairs

Since the conclusion of the 1997 Kyoto Protocol negotiations, the Chinese government has been steadily increasing measures for the reduction of its greenhouse gases (GHG) emissions. Meanwhile, the Russian government has been extremely hesitant to even acknowledge humanity's role in climate change. This thesis investigates why China and Russia have chosen to take such divergent paths regarding climate change after compliance obligations were established at Kyoto. The factors considered include shifts in national public opinion regarding climate change, economics, demographics, expected future effects of global warming, resources, and the Kyoto Protocol itself. The case studies of Chinese and Russian climate change policies and programs highlight three significant factors in the divergence: 1) the Kyoto Protocol, which set the initial policy baselines for both countries; 2) geography and demography, which forced China to take actions to combat climate change since it is half the size of Russia but has roughly ten times as many people; and 3) the lengthy and continuous leadership of Russia's current president, Vladimir Putin, who has held the position of either president or prime minister since 1999 and has taken virtually no action to combat climate change. [Full Text](#)

Keywords: climate change, China, Russia, U.S. National Security Policy

GPS: PUBLIC UTILITY OR SOFTWARE PLATFORM?

Marc Thibault– Program Analyst, United States Coast Guard

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

Advisor: Rodrigo Nieto-Gomez, Department of National Security Affairs

Second Reader: Lauren Wollman, Center for Homeland Defense and Security

The Global Positioning System (GPS), a satellite navigation system, is critical to the United States' national and homeland security. The United States has made GPS resilient to interruption by flying more satellites than required, dispersing its infrastructure, and increasing its signals. Despite these efforts, there is concern that the United States may not be able to overcome disturbances in GPS's operations. Limitations in GPS data and the policy literature prevent the full quantification of exactly how vulnerable GPS is to service interruption. This thesis used constant comparison analysis to examine how a shift in conceptual lens from viewing GPS as a public utility to viewing it as a software platform has changed our understanding of its criticality, resilience, and vulnerability. This methodology overcomes research limitations by using GPS system design, operations, and policies as its data sources. The public utility

lens reveals that the United States has increased GPS resilience through system design and redundancies. The software platform lens shows that the United States further increased GPS resilience by adding navigation signals. Together, the lenses indicate that manufacturers, application developers, and users constrain GPS's increasing resilience. Additional data, models, and research are required to inform policies and decisions to further improve GPS's resilience. [Full Text](#)

Keywords: Global Positioning System (GPS), Global Navigation Satellite Systems (GNSS), Positioning Navigation and Timing (PNT), global utility, public utility, software platform, GPS resilience, GPS augmentation system, disruption of GPS

BUILDING AUTOMATION SYSTEM CYBER NETWORKS: AN UNMITIGATED RISK TO FEDERAL FACILITIES

Shawn Tupper—Senior Special Agent, U.S. Department of Homeland Security

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

Advisor: Kathleen Kiernan, Center for Homeland Defense and Security

Co-Advisor: John Rollins, Center for Homeland Defense and Security

The General Services Administration accesses building-automation system technology that runs federal facility processes such as HVAC, lighting, elevators, and access control via active Internet connections. Currently, these networks are not secure, despite legislation requiring them to be. This thesis investigated whether the Department of Homeland Security (DHS) could leverage existing federal laws, presidential directives, executive orders, government frameworks, and its current cyber and investigative capabilities to establish a strategy to secure federal facility building-automation system cyber networks, or if additional resources are needed. The research uncovered significant vulnerabilities and threats to federal facility building-automation system networks, which, if exploited, could cause a significant impact on the American people, who are dependent on services offered by federal agencies such as the Department of Veterans Affairs and the Social Security Administration. A qualitative research method was used to interpret and analyze government and nongovernment institutional studies and reports, existing cybersecurity frameworks, and scholarly journals to determine which of the policy options offered would provide the best strategy for the DHS moving forward. The thesis concluded that utilizing a combination of private contractors and existing DHS assets would provide the best option. [Full Text](#)

Keywords: industrial control systems, building automation systems, cybersecurity, Federal Protective Service (FPS), United States Secret Service (USSS), Industrial Control Systems Cyber Emergency Response Team (ICS-CERT), General Services Administration (GSA), Shodan, EINSTEIN, CSET, DHS, Department of Homeland Security

CHINA'S SOFT POWER: CHANGING THE WORLD PERCEPTION

This paper has been recognized as outstanding by its department

Chaudhry Ullah—Lieutenant Colonel, Pakistan Army

Master of Science in Defense Analysis and Master of Arts in Security Studies (Middle East, South Asia, Sub-Saharan Africa)

Advisor: Leo Blanken, Department of Defense Analysis

Second Reader: Feroz Khan, Department of National Security Affairs

China has focused on improving its image in the world by relying more on its soft power by investing billions of dollars simply to convince the world to accept its rise in the international system. This paper

uses both quantitative and qualitative methods in order to grade and assess China's success with these efforts. While I could not find any significant relationship between China's tools of soft power and its positive perception building in the international community, I could also not find any significant effect of China's rise on its negative perception building among the international community. This may, in and of itself, be a significant result. More specifically, the research reveals that many of the ideals held by China significantly clash with existing international norms—that China lacks credibility in the exercise of its public diplomacy, and that China relies too heavily on the attractiveness of its culture. [Full Text](#)

Keywords: China, soft power, Asia, Africa, Latin America, China threat, culture, public diplomacy, foreign policy, peaceful rise, win-win strategy, peaceful development, energy, oil, great power, noninterference policy, resources, Beijing Consensus

MASTER OF BUSINESS ADMINISTRATION

ANALYSIS OF THE CAPABILITIES SUPPORTING HUMANITARIAN ASSISTANCE AND DISASTER RELIEF OPERATIONS OF THE INDONESIAN NAVY AND THE UNITED STATES MARINE CORPS MARINE EXPEDITIONARY UNIT

M. Reza Achwandi—Lieutenant Commander, Indonesian Navy

Danny Hamler—Captain, United States Marine Corps

Todd Hoyt—Captain, United States Marine Corps

Master of Business Administration

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

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

The 2014 Quadrennial Defense Review emphasized the importance of the Humanitarian Assistance/Disaster Relief (HA/DR) mission in rebalancing the Asia-Pacific region. The coupling of the U.S. pivot to the Pacific and the frequency of natural disasters in the vicinity of Sumatra, Indonesia, focused this research project on the disaster response capabilities of the Indonesian Navy (Tentara Nasional Indonesia Angkatan Laut [TNI AL]) and the United States Marine Corps—Marine Expeditionary Unit (USMC MEU). To examine the gaps between demand and supply, we derived potential demand through the analysis of historical HA/DR scenarios while garnering potential supply through a study of the TNI AL and USMC MEU organic assets. Through this analysis, we created a capabilities matrix to capture and present both the quantitative and qualitative aspects of HA/DR demand and available responder supply. This matrix encompasses the general categories of personnel, material, logistics, and communication, and how these categories affect the availability of medical support, sustenance, habitat, and infrastructure. The completed matrix identified regional capability shortfalls that can be addressed to increase future HA/DR responsiveness. These include the procurement of additional vertical lift, the pre-positioning of critical supplies, and the building of population resiliency. [Full Text](#)

Keywords: humanitarian assistance, disaster relief, disaster preparedness, capabilities and competencies, collaboration and coordination, military to military partnerships, military capabilities

NAVY ADVERTISING: TARGETING GENERATION Z

David Anderson—Captain, United States Marine Corps

Kenneth Conover—Captain, United States Marine Corps

Jason Jackson—Lieutenant Commander, United States Navy

Edwin Santibanez—Captain, United States Marine Corps

Master of Business Administration

Advisor: Robert Eger, Graduate School of Business and Public Policy

Co-Advisor: Thomas Albright, Graduate School of Business and Public Policy

This study recommends improvements for Navy advertising efficiency by examining characteristics of recruits defined as Generation Z. Data gathered from five waves of the New Recruit Survey, covering September 2012 to April 2015, were separated into two groups by age, with ages 17–21 representing Generation Z recruits and those over 21 as the Other generation. Four main analysis questions centered on parental influences, social media habits, and advertisements received or viewed by the recruits. Our research found that Generation Z places a high value on parental input, suggesting that advertising directly to parents may be a viable option. The research also showed that recruits recall seeing Navy

advertisements on television and on the Internet far more than on any other medium; all new recruits, on average, consume advertising media the same way across different formats; print readership (mediums such as newspapers, magazines, and books) seems to be declining over time. Further research should continue to use the New Recruit Survey and link responses to the Navy's 3C1L Recruiting and Advertising budget. [Full Text](#)

Keywords: Generation Z, advertising, Navy recruiting, New Recruit Survey

LPTA VERSUS TRADEOFF: ANALYSIS OF CONTRACT SOURCE SELECTION STRATEGIES AND PERFORMANCE OUTCOMES

Jacob Baker—Lieutenant Commander, United States Navy

Michael Bono—Lieutenant Commander, United States Navy

Justin DeVoe—Lieutenant Commander, United States Navy

Master of Business Administration

Advisor: Karen Landale, Graduate School of Business and Public Policy

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

The Department of Defense (DOD) spends hundreds of billions of dollars annually to procure highly complex weapon systems, supplies, and services. Due to recent budget constraints, DOD stakeholders are closely examining the strategies and methodologies contracting professionals employ to acquire what the DOD needs. Contracting professionals may use lowest price technically acceptable (LPTA) and tradeoff strategies to procure requirements to maximize the overall best value to the government. The purpose of this research is to determine if a relationship exists between the contract source selection strategy employed, either LPTA or tradeoff, and the contract pre-award and post-award performance metrics. Data were collected from contract files located at Naval Sea Systems Command to determine the potential relationship between LPTA and tradeoff performance metrics. The findings of this research suggest that not enough data were collected to answer the research questions. However, the data contained in this report will be incorporated into a pool of data gathered from previous research efforts to provide adequate statistical power to answer the research questions. The report concludes with recommendations for further research. [Full Text](#)

Keywords: contracting, contract management process, source selection, lowest price technically acceptable, tradeoff

AN INQUIRY INTO THE RESILIENCE OF U.S. NAVY RECRUITS

Christopher Burt—Lieutenant Commander, United States Navy

Ian Barr—Lieutenant, United States Navy

Master of Business Administration

Advisor: Edward Powley, Graduate School of Business and Public Policy

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

The purpose of this study is to develop a better understanding of resilience in U.S. Navy recruits as they go through basic training. We seek to examine factors that contribute to higher or lower levels of resiliency. This study surveyed 299 U.S. Navy recruits to measure resilience and its constructs at four time intervals to examine relationships, trends, and any significant changes. This project used quantitative analysis techniques to surface factors relevant to increasing resiliency. Our results provide

insight to increases in resilience trends and a path model, which investigates causation. Resilience trends demonstrate the possibility to increase resilience capacity through external factors. The important takeaway is we believe results further affirm that resilience may be learned and is not entirely a personality trait. Additionally, a path model found leadership moderated through cohesion and identification can positively impact division resilience. Our results also provide insight for recommended interventions that will focus on leadership, cohesion, and positive framing to increase the resilience capacity of new recruits. We feel that building resilience is essential to producing Sailors that are always ready to execute the Navy's mission. [Full Text](#)

Keywords: naval training command, recruits, basic training, resilience, leadership, cohesion, identification

A BASELINE ANALYSIS OF COMBAT LOGISTICS FORCE SCHEDULING EFFICIENCY

Michael Cribbs—Lieutenant, United States Navy

Master of Business Administration

Advisor: Daniel Nussbaum, Department of Operations Research

Second Reader: Bryan Hudgens, Graduate School of Business and Public Policy

Combatant ships in the Fifth Fleet sphere of operations depend upon Military Sealift Command (MSC) to supply stores and fuel while they are underway. Scheduling the delivery of supplies has predominately been customer driven, which has led to inefficiencies in the utilization of MSC resources. The introduction of Replenishment at Sea Planner (RASP) in 2013 provided a new tool that is expected to increase efficiency of scheduling operations by reducing scheduling errors and manpower needed for fulfillment. The purpose of this research is to analyze data from Fifth Fleet collected before and after RASP with a goal of establishing a baseline efficiency in Combat Logistics Force (CLF) ship utilization. Supply and demand models were built over the data sets, presenting an interesting view of the disproportion of available commodities available to customers. Efficiencies were compared before and after RASP, resulting in a recommendation that the Fast Combat Support Ship (AOE) be the ship of choice due to better efficiency and cost to deliver commodities to the warships in the Fifth Fleet area of responsibility. The trends from the data were mostly inconclusive, however; as a result, this paper recommends expanding the research years for further data analysis to include 2011, 2012, 2014, and 2016. [Full Text](#)

Keywords: logistics, Military Sealift Command, efficiency, freight rates, Combat Logistics Force, replenishment at sea, replenishment at sea planner, coalition support, supply and demand

A COST–BENEFIT ANALYSIS BETWEEN THE CURRENT NAVAL OFFICER RETENTION BONUS PLAN AND THE ENLISTED RETENTION BONUS PLAN

Donald Freeman—Commander, United States Navy

Nicholas Zerler—Lieutenant Commander, United States Navy

Master of Business Administration

Advisor: Amilcar Menichini, Graduate School of Business and Public Policy

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

The current fiscal constraints and increased operational tempo over the last decade have placed a strain on the U.S. Navy and the potential retention of sailors. On September 12, 2014, in an interview with the

U.S. Naval Institute, Vice ADM Bill Moran, Deputy Chief of Naval Operations for Manpower, Personnel, Training, and Education, stated that he has seen signs of a looming sailor exodus. The exodus could be as bad as the post-Cold War period and just before the terrorist attacks of September 11, 2001. This project is a cost–benefit analysis between the current officer-retention bonus plan and the enlisted-retention bonus plan. To aid in the improvement of retention-targeted bonuses across the Navy, our research focuses on the retention rates and effectiveness of current bonus structures, the timing of those bonuses, and internal and external factors affecting retention. [Full Text](#)

Keywords: retention, bonus

CONTRACT SOURCE SELECTION: AN ANALYSIS OF LOWEST PRICE TECHNICALLY ACCEPTABLE AND TRADEOFF STRATEGIES

David Hill–Lieutenant, United States Navy

David Odom–Lieutenant, United States Navy

Jamal Osman–Lieutenant Commander, United States Navy

Wesley Paulk–Lieutenant, United States Navy

Master of Business Administration

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

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

Source selection planning is an important step within the acquisition process. Use of an appropriate source selection strategy is key to minimizing risk and ensuring best value for all stakeholders. On the basis of thorough market research, acquisition professionals must decide at an early stage which source selection strategy (lowest price technically acceptable or tradeoff) to utilize in order to achieve a best value contract award. This research attempts to determine if a relationship exists between contract outcomes (e.g., procurement administrative lead-time, Contractor Performance Assessment Reporting System ratings, and earned value management assessments) and source selection strategy. This research is part of an ongoing research stream. Our research incorporates new data extracted from a large sample of contracts at the Space and Naval Warfare Systems Command and Naval Supply Systems Command. The results suggest there is a relationship between source selection strategy and procurement administrative lead-time. However, there is not yet sufficient data to confirm if a relationship exists between source selection strategy and Contractor Performance Assessment Reporting System ratings, or between source selection strategy and federal supply codes at different systems commands. Future research should focus on gathering more empirical data to assess these relationships. [Full Text](#)

Keywords: contract outcomes tradeoff, lowest price technically acceptable, best value contract management process, source selection strategy

THE COST OF COMMONALITY: ASSESSING VALUE IN JOINT PROGRAMS

This paper has been recognized as outstanding by its department

Rustin Jessup—Major, United States Army

Jamal Williams—Major, United States Army

Master of Business Administration

Advisor: Jesse Cunha, Graduate School of Business and Public Policy

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

In the 21st century, Major Defense Acquisition Programs (MDAPs) have become increasingly joint efforts. This trend has led to expanding program complexities and interdependencies. The resulting cost, schedule, and performance risks often counterbalance, and potentially outweigh, the efficiencies gained through interservice program designs. We define these risks as the cost of commonality. Such costs are often unquantified in cost-benefit analyses in the defense acquisitions process. In this project, we first review the results of three joint MDAPs to evaluate ex-post indications of programmatic shortfalls resulting from commonality costs. We then propose a unique cost-effectiveness model to assess value in joint programs from a broader portfolio perspective. Finally, we apply our Joint Value Model to the Joint Light Tactical Vehicle program as a case study to validate the concept. The Joint Value Model provides a means for managers to evaluate cost-effectiveness in the portfolio context and compare meaningful differences among program alternatives. We recommend use of this model as a tool for program analysis at all stages of system development. [Full Text](#)

Keywords: commonality, cost, benefit, cost-benefit analysis, cost-effectiveness, joint, value, JLTV, JSF, JTRS, TFX, MDAP

EVALUATING THE MODERNIZATION OF MILITARY RETIREMENT

Jonathan Leung—Lieutenant Commander, United States Navy

Paul Notarnicola—Lieutenant Commander, United States Navy

Matthew Poss—Lieutenant, United States Navy

Master of Business Administration

Advisor: Amilcar Menichini, Graduate School of Business and Public Policy

Second Reader: Douglas Brinkley, Graduate School of Business and Public Policy

The purpose of this MBA Project is to examine the Final Report of the Department of Defense's Military Compensation and Retirement Modernization Commission that was released January 2015 and submitted to Congress and the President of the United States. We will evaluate the recommendation for implementing a modernized retirement system, consisting of a blended Defined Benefit and Defined Contribution Plan. The primary tool used to accomplish this goal was applying a Net Present Value (NPV) analysis based on the proposed recommendation, followed by comparing and contrasting the results of various scenarios to the current military retirement plan available to service members. [Full Text](#)

Keywords: military retirement, Net Present Value

A BUSINESS PROCESS ANALYSIS OF THE SURFACE NAVY'S DEPOT MAINTENANCE PROGRAM

Donald Northrup—Lieutenant, United States Navy

Master of Business Administration

Advisor: Nicholas Dew, Graduate School of Business and Public Policy

Second Reader: Matthew Kremer, Graduate School of Business and Public Policy

To maintain the Surface Fleet, the Navy spent approximately \$7.2 billion in FY2015 and requested \$7.8 billion for FY2016. In response to years of costs overruns and missed deadlines, the Navy wants to make better use of these funds by shifting from executing Multi-Ship Multi-Option Contracts with cost-plus fee types to Multi-Award contracts with fixed-price fees. The new contract choice will increase competition and shift risk to the contractor. This thesis conducts an in-depth analysis of the contract change process during execution of depot maintenance availabilities using five ships as case studies. It uses lean principles and lessons from buyer-supplier relationship studies to recommend improvements and to answer two questions. Is the Navy's current construct prepared to execute a new contract strategy? Is this the best decision to reduce cost and meet schedule requirements? The thesis concludes that process improvement is required before shifting to a new contract strategy, and that improving the working relationship with the contractor is paramount to process improvement. [Full Text](#)

ADDITIVE MANUFACTURING: AN ANALYSIS OF INTELLECTUAL PROPERTY RIGHTS ON NAVY ACQUISITION

Carrie Paben—Lieutenant Commander, United States Navy

Wendell Stephens Sr.—Lieutenant Commander, United States Navy

Master of Business Administration

Advisor: Douglas Brinkley, Graduate School of Business and Public Policy

Co-Advisor: Matthew Kremer, Graduate School of Business and Public Policy

The intent of this project was to advance previous research into the benefits and challenges of implementing additive manufacturing (AM) in the Navy. Specifically, this project focused on intellectual property (IP) rights, government rights, and the potential impact current laws and regulations may have on AM implementation into the Navy. Research was conducted in a three phases. First, statutory and regulatory laws relating to IP were reviewed to provide a foundation for research analysis. Next, Department of Defense and Navy regulations and policies and government AM and IP reports were reviewed to understand government data rights standards. Finally, a multi-case study analysis was conducted to determine private and public sector best practices in the management of IP associated with AM. This report concludes with recommendations for Navy management of IP and data rights related to AM. [Full Text](#)

Keywords: additive manufacturing, intellectual property, 3D

U.S. COAST GUARD CUTTER PROCUREMENT LESSONS' IMPACTS ON THE OFFSHORE PATROL CUTTER PROGRAM AFFORDABILITY

Barton Philpott—Lieutenant Commander, United States Coast Guard

Matthew Weber—Lieutenant Commander, United States Coast Guard

Master of Business Administration

Advisor: Fotis Papoulias, Department of Systems Engineering

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

The U.S. Coast Guard's upcoming acquisition of the Offshore Patrol Cutter (OPC) offers many opportunities to leverage recent procurement lessons to achieve the program's affordability requirement of \$310 million per hull. We explore the question of how lessons learned from the National Security Cutter (NSC) and Fast Response Cutter (FRC) procurement programs were applied to the OPC acquisition strategy to achieve affordability. We examine procurement lessons addressing management reforms, best practices in competition, contract structure, multiyear procurement, requirements generation, and test and evaluation. We employ a cost estimation model developed by Jeffrey Lineberry and first advanced in his 2012 work "Estimating Production Costs While Linking Combat Systems and Ship Design." We validate the Coast Guard's OPC cost requirement of \$310 million per hull using notional design data. We further illustrate the impact that varying specific design characteristics (speed, personnel, and length/beam) have on ship production cost. Finally, we conclude that the U.S. Coast Guard has successfully incorporated lessons from the NSC and FRC procurement programs into the OPC acquisition strategy, and we present a trade-off analysis that program managers may use in future source selection processes. [Full Text](#)

Keywords: acquisition management, affordability, Coast Guard, contract management, contract structure, homeland security, offshore patrol cutter, lessons learned, procurement, program manager, requirement, ship production, source selection, strategy, ship procurement, cutter procurement

ANALYSIS OF NAVAL AMMUNITION STOCK POSITIONING

David Sharp—Captain, United States Marine Corps

Eric Rossmanith—Captain, United States Marine Corps

Master of Business Administration

Advisor: Geraldo Ferrer, Graduate School of Business and Public Policy

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

Naval Supply Systems Command Global Logistics Support Ammunition (NAVSUP GLS AMMO) is considering an alteration of the current Navy ammunition stock positioning system. The purpose of this project is to analyze the cost and delivery performance risk associated with either centralizing the Navy's ammunition stockpiles and positioning them at an inland Army depot, or decentralizing the ammunition stockpiles and positioning them at coastal Navy facilities. A Monte Carlo simulation model was developed to simulate expected cost and delivery performance risk using historical demand data and rates provided by NAVSUP GLS AMMO. These measures of risk enable NAVSUP GLS AMMO to determine the probability that the centralized or decentralized system will outperform the status quo system with regard to cost and delivery performance. [Full Text](#)

Keywords: supply chain management, Monte-Carlo simulation, risk, delivery performance, stock positioning

MASTER OF SCIENCE

Master of Science in Applied Mathematics

AERIAL LOGISTICS MANAGEMENT FOR CARRIER ONBOARD DELIVERY

Samuel Chen—Lieutenant, United States Navy

Master of Science in Operations Research and Master of Science in Applied Mathematics

Advisor: Kyle Lin, Department of Operations Research

Co-Advisor: Wei Kang, Department of Applied Mathematics

Second Reader: Michael Atkinson, Department of Operations Research

Carrier onboard delivery (COD) is the use of aircraft to transport people and cargo from a forward logistics site (FLS) to a carrier strike group (CSG). The goal of this thesis is to study how the real-time cargo tracking capability can reduce the delay of high-priority cargo while increasing that of low-priority cargo. To do so, we analyze data from COD operations between 2010 and 2015 to develop a simulation model, and use those data to infer model parameters. Our simulation results indicate that, with two C-2A aircraft currently used by the Navy, real-time cargo tracking can reduce the delay of high-priority cargo by more than 50%, while increasing that of low-priority cargo by about 25%. The Navy plans to replace C-2A with a variant of V-22 Osprey for COD operations in the near future, and is conducting cargo space studies to facilitate this transition. By testing a few different model parameters based on studies available for V-22, our simulation results indicate a similar observation of delay tradeoff between high-priority cargo and low-priority cargo, although the tradeoff is less pronounced, mainly because three V-22 will be stationed at the FLS.

[Full Text](#)

Keywords: carrier onboard delivery (COD), C-2A Greyhound, CMV-22B Osprey, carrier strike group (CSG), forward logistics site (FLS), sea base, discrete event simulation (DES), stochastic

OPTIMIZING SEARCH PATTERNS FOR MULTIPLE SEARCHERS PROSECUTING A SINGLE CONTACT IN THE SOUTH CHINA SEA

Zachary Lukens—Lieutenant, United States Navy

Master of Science in Applied Mathematics

Advisor: Hong Zhou, Department of Applied Mathematics

Second Reader: Michael Atkinson, Department of Operations Research

Search and detection theory encapsulates a broad range of scenarios, from searching for lost car keys in a parking lot to prosecuting a submarine in the South China Sea. This research draws on oceanographic properties to develop search radii for two surface ships, searching for a submarine at various speeds, utilizing one of three search patterns: in-line spiral search, in-line ladder search, and a multi-path ladder search. Analysis reveals which parameters yield the highest probability of detection in a 14nm by 14nm search area based on the oceanographic properties at 21N 119E. [Full Text](#)

Keywords: search theory, undersea warfare, South China Sea, anti-submarine warfare

Master of Science in Applied Physics

THE DESIGN AND IMPLEMENTATION OF A PROTOTYPE SURF-ZONE ROBOT FOR WATERBORNE OPERATIONS

Manuel Ariza–Lieutenant, Colombian Navy

Master of Science in Applied Physics

Advisor: Richard Harkins, Department of Physics

Second Reader: Fabio Alves, Department of Physics

Three-dimensional (3D) simulation, Fused Deposition Modeling (FDM) technology and Computer Numerical Control (CNC) milling are used to design and implement a waterborne surf-zone robot prototype. This robot is an autonomous platform meant to be a test-bed for sensors and algorithms for future developments; a key enabler is its modular design. It combines the capabilities of an untethered Remotely Operated Vehicle (ROV) and an Unmanned Ground Vehicle (UGV), being able to transition between the maritime and ground environments. Components for the robot are modeled using Solidworks and later 3D printed or CNC milled in aluminum. A five-spoke Whег variant is used for mobility on land, and three thrusters in a typical ROV configuration (one vertical, two lateral) provide water mobility. Channels to direct water flow around the waterproof cylinder are implemented as a novel way to avoid a through hole for the vertical thruster. Modular design enables platform design modifications and sensors to be changed or added for different missions. All sensible actuators, sensors, cabling and parts are waterproofed to withstand the difficult conditions of the surf zone. [Full Text](#)

Keywords: surf-zone, robot, vehicle, unmanned, autonomous, platform, 3D printing, CAD, robotics, FDM technology, Solidworks, CNC milling, waterproof

EFFECTS OF RELATIVE PLATFORM AND TARGET MOTION ON PROPAGATION OF HIGH ENERGY LASERS

Hayati Emir–Lieutenant Junior Grade, Turkish Navy

Master of Science in Applied Physics

Advisor: Joseph Blau, Department of Physics

Co-Advisor: Keith Cohn, Department of Physics

To facilitate the study of engagement scenarios with high energy lasers, the Directed Energy Physics Group at the Naval Postgraduate School developed a laser performance code called Atmospheric NPS Code for HEL Optical pRopagation (ANCHOR). This code uses well-known analytical scaling laws and a scriptable user interface to allow the quick exploration of multi-dimensional parameter studies. Recently, a new capability was added that incorporates relative platform/target motion. This study demonstrates this new capability, and compares ANCHOR results with those obtained with the full diffraction code built into WaveTrain. [Full Text](#)

Keywords: directed energy weapons, high energy lasers, atmospheric propagation, relative platform, target motion

DESIGN AND ANALYSIS OF MEGAWATT CLASS FREE ELECTRON LASER WEAPONS

Weisheng Joseph Ng—Civilian, Singapore

Master of Science in Applied Physics

Advisor: Joseph Blau, Department of Physics

Co-Advisor: Keith Cohn, Department of Physics

Free Electron Lasers (FELs) are desirable for defense against a spectrum of threats, especially in the maritime domain, due to their all-electric nature, their wavelength tunability to atmospheric propagation sweetspots, and their scalability to megawatt class lasers. In this thesis, we exploit these characteristics to design, simulate, and analyze both amplifier and oscillator FELs using the FEL 4-D code developed by the Physics Directed Energy (DE) Group at the Naval Postgraduate School (NPS). Propagation analysis is performed on the designs using the Atmospheric NPS Code for High Energy Laser Optical Propagation (ANCHOR), also developed by the NPS Physics DE Group, to arrive at various lethality estimates that allow us to quantify the weapon's effectiveness in its operating domain. We conclude that megawatt class FELs, while lacking in technological maturity, would provide an effective defense, especially against hardened, time-critical threats such as sub-sonic and super-sonic anti-ship missiles. [Full Text](#)

Keywords: directed energy weapons, high energy lasers, Free Electron Laser, FEL oscillator, FEL amplifier, FEL modeling, atmospheric propagation modeling

POWER AND ENERGY STORAGE REQUIREMENTS FOR SHIP INTEGRATION OF SOLID-STATE LASERS ON NAVAL PLATFORMS

Joshua Valiani—Lieutenant, United States Navy

Master of Science in Applied Physics

Advisor: Joseph Blau, Department of Physics

Co-Advisor: Keith Cohn, Department of Physics

The U.S. Navy's interest in high-energy lasers (HELs) dictates the need for further study into the propagation of laser light through different atmospheric conditions. Due to the amount of energy required to power these laser weapons systems and the limited amount of available energy onboard ships, different energy storage systems need to be explored. For this research, two locations were studied: the coast of Cuba and the coast of Russia. These two locations were studied during moderate winter conditions for varying laser output power: 150 kW, 500 kW, and 1 MW. The laser performance code ANCHOR was used to estimate the number of successful HEL engagements that can proceed against a certain target using various configurations of energy storage as the laser output power is varied. [Full Text](#)

Keywords: energy storage, lithium-ion batteries, lead acid batteries, atmospheric propagation, laser, ANCHOR

Master of Science in Computer Science

RAPIDLY DEPLOYABLE MOBILE SECURITY SOLUTION

The following thesis was recognized as outstanding by its department

Liam Dorney—Lieutenant, United States Navy

Travis Miller—Lieutenant, United States Navy

Master of Science in Computer Science

Advisor: Man-Tak Shing, Department of Computer Science

Second Reader: Arijit Das, Department of Computer Science

The Navy has seen a significant increase in the presence of mobile and smart devices on its units due to advancements in technology and younger sailors' desire to be connected at all times. These devices create security threats due to their easily concealable size and their host of connectivity and image related features. The insider threat (intentional or not) now includes the ability to take photos, record conversations, share data wirelessly, and communicate official-use and classified information, all more easily than ever before. Current enterprise solutions and associated policy do not address managing personal devices. In fact, management of personal devices is currently outside the Department of Defense (DOD)'s effort to control personal electronic devices (PEDs) since the organization does not own the device and, therefore, has no way to mandate what must or must not be installed on them. The current path to a bring-your-own-device (BYOD) policy is unclear. Security vulnerabilities with these devices have not been addressed in a uniform matter in policy or in practice. It is with these statements in mind that we address how to take the first steps in developing feasible management of personal devices on naval units and potentially throughout the DOD. In this thesis, we provide a thorough evaluation of National Institute for Standards and Technology, Defense Information Systems Agency, and DOD publications to provide a starting point for adapting current policy and for guiding the development of our application. We then examine the feasibility of implementable software application solutions to hardware features that pose a threat to security. Specific research addresses why each hardware feature on a mobile device is a security concern, how it is controlled inside the Android Studio API, and how we utilize these controls to lockdown and then unlock said hardware features through a simple proof of concept Android application. Finally, we provide examples of how future work can grow our application into a security manager— controlled program to secure devices and find a path toward making BYOD a reality. [Full Text](#)

Keywords: mobile device, mobile security, android application program, bring your own device (BYOD), cyber security, cyber policy, insider threat, U.S. Navy cyber policy, risk management

SOFTWARE ARCHITECTURE FOR ANTI-SUBMARINE WARFARE UNMANNED SURFACE VEHICLES

Stephen Fahey—Lieutenant, United States Navy

Master of Science in Computer Science

Advisor: Luqi, Department of Computer Science

Second Reader: Winford Ellis, Undersea Warfare Academic Group

The U.S. Navy seeks to reduce costs associated with anti-submarine warfare (ASW) operations by exploring the use of unmanned surface vehicles (USVs). Currently, the process of finding submarines tends to be tedious and manpower-intensive due to the high volume of acoustic data with limited means to filter for valuable information. Therefore, innovative software frameworks are required to transition from a one-to-many to a many-to-one USV/ human interaction model. By examining potential

software frameworks, this thesis addresses many of the benefits and challenges inherent to using USVs in dynamic maritime environments. Furthermore, this evaluation provides a building block for the continued development of USV software systems. [Full Text](#)

Keywords: USV, ASW, autonomous systems, artificial intelligence, software architecture, unmanned systems

WIRELESS SENSOR BUOYS FOR PERIMETER SECURITY OF MILITARY VESSELS AND SEABASES

Stephen Kent—Captain, United States Marine Corps

Master of Science in Computer Science

Advisor: Gurminder Singh, Department of Computer Science

Co-Advisor: John Gibson, Department of Computer Science

Naval vessels at anchor and seabases are vulnerable to attack by small surface crafts. The past two decades have demonstrated that attacks of this type are indeed possible, and that current security measures may not be sufficient to mitigate such a threat. As technology matures, it should be implemented into providing security for these valuable naval assets. An example of technology to be incorporated is wireless sensor networks. These wireless sensor networks have been utilized in recent conflicts, in the form of unattended ground sensors, with a high degree of success. By incorporating these ground sensors in an open ocean environment, attacks by small surface crafts toward naval vessels and seabases may be precluded. The innovation of attaching wireless sensor nodes to buoys and positioning them around naval vessels to provide the necessary standoff against attack was investigated. Wireless sensor buoys were created using commercial-off-the-shelf products and existing prototype wireless sensor nodes. The tests that were conducted during this thesis determined that the current sensor nodes are suitable and could be implemented in creating an ad hoc network on an open ocean environment. Future work to include the addition of alternate sensor modalities and longer ranging networks should be investigated. [Full Text](#)

Keywords: Ad-Hoc Network, Adaptable sensor system, Expeditionary Force 21, Light Detection and Ranging, Passive Infrared, Scheduler and Asynchronous/Synchronous, seabase, Shared Information Space, Unattended Ground Sensors, Wireless Sensor Buoys, Wireless Sensor Network

FREE SPACE OPTICAL COMMUNICATION FOR TACTICAL OPERATIONS

Jin Wei Lai—Civilian, Singapore Technologies Kinetics Limited

Master of Science in Computer Science

Advisor: John Gibson, Department of Computer Science

Co-Advisor: Gurminder Singh, Department of Computer Science

The increasing demand for data bandwidth is a present and relevant issue for communications. Military communications further require secure connections for data transfer. The Free Space Optical (FSO) communication system, with its ability to connect at a high data rate, offers an appealing solution to the current need. Using laser technology and transmitting at a wavelength invisible to the human eye, FSO is difficult to detect and intercept, providing a highly secure means of communication. However, it faces the limitation of being a strictly line-of-sight communication technology and is known to be greatly affected by atmospheric attenuation. This thesis documents three experiments involving FSO technology, including the process of the experiment preparations, laser-related hazard assessment, and

implementation of a standard procedure to mitigate any possible risk. The contribution of this thesis is the acknowledgment that this proposed process is feasible. Experiments were conducted on an SA Photonics NEXUS 3 FSO Communications System. From the gathered results, the system was assessed to provide high throughput and low frame loss. Our work also ascertains that FSO is a technology that can become the next-generation means of military communications. Specifically, our findings indicate that the NEXUS has potential and merits further testing and development for military communications.

[Full Text](#)

Keywords: free space optics, communications, computer science, networking, laser communications

SERVER-BASED AND SERVER-LESS BYOD SOLUTIONS TO SUPPORT ELECTRONIC LEARNING

Brian McCarthy—Captain, United States Marine Corps

Joshua Benson—Captain, United States Marine Corps

Master of Science in Computer Science

Advisor: Man-Tak Shing, Department of Computer Science

Co-Advisor: Arijit Das, Department of Computer Science

Over the past 10 years, bring your own device has become an emerging practice across the commercial landscape and has empowered employees to conduct work-related business from the comfort of their own phone, tablet, or other personal electronic device. Currently in the Department of Defense, and specifically the Department of the Navy, no viable solution exists for the delivery of eLearning content to a service member's personal device that satisfies existing policies. The purpose of this thesis is to explore two potential solutions: a server-based method and a server-less method, both of which would allow Marines and Sailors to access eLearning course material by way of their personal devices. This thesis will test the feasibility and functionality of our server-based and server-less solutions by implementing a basic proof of concept for each. The intent is to provide a baseline from which further research and development can be conducted, and to demonstrate how these solutions present a low-risk environment that preserves government network security while still serving as a professional military education force multiplier. Both solutions, while demonstrated with limited prototypes, have the potential to finally introduce bring your own device into the Department of the Navy's eLearning realm. [Full Text](#)

Keywords: bring your own device, personal electronic device, server-based, server-less, untethered, eLearning

MESH NETWORKING IN THE TACTICAL ENVIRONMENT USING WHITE SPACE TECHNOLOGY

This paper has been recognized as outstanding by its department

Simon Sanchez—Captain, United States Army

Master of Science in Computer Science

Advisor: Geoffrey Xie, Department of Computer Science

Second Reader: John Gibson, Department of Computer Science

The transition of the military from wars within two known and established theaters to a focus on a dynamic and hastily occupied combat environment necessitates the need for a similarly dynamic and adaptable communications backbone. Traditionally, Army units have relied on either FM communications over short distances or expensive radios to communicate over long distances. FM

communications often require retransmission to extend their reach while expensive radio systems often rely on other resources such as satellites. The analog-to-digital television conversion saw the birth of white space spectral technology, which dynamically allocates unutilized spectral space within the television broadcast range to transmit data. This research explores the use of white space spectral technology in the creation of a dynamically established communications infrastructure for the purpose of repeating communications originating from numerous existing platforms in the tactical environment. A comparative analysis was conducted between an implementation of this technology, the Carlson Rural Connect, and similar solutions, specifically, a variant of the Harris 117G, currently available within the military in order to explore the merit of this technology for use as a communications relay in the tactical environment. The results obtained in these experiments demonstrate the potential use of white space technology as a repeater in the tactical environment. Though this potential exists, this technology requires time, a dedicated development effort, and additional testing and experimentation before it is refined enough for use in military operations. [Full Text](#)

Keywords: tactical communications, white space, relay, television

AN APPROACH FOR DETECTING MALICIOUS EMAILS USING RUNTIME MONITORING WITH HIDDEN DATA

Kristin Sellers–Lieutenant, United States Navy

Master of Science in Computer Science

Advisor: Doron Drusinsky, Department of Computer Science

Second Reader: Man-Tak Shing, Department of Computer Science

Computer systems continue to be at risk of attack by malicious software attached to email. Email has been determined to be the cause of 80% of computer virus infections. Millions of dollars are lost yearly due to the damage brought by malicious emails. Popular approaches toward the defense against malicious emails are antivirus scanners and server-based filters. Further, state-of-the-art methods are being employed to enhance security against malicious programs. However, despite efforts to protect personal information in emails, malicious programs continue to pose a significant threat. This thesis presents the application of a hybrid of Runtime Monitoring and Machine Learning for monitoring patterns of malicious emails. The system is designed in a way that it gathers malicious emails to determine whether they are suspicious, unknown, or benign. The application of runtime monitoring helps reduce the chance that suspicious emails are spread and lowers the likelihood that users will be threatened. Patterns were developed in Rules4business.com to facilitate the detection of threats and apply rules to the identified rules validation, while at the same time tracking them. The runtime monitoring application system entails the detection of the malicious emails by assessing the pattern in which they are sent and qualifying them into different states identified as suspicious, unknown, or benign. Through the application of the system, it would be possible to eliminate threats posed to private individuals and corporations emanating from the malicious emails. We performed deterministic runtime monitoring, built a Hidden Markov Model (HMM), and performed runtime monitoring with hidden data. It is the reasoning about the patterns of malicious emails with hidden artifacts that provides the potential of providing improved classification. [Full Text](#)

Keywords: malicious emails, runtime monitoring, state-chart assertions, formal specifications, Hidden Markov Model

Master of Science in Contract Management

AN ANALYSIS OF THE DEPARTMENT OF DEFENSE'S USE OF OTHER TRANSACTION AUTHORITY (10 U.S.C. 2371)

Catherine Stevens—Civilian, Department of Defense

Master of Science in Contract Management

Advisor: E. Cory Yoder, Graduate School of Business and Public Policy

Co-Advisor: Linda Allen, Retired, GSA, Senior Executive Service

This research provides an analysis of the Department of Defense's historical and current use of Other Transaction (OT) authority as codified in Section 10 of United States Code (U.S.C.) 2371. The 2016 National Defense Authorization Act made the OT for prototype authority permanent. Methodology includes reviews of available literature such as Government Accountability Office (GAO) audit reports, DOD Inspector General reports, and studies by the Congressional Research Service, research by the RAND institution, and Senate and House testimony. Interviews with three OT subject-matter experts provide valuable insight into the creation of the original language as well as legislative changes to OT authority. OT authority has allowed the DOD greater flexibility in working with commercial companies that have traditionally not worked with the federal government in research and development (R&D) efforts. OTs are not subject to the same laws and regulations that govern standard procurement contracts, grants, and cooperative agreements. Research shows that OTs can be a powerful instrument in advancing technology and innovation in R&D. It is imperative that the DOD continue to promote understanding of this unique authority in order to remain on the cutting edge of state-of-the-art technologies. [Full Text](#)

Keywords: Other Transactions, research and development, prototype

AN ANALYSIS OF CYBERSECURITY AND HOW IT IS AFFECTING A CONTRACT WRITING SYSTEM, SEAPORT

Bill Turner—Civilian, Department of the Navy

Daniel Belcher—Civilian, Department of the Navy

Danielle Allen—Civilian, Department of the Navy

Master of Science in Contract Management

Advisor: Raymond Jones, Graduate School of Business and Public Policy

Co-Advisor: Stacy McQuage, Naval Surface Warfare Center Dahlgren Division

The purpose of this paper is to research cybersecurity and whether it creates inefficiencies and ineffective business support for the DOD—specifically, the contract writing system SeaPort. Is cybersecurity becoming too restrictive, making the ability to support the programs and warfighters inefficient and ineffective? What business practices could be put in place to protect the DOD without hindering contract and business support to the warfighter? This research topic came about due to the underperformance of SeaPort when used by NAVSEA contract specialists at Dahlgren. The research begins with a brief overview of the Internet, cybersecurity, and SeaPort contract writing system. The literature review describes the private and public sectors with regard to cybersecurity as well as any policies related to cybersecurity. Sixteen (16) SeaPort users were surveyed in order to gain an understanding of the issues surrounding SeaPort. We discovered that SeaPort, indeed, was having issues regarding PDF generation, FPDS-NG reporting, and overall latency. A direct correlation between cybersecurity and SeaPort efficiency could not be proven; however, theoretically, cybersecurity can

be attributed. Recommendations include adding more servers to existing SeaPort network infrastructure and further research conducted by cyberexperts within the government with the authority to access direct cyberreports on the system. [Full Text](#)

Keywords: SeaPort, cyber security, help desk, speed, cyber threat, cyber attack

Master of Science in Defense Analysis

MULTINATIONAL COUNTER-PIRACY OPERATIONS: HOW STRATEGICALLY SIGNIFICANT IS THE GULF OF GUINEA TO THE MAJOR MARITIME POWERS?

Pakiribo Anabraba—Captain, Nigerian Navy

Master of Science in Defense Analysis

Advisor: Kalev Sepp, Department of Defense Analysis

Co-Advisor: Jeff Kline, Department of Operations Research

Piracy in the Gulf of Guinea regularly exceeded that of the Gulf of Aden between 2000 and 2007. But the major maritime powers established counter-piracy operations in the Gulf of Aden without replicating the same in the Gulf of Guinea. Since 2004, the United States has closely monitored counter-piracy operations in the Malacca Strait after a failed earlier attempt to materially provide such services. Why are the United States and other maritime powers interested in the Gulf of Aden and Malacca Strait? If the Gulf of Guinea states would allow these powers to establish a counter-piracy task force, does the region have the strategic heft to attract these powers? The search for answers to these questions informs this study. The study, which is essentially comparative, synthesizes and analyzes existing quantitative and qualitative data. It reveals that the strategic importance of the Gulf of Guinea is minor compared to the Malacca Strait and the Gulf of Aden. Therefore, the thesis urges the Gulf of Guinea states to search for regional solutions that would materialize improvements in maritime regime governance, security, and development. [Full Text](#)

Keywords: piracy, Gulf of Guinea, Gulf of Aden, maritime powers, Malacca Strait, multinational counterpiracy operations, regional maritime security solutions, cost of piracy, maritime strategic significance

TOWARD A THEORY OF HYBRID WARFARE: THE RUSSIAN CONDUCT OF WAR DURING PEACE

Stephen Dayspring—Chief Warrant Officer 4, United States Army

Master of Science in Defense Analysis

Advisor: Douglas Borer, Department of Defense Analysis

Second Reader: Ian Rice, Department of Defense Analysis

With the Russian annexation of Crimea and the undeclared conflict in eastern Ukraine, Western policy analysts have asked if Russia's actions represent a new, more covert approach to warfare. Understanding Russia's perspective on international relations is imperative to supporting potential targets of future Russian action, and specifically, to updating NATO's defensive protocols that are predicated on response to clear military violations of sovereignty. This study uses an existing model for the weaponization of all instruments of state power to examine three case studies that exemplify hybrid political and military forms of war: the 2008 Russian War with Georgia, the 2014 Russian annexation of Crimea, and the 2014–2015 war in eastern Ukraine. This analysis reveals that the concept of hybrid

warfare is often too narrowly focused on a conflict's kinetic aspects. In practice, hybrid warfare begins by establishing strategic objectives and employing means that violate another state's sovereignty during a time of peace. Findings further point to successful outcomes when coercive violence is timed to minimize the chances of international military response. Hybrid warfare also holds promise for other malign actors who wish to pursue objectives without directly confronting Western military strength.

[Full Text](#)

Keywords: Hybrid warfare, inter-state conflict, Russia, political warfare, non-linear warfare, active measures

MARITIME SOF IN THE LITTORALS: THEORETICAL PRINCIPLES FOR SUCCESSFUL LITTORAL SPECIAL OPERATIONS

Torbjorn Grimeland—Lieutenant Commander, Royal Norwegian Navy

Oscar van der Veen—Major, Royal Netherlands Marine Corps

Master of Science in Defense Analysis

Advisor: Kalev Sepp, Department of Defense Analysis

Second Reader: Ian Rice, Department of Defense Analysis

This thesis uses past experiences to help develop a theoretical framework for maritime special operations forces (SOF) to succeed in the littorals. The theoretical framework defines six principles important to special operations in littoral spaces: deliberate planning, tailored force, specified mobility, joint support, cover/concealment, and innovation. Five historical case studies, followed by a vignette, show the importance of these theoretical principles for planning and executing successful special operations in this complex environment. These principles should be considered for incorporation into any future SOF doctrine or concepts designed for this environment. For more than a decade of deployment in Afghanistan and Iraq, maritime SOF focused on land warfare. However, most maritime and amphibious forces are currently refocusing their efforts to their core capabilities. General statistics indicate that, because of population growth, urbanization, and half the world's population living no more than 120 miles from a coast, future conflicts and humanitarian disasters will likely take place in the littorals. Littoral operations are vastly different from land-locked or open-water operations. Maritime SOF units must prepare for future operations in the littorals. [Full Text](#)

Keywords: SOF, littorals, maritime special operations, principles of war, doctrine

DECISION MAKING IN CHAOS

Isaac Tyler—Civilian, Defense Intelligence Agency

Ariel Tyler—Civilian, Defense Intelligence Agency

Master of Science in Defense Analysis

Advisor: Hy Rothstein, Department of Defense Analysis

Second Reader: Erik Jansen, Department of Information Sciences

Second Reader: Frank Barrett, Graduate School of Business and Public Policy

How do military special operations officers make quick decisions in complex, fast-moving combat environments where the quality and speed of a decision could mean the difference between life and death? This qualitative study of Army and Navy special operations officers explores the factors that contribute to each individual's decision-making process. The findings reveal that chaos is a function of

enemy sensebreaking efforts, and to overcome this, leaders must first internalize the gravity of their current circumstances, a process referred to as sense conversion. After this point, they are able to begin the sensemaking process that allows them to make an informed decision. This study led to a model of rapid decision making that revealed both the individual process as well as external factors, such as cohesion, that played critical roles in their ability to make decisions in chaos. [Full Text](#)

Keywords: sensebreaking, sense conversion, sensemaking, decision making, cohesion, chaos

CHINA'S SOFT POWER: CHANGING THE WORLD PERCEPTION

This paper has been recognized as outstanding by its department

Chaudhry Ullah—Lieutenant Colonel, Pakistan Army

Master of Science in Defense Analysis and Master of Arts in Security Studies (Middle East, South Asia, Sub-Saharan Africa)

Advisor: Leo Blanken, Department of Defense Analysis

Second Reader: Feroz Khan, Department of National Security Affairs

China has focused on improving its image in the world by relying more on its soft power by investing billions of dollars simply to convince the world to accept its rise in the international system. This paper uses both quantitative and qualitative methods in order to grade and assess China's success with these efforts. While I could not find any significant relationship between China's tools of soft power and its positive perception building in the international community, I could also not find any significant effect of China's rise on its negative perception building among the international community. This may, in and of itself, be a significant result. More specifically, the research reveals that many of the ideals held by China significantly clash with existing international norms—that China lacks credibility in the exercise of its public diplomacy, and that China relies too heavily on the attractiveness of its culture. [Full Text](#)

Keywords: China, soft power, Asia, Africa, Latin America, China threat, culture, public diplomacy, foreign policy, peaceful rise, win-win strategy, peaceful development, energy, oil, great power, noninterference policy, resources, Beijing Consensus

Master of Science in Electrical Engineering

GENERALIZED HOUGH TRANSFORM FOR OBJECT CLASSIFICATION IN THE MARITIME DOMAIN

Pornrerker Rerkngamsanga—Lieutenant, Royal Thai Navy

Master of Science in Electrical Engineering

Advisor: Murali Tummala, Department of Electrical and Computer Engineering

Co-Advisor: James Scrofani, Department of Electrical and Computer Engineering

A generalized Hough transform (GHT)-based classification scheme for an object-of-interest in maritime domain images is proposed in this thesis. First, the object edge points are extracted and used to generate a representation of the object as a Hough coordinate table by using the GHT algorithm. The table is then reformatted to a contour map called a Hough features map. The coordinates of dominant peaks, or Hough features, on the map are extracted and fed into a feed-forward, back-propagation neural network for classification. In this research, the scheme is tested using perfect shapes of triangles, squares, circles, and stars and maritime domain images of ships, aircraft, and clouds, and the classification results obtained are reported. [Full Text](#)

Keywords: generalized Hough transform, object detection, object classification, discrete cosine transform

COMPARISON OF TWO RAILGUN POWER SUPPLY ARCHITECTURES TO QUANTIFY THE ENERGY DISSIPATED AFTER THE PROJECTILE LEAVES THE RAILGUN

Mitchell Stewart—Lieutenant, United States Navy

Master of Science in Electrical Engineering

Advisor: Alexander Julian, Department of Electrical and Computer Engineering

Co-Advisor: Giovanna Oriti, Department of Electrical and Computer Engineering

Railgun muzzle flash, or post-fire arcing, is a major concern to the Navy because of the potential associated thermal stresses. In this thesis, we compared two railgun power supplies in Matlab Simulink to quantify their associated post-fire energy. When the armature exits the rails, a finite energy from the railgun pulsed-power supply is inductively stored in the rails and discharges at the muzzle. This energy, which is due to the loss of the low-voltage electrical contact that is ordinarily between the armature and the rail, is forced by the system inductance to flow as an electrical discharge, creating a muzzle flash. Quantification of this post-fire rail energy in our simulation from both the existing railgun power supply and the proposed power supply—a thyristor-based power supply versus a buck-boost converter, respectively—reveals that the buck-boost converter topology is better suited for the railgun, particularly at minimizing the post-fire muzzle energy. The minimization of the post-fire energy allows for an extended rail life and potentially longer usage. [Full Text](#)

Keywords: railgun, power supply, post-fire energy

Master of Science in Engineering Acoustics

RESOLUTION OF PORT/STARBOARD AMBIGUITY USING A LINEAR ARRAY OF TRIPLETS AND A TWIN-LINE PLANAR ARRAY

Stilson Veras Cardoso—Civilian, Brazilian Navy

Master of Science in Engineering Acoustics

Advisor: Lawrence Ziomek, Department of Electrical and Computer Engineering

Second Reader: Monique Fargues, Department of Electrical and Computer Engineering

This thesis is a study on the ability of towed sonar arrays to resolve the PS (port/starboard) ambiguity problem, and focuses on a twin-line planar array and a linear array of triplets. A twin-line planar array is commonly employed in underwater warfare. The goal is to offer the reader a comprehensive understanding of the method used for the solution of the PS ambiguity problem, concerning the beam-former's complex weights, operating frequency, and limit on beam steering. Initially, the basic characteristics and functional blocks, technical, and operational peculiarities of towed linear sonar arrays are presented, and then a single triplet, a linear array of triplets, and a twin-line planar array are respectively examined in detail. The research consists of mathematical modeling of the elements and the arrays, calculation of beam patterns for study cases, and signal processing simulations programmed in MATLAB. The simulations make use of a signal generator, designed to assess the performance of the twin-line planar array. The generator provides the reader with a systems view of the array operation, taking into account the characteristics of the target and medium. [Full Text](#)

Keywords: towed sonar array, port/starboard ambiguity problem, single triplet, linear array of triplets, twinline planar array

Master of Science in Management

RESILIENCE AMONG NAVAL RECRUITS: A QUANTITATIVE AND QUALITATIVE ANALYSIS OF INTERVENTIONS AT RECRUIT TRAINING COMMAND AND IMPLICATIONS ON FLEET READINESS

Maribel Challburg—Lieutenant, United States Navy

Caroline Brown—Lieutenant Junior Grade, United States Navy

Master of Science in Management

Advisor: Edward Powley, Graduate School of Business and Public Policy

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

This study is designed to quantitatively and qualitatively measure recruit resilience at the Naval Recruit Training Command (RTC) and to develop interventions that increase recruit resilience. This study administered three resilience-building interventions to 713 recruits across eight divisions and collected surveys at four time intervals to measure changes in self-reported resilience. We conducted interviews with recruits and recruit division commanders (RDCs) to gather qualitative data on significant factors that affect the resilience-building process. Our quantitative analysis methods included difference mean tests, regression analysis, and correlation analysis to determine the most effective interventions. Qualitative analysis methods are used to provide insight into recruit behavior, mental states, and internal resilience. Our quantitative results suggest that appreciative guided conversations using positive, meaningful experience-based questions yield significant increases in recruit resilience. Our qualitative analysis revealed numerous enablers, disablers, and facilitators that impact the recruit resilience process. The influence of family and religion cannot be overstated as sources that have a positive effect in a recruit's resilience process. We recommend that RTC implement a long-term resilience intervention program of appreciative guided conversations for all recruits. By improving recruit resilience, the RTC can graduate stronger, healthier recruits who positively contribute to fleet readiness. [Full Text](#)

Keywords: resilience, recruit, Recruit Training Command, newcomer identification, intervention

THE EFFECT OF GRADUATE EDUCATION TIMING ON THE RETENTION OF SURFACE WARFARE OFFICERS

Eric Clark—Lieutenant, United States Navy

Master of Science in Management

Advisor: William Hatch, Graduate School of Business and Public Policy

Co-Advisor: Chad Seagren, Graduate School of Business and Public Policy

Co-Advisor: Simona Tick, Graduate School of Business and Public Policy

This thesis examines the effect of the timing of graduate education attainment on retention of officers within the surface warfare community. Navy surface warfare officers (SWOs) commissioned between fiscal years 1999 and 2003 were classified as having no graduate degrees or as earning their master's degrees prior to service, before five years of service, between five and 10 years of service, and after 10 years of service. Differential bivariate probit analysis was used to determine the effect of the timing of graduated education attainment on retention to the tenth, eleventh, and twelfth years of service as well as promotion to O-4. The findings show that SWO department heads who earn master's degrees at any

point within their careers are more likely to retain. Officers who earned a graduate degree before commissioning or prior to five years of commissioned service are no more likely to retain compared to SWOs with no graduate education, while those who obtained graduate education after five years of service are significantly more likely to retain. In addition, the findings show that department heads earning master's degrees at any point within their careers are more likely to promote to O-4 compared to those who had not earned master's degrees. Graduate education shows to have the potential of a strategic investment in human capital that can be used by the Navy as a retention tool. Future work can address the potential selection bias associated with higher retention of those with graduate education attained after five years of commissioned service by SWOs who might already be committed to a Navy career. [Full Text](#)

Keywords: manpower, manning, SWO, career planning, graduate education, retention, subspecialty

A VALIDATION OF THE PROPOSED ROYAL AUSTRALIAN NAVY STANDARD WORK WEEK AND NAVAL MANAGEMENT DIARY USING A SIMULATED CREW OF AN ARMIDALE CLASS PATROL BOAT

Jessica Groot—Lieutenant, Royal Australian Navy

Master of Science in Management

Advisor: Nita Shattuck, Department of Operations Research

Second Reader: Michael Smith, Graduate School of Business and Public Policy

This thesis investigated the validity of the Royal Australian Navy's proposed Navy Standard Work Week (NSWW) model and the Navy Management Diary (NMD) with its accompanying fatigue measurement tool. A simulated 21-member Armidale Class Patrol Boat (ACPB) crew was constructed in the NMD to assess the NSWW. The NMD fatigue measurement tool and the Sleep, Activity, Fatigue and Task Effectiveness (SAFTE) model, and its software instantiation, the Fatigue Avoidance Scheduling Tool (FAST), were used to estimate risk for the periods of activity across the three weeks, resulting in comparison of the associated risk levels identified by the NMD fatigue tool and corresponding FAST scores. In the proposed RAN NSWW model, the category of maintenance most often exceeded its allocated hours, leading to the recommendation that further research on a larger sample might address whether the proposed NSWW should be customized to be platform and occupation specific. The NMD and FAST software tool comparisons resulted in statistically significant differences in predicted risk. The discussion speculates on why these discrepancies exist between the two software tools. The thesis recommends that this methodology be replicated using a larger sample and include empirical observations of performance in actual operations before comparing to FAST-generated predicted effectiveness levels. [Full Text](#)

Keywords: actigraphy, crew endurance, crew performance, fatigue management, fatigue mitigation, sleep, FAST, SAFTE, Navy Management Diary, Royal Australian Navy, simulation

MOVEMENT OF FUEL ASHORE: STORAGE, CAPACITY, THROUGHPUT, AND DISTRIBUTION ANALYSIS

Michael Herendeen—Captain, United States Marine Corps

Master of Science in Management

Advisor: Chad Seagren, Department of Operations Research

Second Reader: Kenneth Doerr, Graduate School of Business and Public Policy

The Marine Corps' recent reemphasis on amphibious operations has identified a potential operational

reach gap in the sustainment window of the Marine Expeditionary Brigade (MEB) in an undeveloped theater. This problem is defined by a limited capacity to move fuel ashore from tactical and seabased assets, coupled with increasing rates of end-user consumption. In the absence of host-nation support, sustaining the MEB during operations ashore requires joint interoperability of several fuel distribution systems and methods of resupply. The success of the seabased logistics network will depend on the use of a modern planning and forecasting approach. It is the aim of this study to understand the connection between the GCE's operational behavior and its fuel demand. This is accomplished through the use of the MAGTF Power and Energy Model to create a fuel usage data set. Subsequent regression analysis reveals key trends and provides insight into how operational decisions can result in marginal changes to fuel demand. Finally, this study examines the feasibility of fuel movement ashore using only the ship-to-shore connectors available to the MEB. [Full Text](#)

Keywords: Marine Corps, fuel, energy, logistics, expeditionary, amphibious, operational reach

ARE WE HOPING FOR A BOUNCE? A STUDY ON RESILIENCE AND HUMAN RELATIONS IN A HIGH RELIABILITY ORGANIZATION

Robert Johns—Lieutenant Commander, United States Navy

Master of Science in Management

Advisor: Edward Powley, Graduate School of Business and Public Policy

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

This study analyzes the various resilience factors associated with a military high reliability organization (HRO). The data measuring organizational resilience was gathered from surveys aboard a U.S. Naval vessel in March and October of 2015. A review of the surveys determined that there were potential differences in levels of resilience across the enlisted and officer ranks within the organization. A multiple linear regression model was used to search for any significant effects of rank on psychological safety. The findings confirmed that the leadership ranks of E4 to E6 reported lower rates of psychological safety. The study also found moderating effects on rank and psychological safety, such as identification as a sailor and identification with one's division. The data analyzed in this project suggests that the organization should promote and support psychological safety through processes and cultural changes. Specific tools that could be used include positive socialization of newly arriving members and the use of good catch logs to reinforce the organization's high reliability culture. [Full Text](#)

Keywords: resilience, high reliability organization, leadership, relational coordination, social support, psychological safety, cohesion, organizational effectiveness

THE EFFECT OF STEM DEGREES ON THE PERFORMANCE AND RETENTION OF JUNIOR OFFICERS IN THE U.S. NAVY

William Maugeri III—Lieutenant, United States Navy

Master of Science in Management

Advisor: Simona Tick, Graduate School of Business and Public Policy

Co-Advisor: Stephen Mehay, Graduate School of Business and Public Policy

The Navy has long operated under the Rickover hypothesis, stressing the importance of recruiting and retaining science, technology, engineering, and mathematics (STEM)—background officers to man increasingly technologically advanced weapon systems. This thesis tests the validity of this hypothesis by

analyzing the performance and retention of junior officers with STEM degrees compared to those of junior officers with non-STEM degrees. Additionally, this thesis examines the effects of college selectivity, commissioning source, and various demographics on performance and retention. While previous research on the effects of STEM degrees on junior officer performance and retention has been largely inconclusive, the findings of this thesis show that a STEM degree has positive and significant effects on retention and on promotion to O-4 and a negative effect on fitness-report performance. Further research can be done to examine which STEM majors are most likely to succeed and how lateral transfer opportunities impact STEM officer performance and retention. [Full Text](#)

Keywords: STEM degree officers, retention and performance of junior Navy officers

STUDY OF FEMALE JUNIOR OFFICER RETENTION AND PROMOTION IN THE U.S. NAVY

David Mundell—Lieutenant, United States Navy

Master of Science in Management

Advisor: Simona Tick, Graduate School of Business and Public Policy

Co-Advisor: Stephen Mehay, Graduate School of Business and Public Policy

Co-Advisor: Mark Eitelberg, Graduate School of Business and Public Policy

The Military Leadership Diversity Commission of 2011 and top Navy leaders have stressed the importance of achieving gender integration in the military, making it one of the Navy's top priorities. This study examines the promotion and retention rates of Navy officers, focusing on women of various racial/ethnic backgrounds. The study uses quantitative multivariate analysis to identify demographic and professional factors, such as gender, race/ethnicity, educational level, commissioning source, and Navy designator (military occupational specialty) to explain differences in outcomes of retention, promotion, and lateral transfers other communities. Using data on over 16,000 Navy officers commissioned from 1999 to 2003, the results from regression analyses show women are less likely than men to stay in the Navy, but there are no differences in promotion rates to O-4 and lateral transfers to other communities. Also, officers who obtain graduate-level education or transfer laterally to other communities by 10 years of service have higher rates of retention and promotion. Thus, one approach toward retaining more women in the Navy is to expand their opportunities for graduate-level education and lateral transfer. Further research is needed to study the influence of these factors, particularly lateral transfers, on the stay-leave decisions of women. [Full Text](#)

Keywords: Navy, officer, female, women, promotion, retention, lateral transfer

AN ANALYSIS OF THE IMPACT OF FINANCIAL FACTORS ON THE WELL-BEING OF MILITARY OFFICERS

This paper has been recognized as outstanding by its department

Brian Turner—Major, United States Marine Corps

Master of Science in Management

Advisor: Juanita Rendon, Graduate School of Business and Public Policy

Co-Advisor: Steven Landry, Graduate School of Business and Public Policy

The purpose of this research study was to survey resident Naval Postgraduate School (NPS) students about various financial factors to determine which factors have the most significant impact on subjective well-being. An online voluntary and anonymous survey was deployed to students about various financial factors, nonfinancial factors, and constraints on resources. This research replicates a

previous study conducted primarily with enlisted soldiers. Based on the analysis, having enough net worth to be set for retirement, having emergency savings of \$1,000 to \$2,000, and having financial knowledge are all statistically significant variables affecting an individual officer's subjective well-being. Additionally, having over \$5,000 of vehicle debt, being separated from a spouse, and having any dependents (excluding a spouse) result in a marginally negative impact on an officer's subjective well-being. Neither rank nor age were found to have any statistical significance with regard to well-being. The analysis highlights some differences between the mostly enlisted population previously surveyed and the officers at NPS. One difference was that credit card debt has less impact on the subjective well-being of officers at NPS than was found in the previous study. Finally, the analysis provides some recommendations for future personal financial education of military officers. [Full Text](#)

Keywords: personal financial management, subjective well-being, financial factors

ROLE OF SOCIAL NETWORKS IN RESILIENCE OF NAVAL RECRUITS: A QUANTITATIVE ANALYSIS

Andrea Watling—Lieutenant, United States Navy

Master of Science in Management

Advisor: Edward Powley, Graduate School of Business and Public Policy

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

The overall purpose of this study is to make a connection between the positive energy levels of Navy recruits and their resilience. We also want to understand the patterns of social networks that might help identify and improve resilience. This study hypothesizes that groups receiving positively framed resilience interventions were more likely to show higher levels of resilience than control groups. Data for this project comes from the Navy's Recruit Training Command in Great Lakes and comprises 1,297 total surveys from a total of eight divisions of recruits at two different time periods. Quantitative analyses using surveys and network data examine the effects of positive energy on recruit resilience within the social networks. The findings of this research suggest that there is a relationship between positive energy networks and resilience. This research serves as a foundation for future research on social networks in the U.S. Navy and provides some recommendations for future work to extend the study on resilience. [Full Text](#)

Keywords: resilience, cohesion, density, procedural justice

Master of Science in Mechanical Engineering

CHARACTERIZATION OF ALUMINUM-MAGNESIUM ALLOY REVERSE SENSITIZED VIA HEAT TREATMENT

Kevin Gamble—Lieutenant Commander, United States Navy

Master of Science in Mechanical Engineering

Advisor: Kim Tran, Department of Mechanical and Aerospace Engineering

Co-Advisor: Sarath Menon, Department of Mechanical and Aerospace Engineering

Second Reader: Terry McNelley, Department of Mechanical and Aerospace Engineering

This research explores a novel repair technique to reverse the sensitization of aluminum magnesium (Al-Mg) alloys. Al-Mg alloys can become sensitized when magnesium comes out of solution as a second phase, Al_3Mg_2 , on the grain boundaries, eventually forming a continuous network and increasing susceptibility to intergranular stress corrosion cracking (SCC). Sensitized 5456 Al-Mg alloy samples

removed from active Navy ships were metallographically characterized. These were compared to similar samples that were heat treated in order to reverse the sensitization effect. Both of these were also compared to as wrought 5456 aluminum. All samples were also tested for tensile strength and degree of sensitization using the ASTM G67 Nitric Acid Mass Loss Test (NAMLT). Two heat treatment profiles were compared. Both of these profiles successfully reversed the sensitization effect, with similar performance. Heat treatment may have affected the tensile properties and negatively degraded the resulting microstructure by annealing the material. Therefore, more research is necessary to prove this technique's suitability for shipboard repair. [Full Text](#)

Keywords: reverse sensitizing 5456 aluminum alloy

PREDICTING THE ACCURACY OF UNGUIDED ARTILLERY PROJECTILES

Wee Yeow Lim—Captain, Singapore Armed Forces

Master of Science in Mechanical Engineering

Advisor: Morris Driels, Department of Mechanical and Aerospace Engineering

Second Reader: Christopher Adams, Department of Mechanical and Aerospace Engineering

A method for predicting the accuracy of unguided artillery projectiles is presented in this thesis. The goal was to develop a standalone program that would estimate accuracy without the need for a large database of weapon trajectory data. The presented method uses a simplified version of the modified point mass trajectory model and error computation models to predict error metrics that are particularly useful in predicting damage effects on various types of targets using the Joint Weaponing System (JWS). The developed program is coded in Visual Basic, and the error metrics can typically be computed in less than 30 seconds for most ranges, in the computation precision specified in this thesis. The program was verified by comparing it against the FT 155-AM-02 firing table for the M107(HE) 155mm artillery projectile. The verification results demonstrate that the developed trajectory model closely matches the basic trajectory data to within 2% and ballistic partials to within 7% for most ranges of interest. Accuracy metrics derived from the ballistic partials generated from the developed program are within 10% of those derived from the firing table's ballistic partials for typical firing ranges. The model is able to take into account wind effects and varying levels of meteorological data staleness. The developed program is named the Indirect Fire Delivery Accuracy Program (IFDAP), and it can be used to predict accuracies for any unguided projectile given the required aerodynamic coefficients, physical properties, and error budgets. [Full Text](#)

Keywords: accuracy, error, artillery, unguided, modified point mass, indirect fire

INITIAL TESTING FOR THE RECOMMENDATION OF IMPROVED GAS METAL ARC WELDING PROCEDURES FOR HY-80 STEEL PLATE BUTT JOINTS AT NORFOLK NAVAL SHIPYARD

Veronika Rice—Lieutenant, United States Navy

Master of Science in Mechanical Engineering

Advisor: Young Kwon, Department of Mechanical and Aerospace Engineering

Second Reader: Ryan McCrillis, United States Navy, Norfolk Naval Shipyard

Hull cut welding proficiency is an essential skill maintained by personnel at naval shipyards. This thesis explores arc weld theory to develop ideal submarine hull butt joint designs and recommends preliminary testing to be used to develop improved butt joint welding procedures at Norfolk Naval

Shipyards. Pulsed gas metal arc welding (GMAW-P) is the ideal process for shipboard hull welding applications, theoretically. Butt joint samples were created using HY-80 steel plate so that the following comparisons could be made: 90%Ar-10%CO₂ versus 95%Ar-5%CO₂ shielding gases and their effect upon weld penetration, Miller brand versus Lincoln Electric brand power supply synergic GMAW-P algorithm performance, and Single-V versus Double-V butt joint design. Based upon the creation of butt joint samples, it was determined that 90%Ar-10%CO₂ is a more ideal gas mixture for this application and that Lincoln Electric brand machines have preferred interface by Norfolk Naval Shipyard welders. Future research is still needed in a controlled environment to develop optimized GMAW-P procedures. [Full Text](#)

Keywords: gas metal arc welding, submarine, hull cut, butt joint, weld, shielding gas, HY-80 steel, plate

EVALUATION OF COMPOSITE-HULL SHIPS OPERATING IN ARCTIC ICE

Ryan Tran—Ensign, United States Navy

Master of Science in Mechanical Engineering

Advisor: Young Kwon, Department of Mechanical and Aerospace Engineering

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

As ocean temperatures rise, naval exploration around the Arctic Ocean is increasing due to the rapidly melting ice caps. Extensive research is thus being conducted to determine the interaction between ice and steel hulls in anticipation of opening sea lanes. While the majority of the research focuses on traditional steel-hull ships, limited research has been conducted on composite-hull ships to determine how this material will respond in Arctic waters. Therefore, the purpose of this study is to evaluate how composite materials interact with free-floating ice. The program, DYSMAS, conducted a computational parametric analysis to determine how increasing ship velocity, expanding ice block size, adding ice blocks, and changing the hull shape (vertical, tumblehome, and flared) affected the ship's performance. The numerical tests reveal that the ice block position has the greatest influence on the effective stress for the ship. Additionally, a second component of this thesis was to design and build a wave generating system. The system was designed and partially built, but an unexpected closure prevented the completion of construction. This project provides the foundation for both experimental and computational research relevant to composite-hull ships transiting through ice fields. [Full Text](#)

Keywords: composite, ships, Arctic, sea ice, DYSMAS, wave generator, plunger

FEASIBILITY STUDY ON MISSILE LAUNCH DETECTION AND TRAJECTORY TRACKING

Chee Mun Kelvin Wong—Civilian, Defence Science Technology Agency

Master of Science in Mechanical Engineering

Advisor: Oleg Yakimenko, Department of Systems Engineering

Second Reader: Fotis Papoulias, Department of Systems Engineering

With the increased use of Unmanned Aerial Vehicles (UAVs) in military operations, their role in a missile defense operation is not well defined. The simulation program discussed in this thesis studies the feasibility of utilizing UAVs to patrol a potential Intercontinental Ballistic Missile (ICBM) launch area using a single or multiple Counter Unmanned Aerial Vehicles (CUAVs), detecting the launch event and tracking an ICBM using the CUAVs' onboard optical sensors. The ultimate goal is to assess the parameters of ICBM ascent and provide target information to bring the attacking UAVs onto the anti-missile launch course to reliably intercept the threat. This thesis explores the challenges in creating a

simulation program to process video footage from an unstable platform and the limitations of using background subtraction method to detect the missile motion. Although the simulation program test results showed that it is unable to consistently detect a missile launch and track its trajectory for all the test videos, the developed algorithms allowed a surveillance UAV to detect a missile launch for most of the videos and also track its trajectory with an accuracy that is sufficient for targeting purposes. This thesis is limited to using the simulation program to detect a launch event offline and is based on the amateur rocket launch data gathered during the launch trials at Mojave Desert in May of 2016. [Full Text](#)

Keywords: missile launch detection, missile trajectory tracking, computer vision, ORB (Oriented FAST and Rotated BRIEF)

Master of Science in Meteorology and Physical Oceanography

INTER-ANNUAL VARIABILITY OF THE ACOUSTIC PROPAGATION IN THE YELLOW SEA IDENTIFIED FROM A SYNOPTIC MONTHLY GRIDDED DATABASE AS COMPARED WITH GDEM

Colleen McDonald—Lieutenant Commander, United States Navy

Master of Science in Meteorology and Physical Oceanography

Advisor: Peter Chu, Department of Oceanography

Co-Advisor: Tetyana Margolina, Department of Oceanography

This research investigates the inter-annual acoustic variability in the Yellow Sea identified from the Synoptic Monthly Gridded-World Ocean Database (SMG-WOD) as compared with the Navy's Global Digital Environmental Model (GDEM). The SMG-WOD has a horizontal resolution of 1°, 28 vertical levels from the surface to 3000 m depth and one-month temporal increments allowing individual years of acoustic data to be analyzed, whereas GDEM is a climatological database with a horizontal resolution of 1/4° and 78 vertical levels. The Yellow Sea is a semi-enclosed basin located between China and Korea with a mean depth of 40m; acoustics are driven by shallow water dynamics and interaction with the bottom. Seven distinct locations were selected for acoustic comparison based on various depths and bottom types. Composite analysis of the sound speed profiles reveals evident inter-annual variability at all locations, superimposed into a strong seasonal variability. Overall, SMG-WOD produces longer propagation ranges than GDEM in the winter, while ranges in the summer are similar within the two datasets, as modeled in BELLHOP. The most reflective bottom sediment (gravel) produced the longest ranges in both summer and winter, in contrast to other locations, which presented higher attenuation values and produced extremely limited ranges in the summer. Inter-annual variability, as expressed by extended acoustic ranges in SMG-WOD, indicates the need for a dataset with temporal resolution but optimally with higher vertical and horizontal resolution. [Full Text](#)

Keywords: Yellow Sea, inter-annual variability, shallow water acoustics, GDEM, Synoptic Monthly Gridded (SMG)-WOD, BELLHOP

IN-SITU OBSERVATION OF UNDISTURBED SURFACE LAYER SCALAR PROFILES FOR CHARACTERIZING EVAPORATIVE DUCT PROPERTIES

Richard Rainer—Lieutenant, United States Navy

Master of Science in Meteorology and Physical Oceanography

Advisor: Qing Wang, Department of Meteorology

Second Reader: Wendell Nuss, Department of Meteorology

Understanding the vertical variations of temperature and humidity in the marine atmospheric surface layer (MASL) is extremely important for naval and civilian applications. In particular, such variations affect the propagation of electromagnetic waves (EM) by forming an evaporation duct. However, direct measurements of these profiles have been difficult from a large ship because of the disturbance introduced by the platform. In this thesis, the design, deployment, and initial data analyses of a marine atmospheric profiling system (MAPS) is introduced. The MAPS is developed as part of the Coupled Air Sea Process and EM ducting Research (CASPER) project. It is capable of making repeated measurements of the lowest tens of meters of the MASL from a small Rigid Hull Inflatable Boat (RHIB), or a small work boat, equipped with a tethered profiling system and a small meteorological mast. For each profiling set at a given location, 10-15 profiles were made to allow sufficient samples to derive the mean profile. This thesis discusses the methods for controlling data quality and obtaining the mean profiles from the scattered profiling data. Evaporation duct height and strength are derived and compared to those generated from an evaporation duct model using various input from measurements. [Full Text](#)

Keywords: evaporative duct, CASPER, maritime atmospheric surface layer, air-sea interaction, vertical profile

Master of Science in Modeling, Virtual Environments, and Simulation

DISCRETE EVENT SIMULATION MODEL OF THE POLARIS 2.1 GAMMA RAY IMAGING RADIATION DETECTION DEVICE

Andres Juarez—Captain, United States Marine Corps

Master of Science in Modeling, Virtual Environments, and Simulation

Advisor: Arnold Buss, MOVES Institute

Second Reader: Steve Mullins, Department of Information Sciences

The nuclear threat remains a top priority for the United States government; there are many agencies whose sole focus is thwarting terrorist actions. As layer upon layer of both passive and active defensive measures are employed, the research community continues to bear new tools to aid in detection of radiological material. Incorporating and developing tactics, techniques, and procedures (TTPs) for those devices becomes a challenge in and of itself. For this thesis, the Polaris 2.1 Gamma Ray Imaging Radiation Detection Device (Polaris) was selected as the technology to be modeled. The platform, Simkit, was utilized to create a discrete event simulation (DES) model of the Polaris. After carefully constructing the DES, multiple simulations were run measuring the time to detect all radiation sources in the simulated environment. Then, all data and parameters from the simulation were used for statistical analysis to determine significant factors in the DES—for example, not only was the strength of the radiation source significant, but so was the amount of variance introduced into the DES. These results are non-intuitive and pave a path for further research to enhance the DES and find the optimal TTPs for this device from both the tactical and operational perspectives. [Full Text](#)

Keywords: discrete event simulation model, radiation detection, factor analysis

MODELING ANTI-AIR WARFARE WITH DISCRETE EVENT SIMULATION AND ANALYZING NAVAL CONVOY OPERATIONS

Ali Opcin–Lieutenant Junior Grade, Turkish Navy

Master of Science in Modeling, Virtual Environments, and Simulation and Master of Science in Operations Research

Advisor: Arnold Buss, MOVES Institute

Co-Advisor: Thomas Lucas, Department of Operations Research

Second Reader: Paul Sanchez, Department of Operations Research

Anti-air warfare (AAW) is a primary naval warfare area. Using AAW tactics and concepts of operations, this research explores the most critical success factors of convoy operations. In this study, a discrete event simulation (DES) was built by modeling ships, and their sensors and weapons, to simulate convoy operations under air threat. Where classified data was unavailable, assumptions were made and approximations were used in constructing the ships, weapons, and sensors. The model was used to simulate over 1.5 million naval battles varying 99 input variables using sophisticated and systematically created data combinations. To select the input settings over a specific range of input variables, a nearly orthogonal nearly balanced (NOB) Latin hypercube design was used. The effects of these input changes on the outputs were analyzed using partition trees and nominal logistic regression. The primary response variable was the survival of the High Value Unit (HVU) as a binary outcome. According to the analysis, in a convoy operation under air threat, the surface-to-air missile (SAM) specifications of the screen ships, the staying power of the HVU, and the anti-ship missile (ASM) specifications of the enemy ships had the most significant effect on the survival of the HVU. [Full Text](#)

Keywords: discrete event simulation, modeling anti-air warfare, Simkit, component based

Master of Science in Network Operations and Technology

DEVELOPMENT OF A BIG DATA APPLICATION ARCHITECTURE FOR NAVY MANPOWER, PERSONNEL, TRAINING, AND EDUCATION

Khristian Caidoy–Lieutenant, United States Navy

Armin Moazzami–Lieutenant, United States Navy

Anthony M. Santos–Lieutenant, United States Navy

Master of Science in Network Operations and Technology

Advisor: Magdi Kamel, Department of Information Sciences

Second Reader: Albert Barreto, Department of Information Sciences

Navy Manpower, Personnel, Training, and Education (MPTE) decision-makers require improved access to the information obtained from the vast amounts of data contained in a number of disparate databases/data stores to make informed decisions and understand second- and third-order effects of those decisions. Toward this end, the research effort of this thesis was two-fold. First, this thesis examined and proposed an end-to-end application architecture for performing analytics for the Navy. Second, it developed a decision-tree model to predict retention of post-command aviators, using the Cross-Industry Standard Process for Data Mining (CRISP-DM), in support of one of the Navy's MPTE concerns: retention in the post-command aviator community. This research concluded that with the

exponential collection and growth of diverse data, there is a need for a combination of big data and traditional data warehousing architectures to support analytics at MPTE. The data-mining effort developed a preliminary predictive model for post-command aviation retention and concluded that the number of NOBCs, particularly non-aviation NOBCs, was the most important indicator for predicting retention. Additional data sources, particularly those that contain fitness reports/evaluations, need to be included in order to improve the accuracy of the model. [Full Text](#)

Keywords: big data, application architecture, enterprise architecture, OPNAV N1, manpower, personnel, training, education, predictive modeling, CRISP-DM, aviation community retention

FIGHTING THE NETWORK: MANET MANAGEMENT IN SUPPORT OF LITTORAL OPERATIONS

The following thesis was recognized as outstanding by its department

Matthew Maupin—Lieutenant, United States Navy

Master of Science in Network Operations and Technology

Advisor: Alex Bordetsky, Department of Information Sciences

Second Reader: Wayne Porter, Global Public Policy Academic Group

Advances in computer processing and communications capabilities have contributed to the recent explosion of mesh network technologies. The operational benefits of these technologies are of particular interest for those operating in the littorals. The dynamic complexities of the littorals force tactical decision-makers to adapt to a constantly changing battlespace in a constrained temporal and spatial environment. Ongoing research into the integration of unmanned systems and sensors as mobile ad-hoc network (MANET) nodes highlights the significant potential to improve situational awareness and force efficiency in the littoral environment. However, difficulties associated with tactical network operations and management make the littorals particularly challenging. There remains a need for a unified approach to managing these networks in a coherent and effective manner. The complexity of the littorals emphasizes the inherent interconnectedness of MANET management and command and control (C2). As a result, new and innovative approaches to C2 are also required. This thesis explores the value of modern network management systems as they contribute to the richness of the human-network interface as well as the integration of network management and maneuver at the tactical level. The result is a proposal for a novel framework for littoral MANET management and C2 as a corollary of cyber-physical maneuver. [Full Text](#)

Keywords: mesh networking, MANET, command and control, littoral operations

FIELD-DEPLOYABLE VIDEO CLOUD SOLUTION

The following thesis was recognized as outstanding by its department

Jonathan Stephens—Lieutenant Commander, United States Navy

Robert Adams—Lieutenant, United States Navy

Master of Science in Network Operations and Technology

Advisor: Gurminder Singh, Department of Computer Science

Second Reader: Brian Steckler, Department of Information Sciences

Digital video has become a ubiquitous communications tool. In recent years, great advances have been made in the capture and display of ultra-high definition (UHD) video. Delivering UHD video over networks, however, requires a high-throughput connection that is not always present, especially in wireless networks. The U.S. Navy has established a need for video services that can distribute high-

quality video from within the fleet to anywhere in the world at a moment's notice. This requires a high-throughput satellite communications system that links ship-based assets with each other as well as with land-based assets. This thesis evaluates a satellite communications solution that can be used to deliver UHD video to customers during at-sea periods for a wide variety of use cases and applications. A mobile video content management server was evaluated and then coupled with a high-throughput satellite communications solution to meet public affairs' digital video content demands. Our evaluation of the O3b Network's transportable tracking fly-away antenna system reveals that it can adequately handle the network demand of UHD video content transmission. [Full Text](#)

Keywords: digital video engineering, compression, video collaboration, video editing, ultra-high definition video, HD video, 4k, MEO Satellite, O3b Networks Satellite, TFAAS

Master of Science in Operations Research

MANNED AND UNMANNED AIRCRAFT EFFECTIVENESS IN FAST ATTACK CRAFT/FAST INSHORE ATTACK CRAFT ASUW KILL CHAIN EXECUTION

Alexander Anderson—Commander, United States Navy

Master of Science in Operations Research

Advisor: Daniel Nussbaum, Department of Operations Research

Co-Advisor: Michael Atkinson, Department of Operations Research

The ability of unmanned aerial vehicles to execute intelligence, surveillance, reconnaissance, and targeting and strike missions creates a trade-space decision for naval aviation programmatic decision makers. In the military's current fiscal climate, manned and unmanned aircraft compete for limited funding. This study takes a simulation approach using the simulation modeling framework based on intelligent objects (SIMIO) environment to model a fast attack craft/fast inshore attack craft anti-surface warfare expanded kill chain. It tests and analyzes multiple manned and unmanned aircraft configurations. In the evaluation of unclassified concepts of operation and use of unclassified data sources, results indicate that aircraft attrition due to hostile weapon engagements is the dominant factor in the determination of concept of operation efficiency. Based on the operational environment, low-cost and less capable unmanned aircraft provide an alternative to the increased survivability of manned aircraft or more capable and higher-cost unmanned aircraft. We provide quantifiable metrics that enable the efficient and effective selection of aircraft to execute fast attack craft/fast inshore attack craft anti-surface warfare kill chains. [Full Text](#)

Keywords: unmanned aerial vehicles, manned aircraft, kill chain, surveillance, detection, SIMIO

AN EXPLORATORY ANALYSIS OF PROJECTED NAVY OFFICER INVENTORY STRENGTH USING DATA FARMING

Peter Bazalaki—Lieutenant, United States Navy

Master of Science in Operations Research

Advisor: Samuel Buttrey, Department of Operations Research

Second Reader: Thomas Lucas, Department of Operations Research

U.S. statutory policy requires the armed services to continuously balance manpower inventory with congressionally authorized requirements. Inaccurate forecasts put the Navy's budget at risk and degrade overall mission readiness. Navy policymakers must be able to rely on accurate inventory forecasts to

develop necessary manpower plans that steer inventory to match planned authorizations. Strength planners, in turn, rely on forecasting models like the Officer Strategic Analysis Model (OSAM) in an attempt to accurately predict future inventory levels. This study utilizes applications of data farming to OSAM to simulate Unrestricted Line Officer (URL) inventory over a seven-year period. Additionally, the research utilizes applications of Design of Experiments (DOE) to project Surface Warfare Officer (SWO) inventory across a variety of assumptions, including a proposed Enhanced Probationary Officer Continuation and Re-designation (EPOCR) policy. Analysis finds that current policy will reduce FY2016 URL inventory by 8% over a seven-year period and over-execute SWO inventory authorizations by 40%. We find that EPOCR reduces operating strength deviation (OSD) in total SWO inventory strength by 12% by FY2022. Additionally, implementing a low accession plan and a high transfer plan is the most robust in correcting OSD. When implemented correctly, EPOCR has the potential to decrease OSD to modest levels with minimal risk of under-execution. [Full Text](#)

Keywords: manpower, end strength, design of experiments, simulation, Officer Strategic Analysis Model (OSAM), inventory projection, data farming, robust analysis, meta-modeling

ANTI-SUBMARINE WARFARE SEARCH MODELS

This paper has been recognized as outstanding by its department.

Roey ben Yoash—Captain, Israel Defense Forces

Master of Science in Operations Research

Advisor: Moshe Kress, Department of Operations Research

Co-Advisor: Michael Atkinson, Department of Operations Research

Second Reader: Roberto Szechtman, Department of Operations Research

Stealth and high endurance make submarines ideally suited to a variety of missions, and finding ways to detect, track, and, if necessary, acquire and attack them has long been a topic of research. In this thesis, we study effective ways to operate an MH-60R helicopter in anti-submarine warfare (ASW) missions. Following an initial cue given by an external source indicating the presence of a possible submarine target, a helicopter is sent to detect, follow, acquire, and attack the submarine. To perform its mission, the helicopter can carry various payloads of sensors and torpedoes. The first part of the thesis focuses on a helicopter equipped with dipping sonar and develops a model that optimizes the operation of the helicopter and measures its effectiveness. We analyze the effect of the different input parameters, such as helicopter speed, submarine speed, sensor detection radius, and travel time to the point of detection on the optimal dipping pattern and the probability of mission success, and show that arrival time is the most important parameter. We also address the optimization problem associated with the payload of a helicopter on an ASW mission and determine the best mix of fuel, sensors, and weapons for a helicopter on such a mission. [Full Text](#)

Keywords: anti-submarine warfare, search and detection

OTTER: AN OPTIMIZED TRANSIT TOOL AND EASY REFERENCE

The following thesis was recognized as outstanding by its department

Warren Blackburn—Lieutenant Commander, United States Navy

Master of Science in Operations Research

Advisor: Emily Craparo, Department of Operations Research

Co-Advisor: Connor McLemore, Operations Analysis Program Office

Second Reader: Dan Nussbaum, Department of Operations Research

Fuel efficiency is a priority for the chief of naval operations (CNO) as stated in the CNO's Position Report: 2014. While a number of fuel-saving measures have been implemented in recent years, the effects of operational transit speed on fuel consumption have not been adequately understood as a variable. The commanding officers of ships use fuel-usage curves to determine the most efficient propulsion-plant speed. Fuel efficiency is typically gauged by maintaining a consistent optimal speed. Often there are combinations of speeds that are more efficient than a constant speed. The transit fuel planner, developed in the Naval Postgraduate School's operations research department by Brown, Kline, Rosenthal, and Washburn in 2007, calculates speed combinations to achieve fuel savings for a given single ship. This thesis adds additional capacities based on common principles. We provide an omnibus tool, the Optimized Transit Tool and Easy Reference (OTTER), with two complementary components: Dynamic OTTER and Static OTTER. Dynamic OTTER is a versatile, interactive transit-planning tool for any ship class that accommodates drill scheduling, a critical feature. The second tool, Static OTTER, is a generic, optimal solution to individual ship transit-speed combinations, in the form of a printable reference sheet that can be used independently. These products are being implemented by United States Navy surface ships and will yield significant fuel savings, equating to additional time on station.

[Full Text](#)

Keywords: OTTER, fuel optimization, transit fuel planner, fuel savings, fuel consumption, replenishment at sea planner surface fleet, surface action group planner

OPTIMAL REPAIR AND REPLACEMENT POLICY FOR A SYSTEM WITH MULTIPLE COMPONENTS

Jan-Wilhelm Brendecke—Major, German Army

Master of Science in Operations Research

Advisor: David Alderson, Department of Operations Research

Co-Advisor: Kyle Lin, Department of Operations Research

Second Reader: Michael Atkinson, Department of Operations Research

This thesis formulates and solves a Markov decision problem to find the optimal repair and replacement policy for a system of multiple components whose failure rates are age-dependent. We assume that the failure rate for an old component is higher than for that of a new component. When a component fails, it can either be replaced, making it new, or repaired, making it functional but old. An old component can also be replaced proactively. We formulate the model for a single component as a linear program, and perform parametric analysis on the transition probabilities and system rewards to understand when different policies are optimal. We extend the model to include multiple, independent components, and apply the model to a notional infrastructure network whose performance depends on the state of its network links. [Full Text](#)

Keywords: failure, repair, replace, multiple component models, maintenance models, Markov decision process

AERIAL LOGISTICS MANAGEMENT FOR CARRIER ONBOARD DELIVERY

Samuel Chen—Lieutenant, United States Navy

Master of Science in Operations Research and Master of Science in Applied Mathematics

Advisor: Kyle Lin, Department of Operations Research

Co-Advisor: Wei Kang, Department of Applied Mathematics

Second Reader: Michael Atkinson, Department of Operations Research

Carrier onboard delivery (COD) is the use of aircraft to transport people and cargo from a forward logistics site (FLS) to a carrier strike group (CSG). The goal of this thesis is to study how the real-time cargo tracking capability can reduce the delay of high-priority cargo while increasing that of low-priority cargo. To do so, we analyze data from COD operations between 2010 and 2015 to develop a simulation model, and use those data to infer model parameters. Our simulation results indicate that, with two C-2A aircraft currently used by the Navy, real-time cargo tracking can reduce the delay of high-priority cargo by more than 50%, while increasing that of low-priority cargo by about 25%. The Navy plans to replace C-2A with a variant of V-22 Osprey for COD operations in the near future, and is conducting cargo space studies to facilitate this transition. By testing a few different model parameters based on studies available for V-22, our simulation results indicate a similar observation of delay tradeoff between high-priority cargo and low-priority cargo, although the tradeoff is less pronounced, mainly because three V-22 will be stationed at the FLS. [Full Text](#)

Keywords: carrier onboard delivery (COD), C-2A Greyhound, CMV-22B Osprey, carrier strike group (CSG), forward logistics site (FLS), sea base, discrete event simulation (DES), stochastic

A BROWNIAN BRIDGE MOVEMENT MODEL TO TRACK MOBILE TARGETS

This paper has been recognized as outstanding by its department.

Chun Chieh Cheng—Major, Singapore Armed Forces, Army

Master of Science in Operations Research

Advisor: Dashi Singham, Department of Operations Research

Second Reader: Michael Atkinson, Department of Operations Research

The Brownian bridge movement model (BBMM) models target movement between two known points as a Brownian bridge. This thesis extended the BBMM to account for multiple starting and ending points and to account for intelligence inputs midway through the target movement. The BBMM is applied to a military scenario where U.S. forces are conducting surveillance to monitor the breakout of Chinese forces in the South China Sea. Probability heat maps, depicting the probability of a target location at discrete times, are generated through simulations in MATLAB. Using the heat maps, this thesis developed an algorithm to automate the placement of sensors to detect the target. This thesis focused on the use of a network of unmanned sensors as the means for target detection. The relationship between the sensors' attributes and the probability of detection is explored through a meta-experiment. The experiment utilizes a three-stage algorithm that generates heat maps, deploys sensors and randomizes intelligence inputs, and measures the probability of detection. A trade-off analysis was conducted and showed that to achieve a higher probability of detection, it is more effective to have sensors cover a wider area at fewer discrete points in time than to have a greater number of discrete looks using sensors covering smaller areas. [Full Text](#)

Keywords: Brownian bridge movement models, unmanned sensors, probability of detection, search and detection, simulations

AN EXPLORATORY ANALYSIS OF ECONOMIC FACTORS IN THE NAVY TOTAL FORCE STRENGTH MODEL

William DeSousa—Ensign, United States Navy

Master of Science in Operations Research

Advisor: Thomas Lucas, Department of Operations Research

Second Reader: Samuel Buttrey, Department of Operations Research

Accurate forecasts of U.S. Navy enlisted end-strength are crucial for budgetary planning and the development of manpower policies. An improving economy and increased employment opportunities in the civilian sector could cause a significant problem for enlisted retention. The Navy Total Force Strength Model (NTFSM) is a new stochastic simulation that is intended to offer manpower analysts more accurate enlisted manpower projections than those projected with the current tool. NTFSM uses historical data and user-defined inputs for economic factors to project monthly retention losses. However, NTFSM is still in the testing phase and its overall behavior is largely unknown. In particular, the analysts that NTFSM was designed to help are unsure of the effects that the economic factors, which they need to enter themselves, have on NTFSM's output. This thesis investigates the behavior of NTFSM's output and the sensitivity of the user-entered economic factors. Using design of experiments and data mining, a variety of scenarios are simulated and then analyzed to better understand the behavior of the model and to determine the sensitivity of the user-defined economic factors. The results of the analysis unexpectedly show that NTFSM's economic factors have no significant impact on NTFSM's end-strength output; this warrants further investigation. [Full Text](#)

Keywords: manpower, end strength, design of experiments, simulation, Navy Total Force Strength Model (NTFSM)

LINEAR OPTIMIZATION OF FREQUENCY SPECTRUM ASSIGNMENTS ACROSS SYSTEMS

The following thesis was recognized as outstanding by its department

Steven Fischbach—Lieutenant, United States Navy

Master of Science in Operations Research

Advisor: Jeffrey Hyink, Department of Operations Research

Co-Advisor: Connor McLemore, Operations Analysis Program Office

Second Reader: W. Matthew Carlyle, Department of Operations Research

Development and acquisition of naval communication, data, and radar systems for ships are an almost entirely modular process. For this reason, virtually all existing systems have separate controllers, antennas, and transmitters. However, future systems could use existing planar antennas that operate across a range of frequencies and create a variety of complex waveforms, eliminating the need to develop separate antennas and transmitters. Additionally, frequency use plans are expensive in terms of time and effort to develop and change. The Integrated Topside (InTop) joint Navy industry open architecture study published in 2010 described the need for an integrated sensor and communication system that is modular, scalable, and capable of performing multiple functions. Such a system requires a scheduling and frequency deconfliction tool capable of representing the current antenna configuration and matching those capabilities with requests for frequency space and time. This thesis describes SPECTRA, an integer linear program that can prioritize and optimize the scheduling of available antennas to deconflict time, frequencies, systems, and capabilities. It can be uniquely tailored to any platform including naval warships, aircraft, and ground sites. [Full Text](#)

Keywords: frequency optimization, multisystem scheduling program, frequency deconfliction, frequency

selection tools, frequency allocation, transmission optimization, electromagnetic maneuver warfare, electronic protection, assignment model

EVALUATING EFFECTIVENESS OF A FRIGATE IN AN ANTI-AIR WARFARE (AAW) ENVIRONMENT

Serif Kaya—Lieutenant Junior Grade, Turkish Navy

Master of Science in Operations Research

Advisor: Jeffrey Kline, Department of Operations Research

Second Reader: Thomas Lucas, Department of Operations Research

Designing naval ship capabilities for shipbuilding is a challenging process requiring comprehensive technical and tactical studies. Technical studies involve ship design characteristics such as engineering, weapon, and support systems. Tactical studies include the anticipated area of operation, expected threat, the capabilities of the enemy, and potential missions to accomplish. Both studies are used in ship design to determine the ship's required combat capabilities before finalizing the hull design. This research uses the agent-based modeling tool Map Aware Non-Uniform Automata (MANA) to explore the best combat capabilities for a frigate in an anti-air warfare (AAW) environment. Regression and partition trees are used to analyze factors that influence the measures of the friendly frigate's survivability and number of enemy casualties. This study also investigates the use of a prospective ship-based unmanned aerial vehicle (UAV) in AAW operations. We find that the inclusion of Point Defense Missile Systems with long and medium range surface-to-air missiles has the most positive effects on ship survivability. By contrast, we find inclusion of a UAV in this mission has little effect. [Full Text](#)

Keywords: agent-based modeling, anti-air warfare (AAW), weapon selection, unmanned aerial vehicle, simulation, design of experiments, combat systems

HETEROGENEOUS DEFENSIVE NAVAL WEAPON ASSIGNMENT TO SWARMING THREATS IN REAL-TIME

The following thesis was recognized as outstanding by its department

Christopher Laird—Lieutenant, United States Navy

Master of Science in Operations Research

Advisor: Connor McLemore, Operations Analysis Program Office

Second Reader: W. Matthew Carlyle, Department of Operations Research

This thesis develops an automated decision aid capable of generating defensive engagement profiles for use in naval shipboard defense. It allows the efficient pairing of multiple defensive weapon systems to several incoming threats operating in multiple domains by providing the operator with recommended weapon-target pairings based on current defensive capabilities and threat profiles. The model consists of a pre-processing algorithm and a reward-based, mixed-integer programming model that takes as inputs the available defensive weapon system capabilities and incoming target information and outputs a recommended engagement profile. Recommended weapon-target pairings are based on the priority of the threat, the time available to engage it, and the probability of successfully countering it. Additionally, the model allows for future planning against threats that may currently be outside the defensive envelopes of the ship, but based on current heading and speed may become available for pairing, thereby allowing the operator to plan future defensive actions. For scenarios involving four defensive weapons and 13 targets, this model produces an optimal engagement profile in approximately two seconds on a general-purpose laptop and has the potential to be continuously run to provide real-time recommendations to the operator. [Full Text](#)

Keywords: weapon-target pairing, optimization, battlespace management, decision aid, integer programming, swarming threats, ship defense

NAVY OPERATIONAL PLANNER - UNDERSEA WARFARE MODULE

Guy Molina–Lieutenant, United States Navy

Master of Science in Operations Research

Advisor: W. Matthew Carlyle, Department of Operations Research

Second Reader: Jeffrey Kline, Department of Operations Research

Joint maritime operational planning is the difficult task of assigning various platforms to accomplish a multitude of missions in several areas of operations. The task becomes more difficult as resources are limited, mission requirements evolve, and platform capabilities vary. Emerging threats and technology in the undersea domain have created renewed interest and increased the priority of undersea warfare (USW) planning. This thesis develops and provides a proof-of-concept for a decision-support tool to aid operational planning in a USW environment. Specifically, it provides an optimization model with an optimal solution that maximizes multi-mission achievement in a theater USW environment through the scheduling of surface, sub-surface, and air assets over a non-fixed time horizon. Tactics and their mathematical representation are an input to our model. This makes the model easily adapted to any USW scenario and other warfare areas where mission achievement can be measured quantitatively.

[Full Text](#)

Keywords: optimization, integer programming, binary integer programming, navy operational planner, maritime operational planning tool, decision aid, navy logistics, navy mission planner, NMP, NOP, USW, ASW, MIW

MODELING ANTI-AIR WARFARE WITH DISCRETE EVENT SIMULATION AND ANALYZING NAVAL CONVOY OPERATIONS

Ali Opcin–Lieutenant Junior Grade, Turkish Navy

Master of Science in Modeling, Virtual Environments, and Simulation and Master of Science in Operations Research

Advisor: Arnold Buss, MOVES Institute

Co-Advisor: Thomas Lucas, Department of Operations Research

Second Reader: Paul Sanchez, Department of Operations Research

Anti-air warfare (AAW) is a primary naval warfare area. Using AAW tactics and concepts of operations, this research explores the most critical success factors of convoy operations. In this study, a discrete event simulation (DES) was built by modeling ships, and their sensors and weapons, to simulate convoy operations under air threat. Where classified data was unavailable, assumptions were made and approximations were used in constructing the ships, weapons, and sensors. The model was used to simulate over 1.5 million naval battles varying 99 input variables using sophisticated and systematically created data combinations. To select the input settings over a specific range of input variables, a nearly orthogonal nearly balanced (NOB) Latin hypercube design was used. The effects of these input changes on the outputs were analyzed using partition trees and nominal logistic regression. The primary response variable was the survival of the High Value Unit (HVU) as a binary outcome. According to the analysis, in a convoy operation under air threat, the surface-to-air missile (SAM) specifications of the

screen ships, the staying power of the HVU, and the anti-ship missile (ASM) specifications of the enemy ships had the most significant effect on the survival of the HVU. [Full Text](#)

Keywords: discrete event simulation, modeling anti-air warfare, Simkit, component based

ANALYSIS OF PROTECTION MEASURES FOR NAVAL VESSELS BERTHED AT HARBOR AGAINST TERRORIST ATTACKS

Raja Sikandar–Lieutenant Commander, Pakistan Navy

Master of Science in Operations Research

Advisor: Thomas Lucas, Department of Operations Research

Second Reader: Jeffrey Kline, Department of Operations Research

The defense of a naval ship berthed in a harbor is a complex task affected by many factors. These include the fishing vessel density close to the ship and the challenge of discriminating neutral vessels from threats. A naval vessel berthed at harbor is more susceptible to attack than a vessel in open seas. The chances of detecting and countering a terrorist boat vary widely depending on several factors, including early identification of the attack and weapons available. This research uses modeling in Map Aware Non-uniform Automata (MANA) to analyze the protection measures adopted by naval vessels against terrorist boats. The experiments were designed to efficiently generate data, which was then replicated using high-performance computing, to address a wide range of possibilities and outcomes. The data generated were analyzed using a variety of techniques. The study concluded that lethality of Blue weapons is the most important factor in determining Blue's ability to counter a Red suicide boat attack. Additionally, the tactic of firing a warning shot followed by disabling shots within the exclusion zone decreases Blue's success probability. Finally, an exclusion zone of at least 60 meters that is enforced with a patrol boat is recommended. [Full Text](#)

Keywords: simulation, agent-based, design of experiments, force protection, ship self-defense

Master of Science in Physical Oceanography

THE EFFECTS OF DOUBLE DIFFUSION AND BACKGROUND TURBULENCE ON THE PERSISTENCE OF SUBMARINE WAKES

Troy Benbow–Lieutenant, United States Navy

Master of Science in Physical Oceanography

Advisor: Timour Radko, Department of Oceanography

Second Reader: John Joseph, Department of Oceanography

A numerical study has been performed to investigate the feasibility of hydro-dynamically based detection of propagating submersibles. Of particular concern is the possibility of utilizing microstructure measurements as a means of wake identification. The simulations are based on the Massachusetts Institute of Technology's general circulation model (MITgcm), which has been modified for wake analysis. The dissipation of a turbulent wake produced by a sphere uniformly propagating in a doubly stratified environment is examined for three scenarios: (i) a quiescent regime, (ii) a double-diffusive regime, and (iii) a flow with pre-existing turbulence. The analysis of the numerical models was based on two quantities, the dissipation of turbulent kinetic energy (ϵ), and the dissipation of thermal variance (χ). This analysis indicates that wake signatures generated by a one-meter-wide object are detectable

for 0.4 and 1.2 hours, depending on regime, and the detection interval is not strongly sensitive to the density ratio. Double-diffusive convection plays a significant role in the duration of submarine wakes. The extrapolation of the simulations to objects of ~10m propagating with speeds ~10m/s suggests that microstructure-based detection is feasible for at least two hours after the passage of a submersible and significantly longer outside the double-diffusive regime. These results indicate that microstructure-based observations of stratified wakes offer a viable method for the non-acoustic detection of submerged objects. [Full Text](#)

Keywords: fluid dynamics, submarine, wakes, turbulence

CONTINUOUS ACOUSTIC SENSING WITH AN UNMANNED AERIAL VEHICLE SYSTEM FOR ANTI-SUBMARINE WARFARE IN A HIGH-THREAT AREA

Loney Cason III—Lieutenant, United States Navy

Master of Science in Physical Oceanography

Advisor: Peter Chu, Department of Oceanography

Co-Advisor: Kevin Jones, Department of Mechanical and Aerospace Engineering

An unmanned aerial vehicle system called the Aqua-Quad, an ultra-long-endurance hybrid design, developed by researchers in the NPS Department of Mechanical and Aerospace Engineering, is utilized in this thesis. The Aqua-Quad has the capability of landing on the ocean surface and deploying passive acoustic sensors at depth. We investigated the employment of the Aqua-Quad in a general environment, determined sea-state survivability, and verified, using a self-contained acoustic sensor, that the Aqua-Quad can be utilized in undersea warfare. The experiments and data collected on the initial setup of the Aqua-Quad are compared against the Navy's current asset, passive sonobuoys. These comparisons will prove to be influential in the process of building, researching, and developing a new and improved sensor asset with unlimited potential to strive in multiple warfare areas. This research benefits not only the Navy, through enhancement of offensive warfighting by testing the next generation of sonobuoys, but also the oceanographic community with fast sampling and detection.

[Full Text](#)

Keywords: Aqua-Quad, new and improved sonobuoy, unmanned aerial vehicle

STATISTICAL ANALYSIS OF ACOUSTIC SIGNAL PROPAGATING THROUGH THE SOUTH CHINA SEA BASIN

Meihuei Chen—Lieutenant, Taiwan Navy

Master of Science in Physical Oceanography

Advisor: Ching-Sang Chiu, Department of Oceanography

Co-Advisor: Christopher Miller, Department of Oceanography

During the Windy Islands Soliton Experiment, two deep water moorings were deployed 167 km apart in the northeastern South China Sea (SCS) basin to study the effects of nonlinear internal waves on a 400-Hz acoustic signal propagation. The acoustic arrival structure for this path shows five significant arrivals, exhibiting multi-scale variability in travel time and intensity. Time series of moored temperature data, travel time of the first and a late arrival, as well as measured sound intensity were constructed. By analyzing the power spectral density of those time series, six internal tidal constituents were identified, with strong diurnal and semidiurnal energy. The variances in the temperature and travel time were dominated by the internal tides while the largest variance in signal intensity was in the high-frequency

internal-wave band. Coherence analysis of the temperature and travel times indicated that the travel time variance in the tidal band was more related to the temperature fluctuation west of the SCS basin. The observed standard deviations of signal intensity level were plotted against the number of independent arrivals, showing that the relation converges to a modified statistical theory of phase-random multipaths. [Full Text](#)

Keywords: nonlinear internal waves, acoustics, South China Sea, statistics, sound propagation variability

Master of Science in Program Management

ANALYSIS OF RAPID ACQUISITION PROCESSES TO FULFILL FUTURE URGENT NEEDS

Robert Arellano—Civilian, Department of the Army

Ryan Pringle—Civilian, Department of the Army

Kelly Sowell—Civilian, Department of the Army

Master of Science in Program Management

Advisor: Ray Jones, Graduate School of Business and Public Policy

Co-Advisor: Charles Pickar, Graduate School of Business and Public Policy

Co-Advisor: Brad Naegle, Graduate School of Business and Public Policy

The objective of this project is to analyze rapid acquisition processes in order to evaluate the current organization, structure and regulations within the Department of Defense (DOD). This analysis helps determine if the rapid acquisition process used for two programs is repeatable for future endeavors. Additional analysis of identified DOD regulations and organizations shows how the rapid acquisition process expedited these systems and how it benefited the warfighter. The project reviews statutory and regulatory requirements covering the rapid acquisition process in the DOD and compares current DOD processes and the effects of their implementation. The project also reviews the warfighters' actions when DOD entities do not address critical needs within reasonable timelines. The analysis results indicate that the current DOD organization and regulations do not provide an effective means for future rapid acquisition requirements, do not effectively promote the agility needed for rapid acquisition, and actually encumber the rapid acquisition process. [Full Text](#)

Keywords: rapid acquisition, urgent needs, rapid fielding of capabilities

IMPACTS OF TRANSITIONING FROM FIRM FIXED PRICE TO FIXED PRICE INCENTIVE FIRM TARGET CONTRACTS IN PEO MISSILES AND SPACE

Suzanne Makowski—Civilian, Department of the Army

Brandi Ricketts—Civilian, Department of the Army

Shannon Tidwell—Civilian, Department of the Army

Master of Science in Program Management

Advisor: Charles Pickar, Graduate School of Business and Public Policy

Second Reader: Brad Naegle, Graduate School of Business and Public Policy

The objective of this project is to analyze the impacts to major weapon systems programs in Program Executive Office (PEO) Missiles and Space as a result of transitioning from firm fixed price (FFP) contracts to fixed price incentive firm target (FPIF) contracts. This project presents an in-depth examination of FFP and FPIF contract types, including definitions, profit mechanisms, and advantages and disadvantages

associated with each type. This project reviews three iterations of Better Buying Power, with a specific focus on profitability and the use of FPIF contracts. The project presents and analyzes data collected through interviews with PEO Missiles and Space program management and contracting personnel who support programs that have transitioned from FFP to FPIF. The project also examines defense industry profitability and considers the perspective of defense contractors regarding Department of Defense profit policy. The analysis results indicate that the PEO is appropriately applying guidance for choosing FPIF contracts in follow-on production, and that there are both benefits and challenges associated with FPIF contracts. Recommendations include continuing to assess FPIF use for production programs, obtaining actual cost data, and improving incentive contracting workforce training. Further research on the longer-term effects of transitioning to FPIF is recommended. [Full Text](#)

Keywords: firm fixed price, FFP, fixed price incentive firm target, FPIF, incentive, Better Buying Power

AN ANALYSIS OF TEST AND EVALUATION IN RAPID ACQUISITION PROGRAMS

Timothy Tharp—Civilian, Department of the Army

Christopher Voinier—Civilian, Department of the Army

Master of Science in Program Management

Advisor: Brad Naegle, Graduate School of Business and Public Policy

Co-Advisor: Clyde Webster, Department of the Army

Co-Advisor: David Lee, Department of the Army

The last decade of conflict in Operation Enduring Freedom, Operation Iraqi Freedom, Operation New Dawn, and other contingency operations has brought about many technical advances for our Soldiers. In order to get new capabilities fielded quickly, the traditional Department of Defense acquisition cycle was modified to achieve rapid fieldings. This paper examines how requirements are developed for programs of record (PORs) and rapid acquisitions (RAs), and then how test and evaluation (T&E) is administered to each. A materiel release is required for any equipment, regardless of how the requirement is generated. PORs that transition from RAs still must go through the Joint Capabilities Integration Development System process, but the path may be shortened if the gains from the RI are capitalized upon. After examination of two PORs that began as RAs, we found clear examples of how to capitalize on the testing that occurred during the fielding of an RA. We recommend that all RAs conduct T&E in a manner that provides usable data for decision makers and also to inform future PORs. We further recommend that T&E be included during R&D phases of acquisition to reduce T&E burden in later phases of the program. [Full Text](#)

Keywords: test and evaluation, Joint Capabilities Integration Development System, and programs of record

CASE ANALYSIS OF THE JOINT HIGH-SPEED VESSEL PROGRAM: DEFENSE ACQUISITION

Brian Watson—Evaluator/Test Manager, U.S. Army Evaluation Center

Master of Science in Program Management

Advisor: Charles Pickar, Graduate School of Business and Public Policy

Co-Advisor: Brad Naegle, Graduate School of Business and Public Policy

In response to a shifting National Military Strategy that renewed the focus of combat operations on smaller, projectable, and dynamic joint fight entities, both the Army and Navy reviewed requirements to

address capability shortfalls in either their force structure or operational warfighting concepts, or both. Both services' initial capability reviews resulted in a series of Advanced Concept Technology Demonstrations (ACTD) designed to explore the military utility of converted commercial, high-speed, shallow-draft vessels as a materiel solution. This case study investigates the use of the ACTD to support the requirements generation and validation processes, the extent to which Army transformational and mobility factors drove the requirements process, whether or not changes in logistic support plans for Joint High-Speed Vessel (JHSV) impacted Army mission capabilities, and ultimately if these considerations led to a successful joint service acquisition of the JHSV. For both services, the ACTD supported the requirements process but it also presented new challenges in the approach to a joint materiel solution that would satisfy operational needs. That approach prioritized, validated, and incorporated competing operational requirements into a final and unique materiel solution for a system capability that is fielded. [Full Text](#)

Keywords: Advanced Concept and Technology Demonstration (ACTD); Department of Defense (DOD), Theater Support Vessel (TSV), command, control, communications, computers, Intelligence Surveillance and Reconnaissance (C4ISR), Joint High-Speed Vessel (JHSV), Global War on Terrorism (GWOT), Civilian Mariners (CIVMAR), Contract Mariners (CONMAR), Military Sealift Command (MSC), Joint Capability Integration and Development System (JCIDS), Program Executive Office (PEO), Reception Staging Onward Movement and Integration (RSOI)

Master of Science in Systems Engineering

OPERATIONAL ENERGY CAPABILITY PORTFOLIO ANALYSIS FOR PROTECTION OF MARITIME FORCES AGAINST SMALL BOAT SWARMS

Whye Kin Melvin Cheang—Lieutenant Colonel, Republic of Singapore Navy

Master of Science in Systems Engineering

Advisor: Alejandro Hernandez, Department of Systems Engineering

Co-Advisor: Susan Sanchez, Department of Operations Research

Second Reader: Matthew Boensel, Department of Systems Engineering

This research examines the requirements of a capability portfolio for protecting a maritime force against a conventional small boat swarm attack. It provides decision makers with insights gleaned from exploring the trade space between weapon consumption, fuel consumption, and cost against the need to protect the force. Such an attack can deplete a force's resources and create risk to overall mission accomplishment. In this research, the Iranian training attack on a mock U.S. aircraft carrier in the Strait of Hormuz in February 2015 is the basis for the modeled scenario. A notional U.S. carrier group forms the baseline capability. An agent-based simulation scenario models the effectiveness of various capability options added to the baseline. These options include maturing developments such as the littoral combat ship (LCS) with modified Hellfire missiles, Spike LR missiles adapted onto autonomous 11-m unmanned surface vessels (USV), and advanced precision kill weapon system II missiles carried by Fire Scout tactical unmanned aerial vehicles (TUAV). A nearly orthogonal and balanced design, with 512 design points, yields broad insights and ensures an efficient experiment. Partition tree analysis, a non-parametric regression technique, identifies the presence and strength of influential factors. Efficient mixes of LCS, USVs, or TUAVs prove to be critical elements of protecting the maritime force while preserving its capabilities to accomplish the overall mission. [Full Text](#)

Keywords: small boat swarm, small boat threat, tradeoff studies, operational energy, weapon

consumption, fuel consumption, cost, agent-based simulation, agent-based modeling, MANA

SYSTEM ARCHITECTURE FOR LOGISTICS OF A DISTRIBUTED NAVAL SURFACE FORCE

Travis Harlow—Lieutenant, United States Navy

Master of Science in Systems Engineering

Advisor: Eugene Paulo, Department of Systems Engineering

Co-Advisor: Paul Beery, Department of Systems Engineering

The U.S. Navy is committed to conducting offensive operations via a new warfighting concept known as Distributed Lethality. Several articles, blogs, conferences, and task forces provide varying opinions on how one should define Distributed Lethality. This thesis examines the logistical component of Distributed Lethality and provides structure to the concept via the creation of an architectural framework. The methodology for creating this architecture includes portions of the traditional systems engineering process along with model based systems engineering (MBSE) and the Department of Defense Architectural Framework (DODAF) v2.0 schema. Requirements are derived from the stakeholder analysis and then connected to the necessary capabilities to fulfill those requirements. From the capabilities, a variety of operational vignettes—focused on logistical support—are used to identify the necessary operational architecture to support a distributed force. Finally, the operational architecture is decomposed to the underwriting functions that are connected to components and performers for mission execution. In conclusion, the stakeholder is provided with a fully traceable, flexible, and scalable architecture to aid in codifying the Distributed Lethality concept. Recommendations for follow-on research are to focus on identifying the measures of performance and effectiveness of the architecture by linking it to a model for simulation.

Keywords: model based systems engineering, Department of Defense Architectural Framework, system architecture, distributed lethality, adaptive force package, aircraft carrier, littoral combat ship, guided missile destroyer, oiler

A SYSTEMS ARCHITECTURE FOR OPERATIONAL DISTRIBUTED LETHALITY

Clay Johnson—Lieutenant Commander, United States Navy

Master of Science in Systems Engineering

Advisor: Eugene Paulo, Department of Systems Engineering

Second Reader: Paul Beery, Department of Systems Engineering

Distributed Lethality is a new concept in Surface Warfare that involves using small groups of surface combatants to go on the offensive against the enemy. This new concept requires structure and definition, and building a systems architecture for it is an effective way to provide both. This thesis investigates and defines the core requirements of Distributed Lethality and the capabilities that are necessary to meet these requirements. It builds an example mission flow for a Distributed Lethality scenario, and then defines the functions necessary to implement this flow. Finally, the model includes the components that perform the identified functions. The systems architecture for operational Distributed Lethality clearly demonstrates the connections and relationships between each element of the model, allowing for clear traceability from the smallest component to the originating requirement. This systems architecture for operational Distributed Lethality builds the foundation for future Distributed Lethality research and will power operational simulations and wargames.

Keywords: Distributed Lethality, systems architecture, model based systems engineering, Surface Warfare

A SEAKEEPING PERFORMANCE AND AFFORDABILITY TRADEOFF STUDY FOR THE COAST GUARD OFFSHORE PATROL CUTTER

Paul Schmitz–Lieutenant, United States Coast Guard

Master of Science in Systems Engineering

Advisor: Fotis Papoulias, Department of Systems Engineering

Second Reader: Clifford Whitcomb, Department of Systems Engineering

The United States Coast Guard Offshore Patrol Cutter program requires a method to analyze trades made between performance and affordability. Models of seakeeping performance were developed using linear seakeeping analysis, and a cost model was adopted from previous research. Both models were integrated into a decision support tool. Entering a notional Offshore Patrol Cutter design into the tool revealed that the program would likely perform well but could have a high cost risk. The decision support tool connects the two competing ideas of seakeeping performance and system affordability for program managers, while allowing different designs to be tested. Additional research into this topic should consider using more accurate seakeeping analysis techniques to create more accurate seakeeping performance prediction models. [Full Text](#)

Keywords: seakeeping, U.S. Coast Guard, Offshore Patrol Cutter

ACHIEVING SHIP'S MISSION FLEXIBILITY THROUGH DESIGNING, PRINTING AND OPERATING UNMANNED SYSTEMS WITH ADDITIVE MANUFACTURING AND DELAYED DIFFERENTIATION

Mong Lin Sin–Military Expert 6, Republic of Singapore Navy

Master of Science in Systems Engineering

Advisor: Ronald Giachetti, Department of Systems Engineering

Second Reader: Christopher Adams, Department of Mechanical and Aerospace Engineering

The design, print and operate (DPO) concept of operations (CONOPS) is proposed in this thesis as a new means of equipping ships with the appropriate capabilities. A companion concept of delayed differentiation is also introduced. In coupling the two concepts, additive manufacturing of capabilities in-situ becomes a possibility through the equipping of operational units with three building blocks: additive manufacturing systems and their raw materials, commercial off-the-shelf items and field programmable gate arrays. A concept of operations on uses of additive manufacturing was developed to illustrate the flexibility that the nexus of DPO CONOPS and delayed differentiation can engender. A tactical unmanned aerial vehicle (UAV) was used as an illustration to contextualize the concept of operations to enhance the littoral combat ship's survivability when operating in the littorals. Assessments were then made on the feasibility of DPO CONOPS for shipboard uses. A tactical UAV was used as it was assessed to be operationally relevant and significant. Analytical models that could be iterated to achieve the specific-to-mission requirements were developed to analyze and assess the implementation approach. The models focused on the UAV's reliability in fulfilling the mission as well as the build-time of the UAV. [Full Text](#)

Keywords: design, print and operate, DPO, unmanned aerial vehicle, UAV, concept of operations, CONOPS

EVALUATION OF LITTORAL COMBAT SHIPS FOR OPEN-OCEAN ANTI-SUBMARINE WARFARE

Systems Engineering Cohort 311-1430, Team LCS

Master of Science in Systems Engineering and Master of Science in Engineering Systems

Advisor: John Green, Department of Systems Engineering

Co-Advisor: Gregory Miller, Department of Systems Engineering

This report evaluates the littoral combat ship (LCS) and its potential to fulfill the open-ocean anti-submarine warfare (ASW) mission. It is unknown whether the LCS platform can support open-ocean ASW. This report examines which LCS variant, Freedom or Independence, is more suitable for open-ocean ASW. Initial analysis defines the open-ocean ASW problem space in terms of a threat analysis, mission analysis, current concept of operations (CONOPS), and current LCS capabilities. An analysis of alternatives (AoA) uses derived functional and operational requirements within a Pugh matrix to decide which variant best performs ASW and what modifications can improve future designs of the LCS. The analysis shows the Freedom class has marginal advantages in performing open-ocean ASW mission tasks and establishes three areas for improvement: self-noise emissions, weight, and communication. Potential solutions are explored to address these shortfalls and to analyze their impact on the LCS's ability to meet core requirements of the open-ocean ASW mission. This paper concludes that the LCS is capable of fulfilling the open-ocean ASW mission if improvements are made to the design and CONOPS.

[Full Text](#)

Keywords: anti-submarine warfare, littoral combat ship, mission module, systems engineering, requirements development, architecture, capability, functional decomposition, modeling and simulation, ASW, LCS

TRANSPORTATION ANALYSIS EXPLORING ALTERNATIVE SHIPPING OF MARINE EXPEDITIONARY BRIGADE FORCES TO SEABASE IN CONTINGENCY RESPONSE SCENARIOS

Systems Engineering, Team MARFORPAC

Master of Science in Systems Engineering and Master of Science in Engineering Systems

Advisor: Eugene Paulo, Department of Systems Engineering

Co-Advisor: Brigitte Kwinn, Department of Systems Engineering

Co-Advisor: Paul Beery, Department of Systems Engineering

As the U.S. national security policy shifts focus toward the Pacific theater and limited availability of amphibious shipping, Marine Forces Pacific must consider the augmentation of alternative shipping to deploy forces to a seabase location to support military operations in the Pacific Command area of operations. Implementing a model-based systems engineering approach, this capstone project examines the effects of augmenting amphibious shipping with commercial, allied nation, and military sealift command ships to achieve force closure at a seabase and reduce fuel consumption. Multiple shipping alternatives supporting a Marine Expeditionary Brigade in anti-access/area denial (A2/AD) and humanitarian assistance/disaster relief (HA/DR) missions formed the basis for measuring the effects of augmenting amphibious shipping. A simulation was developed to model the operational scenarios, and statistical analysis was performed upon the results of each alternative to identify factors affecting force closure time and fuel consumption. Analysis indicated that the effects of augmenting amphibious shipping vary based upon the mission type. Significant statistical evidence suggests that augmentation of amphibious shipping reduces force closure time and fuel consumption for the A2/AD mission. Based on the research, further investigation into the effects of augmented shipping on the Assembly and Employ phases of seabasing operations is recommended. [Full Text](#)

Keywords: Model-Based Systems Engineering, MBSE, systems analysis, seabasing, Marine Forces Pacific, amphibious shipping

A DECISION SUPPORT SYSTEM FOR EVALUATING SYSTEMS OF UNDERSEA SENSORS AND WEAPONS

Systems Engineering, Team Mental Focus

Master of Science in Systems Engineering and Master of Science in Engineering Systems

Advisor: Bonnie Young, Department of Systems Engineering

Co-Advisor: Paul Shebalin, Department of Systems Engineering

Co-Advisor: Richard Williams, Expeditionary and Mine Warfare

This project developed and analyzed the requirements for a decision support system capable of simulating future naval mine warfare scenarios. As the U.S. Navy explores replacing legacy naval mines with new systems of undersea weapons, it requires the supporting tools to evaluate and predict the effectiveness of these system concepts. While current naval minefield modeling and simulation capabilities provide planners with the capability to design and evaluate the effectiveness of minefields using legacy naval mine capabilities, they are not adequate for the planning and performance modeling of new concepts under consideration. The project addressed gaps in the Navy's capability to simulate mine warfare scenarios involving arrays of distributed sensors linked with autonomous mobile weapons by reviewing the current innovations in naval mine warfare development, verifying the gap in current modeling and simulation capabilities, and using systems engineering processes to derive solution requirements. Analysis conducted using prototype simulation capabilities, developed as part of this project, indicates that these future systems will likely outperform legacy mine systems at a competitive cost. [Full Text](#)

Keywords: decision support, simulation system, COA development, COA analysis, capability development, counter mobility, USW, MIW, AUWS, UUV, underwater networks, unmanned systems, autonomous systems

SCENARIO-BASED SYSTEMS ENGINEERING APPLICATION TO MINE WARFARE

Systems Engineering, Team Mine Warfare 2015

Master of Science in Systems Engineering and Master of Science in Engineering Systems

Advisor: Eugene Paulo, Department of Systems Engineering

Co-Advisor: Brigitte Kwinn, Department of Systems Engineering

Co-Advisor: Paul Beery, Department of Systems Engineering

This report builds upon the Team MIW 2014 capstone report in comparing legacy and future mine countermeasures capabilities. The Mark 18 Modification 2 Unmanned Underwater Vehicle was compared to the planned Littoral Combat Ship MCM Mission Package Increment 1 Remote Mine Hunting System as well as the legacy MCM 1 and CH-53E. The Measures of Effectiveness (MOEs) utilized were Area Clearance Rate Sustained and minefield percent clearance. A tailored systems engineering approach based on a modified SE Vee model was utilized to identify stakeholder requirements, conduct analysis of functional and physical architectures, and use these resulting artifacts to modify an existing model. A design of experiments process was utilized to analyze input variables for relationships to the MOEs and compare resulting MOEs from the various configurations. A cost analysis was then performed and, with the performance data, was used to evaluate the relative value of the various configurations.

Conclusions from the data are presented along with recommendations for future analysis. [Full Text](#)

Keywords: model-based systems engineering, design of experiments, measures of effectiveness, mine warfare, mine countermeasures, littoral combat ship, area coverage rate sustained, percent clearance, unmanned underwater vehicle, MK18 Mod 2

UNMANNED SYSTEMS IN INTEGRATING CROSS-DOMAIN NAVAL FIRES

Systems Engineering Analysis, Cohort 23

Master of Science in Systems Engineering Analysis

Advisor: Fotis Papoulias, Department of Systems Engineering

Co-Advisor: Michael Atkinson, Department of Operations Research

The ability to communicate and transmit targeting data via the electromagnetic spectrum is crucial to the U.S. Navy's ability to fight. However, in recent years, potential adversaries have significantly advanced their electronic warfare capabilities, obtaining an ability to interfere with the Navy's use of the electromagnetic spectrum during operations in contested environments. SEA23 investigates concepts of operation focusing on future potential electromagnetic-spectrum warfighting capabilities in the 2025–2030 timeframe. Specifically, we explore these capabilities using modular unmanned and manned platforms capable of carrying communications and data suites to enable cross-domain targeting information in support of tactical offensive operations in a contested, denied, degraded, intermittent, and limited-bandwidth environment. This project focuses on developing a system-of-systems architecture and analyzing alternatives to provide potential solutions while developing the associated concepts of operation. We recommend an architecture based on Link 16 and organic rotary-wing unmanned aerial vehicles to transfer sensor to shooter data in demanding and contested environments.

[Full Text](#)

Keywords: unmanned systems, cross domain, unmanned aerial vehicles, naval fires, targeting, distributed lethality, anti-access, area denial; denied, disrupted, degraded, low-bandwidth environment

TECHNOLOGICAL EVOLUTION OF HIGH TEMPERATURE SUPERCONDUCTORS

Jordan White–Lieutenant, United States Navy

Master of Science in Systems Engineering

Advisor: Clifford Whitcomb, Department of Systems Engineering

Co-Advisor: Fotis Papoulias, Department of Systems Engineering

High temperature superconducting (HTS) cables are currently being used in the commercial energy industry primarily for demonstration purposes and to evaluate the feasibility of large-scale implementation into the electric grid. While still in the evaluation stage, the U.S. Navy is finding the test results promising and is investigating its potential use for future electric ships to supply power to electric propulsion motors and possible high-energy weapons such as rail guns and lasers. Moreover, the Navy successfully tested an HTS degaussing system on a modern U.S. destroyer in 2008. The day of full-scale HTS integration is quickly approaching. This thesis used the IHS Goldfire Cloud Connect software in an attempt to determine any current trends of HTS cable innovation and development based on published patents trends. Specific search criteria and filters were used to determine the applicable technology, and those patents categorized by year, were used to develop a regression model to predict future patent trends. [Full Text](#)

Keywords: electric ships, high temperature superconductor, HTS

MODELING OF ENGINE PARAMETERS FOR CONDITION-BASED MAINTENANCE OF THE MTU SERIES 2000 DIESEL ENGINE

Siew Peng Yue—Civilian, Singapore Technologies Marine Limited

Master of Science in Systems Engineering

Advisor: Robert Koyak, Department of Operations Research

Co-Advisor: Fotis Papoulias, Department of Systems Engineering

Second Reader: Mark Rhoades, Department of Systems Engineering

Condition-based maintenance (CBM) entails performing maintenance only when needed to save on resources and cost. Formulating a model that reflects the behavior of the marine diesel engine in its normal operating conditions would aid in making predictions of the behavior of a condition monitoring parameter. Modeling for CBM is a data-dependent process. Data acquisition, processing, and analysis are required for modeling the behavior of the normal operating conditions of the diesel engine. This thesis leverages on existing data collected through sensors on a diesel engine to describe these conditions using regression analysis. The proposed data selection criteria ensure that data used for modeling are suitable. To model the behavior of the engine, an autoregressive distributed lag (ARDL) time series model of engine speed and exhaust gas temperature is derived. The lag length for ARDL is determined by whitening of residuals using the autocorrelation function. Due to non-normality of the residuals, a nonparametric quantile regression approach is adopted, and the derived model allows us to predict the parameter (exhaust gas temperature) that we consider. [Full Text](#)

Keywords: condition-based maintenance, regression, autoregressive distributed lag, marine diesel engine, modeling, prediction, nonparametric

Master of Science in Systems Technology (Command, Control & Communications)

MULTI-SENSOR IMAGE FUSION FOR TARGET RECOGNITION IN THE ENVIRONMENT OF NETWORK DECISION SUPPORT SYSTEMS

Michail Pothitos—Lieutenant Commander, Hellenic Navy

Master of Science in Systems Technology (Command, Control & Communications)

Advisor: Alex Bordetsky, Department of Information Sciences

Co-Advisor: Gamani Karunasiri, Department of Physics

Co-Advisor: Murali Tummala, Department of Electrical and Computer Engineering

This thesis proposed a concept of distributed management of littoral operations at the tactical level, in which timeliness of information and reduced decision cycles are of critical importance. The use of mesh tactical networks augmented by sensor management, operational databases, and an appropriate level of automation of target recognition can turn the obstacles of land masses in littoral environments into a tactical advantage. Ultimately, this thesis concept aimed to enhance situational awareness by enabling the timely exploitation and dissemination of imagery data from small satellites and unmanned systems at the tactical level. Analyses of simulation and field experimentation results that focused on mobile ad-hoc networks (MANETs)—which connected dissimilar imaging sensors and enabled fusion of captured images—supported this concept. Mesh tactical radios provided an adequate range and quality of service (QoS) to enable networking of kinetic and non-kinetic assets equipped with imaging or data relaying

capabilities and to support dissemination of imagery data. Additionally, multi-spectral image fusion of thermal and visual images for target recognition yielded the best classification performance after the use of speeded-up robust features (SURF) and artificial neural networks (ANNs). [Full Text](#)

Keywords: artificial neural networks, automatic target recognition, mobile ad-hoc networks, network decision support systems, speeded-up robust features, wireless mesh networks, image fusion